

Dec. 9, 1952

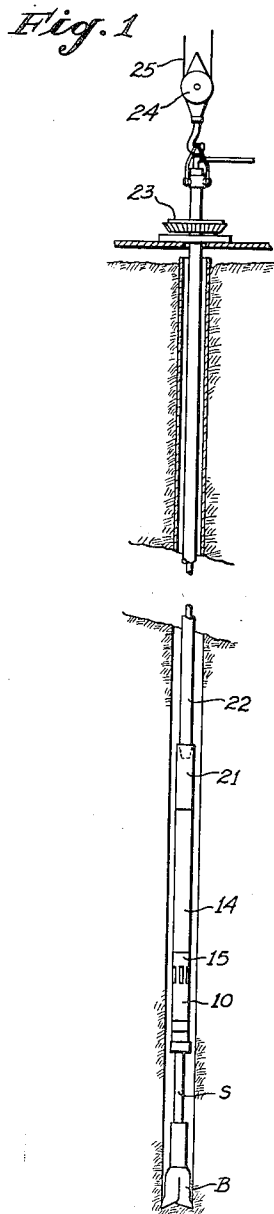
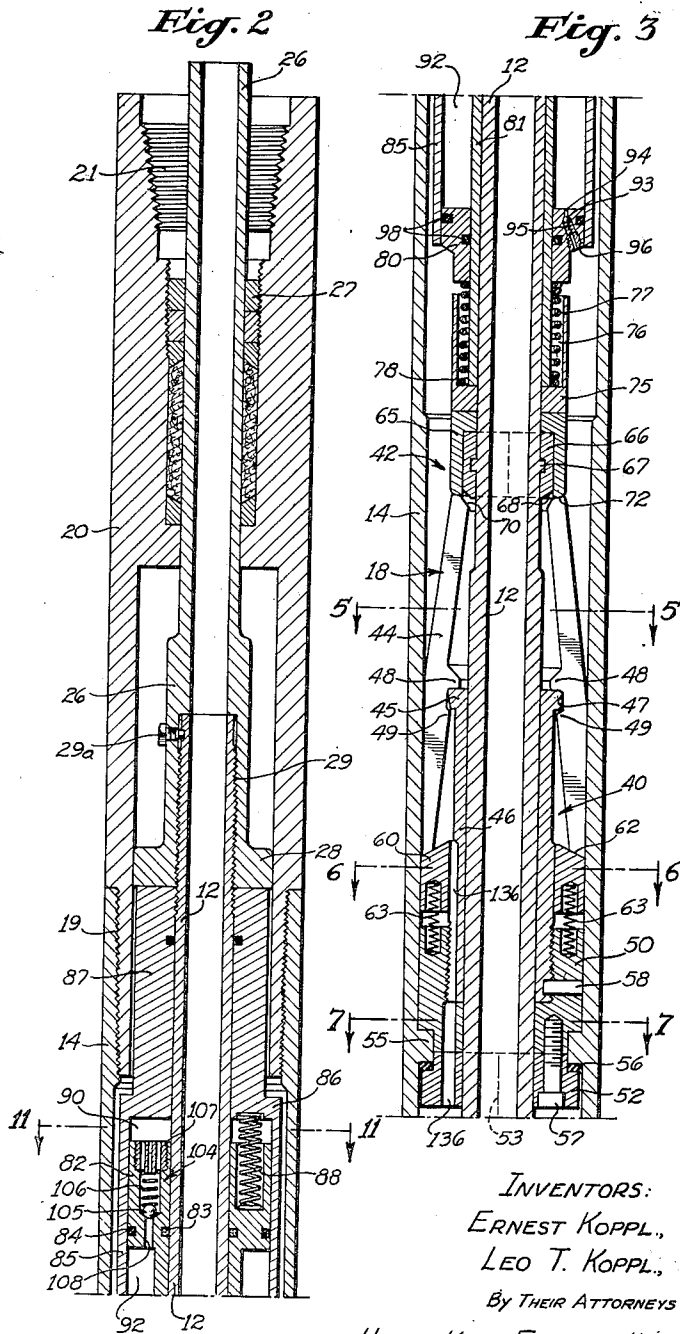
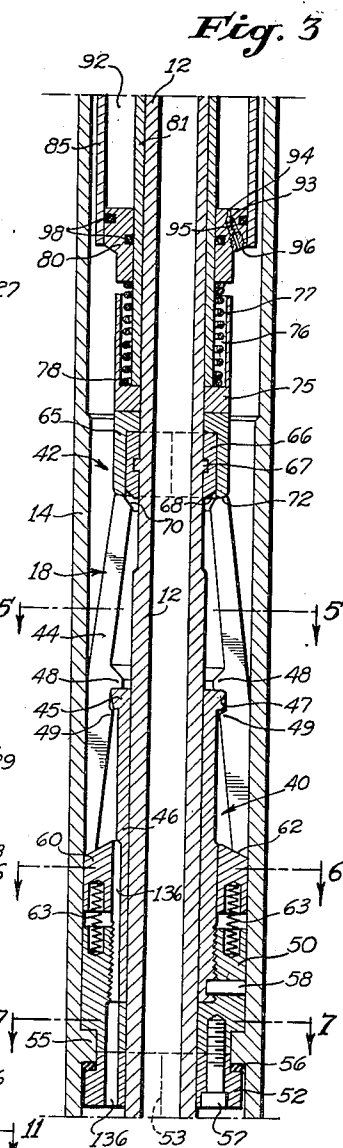
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2,621,024

