This invention relates to a rotary jarring mechanism operated hydraulically and designed for use in connection with the drilling of oil wells.

In oil well "fishing" operations where tools become lost in the well, or the rotary drill pipe becomes stuck or "frozen" in the hole, mechanically operated jar mechanisms are now generally employed to recover and remove such tools, or to jar the pipe loose.

An important object of this invention is to provide a simple jar mechanism connected to the lower end of a rotary drill tube and operated hydraulically to deliver a sudden jarring blow to the pipe or tool being "fished" for to loosen the same.

Further objects of the invention are to provide a hydraulic jar mechanism which consists of few parts, and one that is readily manipulated.

Broadly the invention consists in employing a cylindrical casing provided on its lower end with a "fishing" or drilling tool, detachably secured thereto, and having a pair of upper and lower communicating fluid chambers of unequal diameters. Mounted therein is a hollow stemmed valved jar hammer adapted to be detachably secured to the lower end of a string of rotary drill pipe, the hammer being normally disposed in the lower fluid chamber of the smallest diameter. When an upward pull is exerted on the drill pipe the same will be stretched in length forcing the fluid in the upper chamber slowly through a bleed opening in the upper casing chamber, and as soon as the drill pipe attains its maximum limit of stretch and the jar hammer passes from the lower to the upper chamber, the fluid in the upper chamber will be rapidly discharged therefrom, thus permitting the drill pipe to contract, and the jar hammer to deliver a blow against the casing head to jar the casing and loosen the object fished for.

The jar mechanism is adapted to be mounted in a string of drill pipe and to rotate therewith, provision being made for circulating the mud laden water therethrough during a drilling or fishing operation: As the jar hammer is provided with check valves the fluid discharged from the upper to the lower chamber on a jarring operation will be returned automatically on a movement of the hammer to its normal position in the lower chamber.

Other objects and advantages of this invention, not at this time particularly enumerated will be clearly understood from the following detailed description of the present invention, the annexed drawings forming a part thereof, in which:

Fig. 1 is a side elevation of the hydraulic jar connected in a rotary drill pipe line, a fishing tool known as a "casing spear" being attached to the lower end, the tool shown as entering the upper end of a broken drill pipe.

Fig. 2 is a similar view showing the spear engaging the broken drill pipe.

Fig. 3 is an enlarged longitudinal section through the tool, showing the jar hammer in its lowermost position.

Fig. 4 is a similar view showing the jar hammer moving upwardly in a jarring operation of the tool.

Fig. 5 is a like view, showing the jar hammer ready to impact with the casing head of the tool.

Fig. 6 is a detail view showing the jar hammer impacting with the casing head of the tool.

Fig. 7 is a cross section of the tool taken on line 7—7 of Fig. 3.

Fig. 8 is a view similar to the above taken on line 8—8 of Fig. 3.

Fig. 9 is a partial vertical detail section of the upper portion of the jar mechanism illustrating another form of bleeding the fluid chamber.

Fig. 10 is a view similar to the above, showing still another form of bleeding from the fluid chamber.

Referring now more specifically to the drawings, the rotary jar preferably comprises a metal casing 10, provided with a lower cylindrical chamber 11, and an upper chamber 12 of greater diameter than the lower. The upper end of the casing has a heavy thickened head 13, provided with a centrally disposed bushed bore 14 for the passage therethrough of the stem of the jar hammer. A coupling member 15 is secured in threaded engagement with the lower end of the casing, and the lower end of said member engages the upper tapered socket 17 of a coupling 18, to which is secured a "fishing" tool of any desired type, in this instance shown as a casing spear. Coupling 15 is provided with a central vertical bore 19 that opens at its upper end into a counterbore 20
of larger diameter, the bores providing for the circulation of the mud laden water when the tool is connected in a drill pipe string. Formed integral with the upper end of the coupling 15, a hollow tubular member 21, provided with a removable plug 22 having a squared opening 23 formed therein.

The operating mechanism of the jar is mounted within the casing 10, and comprises a jar hammer having a head 24 of piston form, provided with an upwardly extending hollow stem 25 formed integrally therewith. The diameter of the lower half 26 of stem 25 is less than the bushed bore 14 in the casing head in order to permit of a flow of fluid through said bore when the jar hammer leaves the lower chamber of the casing, as will be explained further on. The upper portion 27 of the stem 25 is threaded and has a sliding fit in bore 14, in which it is normally disposed during the operation of the rotary drill pipe, the threaded end engaging a pipe joint 28 of usual form.

