United States Patent [19]

White

[11] **3,860,076**

[45] **Jan. 14, 1975**

[54] **COMBINATION JAR AND RELEASING TOOL**

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[22] Filed: **Aug. 28, 1973**

[21] Appl. No.: **392,203**

[52] **U.S. Cl.** **175/294,** 166/297

[51] **Int. Cl.** **E21b 1/10**

[58] **Field of Search** 175/294, 296, 297

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Attorney, Agent, or Firm—Marcus L. Bates

[57] **ABSTRACT**

A combination hydraulic jar and releasing tool for wire line operation. The releasing tool has a dog positioned with a "J", with part of the "J" forming a spline which is received within the groove of a piston. The piston reciprocates within a chamber, and has a lower face thereof made into a cam which can be brought to bear against the dog with a cam action, so that the dog is turned out of the "J" when the tool string is set down.

The hydraulic jar comprises a mandrel attached to a piston with the piston being reciprocatingly received within a piston chamber. The chamber comprises adjacent large and small concentrically arranged axial passageways with a valve located therebetween so that the piston, when released from the small chamber, accelerates and impacts against the opposed end of the chamber with a jarring action.

12 Claims, 17 Drawing Figures

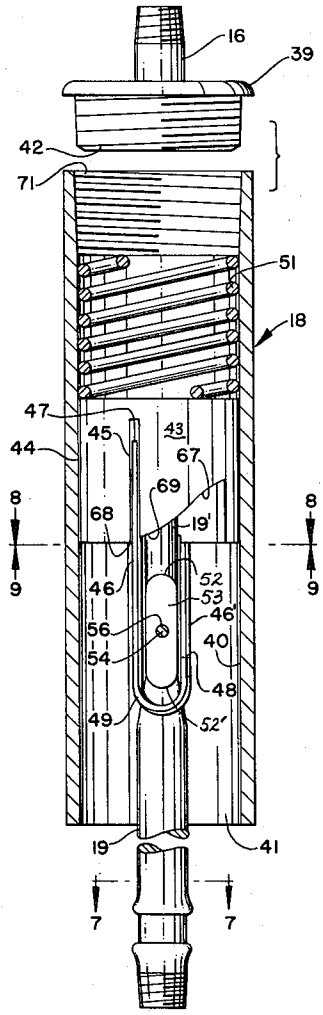


FIG. 1

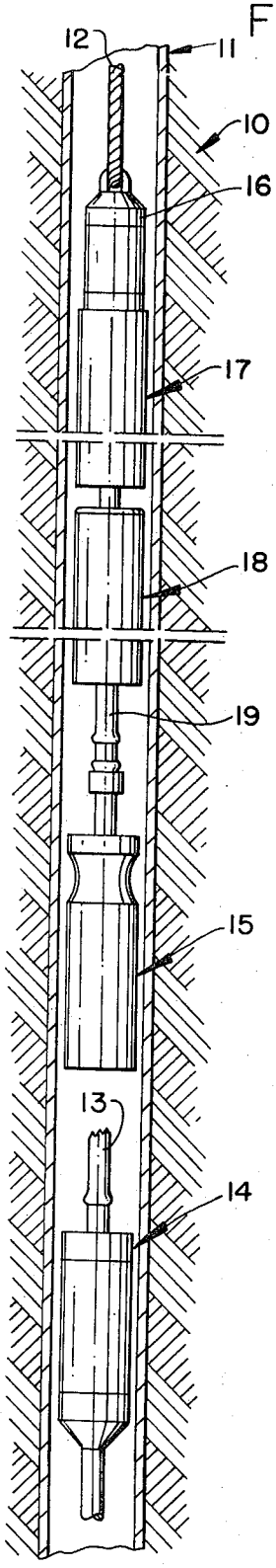


FIG. 3

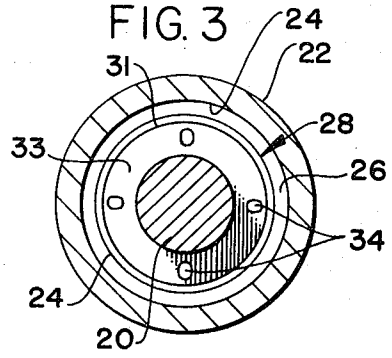


FIG. 5

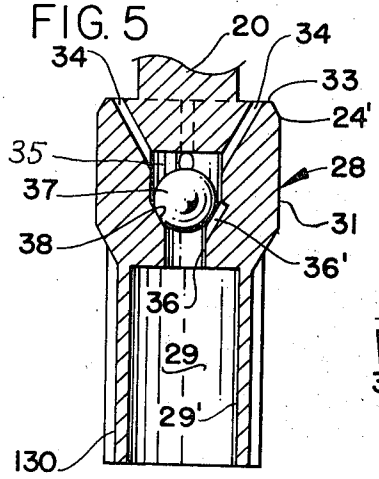


FIG. 4

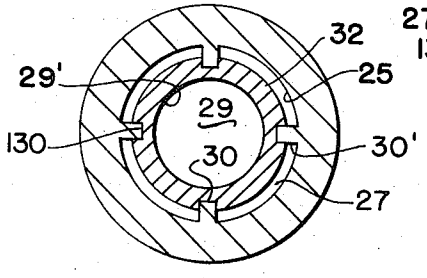
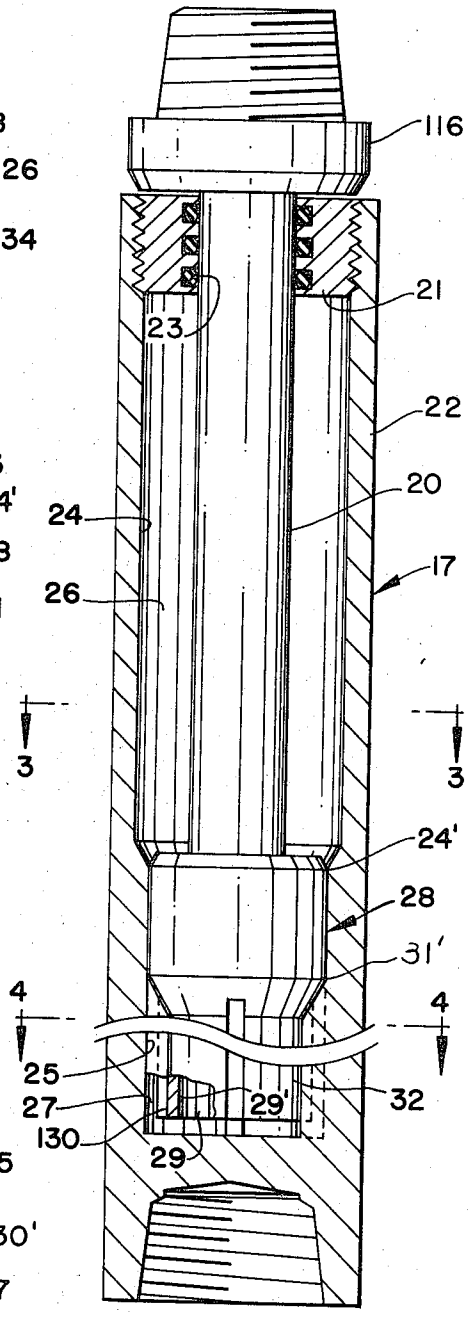