WELL JAR

Filed Sept. 13, 1946

3 Sheets-Sheet 1



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**2,621,024**

WELL JAR

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3 Sheets-Sheet 2

*Fig. 4*

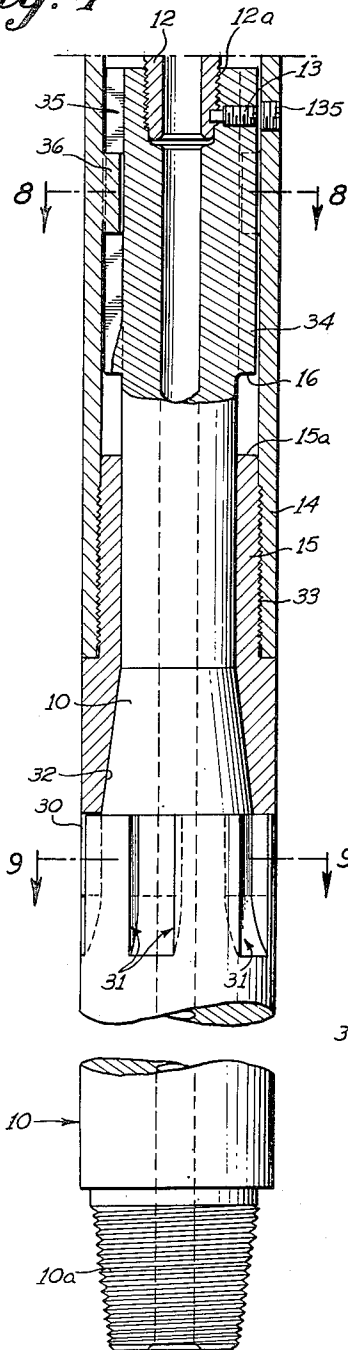


*Fig. 5'*

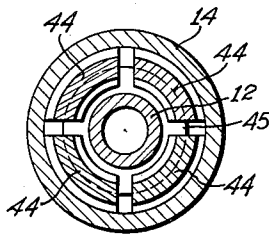


*Fig. 6*

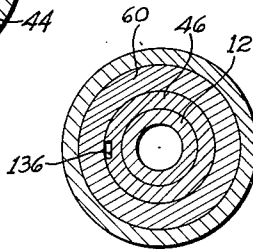


*Fig. 7*

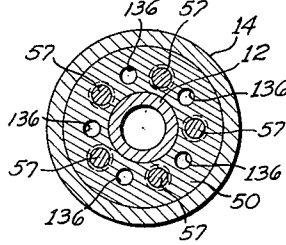


*Fig. 8*

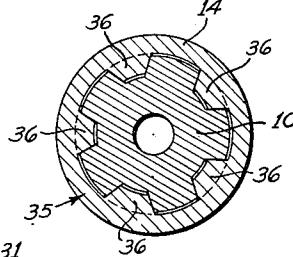
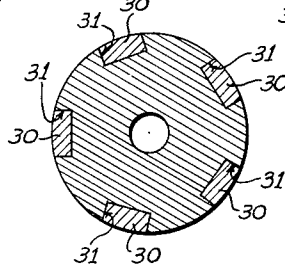


