

July 16, 1968

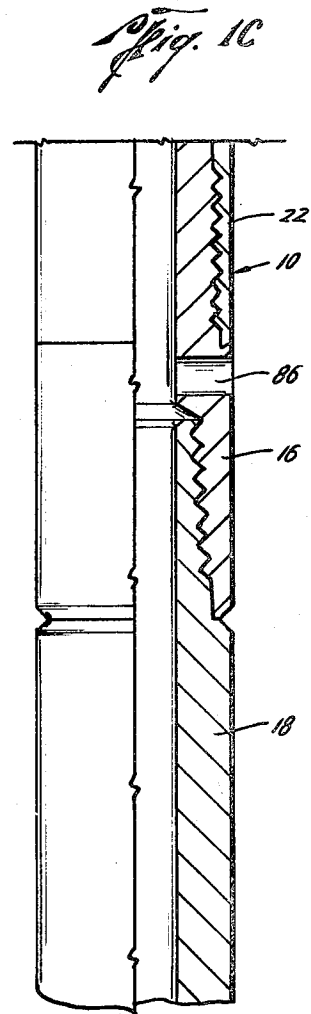
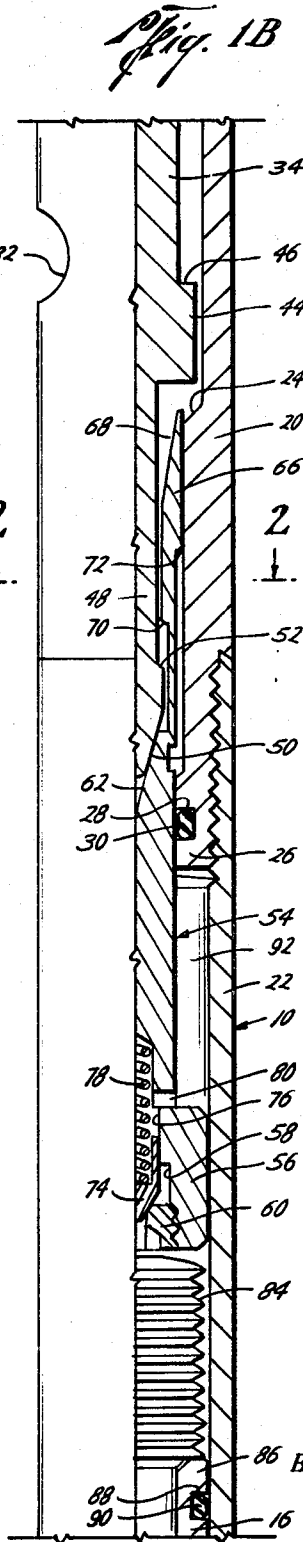
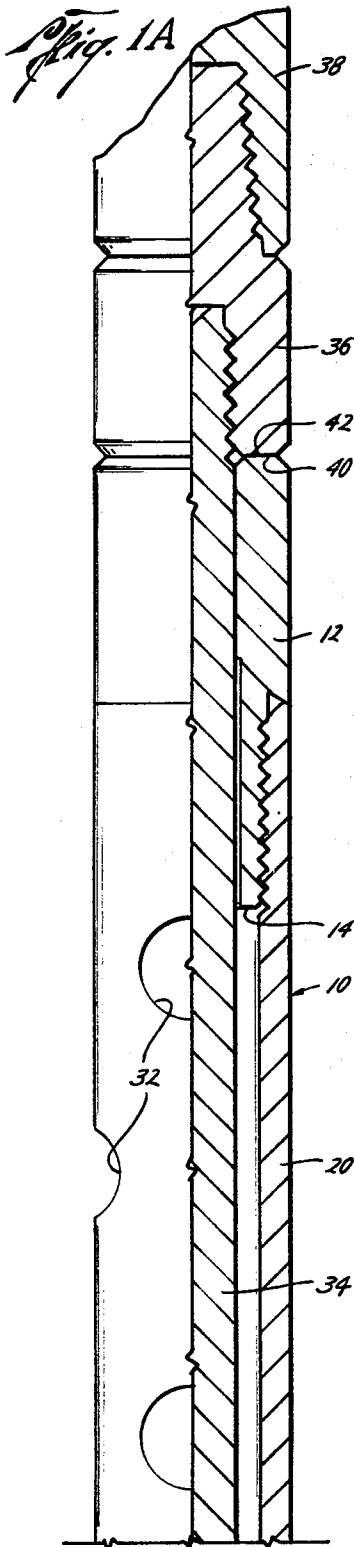
C. B. GREER