FIG. 2



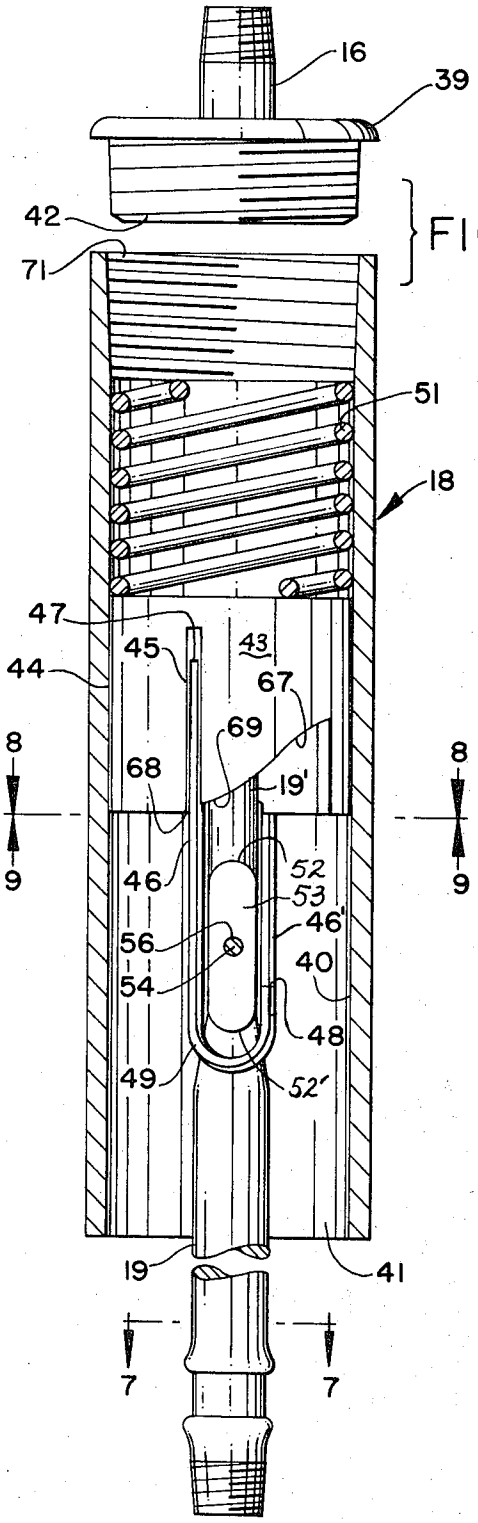


FIG. 6

FIG. 7

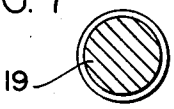


FIG. 8

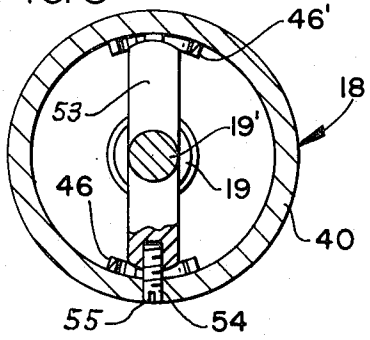


FIG. 9

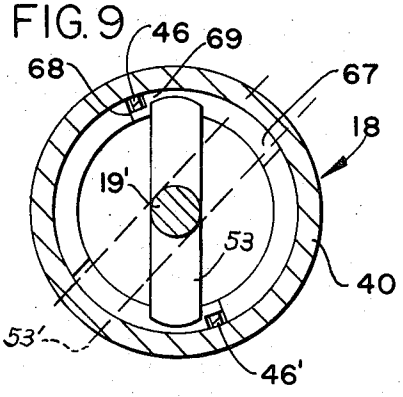


FIG. 10

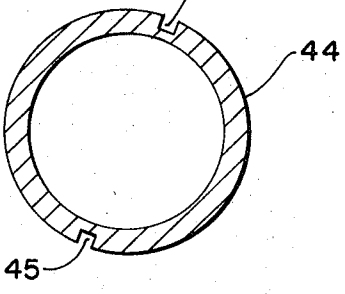


FIG. 11

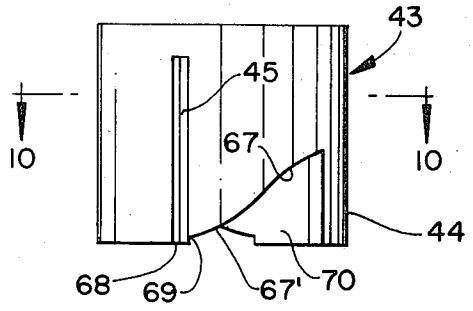


FIG. 12

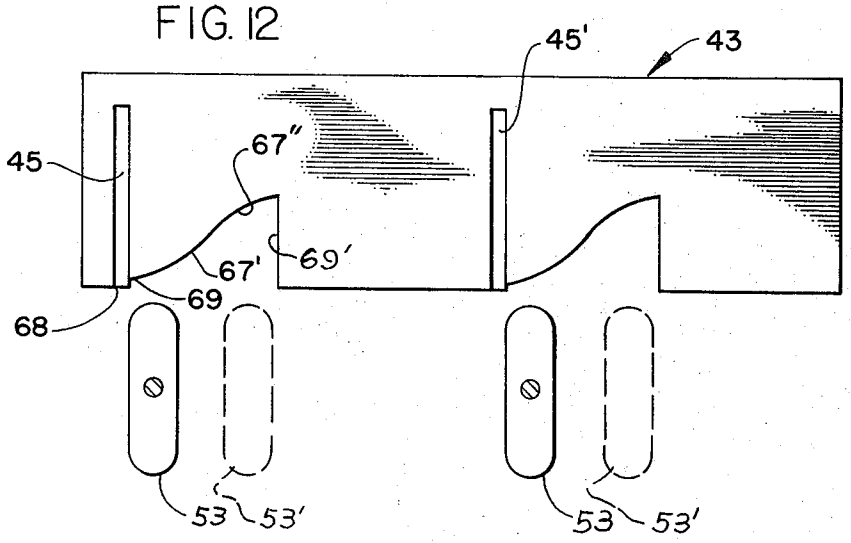


FIG. 13

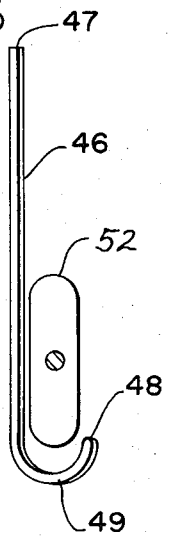


FIG. 14

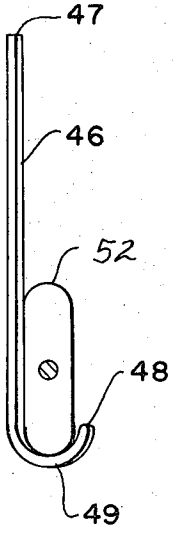


FIG. 15

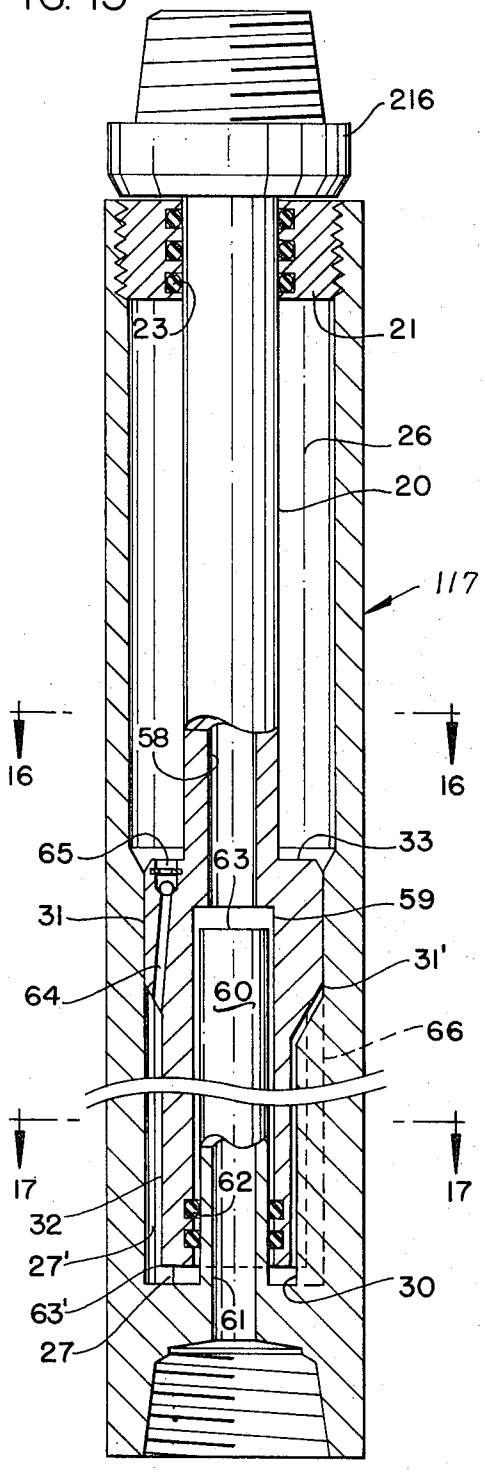


FIG. 16

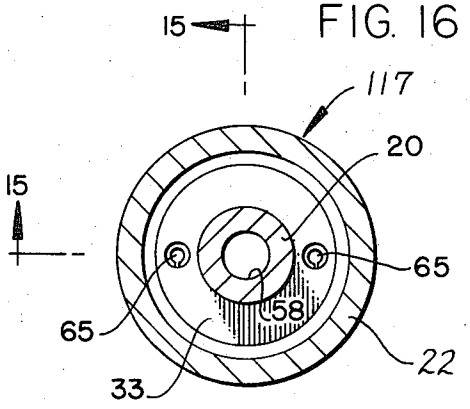
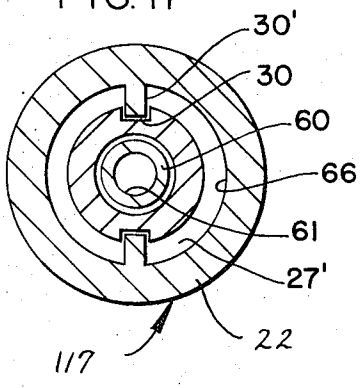


FIG. 17



COMBINATION JAR AND RELEASING TOOL

BACKGROUND OF THE INVENTION

Objects often become stuck downhole in a borehole. For example, a downhole pump actuated by sucker rod sometimes malfunctions, the rod parts somewhere above the pump, and accordingly, the rod must be pulled, and the remaining end thereof extracted from the bottom of the borehole, along with the defective pump. Such a stuck object, regardless of its configuration, or how it arrived in the borehole, is referred to as a "fish."

One prior art means for removing a fish is to attach a fishing tool to the end of a string of sucker rod and run the rod downhole as it is being made up joint by joint, until the tool contacts or engages the fish, whereupon great force can then be applied to the rod