Oct. 24, 1961 D. D. WEBB 3,005,505

HYDRAULIC JAR

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Fig. 1a.

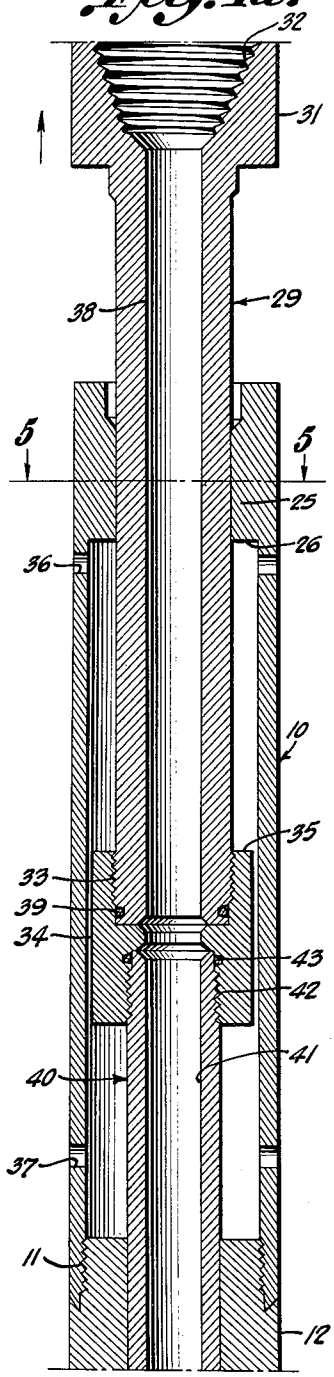


Fig. 1b.

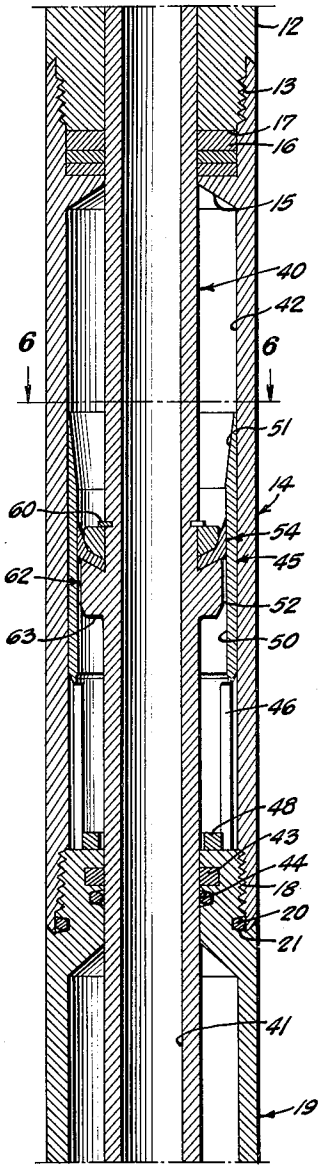
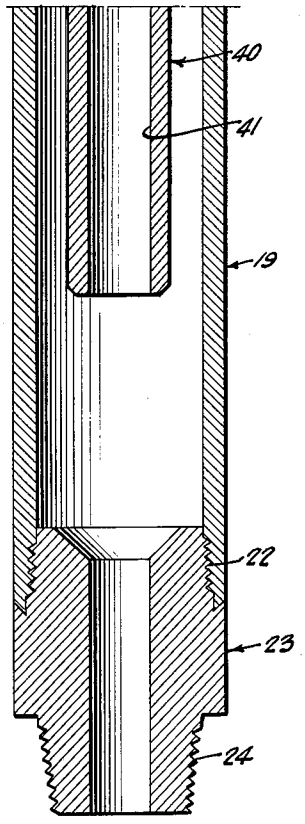


Fig. 1c.



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HYDRAULIC JAR

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Fig. 2.