*Fig. 9*



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WELL JAR

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3 Sheets-Sheet 3

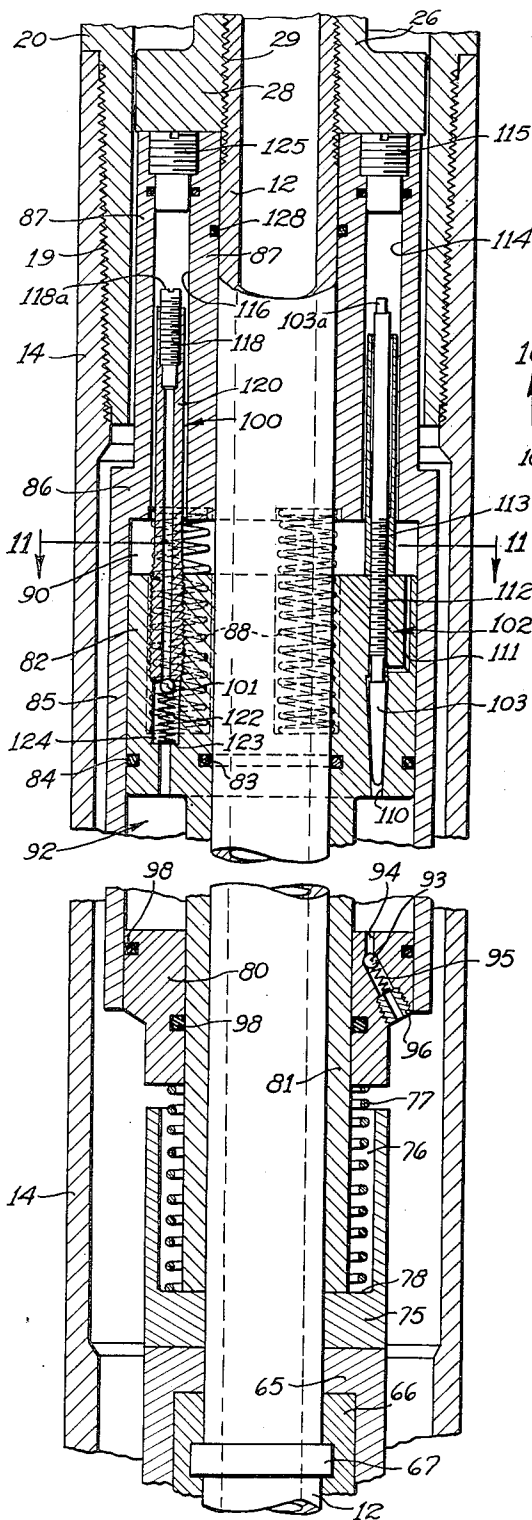


Fig. 10

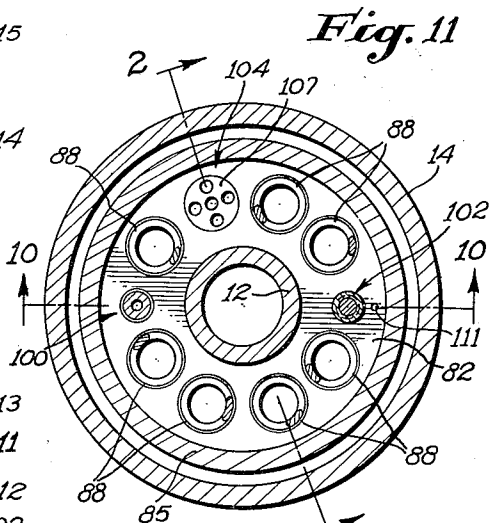


Fig. 11

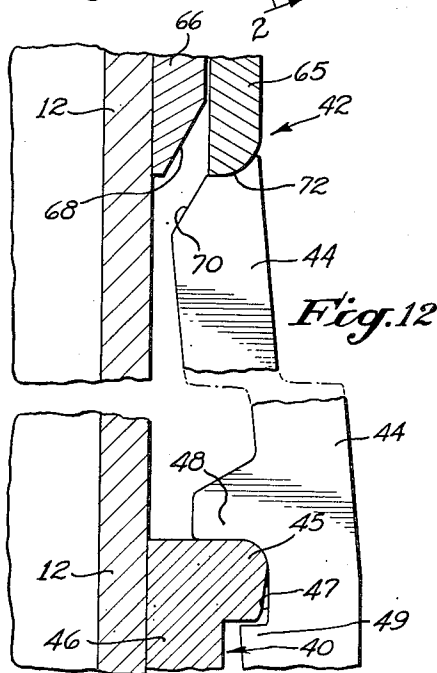


Fig. 12

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## UNITED STATES PATENT OFFICE

2,621,024

## WELL JAR

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Application September 13, 1946, Serial No. 696,880

4 Claims. (Cl. 255—27)

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This invention relates broadly to the art of drilling oil wells by a system well known as the rotary method. More specifically, the invention relates to devices known as well jars which are used on the lower ends of strings of drill pipe for the purpose of loosening drill bits and other pieces of equipment which have become stuck or jammed in the bottom of wells.

During drilling operations as they are conducted in the drilling of deep wells, particularly oil wells, the drill bit, or other portion of the equipment, occasionally becomes jammed in the drill hole due either to the caving in of the formation being drilled or to some other cause. As a result, the drill bit, or other piece of equipment, can be neither turned nor withdrawn by ordinary actuation of the drill pipe to which it is attached. For the purpose of freeing such stuck or jammed equipment, various types of jars have been developed, some of which heretofore have been fairly satisfactory, and others not so satisfactory. Most of them have been provided with friction-type releases.

It is an object of this invention to provide for the industry a well jar which will be positive and efficient in operation, easy to operate, relatively simple in construction, and moderate in cost.

Deep well jars of the type to which the present invention applies function normally by the transmission of a sudden severe blow to a portion of the jar which is attached to the stuck implement. It is a particular object of this invention to provide a jar having positively operating means which serve to release the jar for delivery of the desired blow, as distinguished from friction means intended to operate upon development of a predetermined strain.