in order to extract the fish from the hole. A jar is usually interposed between the fishing tool and the string of rod so that one can reciprocate the rod, thus imparting a jarring action into the fish. Sometimes it is necessary to jar the fish for many hours in order to cause it to become unstuck. Sometimes the rod again parts, whereupon there are two fish to be extracted from the well.

The above described operation is extremely expensive because of equipment rental, the downtime, the standby time, and the cost of expert personnel. Accordingly, it is desirable to have made available a wireline operated combination fishing, jarring, and releasing tool which is low in cost and which enables one to run rapidly downhole on a wireline, engage a fish, place a predetermined tension on the wire line, impact the fish with a tremendous force, and more importantly, be able to release from the fish and fishing tool should the stuck fish refuse to become unstuck.

SUMMARY OF THE INVENTION

This invention relates to a downhole tool and particularly to a combination jar and releasing tool for use in conjunction with fishing tools. The jar has a piston reciprocatingly received within a piston chamber. The chamber is of two different inside diameters (i.d.'s) so that when the mandrel pulls the piston from the small into the large piston chamber, the piston accelerates while traveling through the larger piston chamber and impacts against the end of the large piston chamber, thereby providing for the desired jarring action.

The releasing tool is comprised of a downwardly opening housing having spaced "J's" with one leg of the "J" extending upwardly into a piston chamber, where a piston is reciprocatingly received. The piston has spaced longitudinally extending slots of limited length formed thereon within which the extended leg of the "J" is slidably received. The lower face of the piston is made into a cam so that when the tool string is set down, a dog received within the "J" is pushed against the cam, causing the dog to lift the piston while the cam on the piston turns the dog out of the "J".

Accordingly, a primary object of the present invention is the provision of improvements in a combination hydraulic jar and releasing tool.

Another object of the invention is to provide a hydraulic jar having a mandrel attached to a piston thereof with the piston being reciprocatingly received within axially aligned chambers of different i.d.'s, with the piston and the smaller chamber having means forming a splined connection therebetween so that rotation of the mandrel imparts rotation into the jar body.

A further object of this invention is to provide a hydraulic jar which includes a fluid coupling formed through the mandrel and the main bocy of the jar.

