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J. L. DOWNEN
HYDRAULIC OIL WELL JAR
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2,989,132

FIG. 1.

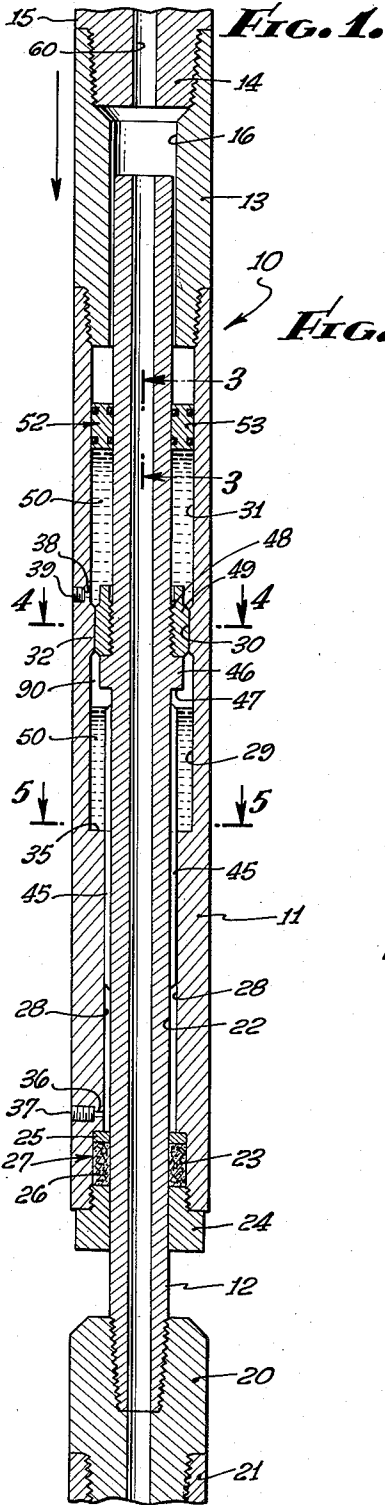


FIG. 2.

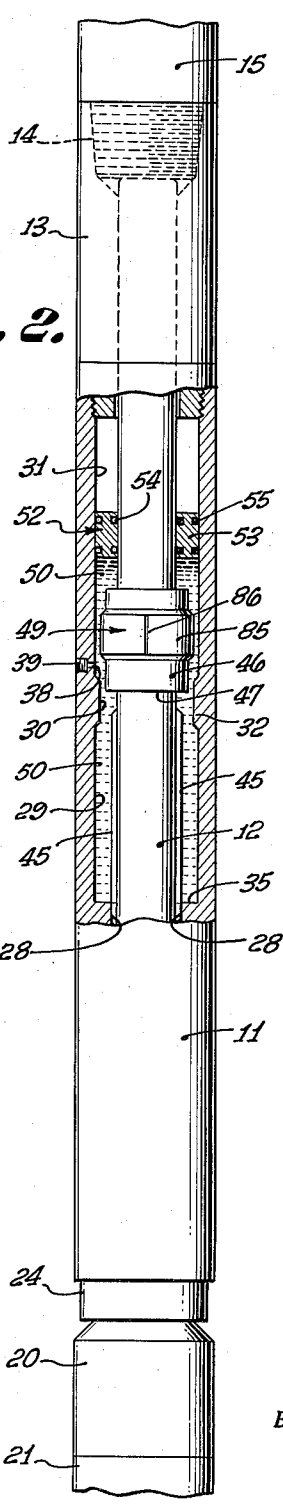


FIG. 3.

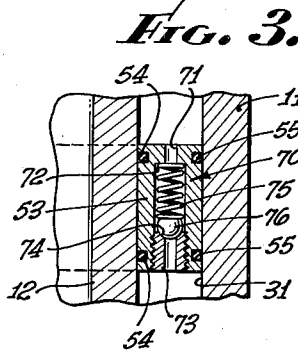


FIG. 4.