3,392,795

HYDRAULIC JAR

Filed Aug. 22, 1966

2 Sheets-Sheet 1



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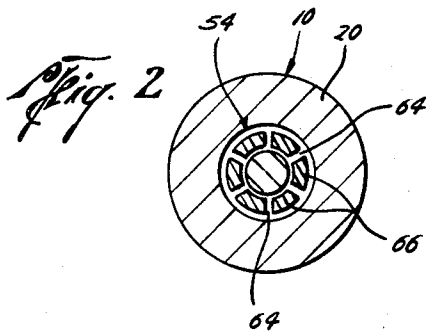
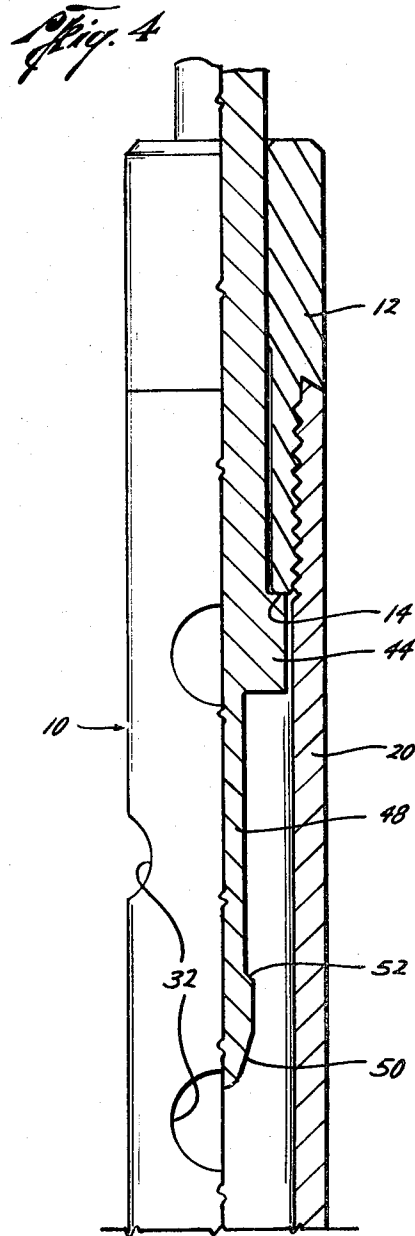
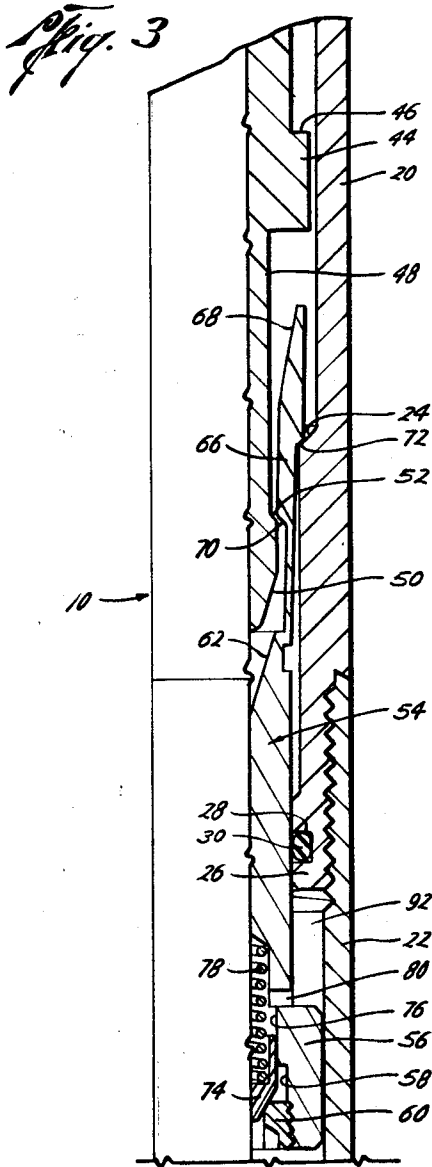
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HYDRAULIC JAR

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6 Claims. (Cl. 175-297)

This invention relates to the drilling and production of oil and gas wells, and more particularly to well jar mechanism for use therein.