A still further object of this invention is to provide a releasing tool having a dog releasibly engaged to a "J", and a cam formed within a piston which provides a means by which the dog can be turned out of the "J".

These and various other objects and advantages of the invention will become readily apparent to those skilled in the art upon reading the following detailed description and claims and by referring to the accompanying drawings.

The above objects are attained in accordance with the present invention by the provision of a combination of elements which are fabricated in a manner substantially as described in the above abstract and summary.

BRIEF DESCRIPTION OF THE DRAWINGS

In FIG. **1** there is diagrammatically illustrated a cross-section of the earth within which there has been formed a borehole, with apparatus made in accordance with the present invention being disposed within the borehole in operative relationship with other apparatus;

FIG. **2** is an enlarged, broken, longitudinal, part cross-sectional view of part of the apparatus disclosed in FIG. **1**;

FIGS. **3** and **4**, respectively, are cross-sectional views taken along lines **3—3** and **4—4** respectively, of FIG. **2**;

FIG. **5** is a fragmentary, part cross-sectional view of part of the apparatus disclosed in FIG. **2**;

FIG. **6** is an enlarged, longitudinal, part cross-sectional view of part of the apparatus disclosed in FIG. **1**;

FIGS. **7**, **8**, and **9**, respectively, are cross-sectional views taken along lines **7—7**, **8—8**, and **9—9**, respectively, of FIG. **6**;

FIG. **10** is a part cross-sectional view taken along line **10—10** of FIG. **11**;

FIG. **11** is a side elevational view of the piston disclosed in FIG. **6**;

FIG. **12** is a hypothetical view of the piston of FIG. **11**;

FIGS. **13** and **14** are diagrammatical, side views which disclose some operative features of the invention;

FIG. **15** is a longitudinal, part cross-sectional representation of a modification of part of the apparatus disclosed in FIGS. **1-5**; and

FIGS. **16** and **17**, respectively, are cross-sectional views taken along lines **16—16** and **17—17**, respectively, of FIG. **15**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the various figures of the drawings, wherever deemed desirable and logical, like or similar numerals relate to like or similar elements of the invention.

In FIG. **1** there is formed through the earth **10** a borehole **11** within which a wireline **12** suspends apparatus made in accordance with the present invention. A broken sucker rod **13** is connected to a downhole pump **14** which has become stuck thousands of feet downhole in

the borehole. Anything stuck downhole in the borehole, such as the pump **14**, is hereinafter referred to as a fish.

A fishing tool **15**, which can take on any number of known forms, is cleverly designed to run downhole, engage the fish, whereupon if sufficient force can be applied thereto the fish will be removed from the borehole.

Swivel, or rope socket **16**, is attached to a hydraulic jar **17**, made in accordance with the present invention. A releasing tool **18** made in accordance with the present invention includes a dog **19** which can be disengaged from the remainder of the releasing tool whenever it is deemed desirable to do so. The dog is attached to the fishing tool by the illustrated coupling member, sometime called a sub or a fastener.

Looking now to the specific details of one of the embodiments of the hydraulic jar **17**, and as particularly seen illustrated in FIGS. **2–5**, the jar is seen to be comprised of a mandrel **20** having a free end made into the form of a coupling **116**, illustrated herein as a pin. Upper closure member **21** is threadily attached to the cylindrical housing **22** and provided with an axial aperture having seal means in the form of spaced o-rings **23** disposed therein so that the mandrel sealingly and slidably engages the closure member.

Axially aligned bores **24, 25**, of different diameters, are joined together at **24'**, and form fluid containing annular chambers as seen at **26** and **27**. The chambers are divided from one another by piston **28**, and are filled with hydraulic fluid or oil.

A lower marginal outer end portion **32** of the piston and a lower marginal inner surface of the smaller chamber are formed into a splined connection as best seen illustrated at **30, 30'**, in FIG. **4**. The piston is formed into a downwardly depending skirt member **32** which forms a passageway **29**, with the passageway always being in fluid communication with the lower chamber **27**. The constant diameter portion **31** of the piston sealingly engages the constant diameter wall portion of the small piston chamber between numerals **24', 31'**, in close tolerance relationship therewith. An abutment in the form of shoulder **33** can abuttingly engage interior face **21** of the closure member with a tremendous force, thereby accelerating the jar and anything which may be attached to the box thereof.

Radially disposed passageways **34** are fluid communication with valve chamber **35**, while passageway **36** flow connects the valve chamber to passageway **29**. A ball **37** cooperates with a seat **38** to form a ball check valve means, while the illustrated small passageway **36'** permits a small flow of fluid across the valve when it is in its seated position.

Looking now to the details of FIGS. **6–10**, the releasing tool **18** is seen to include a cap **39** which terminates in the form of a pin at the upper extremity thereof for attachment to the main body of the beforementioned jar. Cylindrical wall **40** is in the form of a downwardly directed circumferentially extending skirt which provides a downwardly opening cylindrical chamber **41**. Upper wall surface **42** forms the upper extremity of a piston chamber within which a piston **43** is reciprocatingly received for limited movement therein. The piston has an outside diameter (o.d.) **44** which enables it to guidably slide in low friction relationship relative to the interior chamber wall. Groove **45** preferably is in the form of a longitudinally extending slot of limited length which receives one of the spaced splines, or rails **46** therewithin. One end of the rail terminates in abuttingly engagement with the end of the slot to form a stop at **47**, while the opposed end of the rail is seen to terminate at **48**. A lower marginal portion of the rail is bent back upon itself 180° to form a "J" **49**. The rail **49** and recess or slot **45** can be made into any size required for handling the maximum anticipated load requirements. As noted in FIG. **6**, the piston has been forced upwardly so that end **47** is spaced from the terminal end of slot **45**.

