

June 7, 1955

E. W. BAGNELL
HYDRAULIC WELL JAR

2,710,171

Filed June 24, 1952

2 Sheets-Sheet 1

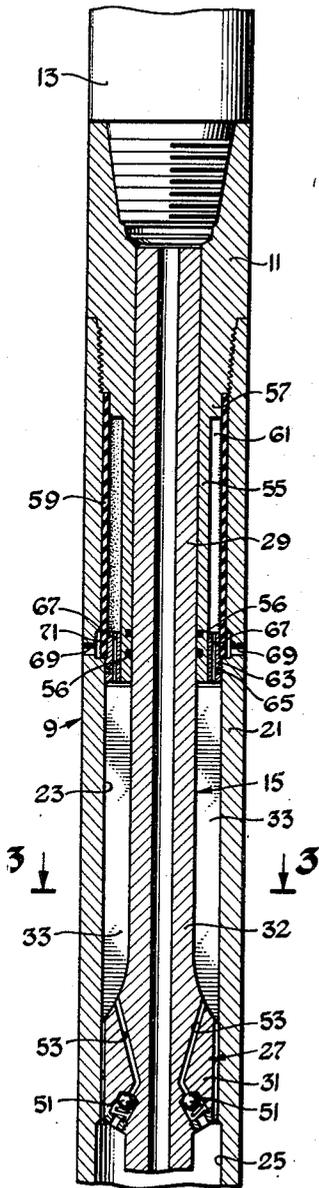


FIG. 1a.

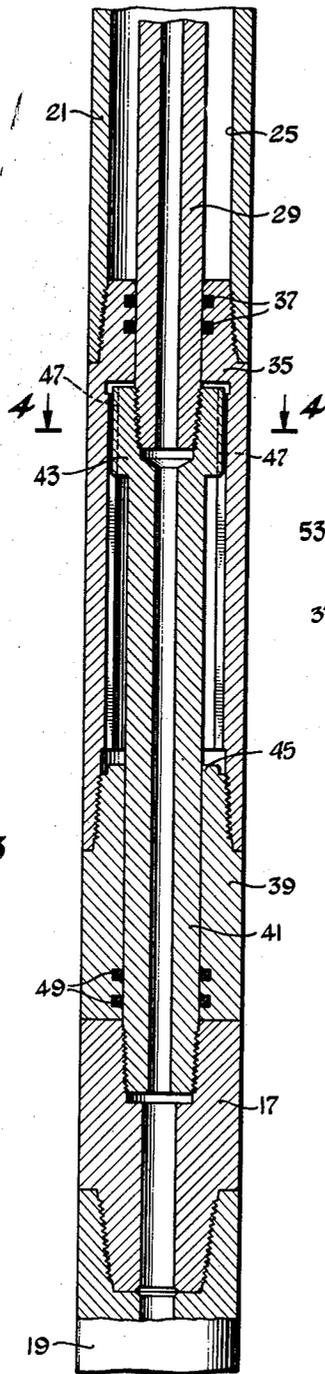


FIG. 1b.

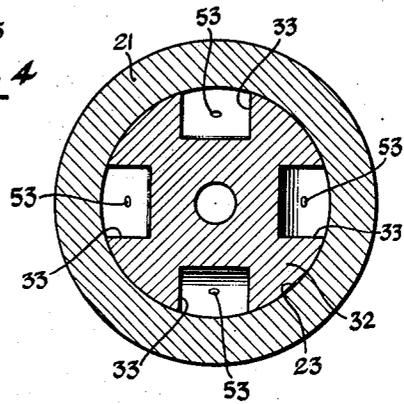


FIG. 3.

