April 6, 1943. G. N. STAFFORD 2,315,905

JARRING TOOL

Filed March 1, 1940

Fig. 1

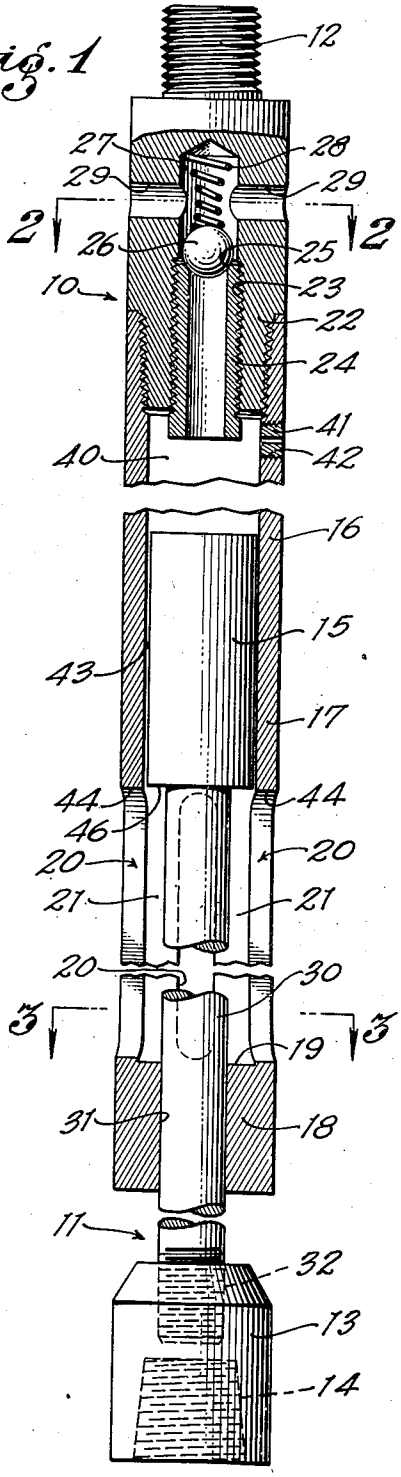


Fig. 2

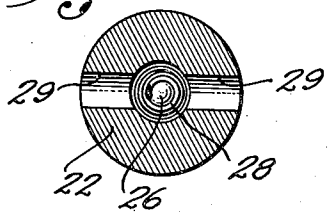
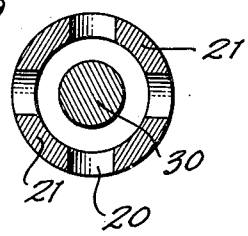


Fig. 3



GUY N. STAFFORD,
INVENTOR.

BY

ATTORNEY

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2,315,905

JARRING TOOL

Guy N. Stafford, Gardena, Calif., assignor to Ira J. McCullough, Los Angeles, Calif.

Application March 1, 1940, Serial No. 321,737

4 Claims. (Cl. 255—27)

My invention relates to jars of the type employed in wells to move objects which are stuck in such wells, and relates in particular to a simple jar especially adapted for use in the cable system of well drilling.

It is an object of the invention to provide a jar which may be employed in a tool line which is suspended or lowered into the well. By "tool line" I means a tool and the suspension means whereby the tool is lowered into the well so that it may be operated. In the practice of the invention the tool may be a drill bit, bailer or swab, or other device which is lowered into a well and which during its operation might become stuck therein. The jar is of such character that it may be a constant part of the tool line so that if at any time the tool of the tool line becomes stuck, the jar may be employed to move the same from the position in which it is lodged.

It is an object of the invention to provide a jar of the character described in the preceding paragraph having cooperating parts preferably in telescopic relation and connected for limited axial movement and having cooperating shoulders which are brought into engagement by relative axial movement of the members so as to impart jarring blows. A special feature of the invention is the provision of a simple movement restraining or retarding means having no cams or shoulders but merely a simple arrangement of parts which retard the movement of the jar member while tension is being applied to the tool line.