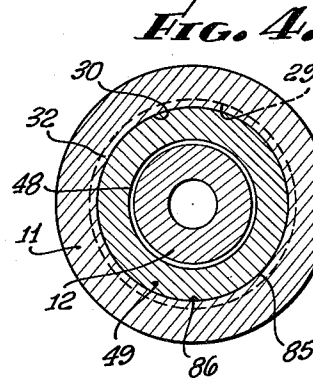
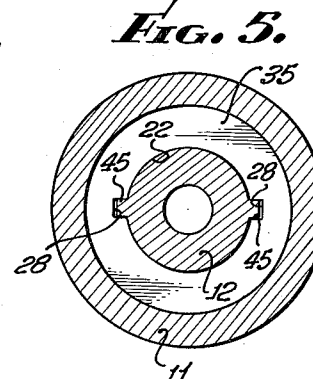


FIG. 5.



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HYDRAULIC OIL WELL JAR

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This invention relates to hydraulic well jars and has as one of its objects the provision of a hydraulic jar which is basically simple in design, relatively inexpensive to build, and yet is very rugged in construction, subject to few disorders, and therefore low in maintenance costs.

The common practice in employing a jar in a drill string just above a grapple to assist in loosening a lost tool (termed a "fish") for withdrawing this from the well, is to depend primarily on a series of upward jarring blows to loosen the fish. Each of these blows is effected by a device in the jar which automatically temporarily restrains upward movement of the lower end of the drill string while the latter is stretched from its upper end, and then suddenly relaxes said restraint to permit the tremendous energy thus elastically stored in the drill string to lift a hammer shoulder in the jar with a snap action over a short distance into impact with an anvil shoulder therein.

Drillers have found it useful in jarring operations to occasionally alternate successive upward jarring blows with a downward blow against the fish. While jars have been provided to permit the driller the option of effecting a snap action blow either upwardly or downwardly, the drill string tends to buckle in the well when it is lowered to support a substantial part of its weight on the jar in order to perform a downward "snap action" blow through said jar. For delivering a downward blow in a fishing operation, the drillers have therefore developed what is termed "spudding" the jar. The type of jar generally used in this is one provided with means to utilize a tensioned drill string for striking a snap action upward blow and which is then adapted to be telescopically collapsed relatively quickly to starting position. To facilitate the spudding operation, a bumper sub with a vertical lost motion of about 16 inches is assembled between the drill string and the jar. There are two styles of spudding operations, the more radical of which produces much the hardest downward blow but is likely to seriously damage the jar. This radical spudding operation immediately follows the upward stretching of the drill stem to strike an upward snap action blow through the mechanism of the jar. As soon as this action is concluded the driller suddenly drops the upper end of the drill string about two-thirds of the total upward stretch required for the upward jar blow, and then resumes support of the drill stem. This snaps the lower end of the drill string downwardly with a rapid and powerful blow which is transmitted through the collapsed bumper sub to the upwardly extended jar. This telescopically collapses the latter in a small fraction of a second whereas it is designed for this collapsing movement to last several seconds at least. While a terrific blow is thus transmitted through the jar to the fish, hydraulic jars subjected to this kind of spudding action were damaged. In some instances the outer mandrel burst from the excessive internal oil pressure developed by the rapid telescoping of the jar. In others the outer mandrel merely took an expansive set.

This damage to the jars caused drillers to refrain from employing this radical type of spudding action excepting when the damage suffered in it appeared justified in order to consummate a fishing operation without delay. In ordinary practice, drillers have therefore substituted for the more radical spudding operation above-described one which is relatively cautious, and results in much less damage to the jars.

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In preparing for this somewhat milder mode of spudding, the driller first lowers the drill string slowly so as to fully collapse both the jar and the bumper sub. He then lifts the drill string so as to extend the bumper sub to its full length while trying to leave the jar in its fully collapsed condition. He now relaxes hold of the drill string where it is held at its upper end and resumes the support of it when it has fallen just less than the vertical distance of the free play in the bumper sub.