A jar of this type is actuated by the application of a lifting force upon the upper end of drill pipe supported from the usual drill rig or derrick and suspended in the well hole, the lower end of the drill pipe carrying the jar. When an implement is badly stuck, continued lifting produces appreciable stretch in the drill pipe and thereby generates a tension or powerful elastic strain. Inasmuch as a drill pipe may be several thousand feet long and is made of steel, the stretch so developed may amount to several feet. Advantage is taken of this elastic strain to yield the desired sharp blow required for loosening the implement. To effect release within the jar so that the blow may be accomplished, latch means or other releasable means is used, this means maintaining engagement of the drill pipe

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with that portion of the jar attached to the stuck implement until such time as sufficient strain has been developed by the lifting force applied to the top of the pipe. When this strain releases the latch mechanism, the elastic energy stored in the drill pipe by reason of the stretch acts suddenly to transmit a powerful blow, this blow being conveniently accomplished by means of a hammer member carried by the drill pipe and cooperating with an anvil member carried by the portion of the jar secured to the stuck implement. However, a friction release for the latch means cannot be made to release uniformly under any given strain because it has been found that such a friction release operates under one applied force at one time and under a substantially different force at another time.

It is, therefore, an important object of this invention to provide a well jar capable of being always released under a given strain. It is another important object of this invention to provide such a jar which is capable of being always released under any selected strain which the operator may deem desirable. It is a further object to provide such a jar which will operate as indicated under any selected strain without the necessity of employing any mechanical adjustment either within the jar or at the surface of the well when it is desired to actuate the device under a strain different from that of the preceding operation.

Another object is to provide, in a jar of the nature indicated, means for simply and automatically resetting the jar between jarring operations.