Biasing means in the form of a spring **51** is interposed between the upper face of the piston and the lower face of the cap. The releasing dog has an upper end portion in the form of opposed outwardly depending enlargements or lugs **53, 53'**, having an upper and lower surface **52, 52'**, formed into a curve for a purpose which will be explained in more detail later on. Shear pin **54** is received through aperture **55** formed in the skirt, and threadily engages an aperture **56** formed in the dog lugs. A fishing neck **19'** upwardly depends from the lugs of the dog.

Opposed cams **67, 67'**, are cut into the lower face of the piston, with the cam commencing near the slot at **69**, and becoming progressively deeper until it terminates at **67''**. The angle formed between edge portions **69'** and **69** must be of a magnitude and length to impart sufficient rotational motion into the lugs of the dog so that the lugs may be turned out of the beforementioned "J". Counter bore **70** is an optional detail of design which greatly simplifies fabrication of the opposed camways, and which allows fluid to be pumped through the entire tool where such an expedient is desired.

The design details of the piston are best comprehended from viewing FIG. **12**, which discloses the exterior configuration of the piston in a hypothetical view obtained by arranging the outer surface of the piston into a flat plane. Lug **53** is moved angularly from the schematically illustrated position **53** to **53'** by the cam of the piston.

In FIGS. **15–17**, the second embodiment of the jar is seen to have a longitudinally extending passageway **58** formed within the mandrel which flow communicates pin **216** with chamber **59** of the piston **31**. Chamber **59** reciprocatingly receives hollow fluid coupling member **60** with the fluid coupling member having an axial passageway **61** in fluid communication with the illustrated box. O-rings **62** sealingly engage the area between the outer peripheral wall surface of member **60** and the inner peripheral wall surface of member **31**.

Radially disposed ribs **30'** commence at the lowermost portion of annulus **27** and terminate at a location spaced from shoulder **33** of the piston, thereby leaving ample piston area for sealingly engaging a circumferentially extending interial peripheral wall surface of the reduced diameter cylinder. Flow passageway **64** flow connects chamber **26** with chamber **27**, with ball check valve assembly **65** being interposed therebetween in the illustrated caged manner. The ball seat is provided with a groove so that a small flow of fluid occurs across the ball check valve means when the piston is urged in an upward direction.

OPERATION

In operation, the hydraulic jar and the releasing tool of the present invention are attached to any suitable fishing tool and rapidly run downhole into the borehole

on a wireline until the fishing tool properly attaches itself to a fish. The wireline is placed under a tension which is less than the designed working strength thereof, whereupon piston **28** commences to travel towards closure member **21** due to leakage which will occur from chamber **26** into the lower chamber, and due to any leakage that might occur across the ball check valve. If it is desired to speed up the interval of the time delay period, the illustrated bypass **36'** can be provided across the seat of the valve of FIG. **5.**

As edge portion **31'** of the piston clears edge portion **24'** of the cylinder, the piston, mandrel, and the tool string attached to the mandrel will accelerate as shoulder **33** travels into abuttment with shoulder **21.** This action jars the fishing tool in an upward direction, thereby providing for an instantaneous force greatly in excess of the force provided by the tensil strength of the wireline.

The wireline is slackened, whereupon the mandrel telescopes back through the closure member **21** until the piston returns to the illustrated position of FIG. **2.** As the piston is stroked in a downward direction, the ball check valve of FIG. **5** enables fluid to be rapidly transferred from annulus **27** into annulus **26,** so that the wireline can again be placed under a predetermined tension so as to produce a second jarring action. The wireline reciprocates the tool string in the above described manner until the fish becomes unstuck and can be retrieved from the borehole.

After a suitable time, should it be concluded that the fish cannot be unstuck in the above described manner, the wireline is placed under sufficient tension to shear pins **54,** thereby bringing surfaces **52'** of the lugs against portion **49** of the "J", whereupon the wireline is slackened and the entire weight of the tool string is brought to bear against the releasing tool. This action causes lugs **53** of the dog to ride up out of the "J" **49** and surface **52** of the lugs brought into engagement with cams **67',** thereby rotating the lugs out of engagement with the "J". The lower end portion **52'** of the lugs which normally set spaced from the lowermost portion of the "J" must be raised above and rotated past end portion **48** of the "J" so that the lugs are free to be withdrawn through the bottom of the cylindrical body.

After the dog has been released from the "J", the tool string is brought to the surface of the ground leaving the dog and fishing tool attached to the fish. The hydraulic jar of FIG. **15,** together with the releasing tool of FIG. **6,** is placed into use by removing coupling member **16** from the releasing tool and substituting therefor a pin which will make up with the box illustrated in FIG. **15.** The pin of the jar, illustrated in FIG. **15,** is connected into a tubing string and the apparatus lowered into the borehole. Before going into the borehole, another dog **19** must be placed within the "J" and a simple fishing tool placed upon the pin end of the dog so as to enable the fishing neck **19'** of the dog which was left downhole to be caught by the new fishing tool. The use of a fishing neck **19'** enables any number of fishing trips to be made downhole, with a simple fishing tool.