The kinetic energy thus set up in the drill string stretches this and forces the bumper sub downwardly rapidly a substantial distance after the sub has been completely collapsed. If the jar is collapsed when this spudding action starts the downward blow thus delivered to the jar is transmitted thereby to the fish without any damage to the jar. It is not always possible however to accurately determine the condition of the jar when this spudding action is started and sometimes the jar is at least partially extended when the blow is delivered to the jar and thus suffers damage by the building up of excessive internal oil pressure incidental to the telescoping of the jar by this blow.

The drillers of course are primarily concerned with successfully terminating the fishing operation and are vexed by the necessity to exercise such extreme caution to prevent damaging the jar, especially when it limits the intensity of the spudding blow which the equipment could otherwise deliver downwardly on the fish.

It is therefore another important object of the present invention to provide a hydraulic oil well jar having means for utilizing a tensioned drill string for striking a snap action upward jarring blow and which is adapted to sustain a radical spudding action at the time the jar is fully extended without suffering any damage therefrom.

In hydraulic jars generally of the prior art, the telescopic collapsing of the jar each time this is reset to start a snap action jarring operation, requires a pumping of a certain volume of operating liquid through a relatively restricted passage and it is this feature which causes the jar to be damaged when it is spudded while the jar is in fully extended condition.

Still another object of the invention is the provision of a hydraulic oil well jar which adjusts itself hydraulically to the telescopic collapsing of the jar in resetting the latter for starting a new jarring operation by the development of a vacuum in the high pressure chamber of the jar, thereby rendering the jar immune to damage by spudding operations even when the jar is in fully extended condition when the spudding blow is delivered thereto.

Another object of the present invention is the provision of a hydraulic oil well jar which includes means for breaking the aforesaid vacuum just prior to the completion of the telescopic movement for collapsing the jar thereby restoring internal operating liquid pressures in said jar to normal.

Heretofore, hydraulic jars controllable by the relative movement between the inner and outer tubular elements being retarded by a restricted reverse flow of liquid past the piston as it travels through the cylinder, have made use of a loose fit between the piston and the cylinder to provide the escape passage. This has proven unsatisfactory because of the large change in rate of escape produced by a very small change in the difference between the diameters of the piston and the cylinder.

The alternative of a small-diameter hole passing axially through the piston has been tried. Such a hole, however, because of its small diameter and substantial length is not only difficult to drill but tends to clog up and thus impair the continued operation of the jar.

Yet another object of the invention is to provide a novel means for allowing a retarded escape of liquid past the piston in such a hydraulic jar at a precisely pre-

determined rate which will be free of all of the foregoing objections and will be relatively easy and inexpensive to produce.

The manner of accomplishing the foregoing objects as well as further objects and advantages will be made manifest in the following description taken in connection with the accompanying drawings in which

FIG. 1 is a vertical sectional view of a hydraulic jar comprising a preferred embodiment of the present invention and illustrates the parts thereof disposed at a point during a resetting relative movement between the outer and inner tubular elements of the jar when the piston is disposed directly within the restricting cylinder of the jar, and shows a partial vacuum which has been drawn on the lower end portion of the liquid chamber of the jar.

FIG. 2 is an elevational view of the jar shown in FIG. 1 with the parts thereof disposed as at the completion of the resetting relative movement between the tubular elements of the jar and with the jar in readiness to commence a jarring operation, a portion of this view being broken away to show the relative positions of the piston, the cylinder and the floating seal at this time.

FIG. 3 is an enlarged fragmentary sectional view taken on the line 3—3 of FIG. 1 and illustrates a liquid escape check valve of the invention which is provided in the annular floating seal thereof.

FIG. 4 is an enlarged cross-sectional view, taken on the line 4—4 of FIG. 1, and illustrating the manner in which a passage is formed in the jar of the present invention to permit a controlled by-passing of liquid past the piston thereof while said piston is moving through said cylinder.

FIG. 5 is an enlarged cross-sectional view taken on the line 5—5 of FIG. 1 and illustrates the manner in which the outer and inner tubular elements of the jar of the invention are associated in splined relation whereby rotary motion may be transmitted through said jar from the drill string on the lower end of which said jar is suspended to a sub at the lower end of the jar which may be connected to the grapple or any other piece of oil well equipment with which the jar may be associated.