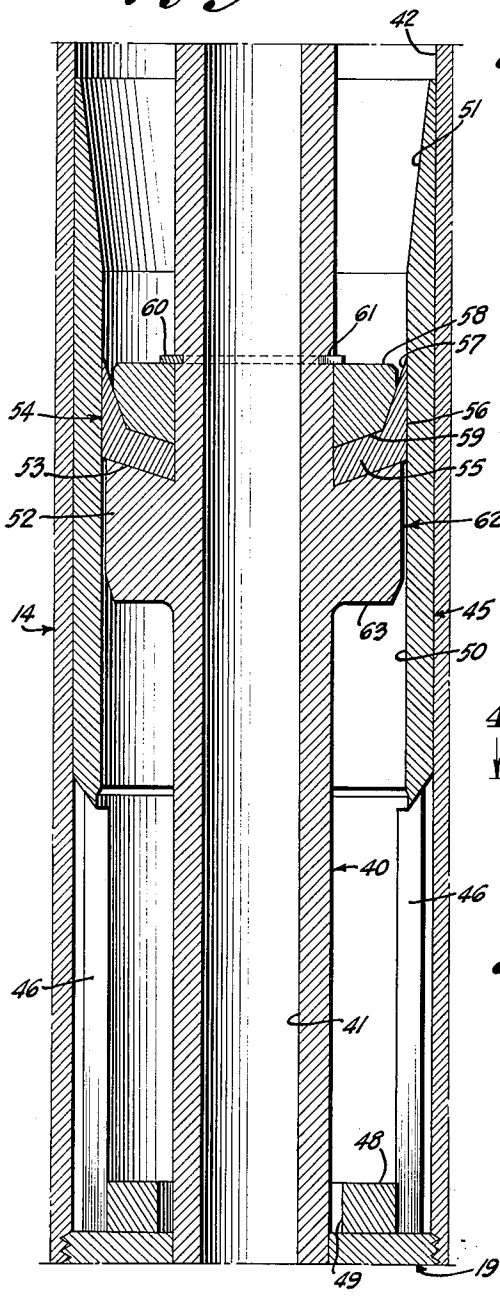


Fig. 3.

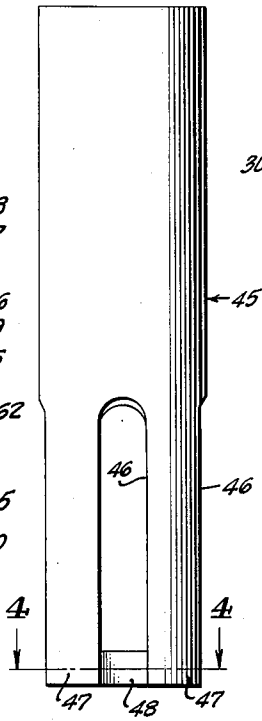


Fig. 5.

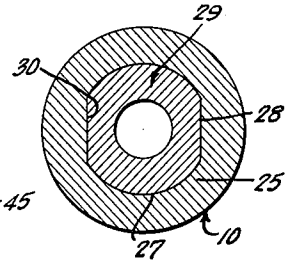


Fig. 6.

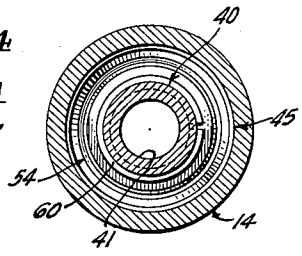
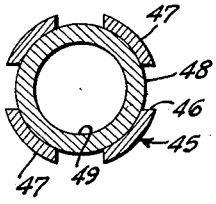


Fig. 4.



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Fig. 7.

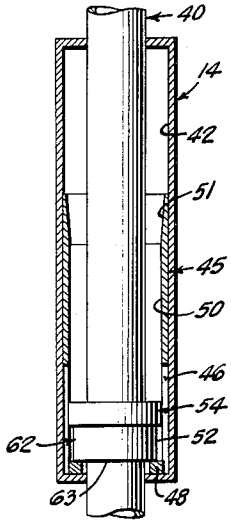


Fig. 8.