In the drilling and carrying out of various operations in the production of oil wells numerous different kinds of equipment are used in the well bore which are frequently suspended and manipulated therein by means of a wire line or cable. Under various conditions of operation there is often danger of such equipment becoming stuck in the well bore, and for this reason it is customary to include in the equipment some form of jarring mechanism which may be operated to jar the equipment loose in case of sticking.

Hydraulic jarring mechanism has been commonly employed for such purposes heretofore, which makes use of a cylinder and plunger arrangement, filled or nearly filled with hydraulic fluid and which is operatable to yieldingly resist a pulling force exerted on the equipment and to suddenly release such resistance to produce a jarring impact of the parts, the internal parts of the mechanism moving in the hydraulic fluid which has a dampening effect on such movement. As heretofore commonly constructed, however, such jarring mechanism has the disadvantage that the hydraulic fluid in the cylinder has a dampening effect on the speed of movement of the parts which reduces the force of the impact. In equipment of this kind there is likelihood of leakage of the fluid from the cylinder resulting in a weakening or failure of the jarring effect. Moreover, due to variations in the pressure in the well bore outside of the cylinder, it becomes necessary to balance the pressure inside of the cylinder with that on the outside to avoid injury to the seal forming means and to provide means for compensating for changes in the volume of fluid in the cylinder under the effect of such external pressures.

The present invention has for an important object the provision of well jar equipment by which the above disadvantages are eliminated while retaining many of the advantages of hydraulically operated jars.

Another object of the invention is to provide well jar mechanism wherein the hammer and anvil of the mechanism are operable while exposed to the fluid in the well bore.

A further object of the invention is the provision of a well jar mechanism which operates in a manner similar to a closed cylinder hydraulic jar, but in which the cushioning effect of the hydraulic fluid is eliminated.

Another object of the invention is to provide well jar mechanism which is capable of operation to deliver a high jarring impact and which is easily and quickly reset to repeat such jarring action.

A still further object of the invention is the provision of well jar mechanism which is of simple design and rugged construction and in which the parts are easily replaceable for the purpose of maintenance and repair.

Briefly described, the jarring mechanism of the invention comprises a tubular barrel having at one end an internal anvil and within which a plunger or mandrel is slidable having a hammer portion positioned to deliver an impact against the anvil upon a sudden extension of the barrel and plunger, there being also latching means on the barrel and plunger positioned for coaction when the barrel and plunger are in retracted position to yieldingly resist relative longitudinal movement of the barrel and plunger in a direction to extend the same and which is releasable when the barrel and plunger reach a predeter-

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mined position of extension to allow the sudden extension of the barrel and plunger to cause the hammer to deliver an impact on the anvil.

A preferred embodiment of the invention is illustrated in the accompanying drawings, wherein:

FIGURE 1A is a fragmentary side elevational view, partly in longitudinal, central cross-section, of the upper portion of the jar of the invention;

FIGURE 1B is a downward continuation of FIGURE 1A showing an intermediate portion of the jar of the invention with the parts thereof in retracted position and the latching mechanism in latch condition;

FIGURE 1C is a downward continuation of FIGURE 1B showing the lower end portion of the jar of the invention;

FIGURE 2 is a cross-sectional view, taken along the line 2-2 of FIGURE 1B, looking in the direction indicated by the arrows;

FIGURE 3 is a view similar to that of FIGURE 1B showing the latching mechanism in released condition, and

FIGURE 4 is a view similar to that of FIGURE 1A showing the positions of the parts at the time of the delivery of an impact by the hammer of the jar against the anvil thereof.

Referring now to the drawings in greater detail, the jar of the invention comprises an elongated cylinder or barrel, generally designated 10, having at its upper end a radially inwardly thickened anvil member 12 threadably attached thereto and whose lower end is formed with an internal, downwardly facing impact face 14 in the barrel.

At its lower end the barrel is threadably connected to the upper end of a connector element or sub 16 by which any equipment, such as that shown at 18 in FIGURE 1C, which it may be desired to support in the well bore is connected to the barrel.

The barrel 10 may conveniently be formed of upper and lower sections 20 and 22, respectively, threadably connected together, the upper section 20 being formed near its lower end with an inwardly thickened portion, providing an annular, upwardly facing, tapered shoulder 24, and with an inwardly thickened lower end portion 26 having an inwardly opening, annular seal receiving groove 28 within which seal forming means such as the O-ring 30 is disposed.

The upper barrel section 20 is also provided with openings, such as those shown at 32 through which well fluid may flow freely into and out of the barrel.