Referring specifically to the drawings the invention is shown therein as embodied in a hydraulic oil well jar 10 which includes an outer tubular element 11 and an inner tubular element 12 which are telescopically related to each other for relative axial movement in the operation of the jar. As shown in FIG. 1, the tubular element 11 forms a sleeve which is internally threaded at its upper end so as to screw on an upper jar sub 13 which in turn is adapted to screw onto the lower pin 14 of a tubular drill string 15 on which the jar 10 is suspended. The sub 13 has a substantial cylindrical bore 16 the function of which will be made clear hereinafter.

The inner tubular element 12 is externally threaded at its lower end and screws into a lower jar sub 20 which has means for threadedly connecting it to the upper end of a grapple 21 designed for engaging an object stuck in a well.

The tubular element 11 has a bore 22 at the lower end of which a counter bore 23 is provided, the lower end of said counter bore being threaded to receive a plug 24 for trapping a junk ring 25 and a mass of packing 26 between said plug and said ring for forming a fixed seal means 27 between the sleeve 11 and the inner tubular element 12 of the jar. The bore 22 is also provided with spline grooves 28. The sleeve 11 likewise has counter bores 29, 30 and 31, the counter bore 30 being somewhat larger in diameter than the bore 22 and the counter bores 29 and 31 having diameters greater than the counter bore 30 so that the latter counter bore forms an annular radially inwardly projecting cylinder 32 separating the counter bores 29 and 31. For purposes of distinguishing between counter bores 29 and 31, these may be referred to respectively as primary and secondary

counter bores. An annular radial impact face 35 is provided on the sleeve 11 at the juncture of the bore 22 and the counter bore 29.

The sleeve 11 is provided with a filler hole 36 and a filler plug 37 for closing the same at a level just above the junk ring 25. This sleeve is also provided with an air vent hole 38 and a plug 39 for closing the same at a level just above the counter bore 30.

The internal tubular element 12 comprises a tubular mandrel of uniform internal and external diameter throughout the length thereof excepting for the external threads at the lower end; for the provision of splines 45 formed thereon for interengagement with the spline grooves 28 of the sleeve 11, and excepting for the provision on said mandrel of an annular external shoulder 46 having a radial downward impact face 47, and excepting for threads 48 provided on said mandrel just above the shoulder 46 onto which an internally threaded annulus 49 is adapted to be screwed so that this forms a piston on said mandrel which is adapted to move axially through the cylinder 32 with a close sliding fit, as shown in FIG. 1.

As is clearly shown in FIG. 1, the tubular elements 11 and 12 of the jar 10 cooperate to provide, in the annular space between these elements, an operating liquid chamber 50, one end of which is closed by the fixed annular seal 27 provided by the junk ring 25, packing 26 and plug 24. The other end of operating liquid chamber 50 is closed by a floating seal 52 which comprises a metal ring 53 having annular grooves formed internally and externally therein to accommodate O-rings 54 which form a sliding liquid-tight sealing engagement between the ring 53 and the inner element 12 and O-rings 55 which form a liquid-tight sliding sealing engagement between the metal ring 53 and bore 31 of sleeve 11. The O-rings 54 and 55 thus operate to form a liquid tight seal between elements 11 and 12 within the bore 31 thereby forming an effective liquid-tight closure separating the liquid chamber 50 from the space in the upper end of bore 31 which communicates through the bore 16 of the sub 13 with a mud passage 60 of the drill string 15.

Confined in the chamber 50 of the jar 10 is a body of operating liquid which is ordinarily a light lubricating oil. This chamber is normally completely filled with this oil so that there is no air in chamber 50 whatsoever. In some cases the ambient fluid surrounding the jar 10 will be air but in most cases the ambient fluid both internal and external in which the jar 10 operates is rotary mud which flows downwardly through the mud passage 60 of the drill string, through the jar 10 and grapple 21 and outward into the well (not shown) in which the jar 10 is operating. Whatever this ambient fluid may be, however, it comes into contact with the upper face of the floating seal 52 and also with the lower face of the fixed annular packing seal 27 and is completely excluded by these two seals from the liquid chamber 50.