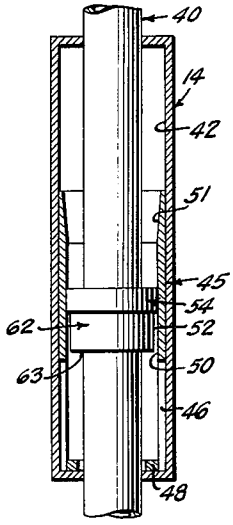


Fig. 9.

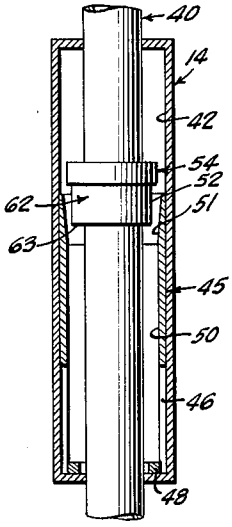


Fig. 10.

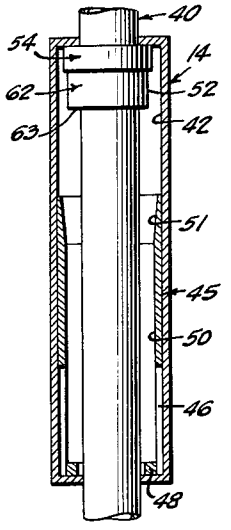


Fig. 11.

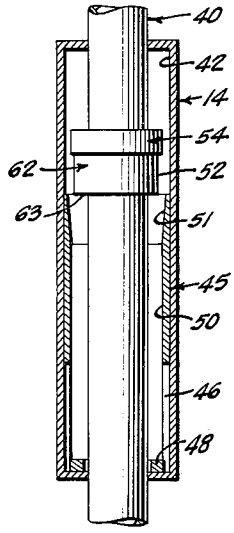


Fig. 12.

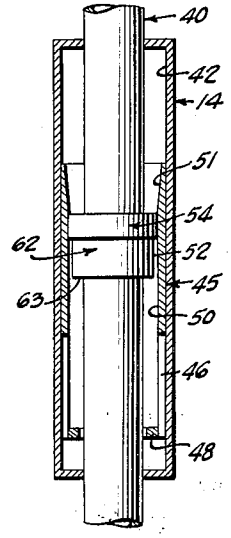


Fig. 13.

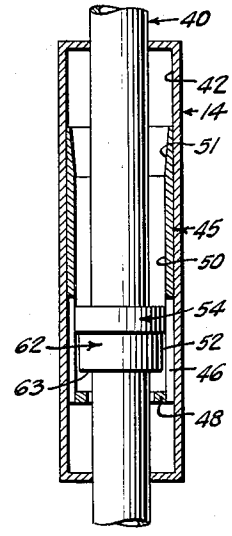
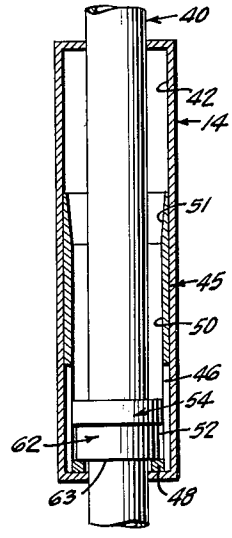


Fig. 14.



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3,005,505
HYDRAULIC JAR

Derrel D. Webb, Houston, Tex., assignor to Houston Engineers, Inc., Houston, Tex., a corporation of Texas

Filed July 27, 1959, Ser. No. 829,658
8 Claims. (Cl. 175—297)

This invention relates to well apparatus and more particularly to a hydraulic jar designed to impart an impact to well tools or other objects lodged in a well bore for the purpose of removing the same. The invention is an improvement over that shown in Patent No. 2,802,703, to Harry W. Harrison, issued August 13, 1957.

As is well known, broken drills, broken sections of pipe and other objects occasionally become lodged in the bore of a well during drilling operations and when this occurs, drilling operations must be suspended until the objects have been removed. This often requires long and tedious fishing operations and in order to facilitate the removal of such objects, it has heretofore been proposed to utilize various types of jarring mechanisms to impart an impact to the object lodged in the well bore in order to free the same and such jarring mechanisms have also included those of the so-called hydraulic type in which a fluid is utilized to facilitate building up a force or tension in a pipe string or the like, which when released, imparts an upward impact to the objects lodged in the well bore in order to free the same.