A plunger 34 is slidably extended into the upper end of the barrel through the anvil member 12, and has at its upper end a sub or connector 36 threadably connected thereto, which in turn is threadably connected to any desired weight elements, or the like, such as that indicated at 38 in FIGURE 1A. The weight elements 38 may be connected in a well known manner to a wire line or cable, by any usual means, not shown, whereby the equipment may be suspended in a well bore, or attached to a packer element of the pump-out type for actuation with a pump from the ground level.

The lower end face 40 of the member 36 forms an impact face positioned for engagement with the upper end face 42 of the anvil 12 to deliver a downward impact on the barrel during the operation of the jar.

Within the barrel, the plunger 34 is formed near its lower end with an external, annular enlargement 44 forming a hammer having an upwardly facing impact face 46 positioned for engagement with the lower end face 14 of the anvil 12 to deliver an upward impact to the barrel.

The plunger 34 also has a downward extension 48 extending downwardly beyond the hammer 44 and which is formed with a tapered lower end portion 50 and an external, annular, tapered shoulder 52 above its lower

end. The extension 48 forms a part of the latching mechanism of the jar.

The latching mechanism of the jar includes a generally tubular element 54 slidably disposed in the barrel and which is formed at its lower end with an external annular enlargement forming a piston 56 having a lower end recess 58, within which an annular, upwardly facing, valve seat 60 is removably carried. Mediate its ends the latching element 54 is formed with an internal, annular, downwardly tapering face 62 positioned for engagement with the tapered lower end 50 of the plunger 34 to move the element 54 downwardly with the plunger, and above the face 62 the element is longitudinally slotted, as shown at 64 in FIGURE 2 to form flexible, peripherally spaced fingers 66 disposed externally about the extension 48 when the mechanism is latched, as shown in FIGURE 1B. Each of the fingers 66 has at its upper end a downwardly tapering inner face 68 positioned for engagement with the tapered end face of the extension 48 to spread the fingers upon downward movement of the extension into the upper end of the latch element 54, and beneath the face 68 each finger is formed with an inside, tapered shoulder 70 positioned for engagement with the external shoulder 52 of the extension 48 to spread the fingers apart upon unlatching movement of the latching mechanism. The fingers 66 are also each provided with an external, tapered shoulder 72 positioned for engagement with the internal shoulder 24 of the barrel upon downward movement of the element 54 to its latching position, as seen in FIGURE 1B, in which position the fingers will be held in latching engagement with the extension 48 by contact of their outer faces with the internal surface of the barrel.

A downwardly closing valve 74 is movably disposed in a recess 76 in the element 54, extending into the recess 58 thereof and which is yieldingly held in closing engagement with the seat 60 by a coil spring 78 also positioned in the recess 76. The element 54 also has one or more passageways 80 opening into the recess 76 and which lead to the exterior of the element above the piston 56.

A bellows 84, shown in FIGURE 1B is disposed in the barrel beneath the latching element 54 and whose lower end is connected to the upper end of the connector element 16, the interior of the bellows being in communication through its lower end with the interior of the element 16 and the upper end of the bellows being closed.

The connector element 16 also has a passageway 86, shown in FIGURE 1C through which fluid in the well bore externally of the barrel may flow into the bellows 84. At its upper end the connector element 16 has a thickened, annular, end portion 86, which is provided with an external annular groove 88 for the reception of suitable sealing means, such as the O-ring 90, to form a fluid tight seal between the element and the internal surface of the barrel 10. A chamber 92 is thus formed in the barrel between the seals 30 and 90, which is filled with hydraulic fluid and in which the piston 56 is movable longitudinally.

In the operation of the apparatus, the barrel 10 is connected to the well equipment below, which is to be supported in the well bore, which may include a number of sections of pipe, such as the section 18, to suitably weight the barrel, the plunger 34 being connected to a wire line or cable or pump-out device and similarly, suitably weighted, as by means of one or more sections of pipe, such as the section 38. Thus made up, the equipment is lowered in the well bore for operation in a well known manner.