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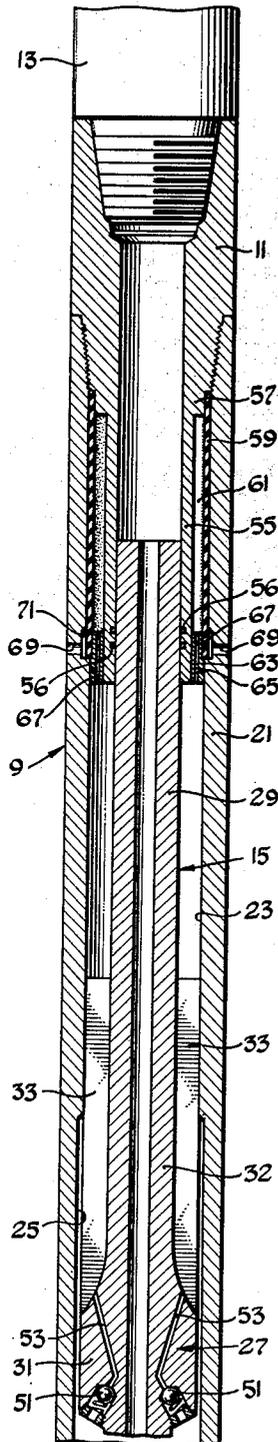


FIG. 2a.

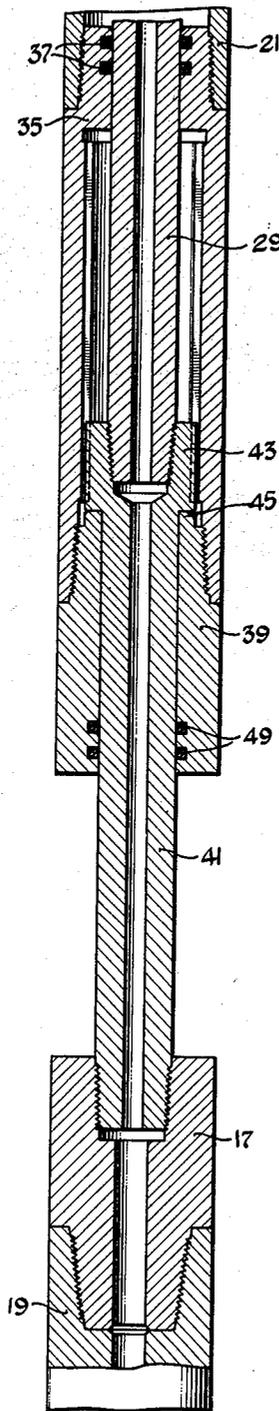


FIG. 2b.

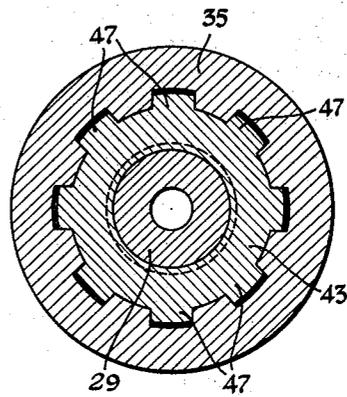


FIG. 4.

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2,710,171

HYDRAULIC WELL JAR

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Application June 24, 1952, Serial No. 295,201

4 Claims. (Cl. 255—27)

This invention relates to an oil well tool and particularly to a hydraulic well jar of the type adapted to be connected at its lower end to a stuck member to be jarred and at its upper end to a drill string, by which the hydraulic well jar can be operated to subject the stuck member to a succession of jarring blows.

In certain types of conventional hydraulic jars, for example that shown in the patent to W. B. Wigle, No. 1,637,505, granted August 2, 1927, a valve member tightly fits within a small bore and is adapted to be forced from the small bore into a larger bore, and during its movement in the small bore to force trapped hydraulic fluid from within the large bore past the valve member into the small bore. This resistance to movement of the valve member is utilized to stretch the drill string so that upon full entry of the valve member into the large bore, the resistance movement is suddenly released to allow the valve member to strike an anvil. The valve member, therefore, also functions as the hammer and is normally referred to as a hammer, although it performs both functions of a valve member and a hammer.