Many of the prior art hydraulic jar mechanisms are exceedingly complex requiring a relatively large number of parts which not only materially increases the cost of such devices, but also renders the same subject to frequent failure, thereby further increasing the cost of well drilling operations, but in the case of many of these prior art hydraulic jar mechanisms, the desired result was not obtained by reason of the fact that such mechanisms not only delivered an upward impact to the object lodged in the well, but in resetting the mechanism for delivering a further impact, an impact was also delivered in the downward direction which often resulted in more firmly lodging the objects in the well bore. In other words, these prior art hydraulic jar mechanisms deliver an impact in both upward and downward directions, whereas the only effective impact is in an upward direction and the downward impact is not only unnecessary and wasteful, but is also a distinct disadvantage in that the same may defeat the very purpose of utilizing the jarring mechanism.

It is accordingly an object of the present invention to provide a hydraulic jar designed to deliver an impact only in one direction.

A further object of the invention is the provision of a hydraulic jar which is relatively simple in construction embodying only three relatively movable parts thereby reducing the cost of manufacture and providing a long-wearing dependable device.

A still further object of the invention is the provision of a hydraulic jar designed to deliver an impact in one direction only and which may be rapidly reset for delivering a further impact, such resetting operation being entirely free of impact in the opposite direction to that desired.

Another object of the invention is the provision of a hydraulic jar utilizing a closed fluid chamber and a fluid of low viscosity, such as motor oil.

A further object of the invention is the provision of a hydraulic jar provided with a closed fluid chamber in which a piston reciprocates, a metallic cup washer being provided on the piston for providing a seal between the portions of the chamber above and below the piston and in which wear is substantially restricted to the metallic cup washer.

A still further object of the invention is the provision

of a hydraulic jar provided with a closed fluid chamber in which a piston reciprocates, the piston being provided with a metallic cup washer of a relatively soft material, such washer providing a seal between the portions of the fluid chamber above and below the piston there being also provision for conveniently removing and replacing the cup washer in the event of wear or damage thereto.

Another object of the invention is the provision of a hydraulic jar having slidable and non-rotatably interrelated parts which permits applying a torque through the jar mechanism to the fishing tool or other object to which the jar is attached.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1*a* is a longitudinal sectional view showing the upper portion of a hydraulic jar constructed in accordance with this invention;

FIG. 1*b* is a longitudinal sectional view showing the intermediate portion of the hydraulic jar shown in FIG. 1*a*;

FIG. 1*c* is a longitudinal sectional view showing the lower portion of the hydraulic jar of this invention;

FIG. 2 is a longitudinal sectional view to an enlarged scale showing the construction of the piston, as well as the relationship between the piston and the sleeve slidable in the fluid chamber;

FIG. 3 is a side elevational view of the sleeve which is slidable in the fluid chamber;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 3 and showing the inwardly projecting flange in the lower end of the sleeve of FIG. 3;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 1*a* and showing the structure which permits the application of torque through the hydraulic jar of this invention;

FIG. 6 is a sectional view taken substantially on the line 6—6 of FIG. 1*b* and showing the relationship between the intermediate body portion constituting the fluid chamber, the sleeve slidable in the chamber and the piston slidable in the sleeve and chamber;

FIGS. 7 to 10 are fragmentary diagrammatic views in section showing the operation of the hydraulic jar of this invention during delivery of an impact; and

FIGS. 11 to 14 are fragmentary diagrammatic views in section showing the relationship of the various parts during resetting of the tool for delivery of a further impact.