Jar hammer 24 has a sliding length with the cylindrical wall of the lower chamber 11 in order that little or no leak may occur between the chambers when the jar hammer is moved from the lower to the upper chambers, and in order that the fluid in the lower chamber may be displaced or returned to the upper chamber on a return movement of the jar hammer after its operation, the head is provided with a plurality of vertical bores or ports 30, each having a ball check valve 31 mounted in its lower end.

Depending from the jar hammer head 24, is a shank 32, square in cross section and provided with a central bore 33, that is in alinement with the bore formed in head 24 and stem 25. This shank is at all times in sliding engagement with the squared opening 23 formed in the plug 22 of the hollow extension 21, and its cross sectional area is less than the area of the opening 23, in order that the fluid may pass from the bore in the jar hammer stem into the casing chambers of the jar mechanism. By providing the movable jar hammer with a squared shank both the stationary and movable members of the jar mechanism will at all times be rotatably connected, this feature being necessary when rotary fishing tools are employed with the mechanism or the same is permanently mounted in the rotating drill pipe string.

The operation of the mechanism is as follows: Should the drill pipe become broken apart as illustrated in Figs 1 and 2, the upper string of drill pipe is withdrawn from the "hole" and the broken section of the pipe is removed from the string. The jar mechanism is then connected to the end of the lowermost section in the manner heretofore described. A fishing tool (in this case a casing spear), is then screwed to the lower end of the jar casing, and the drill string is then again lowered into the well hole 34, the spear 35 entering the upper open end of the broken section of drill pipe, to which the drill is secured, as shown in Fig. 2. It will be understood that when the drill string with the jar mechanism is lowered into the end of the broken drill pipe, the head is forced downwardly into the lower casing chamber 11, the fluid therein passing upwardly through the valve ports in the head to the upper casing chamber 12. When the casing spear is engaged with the upper end of the broken drill pipe lodged in the well, an even continuous pull is exerted on the drill pipe and the jar hammer connected thereto, and as is well known, the metal drill pipe will stretch considerably in length, the distance of such stretch depending entirely upon its length, in some instances a safe stretch being about 24 inches in every 3600 feet. As the bleeder opening 36 at the upper end of the casing is quite small it will be apparent that the drill pipe may be stretched to its maximum length before sufficient fluid is disposed above the jar hammer has been forced through the bleeder opening to permit the hammer to enter the upper enlarged fluid chamber 12. The instant the hammer leaves the lower chamber the drill pipe will at once contract in length and move upwardly to cause the jar hammer to swiftly impact with the head 13 of the jar casing to deliver a jar to the same and the fishing tool connected therewith. As the upper fluid chamber 12 is of greater diameter than the diameter of the jar hammer, and further as the bore 14 is of greater diameter than the diameter of the lower portion 26 of the hammer stem when disposed therein, the fluid in the upper chamber will be rapidly discharged therefrom. The above operation may be repeated from time to time until the object fished for is loosened sufficiently to enable the operators to raise the same to the surface of the well, the valves in the jar hammer head permitting the flow of fluid from one casing to the other as occasion demands.

It will be understood that by varying the diameter of the bleeder opening 36, that the length of stretch in the drill pipe may be easily regulated, thus should the bleeder opening be relatively small in diameter the maximum amount of stretch of the drill pipe will occur and as a consequence the blow delivered to the casing will be correspondingly heavy, while on the other hand if the bleeder opening is of a sufficient size to permit of a rapid discharge of the fluid from the chambers above the jar hammer, it will be apparent that an operation of the jar mechanism will occur before the maximum length of pipe "stretch" occurs, and as a result the blow delivered will be comparatively light.
In some cases the jar mechanism may be permanently connected in the drill string, and in such case it will be observed that a perfect circulation may be maintained at all times during the drilling operation, the squared shank effecting the rotation of the jar and the drilling tools connected thereto. Thus should the tubing become stuck or frozen in the well hole, a constant circulation of mud laden water is maintained even when there is cessation of rotation. In loosening the “frozen” tubing when such a situation arises, the jar mechanism is operated in the same manner as described in connection with a fishing operation.

Instead of forming the bleeder port in the wall of the cylinder, and in the form of the preceding form it may be formed in the jar hammer head 24, (see Fig. 9), the bleeder port 40 being vertically disposed to one side of the stem 26. In the form illustrated in Fig. 10, the bleeder port is entirely dispensed with the fluid in the upper chamber leaking around the hammer to the lower chamber and an upward movement of the same. With the above exceptions the mechanism and operations in each alternative form is substantially the same as in the form first described.

What I claim is:

1. A rotary jar mechanism comprising a hollow cylinder constituting a fluid chamber having a counter bore at the upper end thereof, and a jar hammer having a stem extending through the upper end of said cylinder and adapted to be connected to a string of pipe, said stem being normally disposed in the lower portion of said cylinder below the counter bore and having a sliding fit therein, whereby when the jar hammer enters the counter bore the fluid therein will be displaced to cause an impact of the hammer with the cylinder.