There are several disadvantages to this construction. The hammer is submerged in hydraulic fluid and it has been discovered that there is a cushioning effect unavoidably created between the hammer and anvil due to the rush of hydraulic fluid past the opposing faces of the hammer and anvil as the two members move together to effect a jarring blow. Furthermore, the hammer becomes deformed during use and, therefore, no longer properly fits within the small bore, and consequently the jarring action tends to become erratic and unpredictable.

A main object of the present invention is to provide a hydraulic well jar overcoming the above disadvantageous operating characteristics by including a separate valve member disposed within a hydraulically filled chamber and a separate hammer connected to the valve member but disposed in a vacant or dry chamber, i. e., one not filled with hydraulic fluid, so that the hammer can strike the anvil without the creation of a cushioning effect, and the valve can properly operate without being battered or deformed by striking the anvil.

A further object of the present invention is to provide a hydraulic jar having a novel diaphragm construction for preventing the creation of voids in the hydraulic fluid chamber.

Various other objects of the present invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Figs. 1a and 1b are successive longitudinal mid-sectional views of a hydraulic well jar embodying the concepts of the present invention, showing the tool at the beginning of a cycle of operation with the hammer spaced from the anvil and the valve member disposed within the small bore.

Figs. 2a and 2b are views similar to Figs. 1a and 1b but show the parts in the positions they assume at the instant of impact between the hammer and anvil.

Fig. 3 is a cross-sectional view of the tool taken along line 3—3 of Fig. 1.

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Fig. 4 is a cross-sectional view of the tool taken along line 4—4 of Fig. 1.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, there is disclosed a hydraulic well jar comprising two main parts, an outer composite tubular mandrel 9 connected at its upper end by a sub 11 to the lower end of a drill string 13, and an inner composite tubular mandrel 15 telescopically received within the outer mandrel and connected at its lower end by a sub 17 to the upper end of a stuck member 19.

Outer composite tubular mandrel 9 includes a tubular valve housing 21 filled with hydraulic fluid such as oil, and having formed therein a small bore 23 and a somewhat larger bore 25 disposed beneath the small bore and in direct communication therewith. Valve member 27 constitutes an enlargement on a tubular valve section 29 of inner composite tubular mandrel 15. The small bore 23 is of such size as to form a tight fit with the valve member 27, and large bore 25 is of such size as to freely accommodate said valve member.

Valve member 27 includes a bottom portion 31 having an unbroken exterior so as to form a plug within a small bore 23, and an upper portion 32 having longitudinally extending by-pass grooves 33 formed therein. Upper portion 32 is arranged so that it is never entirely withdrawn from the small bore and, therefore, forms a pilot for ready passage for the plug portion 31 into the small bore (into which it tightly fits). Upper grooved portion 32 functions to allow fluid to freely pass from the large bore into the small bore once the plug portion 31 has been forced out of said small bore.

Threadedly connected to the lower end of valve housing 21 is a sub 35, which forms a part of the outer composite tubular mandrel 9 and slidably receives the lower reduced end of inner tubular valve section 29. There are high pressure O ring seals 37 provided on the interior of sub 35 in sealing engagement with tubular valve section 29 to prevent the escape of hydraulic fluid from within the valve housing 21.

Sub 35 is connected at its lower end to an anvil sub 39, within which is slidably disposed a tubular hammer section 41 having formed on its upper end an enlarged hammer head 43. Hammer head 43 is threadedly connected to the lower end of tubular valve section 29 and is adapted to violently strike an anvil 45 formed on the upper end of anvil sub 39. Hammer head 43 and sub 35 are nonrotatably connected by a spline formation at 47, see Fig. 4.

Sub 35 forms a vacant housing within which the hammer head operates and this housing is sealed off from the hydraulic fluid by O rings 37, previously mentioned, and from well fluid by O rings 49 provided on the interior of anvil sub 39 in sealing engagement with tubular hammer section 41.