With continued reference to the drawings, there is shown a hydraulic jar constructed in accordance with this invention and which may well comprise an elongated hollow upper body portion **10** to the lower end of which is secured by screw threads or other suitable fastening means **11**, a connecting member **12**. Secured to the lower end of the connector member **12** by screw threads or other suitable means **13** is an intermediate elongated hollow body portion **14** and as best seen in FIG. 1*b*, the intermediate portion **14** is provided adjacent the upper end thereof with an inwardly projecting flange **15** which serves to receive and engage packing rings or washers **16** which in turn are engaged by the lower end **17** of the connecting member **12** thereby providing a fluid tight seal between the connecting member **12** and the interior of the intermediate body portion **14**. The packing rings or washers **16** also perform another function which will be later described. Secured to the lower end of the intermediate body portion **14** by screw threads or other suitable means **18** is a lower elongated hollow body portion **19** and in order to provide a fluid tight connection between the lower body portion **19** and the intermediate body portion **14**, a sealing ring **20** may be seated in an annular groove **21** to engage the lower end of the inter-

mediate body portion 14 to provide such seal. As shown in FIG. 1c, the lower end of the lower body portion 19 is connected by screw threads or the like 22, to a coupling member 23 provided on the lower end thereof with pipe threads 24 for connecting the coupling member 23 and the remainder of the hydraulic jar to a fishing tool or other object to which the same may be attached.

A reduced portion 25 in the upper end of the upper body portion 10 provides a downwardly facing impact receiving shoulder 26 and as shown in FIG. 5, the reduced portion 25 is provided with a non-circular bore 27 having opposed flat surfaces 28 therein, the purpose of which will be presently described.

Slidably received in the bore 27 is an elongated mandrel 29 having opposed flat surfaces 30 engaging the flat surfaces 28 on the reduced portion 25 and consequently, the mandrel 29 is freely slidable in the bore 27 but is non-rotatable therein due to the inter-engagement of the flat surfaces 28 and 30. At the upper end of the mandrel 29 an enlarged portion 31 is provided with a female type thread 32 for permitting convenient coupling of the hydraulic jar of this invention to the lower end of a drill string or the like. The mandrel 29 terminates within the upper body portion 10 and the lower end of the mandrel 29 is secured by screw threads or the like 33, to a hammer member 34 movable within the upper body portion 10 with the mandrel 29. The upper end 35 of the hammer member 34 provides an impact surface for engaging the impact shoulder 26 on the upper body portion 10 in a manner to be later described. In order to permit drainage of fluid from the interior of upper body portion 10, the same may be provided with upper and lower vent or drainage apertures 36 and 37. The mandrel 29 may be provided with an interior bore 38 for flow of flushing fluid therethrough and in order to prevent leakage of such flushing fluid there may be provided packing means in the form of a ring 39 in the joint between the lower end of the mandrel 29 and the hammer member 34.

A piston rod 40 having a bore 41 extending therethrough is secured to the hammer member 34 by screw threads or the like 42 and in order to prevent leakage of flushing fluid, there may be provided a packing ring 43 in the joint between the piston rod 40 and the hammer member 34. The piston rod 40 extends through the intermediate body portion 14 and terminates within the lower body portion 19, as clearly shown in FIG. 1c. The packing rings 16 at the upper end of the intermediate body portion 14 engage the outer surface of the piston rod 40 to provide a packing gland thereby preventing leakage of fluid from within the chamber 42 provided by the intermediate body portion 14 and adjacent the lower end of the body portion 14 there may be provided packing means in the form of packing rings 43 and 44 engaging the outer surface of the piston rod 40 to prevent leakage of fluid from the chamber 42 in the intermediate body portion 14.

Slidably disposed within the chamber 42 of the intermediate body portion 14 is a sleeve 45 and as best shown in FIGS. 2, 3 and 4, sleeve 45 is provided at the lower end with longitudinally extending slots 46 in the wall portion thereof. At the lower end of the sleeve 45 and secured within the fingers 47 provided by the slots 46 by welding or the like, is a ring 48 which provides an inwardly extending flange, the purpose of which will be presently described. The ring 48 is provided with a bore 49 extending therethrough for freely receiving the piston rod 40 as clearly shown in FIG. 2. The intermediate wall section of the sleeve 45 is provided with a smooth cylindrical inner surface 50 and such inner surface 50 merges into an upwardly and outwardly beveled section 51 at the upper end of the sleeve 45, the purpose of which will be later described.