Should the equipment below, connected to the barrel become stuck in the well bore, an upward pull may be exerted on the plunger 34, the external shoulder 52 of the plunger being then engaged with the internal shoulders 70 of the fingers 66 of the latch member 54, so that upward movement of the plunger in the barrel is yieldingly

resisted by the hydraulic fluid in chamber 92 which must leak past the piston 56 to permit such upward movement. When the latch member 54 has moved upwardly slowly with the plunger until the external shoulders 72 of the fingers move upwardly past the internal shoulder 24 of the barrel, the fingers 66 will be flexed radially outwardly to unlatch the plunger, whereupon the plunger will move upwardly suddenly, to engage the impact face 46 of the plunger with the end face 14 of the anvil 12, to deliver an upward jarring impact to the barrel, the valve 74 being opened during such downward movement to allow the flow of fluid in the chamber 92 from beneath the piston 56 to above the same. When the extension 48 engages the fingers 66 of the latch member 54, the fingers will be flexed outwardly to allow the external shoulder 52 to pass downwardly beyond the internal shoulders 70 of the fingers, so that upon downward movement of the latch member the plunger will be latched in its lowered position.

Should it be desired to deliver a downward jarring impact on the barrel, this can be accomplished after the plunger has been extended upwardly, by suddenly lowering the plunger to engage the impact face 40 of the connector 36 with the upper end face 40 of the barrel, such downward impact being the result of the weight of the pipe sections 38 above.

During the operation of the mechanism fluid may flow freely into and out of the barrel above the chamber 92 so that there will be no cushioning effect of such fluid on the impact of the hammer against the anvil.

It will be apparent that the plunger and barrel form inner and outer telescopically arranged parts which are longitudinally movable relative to each other and which form between them a chamber for hydraulic fluid, and that means is provided for yieldingly resisting the relative longitudinal movement of the parts for a portion of the movement thereof in a direction to extend the parts and for allowing free movement of the parts in such direction when the parts reach a predetermined position of such movement.

It will also be apparent that the bellows 84 forms a movable element which is positioned to be acted upon by the pressure of fluid in the well bore externally of the barrel to compensate for any leakage of hydraulic fluid from the chamber 92, whereby the chamber is maintained in a filled condition and the pressure inside of the chamber is balanced with the external pressure.

The length of the stroke of the jarring mechanism may be varied as desired, by changing the length of the upper barrel section 20, whereby the force of the impact may be adjusted. Thus, by attaching the lower barrel part 22 to an upper barrel part of greater length the speed at which the hammer 44 will be moving when the hammer reaches the impact face 14 of the anvil will be increased whereby the force of the impact will be increased accordingly.

The invention is disclosed herein in connection with a particular embodiment of the same, which it will be understood is intended by way of illustration only, it being evident that various changes in the structure of the same can be made within the spirit of the invention and the scope of the appended claim.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. A well jar comprising inner and outer telescopically arranged cylindrical parts movable longitudinally relative to each other, means forming a closed chamber in the outer part, said chamber containing hydraulic fluid and including piston means movably disposed in the chamber and shaped for coaction with said outer part to restrict the flow of fluid past the piston means, means forming a releasable connection between said piston means and said inner part to cause the piston

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means to move with the inner part during a portion of the relative longitudinal movement of the parts in either direction, and including means for releasing the inner part when the inner part reaches a predetermined position during relative longitudinal movement of the parts in one direction, and

means forming impact faces on the parts positioned for impact delivering engagement when the parts reach the limits of their relative longitudinal movement in either direction.

2. The well jar as claimed in claim 1, including means forming a passageway through which fluid in the chamber may flow from one side of the piston means to the other side thereof, and

means for closing said passageway during movement of the piston means in response to relative longitudinal movement of the parts in said one direction and for opening the same during movement of the piston means in response to relative longitudinal movement of the parts in the other direction.

3. The well jar as claimed in claim 1, wherein said releasable connection means includes

a cylindrical element formed at one end with peripherally spaced flexible finger,

means on said fingers and said inner part positioned for coaction to releasably connect the inner part to said element for movement therewith in one direction upon inward flexing movement of said fingers and to release the inner part upon outward flexing movement of the fingers,

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means on said fingers and said outer part positioned for coaction to flex said fingers inwardly when the parts reach a predetermined position of their relative longitudinal movement in said other direction and to allow outward flexing of the fingers when the parts reach a predetermined position of their relative longitudinal movement in said one direction.

4. The well jar as claimed in claim 1, wherein said outer part is formed with openings positioned to allow the flow of well fluid into and out of the outer part at locations outside of said chamber.

5. The well jar as claimed in claim 1, including means exposed to the pressure of fluid externally of said outer part positioned to transmit such pressure to the fluid in said chamber.

6. The well jar as claimed in claim 5, wherein said pressure transmitting means is flexible.

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