At the beginning of a jarring stroke (see Figs. 1a and 1b), valve member 27 is disposed within small bore 23 and is maintained in somewhat the same absolute position during operation of the hydraulic jar because of its connection to the stuck member 19. Upon upward movement of the drill string 13, outer tubular mandrel 9 is pulled upwardly forcing the hydraulic fluid trapped in housing 21, between sub 35 and valve member 27, upwardly between the exterior of said valve member and the walls of small bore 23 into the upper end of said small bore. This naturally creates a heavy resistance to upward movement of the drill string so that there results a relatively slow upward movement of outer mandrel 9 and a stretching of the drill string until the upper edge of the large bore 25 passes the upper edge of the plug portion 31 to uncover the by-pass grooves 33, at which time the valve housing is released, whereupon outer

mandrel 9 suddenly jumps upwardly (the stretched drill string contracting) to bring hammer head 43 and anvil 45 into violent engagement to cause a jarring blow to be dealt to stuck member 19. Since there is no hydraulic fluid in the chamber in which hammer head 43 operates, there is no cushioning effect created between the hammer and anvil, to therefore allow a more violent engagement between the hammer and anvil than heretofore realized in prior hydraulic jars of the type set forth above. It is pointed out that, as shown in Figs. 2a and 2b, valve member 27 at the end of the stroke of the housing 21 is still spaced from the upper end of sub 35 so that no cushioning effect is created in the valve chamber. It is further pointed out that since the valve member does not strike the anvil, it is not deformed or battered and will continue to properly fit within the small bore and insure proper operation of the well jar.

After the jarring stroke, the drill string 13 is lowered and the valve housing 21 readily moves down relative to valve member 27 with the fluid by-passing through grooves 33. Suitable spring-loaded ball valves 51 are provided in valve member 27 to allow hydraulic fluid to by-pass the valve member through by-pass ducts 53 formed in said valve member, upon entrance of the plug portion 31 of said valve member into small bore 23, to readily allow full retraction of the valve member within said small bore. The upper end of lower sub 17 engages the lower end of anvil sub 39 to limit downward movement of housing 21 relative to valve member 27.

Housing 21 is connected at its upper end to the lower end of top sub 11, said top sub having a reduced depending tubular portion 55 slidably received about the upper end of tubular valve section 29, and having its exterior spaced from the interior of valve housing 21 as is apparent from the drawings. O ring seals 56 are provided on the interior of tubular portion 55 in sealing engagement with tubular valve section 29.

Adjacent the upper end of tubular portion 55, sub 11 is formed with an annular step 57 which receives thereon the upper end of a sleeve type flexible diaphragm 59, the interior of which is spaced from the exterior of tubular portion 55 to provide a reserve oil space 61. The upper end of diaphragm 59 is secured to step 57 and the lower end of said diaphragm is secured to the exterior of a ring 63, which is connected to the lower end of tubular portion 55. Ring 63 carries on its exterior an O ring seal 65 in sealing engagement with the interior of valve housing 21, and has oil passages 67 extending axially therethrough to provide communication between the oil reserve space 61 and the interior of valve housing 21.

Valve housing 21 is ported at 69 and annularly relieved at 71 so as to subject the exterior of diaphragm 59 to the well pressure. The diaphragm will flex under the influence of the well pressure to an extent to prevent the creation of any voids in the hydraulic fluid chamber defined by the housing 21, particularly upon the unavoidable escape of hydraulic fluid therefrom such as past O rings 56.

By the present invention a hydraulic well jar has been provided in which the anvil and hammer are permitted to more violently come into impact because the hammer operates in a vacant instead of a hydraulic fluid-filled chamber. Furthermore, the valve member is separate from but connected to the hammer and so does not come into violent engagement with any abutment, and therefore its proper fit within the small bore of the tool is assured, and therefore proper operation of the tool is attained.