Under abnormal operating conditions one or the other of these seals may fail or wear so as to permit the admission of ambient fluid, either liquid or gaseous, into the liquid chamber 50. The present invention envisages this possibility and provides a means for ejecting from the liquid chamber 50 any excess quantity of fluid which might thus be admitted to this chamber.

This means is comprised in a spring check valve 70 which is provided in the metal ring 53, as illustrated in FIG. 3. This valve includes a bore 71 which is formed vertically in the ring 53 and has a deep counter bore 72 the lower end of which is internally threaded to receive a sleeve 73 having a valve seat 74 formed on its inner end. Held on this seat by a very stiff coil spring 75 is a ball 76. The manner in which the valve 70 functions to relieve the chamber 50 of excess fluid will be made clear in the description of the operation.

The peripheral face 85 of the piston 49 is made to fit so closely with the counter bore 30 of the cylinder 32

when said piston is passing through this cylinder than an inconsiderable amount of liquid is permitted to by-pass the piston. There is a definite reason for this close fit between the piston 49 and cylinder 32. It is to permit a close regulation of the exact amount of liquid which is allowed to by-pass the piston 49 when a given pressure of liquid is imposed on this piston. An accurate determination of the rate of flow of liquid by-passing the piston 49 is provided by forming a groove 86 vertically in the external surface 85 of the piston 49 so that practically the sole passage of liquid past the piston 49 is the groove 86. While it is preferable to form the groove 86 in the peripheral surface 85 of the piston 49 this groove could of course, alternatively, be formed in the counter bore 30. For convenience however it is preferable to form groove 86 in the piston 49 as above described.

Operation

The preferred embodiment of the invention is shown in FIG. 2 with the parts thereof properly related for starting a jarring operation which culminates in delivering a sharp upward blow to the grapple 21 and the fish (not shown) engaged thereby.

Starting with the parts thus related, the jarring operation is effected by applying an upward force on the jar 10 by lifting on the drill string 15 from the surface of the well. As the string is lifted, the sleeve 11 which is secured to the lower end of the drill string, is also lifted bringing the cylinder 32 into contact with the lower end of the piston 49 and thus trapping operating liquid in the lower end of the chamber 50 between the cylinder 32 and the lower fixed annular seal 27. Further upward movement of the sleeve 11 is retarded by the necessity of the operating liquid to escape from the lower end of chamber 50 upwardly past the piston 49. As above pointed out, the only escape provided for this liquid is through the groove 86, and this, of course, is relatively slow thereby permitting a tremendous upward strain or tension to be applied to element 11 through the drill string 15 while the sleeve 11 is gradually pulled upwardly over the piston 49 as the operating liquid escapes upwardly through the groove 86.

When the sleeve 11 has thus been lifted to the point where the cylinder 32 rises above the upper end of the peripheral surface 85 of piston 49, the liquid in the lower portion of the chamber 50 is free to flow from said portion of chamber 50 upwardly around the piston 49 and thus free the drill string from downward restraint allowing the drill string to suddenly contract axially, imparting to the sleeve 11 a very rapid upward movement bringing the impact faces 47 and 35 into sudden engagement and striking a heavy blow upwardly on the annular shoulder 46 of the element 12 of the jar. This blow of course is transmitted through this element and the sub 20 to the grapple 21 which is engaged with the fish stuck in the well.

The normal resetting of the jar 10 to bring the parts thereof into the relative positions in which these are shown in FIG. 2, is accomplished by lowering the drill string 15 and the sleeve 11 of the jar 10 until the plug 24 at the lower end thereof comes to rest on the sub 20. Assuming that the jarring operation is taking place near the bottom of a well 7000 feet deep, for instance, the outside diameter of the jar as shown in the drawings would be 3". Thus, since the distance the sleeve 11 travels downwardly from jarring relation with inner element 12 to its reset relation therewith, as shown in FIG. 2 is about 1½ times said outside diameter of the jar, the distance element 11 is thus lowered for resetting the jar is approximately 4½ inches.