With particular reference to FIG. 2, it will be seen that the piston rod 40 is provided with an integral annular shoulder 52 which is disposed on the piston rod 40 in such a manner as to be movable therewith between the upper and lower ends of the chamber 42 in the intermediate body portion 14. While the annular shoulder 52 is shown as being integral with the piston rod 40, nevertheless, such annular shoulder may, if desired, be made separate from the piston rod 40 and secured thereto in any suitable or desired manner. The upper surface 53 of the annular shoulder 52 is beveled upwardly and outwardly and the surface 53 serves to receive and support an upwardly opening cup washer 54. The cup washer 54 may be formed of brass or other metallic material having similar and suitable properties and the washer 54 is provided with a downwardly and inwardly extending flange portion 55 which engages the surface 53 on the annular shoulder 52 and the outer surface 56 of the washer 54 is substantially cylindrical and engages the inner surface 50 of the sleeve 45 to provide a sealing engagement therebetween. The inner surface 57 of the upper portion of the washer 54 is flared upwardly and outwardly in order to provide for limited deformation of the washer 54 by reason of the fluid pressure exerted against the surface 57 to urge the outer surface 56 of the washer 54 into engagement with the inner surface 50 of the sleeve 45. The washer 54 is secured in position on the piston rod 40 and in engagement with the upper surface 53 of the annular shoulder 52 by a retaining ring 58 received on the piston rod 40 and engaging the upper surface 59 of the flange 55 of the washer 54, as well as engaging a portion of the flared surface 57 of the washer 54. The retaining ring 58 is held in place in engagement with the washer 54 by a snap ring 60 removably received in a groove 61 in the outer surface of the piston rod 40. Replacement of the washer 54 may be accomplished merely by removing the snap ring 60 and the retaining ring 58, after which a new washer 54 may be placed on the piston rod 40 and clamped in position by replacing the retaining ring 58 and the snap ring 60.

The cup washer 54 engages the inner surface 50 of the sleeve 45 as described above, and this engagement provides a seal, but as the fluid pressure builds up above the washer 54 as later described, the seal between the washer 54 and the sleeve 45 is partially sufficient to prevent leakage of fluid from above the washer 54 to below the same and, therefore, even though an incompressible fluid is contained in the chamber 42 of the intermediate portion 14 above the washer 54, such fluid under high pressure is permitted to bleed by the outer cylindrical surface of the sleeve 45, i.e., between the outer cylindrical surface of the sleeve 45 and the inner cylindrical surface of the intermediate portion 14, to the lower portion of the chamber 42 in the intermediate body portion 14. Since the washer 54 is formed of brass or other metal of similar properties and since the sleeve 45 engaged by the washer 54 is of steel, wear is substantially restricted to the relatively soft material of the washer 54 and since such washer may be conveniently replaced, this structure materially reduces the cost of maintaining the hydraulic jar of this invention in operation and also operates to maintain a relatively high efficiency.

In describing the operation of the hydraulic jar of this invention, it is to be assumed that a drill string or the like is attached to the enlarged portion 31 on the upper end of the mandrel 29 and that a fishing tool or other device is attached to the threaded portion 24 on the lower end of the coupling member 23 attached to the lower end of the lower body portion 19. It is also to be assumed that the chamber 42 of the intermediate body portion 14 is substantially filled with a suitable hydraulic fluid, such as motor oil or other fluid having similar and suitable properties. With particular reference to FIGS. 7 to 10, there is shown diagrammatically the sequence of operation during delivery of an impact and as shown in FIG. 7, the annular shoulder 52, as well as the cup washer 54 which together provide a piston 62 and the sleeve