While I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A hydraulic well jar, comprising a tubular body adapted to be connected at its upper end to a supporting string of pipe and reciprocably receiving a mandrel which is adapted to be connected at its lower end to a member to be jarred, said body having an upper enlarged bore portion forming a fluid-filled chamber and a lower enlarged bore portion forming a vacant chamber, the bore between said chambers being restricted and the walls thereof sealingly engaging the mandrel, the fluid-filled chamber having a portion of slightly smaller diameter than the remainder of said chamber, an enlargement on said mandrel forming a valve adapted to slidably engage said smaller diameter portion, said valve being adapted to retard movement of said mandrel relative to said body when in said smaller portion and then suddenly release the tubular body from the mandrel in response to an upward pull on the body when it leaves said smaller portion, one end wall of said vacant chamber constituting a hammer adapted to strike an anvil within said chamber and fixed to said mandrel upon release of the tubular body, and a resilient sleeve-shaped diaphragm fastened at both its ends to the wall of the fluid-filled chamber and having its exterior in communication with the fluid in the well bore exterior of the tubular body, whereby the space occupied by any fluid leaking from the chamber will be taken up by inward flexing of the diaphragm under influence of the well fluid.
2. A hydraulic well jar, comprising a tubular body adapted to be connected at its upper end to a supporting string of pipe and reciprocably receiving a mandrel which is adapted to be connected at its lower end to a member to be jarred, said body having an upper enlarged bore portion forming a fluid-filled chamber and a lower enlarged bore portion forming a vacant chamber, the bore between said chambers being restricted and the walls thereof sealingly engaging the mandrel, the fluid-filled chamber having a portion of slightly smaller diameter than the remainder of said chamber, an enlargement on said mandrel forming a valve adapted to slidably engage said smaller diameter portion, said valve being adapted to retard movement of said mandrel relative to said body when in said smaller portion and then suddenly release the tubular body from the mandrel in response to an upward pull on the body when it leaves said smaller portion, one end wall of said vacant chamber constituting a hammer adapted to strike an anvil within said chamber and fixed to said mandrel upon release of the tubular body, a resilient sleeve-shaped diaphragm fastened at both its ends to the wall of the fluid-filled chamber and having its exterior in communication with the fluid in the well bore exterior of the tubular body, whereby the space occupied by any fluid leaking from the chamber will be taken up by inward flexing of the diaphragm under influence of the well fluid, and means for preventing rotation between the tubular body and the mandrel.
3. A hydraulic well jar, comprising a tubular body adapted to be connected at its upper end to a supporting string of pipe and reciprocably receiving a mandrel which is adapted to be connected at its lower end to a member to be jarred, said body having a fluid-filled chamber connected to a vacant chamber by a bore through which the mandrel extends, means for preventing fluid flow between the mandrel and the walls of the bore, a sudden release hydraulic valve in the fluid-filled chamber carried by the mandrel and cooperable with small and large bores in the fluid-filled chamber to retard and then suddenly release the tubular body from the mandrel in response to an upward pull on the body, one end wall of said vacant chamber constituting a hammer adapted to strike an anvil within said chamber and fixed to said mandrel upon release of the body, and a resilient sleeve-shaped diaphragm fastened at both its ends to the wall

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of the fluid-filled chamber and having its exterior in communication with the fluid in the well bore exterior of the tubular body, whereby the space occupied by any fluid leaking from the chamber will be taken up by inward flexing of the diaphragm under the influence of the well fluid.

4. A hydraulic well jar, comprising a tubular body adapted to be connected at its upper end to a supporting string of pipe and reciprocally receiving a mandrel which is adapted to be connected at its lower end to a member to be jarred, said body having a fluid-filled chamber connected to a vacant chamber by a bore through which the mandrel extends, means for preventing fluid flow between the mandrel and the walls of the bore, a sudden release hydraulic valve in the fluid-filled chamber carried by the mandrel and cooperable with small and large bores in the fluid-filled chamber to retard and then suddenly release the tubular body from the mandrel in response to an upward pull on the body, one end wall of said vacant

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chamber constituting a hammer adapted to strike an anvil within said chamber and fixed to said mandrel upon release of the body, a resilient sleeve-shaped diaphragm fastened at both its ends to the wall of the fluid-filled chamber and having its exterior in communication with the fluid in the well bore exterior of the tubular body, whereby the space occupied by any fluid leaking from the chamber will be taken up by inward flexing of the diaphragm under the influence of the well fluid, and means for preventing rotation between the tubular body and the mandrel.

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