During the initial phase of this downward movement of sleeve element 11, the portion of oil chamber 50 embraced by counter bore 29 allows the operating oil to flow freely axially past the piston 49, thereby setting up no resistance to such downward travel of element 11.

When the lower end of cylinder 32 reaches the upper end of piston 49, however, and starts to slide downwardly

over this at a reasonable rate of down travel of the drill string 15 in this resetting operation, which, for instance, might be one inch per second, the close fit between the piston 49 and cylinder 32 prevents a flow of oil between the piston and cylinder excepting along groove 86, and, at this rate of descent of sleeve 11, oil cannot flow downward through this groove fast enough to keep the portion of chamber 50 embraced by counter bore 29 filled with oil.

A vacuum 90 is thus produced in the portion of chamber 50 just beneath cylinder 32. This vacuum imposes a resistance to the second half of the downward movement of the sleeve element 11 in the resetting operation. This resistance is equal to the ambient fluid pressure multiplied by the net area displaced by the piston 49. The ambient pressure at a depth of 7000 feet being about 3010 p.s.i., and the net piston area about four inches, the resistance offered by the vacuum 90 to the final 2¼ inches of the downward travel of sleeve element 11 is about six tons.

This is approximately the weight of the lowermost 420 feet of the drill string which, in its entirety, is 7000 feet long and weighs over 100 tons.

It is thus evident that the resistance offered by the vacuum 90 to the downward movement of sleeve 11 has no substantial retarding effect on this movement, the latter continuing at about the same rate it started until it terminates with the plug 24 coming to rest on sub 20.

The resistance to this down movement is relaxed by the passage of cylinder 32 downwardly from over the piston 49 just prior to the sleeve 11 coming to rest on sub 20 so that there is no substantial downward acceleration of sleeve element 11 during the very brief interval between the dissipation of vacuum 90 and the end of said down movement of said sleeve.

The resetting operation is therefore concluded, under the conditions above assumed, by the settling of the sleeve 11 of the jar 10 and about six tons of drill string at a speed of about one inch per second onto the sub 20 of said jar.

The resetting operation is thus seen to be accomplished, in the embodiment of the invention disclosed herein, without delivering a substantial downward blow to the fish grapple 21.

The weight of the drill string 15 is imposed on the grapple 21 of course, as the resetting movement terminates, but the entire drill string 15 is travelling at such a low speed when this weight transfer takes place as to have no practical consequence as a jarring action on the grapple.

During downward movement of the sleeve 11 in resetting the jar 10, a substantial amount of the liquid in chamber 50 remains above cylinder 32 trapped between this cylinder and piston 49, on the one hand, and the floating seal 52, on the other. This causes the floating seal 52 to remain spaced a substantial distance above the piston 49 as the sleeve 11 moves downwardly. This almost brings the lower end of sub 13, which constitutes a stop for the upward movement of the floating seal 52, into contact with this floating seal. Normally such contact does not take place, as the jar 10 is designed to provide for free movement of the floating seal 52 upwardly throughout the entire operation of resetting the jar 10. In other words, as the cylinder 32 just starts to move downwardly entirely away from around the piston 49, in this resetting operation, the floating seal ring 52 is still shy of engagement with the sub 13. At this precise point in the resetting operation, the upper portion of counter bore 29 occupied by the vacuum 90 is brought into communication with that portion of the liquid chamber 50 located above said cylinder, whereupon operating liquid rushes downwardly between the cylinder 32 and piston 49 to fill said vacuum. This action of the vacuum of course sucks the floating seal ring 52 downwardly into much closer relation with the piston 49 as this is shown in FIG. 2.

A complete cycle of the normal operation of hydraulic

jar 10 has now been described whereby the jar has been returned to reset condition in readiness for the starting of another upward jarring operation. It will be appreciated that if, for any reason, a substantial amount of ambient fluid secures admission to the liquid chamber 50, this will cause floating seal 52 to engage the sub 13 during the next resetting operation, before the latter is completed, whereupon the excess amount of fluid in chamber 50 will be expelled upwardly therefrom through spring check valve 70.