45 are disposed at the lower end of the chamber 42 in the intermediate body portion 14. In this position, of course, the hammer member 34 will also be disposed at the lower end of the upper body portion 10. An upward force is applied to the drill string connected to the mandrel 29 which in turn will move the piston rod 40 and the piston 62 carried thereby upwardly and the initial upward movement of the piston 62 will be substantially unimpeded, due to the fact that the hydraulic fluid in the chamber 42 may flow through the slots 46 in the sleeve 45 to the lower side of the piston 42. However, upon the upper edge of the cup washer reaching the upper ends of the slot 46, flow of hydraulic fluid from above the piston 62 to below the same will be cut off and, consequently, a pressure will rapidly build up above the piston 62. Since the hydraulic fluid in the chamber 42 of the intermediate body portion 14 is substantially incompressible, further upward movement of the piston 62 will be prevented, due to the fact that the cup washer 54 provides a nearly perfect seal with the inner surface 50 of the sleeve 45 and as a result, hydraulic fluid must slowly bleed or flow by the sleeve 45 to the lower part of the sleeve 45 and then through slots 46. This will permit relatively slow upward movement of the piston rod 40 and piston 62, at which time energy is stored in the drill string above the hydraulic jar of this invention, such energy being proportional to the pressure created above the piston 62. In FIG. 8, the piston 62 is shown substantially midway of the upward movement thereof in the sleeve 45 and as soon as the washer 54 reaches the flared portion 51 in the upper end of the sleeve 45, the fluid above the piston 62 will flow around such piston to the space below the same thereby rapidly dissipating the pressure in the chamber 42 above the piston 62 which results in a rapid upward movement of the piston rod 40 and the piston 62 to the position shown in FIG. 10. The hammer member 34 connected to the piston rod 40 also moves rapidly upward upon release of pressure in the chamber 42 above the piston 62 and as a result, the upper surface 35 of the hammer member 34 engages the lower surface 26 of the reduced portion 25 in the upper end of the upper body portion 10 with a substantial impact, such impact being carried through the intermediate and lower body portions to the coupling member 23 and to the fishing tool or other device connected thereto to be delivered to the object lodged in the well bore. During this sequence of operations the sleeve 45 remains at the lower end of the chamber 42 in the intermediate body portion 14 by reason of the fluid pressure exerted on the upper end of the sleeve 45, as well as on the upper surface of the flange 48 at the lower end of the sleeve 45.

Since more than one impact is usually necessary to dislodge objects jammed or lodged in a well bore, provision is made in the hydraulic jar of this invention for resetting of the same to deliver subsequent impacts without delivering a downward impact which would tend to jam the object more firmly in the well bore and with particular reference to FIGS. 11 to 14, there is shown the sequence of operations during resetting of the jar for a subsequent upward impact. Upon completion of the upward impact stroke, the drill string and mandrel 29, as well as the piston rod 40 and piston 62 is moved downwardly and as shown in FIGS. 11 and 12, the cup washer 54 will be guided into the sleeve 45 by the flared portion 51 in the upper end thereof, which will prevent shearing or damage to the cup washer 54 and also in the event the same has been slightly distorted outwardly, the washer 54 will be returned to its original diameter by the flared surface 51 and as soon as the washer 54 enters the cylindrical portion 50 of the sleeve 45 as shown in FIG. 12, fluid below the piston 42 will be placed under pressure and such fluid will flow through the slots 46 to the lower side of the flange 48 on the sleeve 45 which will result in exerting an upward pressure on such flange 48 to cause the sleeve 45 to move upwardly as clearly shown in FIG. 12. This upward movement of the sleeve 45 results in enlarging the chamber below the piston 62 sufficiently to accommodate the increase in pressure on the relatively incompressible fluid contained below the piston 62. Further downward movement of the piston 62 and upward movement of the sleeve 45 will result in movement of the upper edge of the washer 54 below the upper ends of the slots 46, at which time fluid below the piston 42 will flow through the slots 46 and into the space above the piston 62, after which the piston 62 may move downwardly until the lower end 63 thereof engages the flange 48 on the sleeve 45 which will result in moving the sleeve 45 downwardly to the lower end of the chamber 42 in the intermediate body portion 14, as clearly shown in FIG. 14. The device is now in condition to start the sequence of operation shown in FIGS. 7 to 10 to impart a further upward impact tending to dislodge the object jammed in the well bore.