The apparatus of FIG. **6,** used in conjunction with the apparatus of FIG. **15,** enables high pressure fluid to flow through the tubing string, through passageways **58, 61, 71, 70,** thereby enabling washing out debris which may be the cause of the fish being stuck downhole.

The novel apparatus of FIG. **6** enables the cylinder **18** to be sawed in half, the "J" **46** made into the illustrated form of FIG. **6,** and then welded into place with one "J" being placed on each of the 180° of the skirt member. The skirt member is next welded back into a cylinder, the piston slid into the upper end with the longitudinally extending slots **45** engaging the ribs **46,** whereupon the spring is next placed into position, and the cap **39** threadily affixed thereto. This expedient greatly simplifies the construcion and lowers the cost of the releasing tool.

In the embodiment of FIGS. **2** and **15,** where splines be used, it is necessary that the length of the splined connection be slightly longer than the distance between shoulder **33** and abuttment **21,** so that the splines are not disengaged from one another.

Should the pin **54** inadvertently shear, the lug will be unable to disengage from the "J" until the tool string is set down with sufficient force to cause the biasing means to overcome by relative movement effected between the dog and the cylindrical body of the tool.

The pin is designed to shear at a value less than the breaking strength of the wireline. After shearing, as the tool string is set down, the housing will move in a downward direction about the dog, causing the lugs to move the piston against the spring until surface **52'** of the lug clears end portion **48** of the rail. As the dog continues to move relative to the housing, the piston likewise continues to move against the spring, thereby increasing the rotational moment imparted into the lugs by the cam.

The spring preferably is of sufficient force to cause the cam to rotate the lug against the shorter of the two legs, so that as soon as the dog has moved an amount which enables the lug to clear rail end portion **48,** the dog will immediately rotate free of the "J". For this reason, a sinker bar will sometime be included in the tool string.

The cross-sectional configuration of the releasing tool and jar preferably is circular, although they could be square, for example.

I claim:

1. In combination, a wireline operated jar and releasing tool comprising a downwardly opening housing having an upper end portion with coupling means formed thereon for connection to said jar, and a lower end portion in the form of a circumferentially extending skirt member; said skirt member forming a piston chamber therewithin;

a piston having an upper face, a lower face, and a circumferentially extending side wall, said piston being reciprocatingly received within said piston chamber, means biasing said piston in a downward direction; means forming opposed longitudinally extending slots in the outer marginal side wall of said piston;

opposed rails extending longitudinally of said housing and affixed to the interior of said piston chamber and skirt member, said rail having an upper end portion and a lower end portion, the lower marginal end of said rail being bent back upon itself to form a "J"; the upper marginal end of said rails being received within said slots;

a dog having one end formed into a coupling member for connection to a fishing tool and another end

formed into lugs in the form of opposed enlargements, said opposed enlargements being received within said "J" with said coupling member freely extending therefrom;

the lower face of said piston having opposed recesses formed therein to form a cam means so that said lugs can engage said cam means to cause the lugs to be turned out of said "J" when the dog is forced against said piston, thereby releasing the dog from the housing;

said jar comprising an elongate housing having an axial bore longitudinally extending therethrough, upper and lower closure means at each extremity of said axial bore forming an enclosed jar piston chamber, a piston reciprocatingly received within said piston chamber, and dividing the chamber into an upper and a lower chamber, a mandrel affixed to said jar piston, an axial passageway through said upper closure member; seal means on said upper closure member, said mandrel having a marginal length thereof slidably received through said axial passageway in sealing engagement therewith, and a coupling member formed on the free end portion of said mandrel and the free end portion of said housing;

a portion of said lower chamber having an inside diameter which slidably receives said jar piston in close tolerance relationship therein; an upper portion of said jar piston having an inside diameter larger than the lower portion of said jar piston so that when said jar piston enters said upper portion of said jar piston chamber, a flow path in the form of an annulus is found thereabout;

a check valve, means forming a passageway through said jar piston for enabling flow to occur from said lower chamber, through said jar piston, and into said upper chamber; said check valve being positioned within said passageway for precluding flow from said upper chamber, through said passageway, and into said lower chamber.

2. The releasing tool of claim **1** wherein said recesses are in the form of opposed cavities of increasing depth in the direction in which the lugs are to be turned out of the "J".

3. The releasing tool of claim **1** and further including means forming a splined connection between said jar piston and said housing so that rotation of said mandrel imparts rotation into said body.