In addition to its normal operation described hereinabove, the jar 10 of the present invention possesses the outstanding advantage of not setting up any liquid pressure pockets during its restoration to collapsed condition as shown in FIG. 2, whereby the jar may be subjected to a radical spudding operation as heretofore described, without suffering any damage whatsoever therefrom. In this spudding operation, a bumper sub (not shown) may or may not be assembled between the lower end of the drill string 15 and the upper sub 13 of the jar 10. In either case the operation is effected by performing an upward jarring action with the jar 10 terminating with this completely extended and with the drill string 15 upwardly stretched quite a distance which is sometimes as much as 6 feet.

While thus stretched and just after the upward jarring action in the jar 10 has taken place, the driller releases hold on the upper end of the drill string 15 allowing the entire drill string to drop about two-thirds the distance it had previously been stretched upwardly after which the upper end of the drill string is caught and support thereof resumed allowing the drill string 15 to fall downwardly producing a snapping action at its lower end which impels the same downwardly at a very rapid rate thereby collapsing the jar 10 from its fully extended position to its fully telescoped position shown in FIG. 2 in a small fraction of a second and striking a terrific spudding blow by the impact between the collar 24 and the sub 20. This blow of course is transmitted downwardly to the fish with which grapple 21 is engaged.

The immunity of the jar 10 to damage by this very severe operation, is due to the fact that its hydraulic adjustment during the telescopic return of the jar to collapsed condition is effected by developing a vacuum 90 just below the cylinder 32 of the jar. This vacuum imposes a constant resistance to the telescoping of the jar but it is inconsiderable in view of the tremendous pressures applied downwardly against the jar by the radical spudding action above-described. Furthermore, the vacuum thus employed to adjust the resetting of the jar does not impose any strains on the structure of the jar tending to damage this, and this is true irrespective of the speed with which the jar is telescoped.

It should be noted that there is a necessity for the release of this vacuum by a free flow of oil into the space 90 at the termination of the resetting movement and this is accomplished by the relative shortness of the cylinder 32 and the provision for the piston 49 to be entirely bypassed by the downward movement of this cylinder as shown in FIG. 2 thereby allowing a free flow of oil from the upper portion of the chamber 50 downwardly through the now open cylinder 32 into the lower portion of chamber 50 where the vacuum 90 had existed.

This very useful advantage is coupled with the provision of a completely free floating seal ring 52 having ample room to slide vertically to adjust itself to changes in the amount of space occupied by liquid between the cylinder 32 and seal ring 52. Counter bore 29 may thus be characterized as a high-pressure section of chamber 50 and the counter bore 31 may be characterized as a low pressure section of said chamber. The separation of these two counter bores by the relatively short counter bore 30 forming the cylinder 32 makes possible the performance of all the functions above-described which take

place in the operation of jar 10 and account for the numerous advantages pointed out.

The claims are:

1. A well tool comprising inner and outer telescopically related tubular elements; means for connecting one of said elements to a drill string; means for connecting the other element to an object to be jarred, telescopically overlapping portions of said elements providing an annular chamber for confining an operating liquid within said tool; an annular seal supported on the outer of said elements and slidably engaging the other element to close one end of said chamber; an annular floating seal disposed between and slidably engaging both of said elements to close the other end of said chamber, both of said seals being externally in contact with ambient fluid; a relatively short piston extending radially outwardly into said chamber from said inner element; and a relatively short cylinder formed on said outer element and extending radially inwardly therefrom into said chamber, said outer element also being provided with primary and secondary counterbores, each having a substantially larger internal diameter than said cylinder and a substantially greater length than said piston, said primary counterbore being located adjacent said cylinder between said cylinder and said fixed annular seal, said secondary counterbore being located axially in the opposite direction from said cylinder and containing said floating seal, the latter moving freely axially in said secondary counterbore in response to a differential between axial fluid pressures thereagainst to confine said operating liquid in said chamber and exclude ambient fluid from said chamber, said piston and cylinder uniting when said piston is within said cylinder to comprise a liquid flow restricting means which limits the movement of operating liquid from one of said counterbores past said piston to the other of said counterbores to a flow at a relatively slow rate, relative axial movement between said elements with said piston disposed within said cylinder, in which movement the axial spacing of said piston from said fixed seal increases at a relatively rapid rate, producing a vacuum within the primary counterbore portion of said chamber, while the operating liquid in said secondary bore portion of said chamber occupies the space in said chamber between said piston and said floating seal and is maintained at ambient pressure by the free floating character of said seal, said relative axial movement culminating in said cylinder moving slightly away from over said piston, in the direction therefrom of said fixed seal, operating liquid thus being allowed to rapidly bypass said piston, flowing from said secondary counterbore through said cylinder and into said primary counterbore and relieving said vacuum, a reverse movement between said elements now moving said cylinder reversely over said piston at a positively retarded rate due to the necessity of the operating liquid in the primary counterbore portion of said chamber escaping relatively slowly past said piston into said secondary counterbore portion of said chamber, said elements being respectively provided with axially opposed impact faces which are moved apart coincidentally with the first aforesaid relative movement between said elements producing a vacuum in said primary counterbore, and which are moved together by said reverse relative movement of said elements and ultimately at high velocity, for imparting to said object a jarring blow as said cylinder, in said reverse movement, passes away from over said piston.
2. A combination as in claim 1 in which limit stop means is provided for limiting axial movement of said floating seal away from said cylinder; and spring check valve means provided in said floating seal to permit escape of liquid from said chamber into said ambient fluid when the fluid pressure within said chamber between said cylinder and said floating seal is caused to substantially exceed the ambient fluid pressure by engagement of said floating seal with said stop means, towards

the conclusion of the first relative movement between said elements as aforesaid.

3. A combination as in claim 1 in which said piston has a close, practically liquid-tight sliding fit with said cylinder, and in which a groove is formed in one of the annular meeting faces of said piston and cylinder, said groove connecting upper and lower edges of said face in which it is formed, whereby said groove provides a restricted passage for slowly by-passing liquid past said piston during relative axial movement between said piston and said cylinder while said piston is at least partially disposed within said cylinder.

4. A combination as in claim 1 in which said piston has a close, practically liquid-tight sliding fit with said cylinder, and in which a groove is formed in the peripheral face of said piston, said groove connecting upper and lower edges of said face, whereby said groove provides a restricted passage for slowly by-passing liquid past said piston during relative axial movement between said piston and said cylinder while said piston is at least partially disposed within said cylinder.

5. In a hydraulic oil well jar, the combination of: inner and outer telescopically related tubular elements; means for connecting one of said elements to a drill string; means for connecting the other element to an object to be jarred, telescopically overlapping portions of said elements providing an annular chamber for confining an operating liquid; an annular seal supported on the outer element and slidably engaging the inner element to close one end of said chamber; an annular floating seal disposed between and slidably engaging both of said elements to close the other end of said chamber; a relatively short piston extending radially outwardly from said inner element into said chamber; a relatively short cylinder formed on said outer element and extending radially inwardly therefrom into said chamber into close sliding relation

with said piston when the latter is within said cylinder, said cylinder dividing said chamber into a low pressure section, adjacent and containing said floating seal, and a high pressure section, adjacent said first mentioned seal, there being liquid passage means allowing operating liquid to slowly by-pass said piston, flowing from said high pressure chamber section to said low pressure chamber section when said piston is forced through said cylinder, by an extensive telescopic motion between said elements, said motion between said elements being relatively unrestrained immediately upon said motion between said piston and cylinder producing an axial gap between said piston and cylinder with said piston disposed in said high pressure chamber section; and impact shoulders provided on said elements in axially opposed relation to be suddenly brought together to produce a jarring blow by said unrestrained extensive telescopic motion between said elements, said low pressure chamber section being adequate in length to permit a sudden compressive telescopic motion in the opposite direction between said elements immediately following said blow, which causes said piston to quickly pass through said cylinder into said low pressure chamber section, producing a temporary vacuum in said high pressure chamber section during such passage, and resetting said jar for the initiation of another jarring action.

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