An object of the invention is to provide a jar of the above character having movement restraining or retarding means which for its effect depends upon the hydrostatic pressure of fluid or liquid in the well to exert a force tending to hold cooperating parts against movement during the time a strain is being applied, so that when the cooperating parts are released for jarring movement a relatively sharp and heavy blow will be struck and a correspondingly effective force will be applied to move the object with which the jar is connected. For example, the object to be jarred may be the drill bit. When the bit becomes stuck, the jar, which is mounted adjacent the upper end of the bit, may be actuated by an up and down movement of the cable. In the operation of the jar, the cable is first lowered so that the upper sliding member of the jar may move downward on the lower jar member to effect engagement of the cooperating parts of the retarding or restraining means of the jar. An upward pull is then applied to the cable so as to build up a tension therein prior to the release of the restraining or retarding means. This tension in the cable causes an elongation thereof, and when the restraining or retarding means releases, the contraction of the suspension means, namely, the cable, produces a rapid and forcible upward movement of the upper jarring member so that a heavy jarring blow results from the shoulder of the upper jarring member striking the shoulder of the lower jarring member which is connected to the bit. As hereinbefore indicated the jar may be employed as a constant part of a tool line wherein the tool comprises a bailer which is lowered to the bottom of the well for the purpose of bailing from the bottom of the well materials which may be of such character that sticking of the bailer is a constant hazard. Having the jar at all times ready for immediate use is of material advantage for the reason that the jarring operations may be started before any large degree of settling of solids around or above the tool has time to occur.

It is an object of the invention to provide a restraining or retarding means for a jar of the general character hereinabove described comprising a hollow body having an opening into which a plug may slide, thereby forming a chamber in which a pressure reduction occurs when a force is applied tending to move the plug out of the opening, so that the hydrostatic pressure applied to the outer end of the plug will exert a force tending to hold the plug in the opening.

A further object of the invention is to provide a retarding or restraining means of the character set forth in the preceding paragraph having check valve means for permitting escape of fluid from the chamber as the plug is moved into the opening of the hollow body, and a further object is to provide a device of this character having the cooperating parts so arranged or having means for permitting a limited flow of fluid into the chamber to effect a reduction in the differential of pressure between the exterior and the interior of the device whereby release of the plug from the chamber may be effectuated.

Further objects and advantages of the invention will be brought out in the following part of the specification.

Referring to the drawing which is for illustrative purposes only:

Fig. 1 is an assembly view of a simple form of my invention, partly sectioned, and with intermediate portions of the device cut out to reduce the overall length of the view.

Fig. 2 is a cross-section taken on the plane represented by the line 2—2 of Fig. 1.

Fig. 3 is a cross-section on the plane indicated by the line 3—3 of Fig. 1.

As shown in the drawing, the jar comprises an upper part 10, and a lower part 11 connected for axial sliding movement. The upper part 10 is provided with external means of joinder, shown as a threaded pin 12, whereby it may be connected to a suspension member such as a cable extended down into the well from the hoisting means of the derrick. The lower part 11 is shown with external means of joinder 13, whereby it may be connected to a downwardly extending part of the tool line. Such means of joinder 13 is shown as a head having internal threads 14 whereby it may be secured to the upper end of a tool, such as a drill bit, a socket, or a bailer. The upper part is shown as extending down over and around the upper portion of the lower part, which, in the use of the jar, remains stationary or relatively so due to the fact that it is connected to the upper end of the part to which the jarring effect is to be applied. When the upper part 10 is lowered relative to the lower part 11 cooperating movement retarding or restraining means on the two parts comes into engagement so that the upper part will be restrained from upward movement, or in other words will be in "set" position. These cooperating parts, when they come into engagement, form a chamber in which a reduced pressure, partial vacuum or full vacuum may be effectuated, so that the external hydrostatic pressure exerted by the column of liquid in the well will tend to hold these cooperating parts against separation. Separation of the parts when a pull is exerted tending to raise the upper jar part 10 relative to the lower jar part 11 may be accomplished either by exerting an upward pull greater than the force resulting from the external hydrostatic pressure tending to hold the cooperating parts of the restraining means together, or by increasing the pressure in the chamber by allowing an entry of fluid thereinto.