Another object is to provide in a well jar delayed action means adapted to control the operation of the releasing means, and also to provide for elapse of appropriate time intervals so that the operator may have an opportunity to establish the desired strain for any given jarring operation.

It is a still further object to provide a jar selectively operable under strains ranging from relatively low values to relative high values, so that operations may be initiated with low strains, the strains being successively increased if necessary, whereby to favor the power equipment employed for producing the strains and thereby prolong the life of the machinery employed and the derrick structure from which the drill pipe is suspended.

According to a preferred embodiment, a dash-pot type of control means, containing hydraulic fluid, is used to receive initially pressure applied

by way of the lifting and stretching of the drill pipe, a metering pin or the like being used for slowly bleeding trapped hydraulic fluid out of the dash-pot. As a plunger moves in the dash-pot, tripping means such as levers move into contact with positive actuating means, such as cam faces, whereby the levers or other tripping means are positively moved and the jar is positively released to strike the required blow. Spring means and check valve means serve for quick return of the plunger and resetting of the release means.

Other objects and features of the invention will become apparent to those skilled in the art upon reference to the accompanying drawings wherein a useful embodiment of the invention is illustrated.

In the drawings:

Fig. 1 is a diagrammatic elevational view on a small scale illustrating the jar of the present invention suspended from drill pipe in a deep well below a conventional derrick (not shown);

Figs. 2, 3, and 4 are principally longitudinal sections of the jar on a larger scale and show successive portions of the complete jar from top to bottom, the section of Fig. 2 being indicated by the line 2—2 of Fig. 11;

Figs. 5 to 7 are cross-sectional views taken on lines 5—5, 6—6, and 7—7, respectively of Fig. 3;

Figs. 8 and 9 are cross-sectional views taken on the lines 8—8 and 9—9 respectively of Fig. 4;

Fig. 10 is an enlarged vertical section, as indicated by the line 10—10 of Fig. 11, and showing the mechanism of the lower portion of Fig. 2 and the upper portion of Fig. 3;

Fig. 11 is an enlarged cross section taken on the lines 11—11 of Figs. 2 and 10; and

Fig. 12 is a still further enlarged fragmentary elevation showing the mounting and structural details of the release levers constituting part of the latch mechanism.

In the form of construction disclosed in the drawings, the principal parts comprise a main mandrel 10 (Fig. 4) to which an inner mandrel 12, constituting a mandrel extension, is secured by threads 12a, these mandrels 10 and 12 being non-rotatably fixed together by a lock pin 13 and telescopically received in a sleeve-like body member 14. The lower end of the body member 14 has secured thereto a hammer 15 of sleeve-like formation disposed around the main mandrel 10 and having its upper end disposed within the body member 14. An upwardly facing annular wall 15a of the hammer 15 is adapted to strike an annular downwardly facing anvil shoulder 16 integrally carried by the upper portion of the mandrel 10 within the body member 14 and adjacent the joint between the mandrels 10 and 12.

Within the upper portion of the body member 14 and operatively carried thereby is a latch mechanism 18 (Fig. 3) adapted to cooperate with the upper end of the inner mandrel 12. Attached to the upper extremity of the body member 14 by means of a threaded connection 19 (Fig. 2) is a body joint 20 which, through the medium of a standard box and pin connection 21, serves to connect the body member 14 to the lower end of a string of conventional drill pipe 22. The drill pipe 22, as shown in Fig. 1, extends upward to the surface of the well and into a conventional derrick (not shown) equipped with a rotary table 23, block 24, and hoist line 25 adapted for raising and lowering the drill pipe as required. As seen in Fig. 2, the upper end of the inner mandrel 12 is provided with a wash pipe 26 adapted to move through a packing gland 27 provided in a corre-

sponding bore of the body joint 20. For the purpose of attachment of the wash pipe 26 to the inner mandrel 12, the wash pipe 26 is provided with an integral head 28 secured over the end of the inner mandrel by a threaded connection 29 and lock pin or screw 29a.