4. A releasing tool in the form of a downwardly opening housing, including an upper end portion having coupling means thereon for connection to a tool joint, and a lower end portion in the form of a circumferentially extending skirt member; said skirt member forming a piston chamber therewithin;

a piston having an upper face and a lower face, and a circumferentially extending side wall, said piston being reciprocatingly received for limited movement within said piston chamber, means biasing said piston in a downward direction, and opposed longitudinally extending slots formed in the outer marginal side wall of said piston;

opposed rails extending longitudinally of said housing and affixed to the interior of said piston chamber, said rail having an upper end portion and a lower end portion, the lower marginal end of said rail being bent back upon itself to form a "J"; the upper marginal end of one of said rails being received within one of said slots;

a dog having one end formed into a coupling member for attachement to a fishing tool and another end formed into opposed lugs for being received within said "J" with said coupling member freely extending therefrom;

the lower face of said piston having a cam means formed thereon so that said lugs can be forced into engagement with said cam means to cause said lugs to turn out of said "J", thereby releasing the dog from the housing.

5. The releasing tool of claim **4** wherein said dog includes a shaft, said lugs being in the form of opposed members radially extending from said shaft and having a bottom edge portion for being bottom supported in said "J" and a top edge portion for slidable engagement with said cam means.

6. The releasing tool of claim **4** wherein said cam means is in the form of opposed cavities of increasing depth in the direction required to turn the dog out of the "J", said slot terminating in said piston form an abutment against which said upper end of said rail can be abuttingly received to form a stop member for limiting the downward travel of said piston.

7. The releasing tool of claim **4** wherein said dog includes a shaft, said lugs being in the form of opposed members radially extending from said shaft and having a bottom edge portion for being bottom supported in said "J" and a top edge portion for slidable engagement with said cam means;

said cam means is in the form of opposed cavities of increasing depth in the direction required to turn the dog out of the "J", said slot terminating in said piston to form an abutment against which said upper end of said rail can be abuttingly received to form a stop member for limiting the downward travel of said piston.

8. A hydraulic jar comprising an elongate housing having an axial bore longitudinally extending therethrough, upper and lower closure means at each extremity of said axial bore forming an enclosed piston chamber, a piston reciprocatingly received within said piston chamber, and dividing the piston chamber into an upper and a lower chamber, a mandrel affixed to said piston, means forming an axial passageway through said upper closure member in sealing engagement with said mandrel, a coupling member formed on the free end portion of said mandrel and the opposed end portion of said housing;

said lower chamber having an inside diameter which slidably receives said piston in close tolerance relationship therein; said upper chamber having an inside diameter larger than said chamber so that when said piston enters said upper chamber, a flow path in the form of an annulus is formed thereabout;

a check valve, means forming a passageway through said piston for enabling flow to occur from said lower chamber, through said piston, and into said chamber; said check valve being positioned within said passageway for precluding flow from said upper chamber, through said passageway, and into said lower chamber;

means forming a fluid coupling which forms a flow passageway through said coupling member on said mandrel, through said mandrel, through said piston, and through said coupling member of said housing; so that fluid can be flowed through said jar

while said jar imparts a jarring action into said housing.

9. The improvement of claim **8** and further including means forming a splined connection between said piston and said housing so that rotation of said mandrel imparts rotation into said body.

10. The improvement of claim **8**, and further including a releasing tool in the form of a downwardly opening housing, including an upper end portion having coupling means thereon for connection within said tool joint, and a lower end portion in the form of a circumferentially extending skirt member; said skirt member forming a downwardly opening chamber therewithin;

another piston having an upper face, a lower face, and a circumferentially extending side wall, said another piston being reciprocatingly received within the last said chamber, means biasing the last said piston on a downward direction and opposed longitudinally extending slots formed in the outer marginal side wall of the last said piston;

opposed rails extending longitudinally of the last said housing and affixed to the interior of said skirt member, said rail having an upper end portion and a lower end portion, the lower marginal end of said rail being bent back upon itself to form a "J"; the upper marginal end of said rails being received within said slots;

a dog having one end formed into a coupling member for attachment into said tool joint and another end formed into opposed lugs, said opposed lugs being removably received within said "J" with said coupling member freely extending therefrom;

the lower face of the last said piston having means forming opposed recesses therein to form a cam means so that said lugs can engage said cams to cause the lugs to be turned out of said "J", thereby releasing the dog from the last said housing.

11. The hydraulic jar of claim **8** wherein said fluid coupling includes a downwardly opening axial bore formed within said piston, said axial bore being in fluid communication with said passageway formed through said mandrel;

a hollow fluid coupling member affixed to said housing and reciprocatingly received in sealed relationship within said axial bore of said piston;

the interior of said hollow fluid coupling member being in fluid communication with said coupling member on said housing.

12. The hydraulic jar of claim **8** wherein said fluid coupling comprises a tubular upstanding member affixed to said housing and having the interior thereof in fluid communication with the coupling member formed on said housing;

a downwardly opening axial bore formed within said piston, the last axial bore being in fluid communication with the interior of said mandrel; the last axial bore reciprocatingly receiving said tubular upstanding member in sealed relationship therewithin.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,860,076 Dated January 14, 1975

Inventor(s) Travis B. White

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 20, insert --to-- after "piston".

Column 8, line 45, after "member" insert --, said mandrel having a marginal length thereof slidably received through said axial passageway, seal means on said upper closure member--.

Column 8, line 60, insert --upper-- before "chamber".

Column 8, line 67, substitute --on-- for "of".

Column 9, line 18, substitute --in-- for "on".

Signed and sealed this 15th day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.