In the form of the invention shown, the cooperating parts of the restraining means are built into the jar structure and are shown as consisting of a plug or piston 15 carried on or forming the upper end of the lower part 11, and a hollow body forming a shell or cylinder 16 comprising a portion of the upper jar part 10. In my present simple construction the cylinder 16 comprises the upper part of a steel tube 17 having at the lower end thereof an annular wall 18 providing a shoulder or anvil 19, vertical slots 20 being cut in the tube 16 from the annular wall 18 to the lower end of the cylinder 16 to provide bars 21 extending downward from the lower end of the cylinder 16 to support the annular wall 18 in spaced relation to the lower end of the cylinder, wherein the distance from the shoulder 19 to the lower end of the cylinder will be materially greater than the vertical dimension or length of the piston 15. A plug 22 is screwed into the upper end of the tube 17, this plug having the threaded pin 12 formed thereon and also having a threaded opening 23 to receive a sleeve 24, the upper end of which forms a valve seat 25 for a closure member which may be in the form of a ball 26, thereby forming a check valve. An axial chamber 27 extends upward from the threaded opening 23 and has therein a spring 28 which exerts downward pressure against the ball 26. Discharge openings for the check valve are formed by radial holes 29 which lead outward from the chamber 27.

The lower jar part 11 includes a rod 30 which extends downward from the piston 15 through the opening 31 provided by the annular wall 18 and is connected to the head 13 by a threaded joint 32. The piston 15 may be a relatively close fit in the cylinder 16, or the external diameter of the piston 15 may be made smaller than the internal diameter of the cylinder 16 so as to provide space between the piston and the wall of the cylinder through which a limited flow of liquid may occur, depending upon conditions of use, as will be brought out in the following part of the specification.

For purpose of explanation let it be assumed that the jar is being used in a deep hole wherein the head of liquid in the well produces a high hydrostatic pressure near the bottom of the hole, or, in other words in the zone in which the jar would be operated. To set the jar preparatory to the striking of a jarring blow, the upper part 10 is lowered on the lower part 11 so as to cause the piston 15 to pass into the shell 16, displacing therefrom, through the check valve at the upper end, the fluid trapped in the chamber 40 formed by the cylinder 16, the plug 22, and the piston 15. Upon completion of the step consisting of lowering of the upper member 10 to its lowered position on the member 11, it will be found that the pressure in the chamber 40 is substantially equal to the external hydrostatic pressure, but should an upward force now be applied to the upper part 10, tending to enlarge the chamber 40 by moving the upper wall of the chamber formed by the plug 22 away from the piston, there will be an immediate reduction in pressure in the chamber 40, and if the piston 15 is a tight fit and the chamber 40 entirely closed, this upward movement of the member 10 will produce a vacuum in the chamber 40, providing, of course, the upward force applied to the upper member 10 is sufficient to overcome the hydrostatic pressure exerted downwardly on the plug 22 and upwardly against the lower end of the piston 15 tending to prevent axial expansion of the chamber 40. Under certain conditions of operation the hydrostatic force effective is so large that a pull too great for safe operation must be transmitted through the suspension means to pull the cylinder 16 out of engagement with the piston 15. Under such circumstances I provide means for relieving the reduced pressure in the chamber 40 by admitting a limited flow of fluid into this chamber. This may be accomplished by use of a ported plug 41 screwed into a threaded opening 42 near the upper end of the cylinder 16. In fact, a number of plugs for the opening 42 may be provided, one having no opening therein and the others having openings of different sizes for different inflows of fluid under various conditions of operation. However, in the general practice of my invention I may avoid the use of the plug 41 entirely, and make the piston 15 of such diameter to leave a space 43 therearound through which a relative flow of fluid may pass into the chamber 40 to build up the pressure therein whereby movement of the cylinder 16 upwardly from engagement with the piston 15 may be accomplished by an upward pull on the upper member 10 less than the force which would be required to overcome the hydrostatic pressure acting externally to hold the parts in engagement. As soon as the upward movement of the cylinder

16 brings the upper ends 44 of the slots 20 into coincidence with the upper ends of the piston 15, a free flow of fluid from the exterior into the chamber 40 is permitted and the hydrostatic pressure against the upper and lower ends of the piston and the upper and lower ends of the plug 22 are balanced so that contraction of the suspension member may rapidly move the upper jar member 10 upward so as to bring the anvil 19 into forcible engagement with the shoulder 46 constituting the lower end of the piston 15.