The use of a cup washer on the piston, as above described, permits the use of a hydraulic fluid which is relatively light and of low viscosity, such as motor oil or the like, which materially reduces the power required to operate the device, since the amount of power is absorbed by heavy or high viscosity hydraulic fluids and furthermore, the use of a cup washer of brass or other similar material substantially eliminates wear in other parts of the device, such wear being localized in the washer which may be conveniently removed and replaced. The hydraulic jar of this invention may be operated to deliver relatively rapid upward impacts and reset without delivering a downward impact thereby materially increasing the efficiency of the device and resulting in the rapid dislodgement of objects jammed in a well bore.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a non-circular bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder integral with said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder, a retaining ring received

on said rod and engaging the upper surface of said washer, a groove in said piston rod and a snap ring received in said groove and engaging said retaining ring to secure said washer in place, the upper surface of said washer being flared upwardly and outwardly and the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

2. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder integral with said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder, a retaining ring received on said rod and engaging the upper surface of said washer, a groove in said piston rod and a snap ring received in said groove and engaging said retaining ring to secure said washer in place, the upper surface of said washer being flared upwardly and outwardly and the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

3. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating in said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder on said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder, a retaining ring received on said rod and engaging the upper surface of said washer, a groove in said piston rod and a snap ring received in said groove and engaging said retaining ring to secure said washer in place, the upper surface of said washer being flared upwardly and outwardly and the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

4. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder on said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder, a retaining ring received on said rod and engaging the upper surface of said washer, means engaging said retaining ring and said piston rod to secure said washer in place, the upper surface of said washer being flared upwardly and outwardly and the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

5. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said re-

duced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a pison rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder on said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder, means to secure said washer in place on said annular shoulder, the upper surface of said washer being flared upwardly and outwardly and the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

6. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate body portion, said sleeve being slidably disposed in said intermediate said portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner surface merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder on said piston rod, a yieldable, metallic upwardly opening cup washer received on said piston rod in engagement with the upper surface of said annular shoulder and means to secure said washer in place on said annular shoulder, the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

7. A hydraulic jar comprising an upper elongated hollow body portion, an intermediate elongated hollow body portion removably secured to the lower end of said upper body portion, a lower elongated hollow body portion removably secured to the lower end of said intermediate body portion, a coupling member removably secured to the lower end of said lower body portion, a reduced portion in said upper body portion adjacent the upper end providing a downwardly facing impact shoulder, said reduced portion having a bore extending therethrough, an elongated mandrel slidably and non-rotatably received in said bore and terminating within said upper body portion, a coupling member on the upper end of said mandrel above said upper body portion, a hammer member secured to the lower end of said mandrel and slidable within said upper body portion to engage said impact shoulder, a piston rod secured to said hammer member, said piston rod extending through said intermediate body portion and terminating within said lower body portion, a sleeve of less length than said intermediate portion, said sleeve being slidably disposed in said intermediate body portion, an inwardly extending flange at the lower end of said sleeve, the lower wall section of said sleeve having longitudinally disposed slots therein, the intermediate wall section of said sleeve having a smooth cylindrical inner surface, said inner merging into a beveled section at the upper end of said sleeve and a piston on said piston rod slidably received in said sleeve and movable between the lower and upper ends of said intermediate body portion, said piston comprising an annular shoulder on said piston rod, a yieldable upwardly opening cup washer received on said piston rod and in engagement with the upper surface of said annular shoulder and means to secure said washer in place on said annular shoulder, the outer surface of said washer engaging the cylindrical inner surface of said sleeve during a portion of the upward movement of said piston to provide a seal therewith while permitting a relatively slow fluid flow around said sleeve from the upper to the lower side thereof.

8. In a hydraulic jar, a hydraulic chamber having an outer cylindrical wall, a piston rod extending through said chamber, a shoulder on said piston rod, a yieldable, metallic washer removably secured on said rod and against said shoulder, a hammer member connected to said piston rod, an impact member connected to said cylindrical wall, a sleeve mounted in said hydraulic chamber, said sleeve being movable with respect to both said cylindrical wall and said washer, the outer surface of said washer engaging the inner surface of said sleeve during a portion of the upward movement of said washer to provide a seal between said washer and said sleeve.

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