2. A jar mechanism comprising a casing provided with two communicating chambers of unequal diameter, a jar hammer head normally positioned in the chamber of smaller diameter, and a jar hammer stem carrying said head and extending through the chamber of larger diameter and through the head of said casing, there being a port for bleeding the larger chamber when a pull is exerted on the hammer stem, whereby movement of the hammer head from the chamber of smallest diameter is retarded by fluid in the chamber of the greatest diameter until the pressure is suddenly relieved by passage of the jar head into the larger chamber whereby an impact of the jar hammer upon the casing head is produced to jar the casing and a tool connected with the device.

3. A rotary jar mechanism comprising a casing provided with a lower fluid chamber and an upper fluid chamber of greater diameter having a fluid bleeder port, and a jar hammer head having a stem extending upward through said chambers and through the head of said casing and adapted to be connected with a string of pipe, said hammer being normally disposed in said lower chamber, whereby when a pull is exerted on said hammer stem the hammer head will be retarded in its upward movement by the fluid in the upper chamber to cause a stretch in the drill pipe therefore, the hammer being suddenly released by passing into the upper chamber whereby to produce an impact thereof upon the casing head to jar the same and a tool attached thereto.

4. A rotary jar comprising a cylinder having a fluid chamber and adapted to carry a well fishing tool on the lower end thereof, a jar hammer mounted for reciprocation in said cylinder, a stem secured to said jar hammer and extending without said cylinder, the free end of said stem adapted to be secured to a string of pipe, said jar cylinder having a fluid bleeder port for regulating the speed of movement of the hammer when a pull is exerted on the drill pipe, said cylinder also arranged to discharge the fluid in the cylinder chamber above the hammer before said hammer completes the limit of its upward movement, whereby to cause an impact of the hammer with the cylinder head to jar the same and the fishing tool connected thereto.

5. A rotary jar comprising a casing provided with a lower fluid chamber and an upper connecting chamber of greater diameter having a fluid discharge port therein, a well tool connected to the lower end of said casing and a jar hammer having a stem extending through the upper end of said casing adapted to be connected to the lower end of a string of pipe, said jar hammer being normally disposed in the lower fluid chamber prior to its jarring operation and having a sliding fit therein, whereby when a pull is exerted on the upper end of the drill pipe the same will be stretched in length and released to deliver a jarring blow to the casing and its connected tool when the jar hammer leaves the lower fluid chamber.

6. A rotary jar, including a cylindrical casing having a lower fluid chamber and an upper connecting chamber of larger diameter, a reciprocating jar hammer having an upwardly extending hollow stem normally adapted to be secured to a string of pipe disposed in the lower fluid chamber, said upper chamber having a fluid bleeder port for relieving the pressure of fluid against the jar hammer during its upward movement, the fluid pressure causing a stretch in the length of the pipe when an upward pull is exerted thereon, whereby when the jar hammer leaves the lower chamber the pipe will suddenly contract to deliver a blow to the casing.
ing jar, and valve means in the jar hammer to permit a return of the fluid from the lower to the upper chamber on a return of the hammer to its normal position in the lower chamber.

7. A rotary jar comprising a casing provided with a lower cylindrical fluid chamber and an upper connecting chamber of greater diameter having a fluid discharge port, and a jar hammer having a hollow stem extending through the upper end of said casing and adapted to be connected to a string of pipe, said hammer being normally disposed in the lower chamber and having a sliding fit therein, whereby when an upward strain is imposed on the string of pipe to move the hammer the fluid in the upper chamber will be automatically discharged therefrom to cause the hammer to be arrested by impact with the jar casing.

8. A rotary jar comprising a cylindrical casing provided with an upper fluid chamber and a lower connecting fluid chamber of smaller diameter, the upper chamber having an open fluid discharge port, a jar hammer slidingly mounted in the lower chamber and having an upwardly extending hollow stem adapted to be attached to the lower end of a string of pipe, whereby on a movement of the jar hammer upwardly the fluid pressure in the upper chamber will be automatically relieved when the hammer reaches the upper chamber to cause a jar to be imparted to the casing, and valve means in the hammer to permit a displacement of the fluid in the lower chamber when the hammer is returned to normal.

9. A rotary jar comprising a casing provided with a lower cylindrical fluid chamber and an upper connecting chamber of greater diameter having a fluid discharge port, a jar hammer having a hollow stem extending through the upper end of said casing and adapted to be connected to a string of pipe, said hammer being normally disposed in the lower chamber and having a sliding fit therein, whereby when an upward strain is imposed on the string of pipe to move the hammer the fluid in the upper chamber will be automatically discharged therefrom to cause the hammer to be arrested by impact with the jar casing, and means formed on said jar hammer and slidingly engaging the casing for rotating the same.