When the device is used in a shallow well, no means for permitting an entry of fluid into the chamber 40 need be provided since an excessive force will not be required to move the piston and cylinder out of engagement against the hydrostatic pressure differential.

I claim as my invention:

1. In a jar of the character described, for use in a tool line which extends into a well, the combination of: a cylinder having a wall closing one end thereof, said wall comprising attachment means for connecting it to a part of said line; an annular wall providing an anvil; means connecting said annular wall to said cylinder in a position spaced from the open end thereof, said means comprising a cylindric wall having an opening to connect the open end of said cylinder with the exterior of the jar; a piston slidable from a position in said cylinder wherein it defines a chamber within said cylinder, to a position outside said cylinder and within said cylindric wall wherein it will strike said anvil; a rod extending from said piston through said annular wall; an attachment means at the outer end of said rod for connecting it to another part of said line; and means limiting the entry of fluid into said chamber when said piston is in said cylinder, whereby the fluid pressure differential acting against the exposed ends of said piston and said wall of said cylinder will resist relative movement of said piston toward said anvil until said piston is moved out of said cylinder.

2. In a jar of the character described, for use in a tool line which extends into a well, the combination of: a cylinder having a wall closing one end thereof, said wall comprising attachment means for connecting it to a part of said line; an annular wall providing an anvil; means connecting said annular wall to said cylinder in a position spaced from the open end thereof, said means comprising a tubular wall having a lateral opening extending from said open end of said cylinder to said annular wall; a piston slidable from a position in said cylinder wherein it defines a chamber within said cylinder, to a position outside said cylinder and within said tubular wall wherein it will strike said anvil; a rod extending from said piston through said annular wall; an attachment means at the outer end of said rod for connecting it to another part of said line; means limiting the entry of fluid into said chamber when said piston is in said cylinder, whereby the fluid pressure differential applied to the outer ends of said piston and said wall which closes said end of said cylinder will resist relative movement of said piston toward said anvil until said piston is moved out of said cylinder; and check valve means for permitting a flow of fluid out of said chamber as said piston is moved into said cylinder.

3. In a jar of the character described, the combination of: a tubular shell closed at one end thereof; attachment means at the closed end of said shell; an anvil; means for supporting said anvil in spaced relation to the open end of said shell, said means having a lateral opening to connect the open end of said shell with the exterior of the jar; a piston slidable from a position within said shell wherein it defines a chamber within said shell, to a position outside said shell and within said means wherein it strikes said anvil; and a rod extending from said piston to a point beyond said anvil, said rod having attachment means at the outer end thereof, the outer end of said piston being exposed to pressure of fluid exterior of said shell when said piston is in said shell, and the inner end of said piston being exposed to the pressure in said chamber, whereby the pressure differential applied to the outer ends of said piston and said shell will restrain relative movement of said piston toward said anvil.

4. In a jar of the character described for use in a well having liquids therein, the combination of: a tubular wall elongated in the direction of its axis and being closed at one end, said wall being laterally ported near its other end whereby the tubular wall will be divided into a ported section and a chambered section forming a chamber in open communication with said ported section and communicating with the exterior of the jar through said ported section; and an annular wall forming a shoulder at said other end of said tubular wall; a plunger member extending into said tubular wall through said other end thereof, said plunger member having a piston on its inner end to move from a position in said chamber to a position in said ported section wherein it will strike said shoulder, there being means to permit an out-flow of liquid from said chamber when said piston is moved thereinto and means enabling a limited flow of liquid into said chamber when a force is applied tending to move said piston out of said chamber against the hydrostatic pressure of liquid in the well against the outer end of said piston and the closed end of said tubular wall, and which resists movement of said piston out of said chamber.

GUY N. STAFFORD.