10. A rotary jar comprising a casing having a fluid chamber therein and provided with a fluid bleeder port, a jar hammer having a stem extending upwardly through said casing adapted to reciprocate in said chamber, said hammer and stem having a bore therethrough, means formed on said jar hammer and slidingly engaging the casing for rotating the same, and means for automatically relieving the fluid pressure in said chamber before the hammer reaches the limit of its upward movement, whereby to cause a sudden jar to the casing by impact of the jar members.

11. A rotary jar comprising a casing having a pair of connecting fluid chambers of unequal diameters, said jar mechanism having a fluid bleeder port, a reciprocable jar hammer having a stem adapted to be connected to a string of pipe normally disposed in the chamber of the lesser diameter, said hammer and stem having a bore communicating with the pipe string, means to connect the jar hammer and casing in rotative engagement, means for relieving the fluid pressure against the jar hammer when an upward pull is exerted on the same and before it reaches the limit of its upward movement, whereby to cause a sudden jar to the casing by the impact of the jar members, and valve means in the jar hammer for displacing the fluid in the chamber of lesser diameter when said hammer is returned thereto.

12. A rotary jar comprising a cylindrical casing having aligned bores of different diameters forming fluid chambers, the casing having a fluid bleeder port adjacent the upper end thereof, a movable jar hammer of piston form mounted to reciprocate in said bores, said hammer being normally disposed in the bore of lesser diameter, a hollow stem connected to said hammer and extending through said casing, said stem adapted to be secured to a string of pipe, a shank having a vertical bore and square in cross section, depending from said jar hammer, a hollow member having a squared opening in its upper end wall secured to said casing the shank engaging said squared opening, whereby to connect the casing and hammer in rotative engagement, and a plurality of check valves mounted in said hammer for permitting a discharge of fluid from the lower chamber of lesser diameter when the hammer is returned thereto after a jarring operation.

13. A hydraulic jar mechanism comprising a casing member having a fluid chamber formed therein, a jar hammer head mounted in said casing member having a stem extending without said member, said stem adapted to be connected to a string of pipe, the fluid in said chamber above the hammer head adapted to retard its upward movement when a pull is exerted on the hammer stem, and means to suddenly displace the fluid in the chamber above the hammer head before the same reaches the limit of its upward travel, whereby to cause a sudden impact of the jar hammer head with the casing member.

14. A hydraulic jar mechanism comprising a casing member having a fluid chamber formed therein, a jar hammer head mounted in said casing member having a stem extend.
1,687,505

1. A jar mechanism, comprising a hammer member and an anvil member slackly linked together, means to admit a fluid between the hammer and anvil members, whereby to retard the movement of the hammer when a pull is exerted on the same, and means to free the fluid between said members in order to cause the hammer member to suddenly contact with the anvil member.

2. In a jar, the combination of a hammer member and an anvil member slackly linked together, a hydraulic catch comprising a hammer member and anvil in set position, said catch having means to free the circulation of liquid thereto as to release and trip said hammer.

3. In a jar, the combination of a hammer member and an anvil member slackly linked together, and a hydraulic catch comprising a plunger member operating within a barrel, there being leak passages communicating with said barrel for the passage of liquid whereby said plunger is trapped therein but permitted to move slowly toward release and upon travelling a given distance to be released by freeing the circulation of liquid to said barrel.

4. In a jar, the combination of a hammer member and an anvil member slackly linked together, a hydraulic catch comprising a plunger secured to one of said members, the other member having a plunger barrel in registration therewith, there being leak passages to permit slow circulation of liquid to said barrel, said plunger being arranged to ride outwardly of said barrel so as to permit free circulation of liquid thereto and thereby release said hammer.

5. In a jar, the combination of a hammer member and an anvil member slackly linked together, a hydraulic catch comprising a plunger member operating within a barrel, there being leak passages communicating with said barrel for the passage of liquid whereby said plunger is trapped therein but permitted to move slowly toward release and upon travelling a given distance to be released by freeing the circulation of liquid to said barrel.

6. In a jar, the combination of a hammer member and an anvil member slackly linked together, a hydraulic catch comprising a plunger secured to one of said members, the other member having a plunger barrel in registration therewith, there being a leak passage to permit slow entrance of liquid back of said plunger, the stroke of said hammer being greater than the length of said plunger, whereby passage of said plunger from said barrel trips and releases said hammer.

In witness that I claim the foregoing I have hereunto subscribed my name this 22nd day of April, 1925.

WILSON B. WIGLE.