As seen in Fig. 4, the tubular hammer 15 is slidably and non-rotatably connected with the lower extremity of the main mandrel 10 by means of positioning and driving fingers 30 provided on the lower extremity of the hammer 15 and slidably received in guideways 31 cut in the adjacent portion of the main mandrel 10. This construction is also illustrated by the cross section of Fig. 9. For convenience of construction, and also for the purpose of providing good seating between the parts, the main mandrel 10 and the hammer 15 are frusto-conically formed as indicated at 32. In order to fix the upper end of the hammer 15 to the lower end of the body member 14, a threaded joint 33 is provided, the upper extremity of the hammer 15 filling an annular space between the body member 14 and the main mandrel 10 and thereby directing its upwardly facing annular striking wall 15a toward the anvil shoulder 16 to impart the required jarring blows. The anvil shoulder 16 is provided by the lower end of an annular anvil 34 integral with the upper portion of the main mandrel 10. The anvil 34 has near its top a plurality of spline-ways 35 which receive between them interfitting cooperating, driving and guiding splines 36 integrally provided upon the adjacent inner wall of the body member 14.

As presently to be explained, when the latch mechanism 18 is released to free the body member 14 when placed under proper stretching tension, the annular striking wall 15a imparts a severe blow to the anvil shoulder 16 of the anvil 34 and thereby produces a jar-ring effect upon any implement attached to the lower end of the main mandrel 10. Such attaching means may be a conventional threaded pin connection 10a adapted to be engaged in a corresponding box of any grapple device such as an overshot S connected in turn to the stuck implement, the latter being generally represented by the drill bit B seen in Fig. 1.

The latch mechanism 18 is disposed in operative position within the body member 14 by being in part mounted upon and about the inner mandrel 12 and in part mounted upon the body member 14 and slidably disposed about the inner mandrel 12 above the threaded connection 12a between the two mandrels. To accomplish these ends the latch mechanism 18 comprises a lower portion 40 (Fig. 3) which slides upon the inner mandrel 12, an upper portion 42 which slides upon the upper portion of the inner mandrel 12 to a lesser extent, and release levers 44 which operatively connect the lower and upper portions 40 and 42.

The levers 44 are fulcrumed upon a flange-like annular bearing head 45 carried upon the upper end of a thrust sleeve 46 constituting a part of the lower portion 40 of the latch mechanism and slidably mounted on the lower portion of the inner mandrel 12. Each of the release levers 44, of which four are indicated, are arcuate transversely as seen in Fig. 5. Each lever 44 is grooved as indicated at 47 thereby providing (Figs. 3 and 12) an upper bearing shoulder 48 and a lower retaining shoulder 49, these shoulders 48 and 49 respectively overlying and underlying the flange-like head 45. It will be noted

that the portion of the shoulder 48 inwardly of the groove 47 is curved to rock upon a correspondingly shaped portion of the head 45. The sleeve 46 is threaded into the upper portion of the upper member 50 of a two-part connecting ring (also constituting a part of the lower latch portion 40) of which its lower member 52 is split vertically as indicated by a dotted line 53 (Fig. 3) to facilitate insertion and removal. The two-part connecting ring 50, 52 is employed for the purpose of binding the sleeve 46 to the body member 14 and preventing longitudinal movement of the release levers 44 and the sleeve 46 with respect to the body member 14 when the inner mandrel 12 slides within the sleeve 46. This retention of the connecting ring 50, 52 is accomplished through the medium of an internal annular actuating rib 55 integrally carried by the inner wall of the body member 14. An annular rubber cushion 56 is employed between the rib 55 and the connecting ring member 52 for the purpose of absorbing chatter and resisting wear. The ring members 50 and 52 are secured together by means of cap screws 57. As is apparent, the upper connecting ring member 50 is introduced from above during installation and the two parts of the lower connecting ring member 52 are introduced from below during installation, the cap screws 57 being also introduced from below and threaded into position with a long tool. To insure against loosening of the sleeve 46 in the upper connecting ring member 50, a transversely disposed locking pin 58 may be used if desired. As seen in Fig. 3, the two ring members 50 and 52 are rabbeted to accommodate the annular rib 55, and the upper portion of the upper ring member 50 is offset outwardly to accommodate the lower end of the sleeve 46. Above the upper end of the connecting ring member 50 and between the sleeve 46 and the body member 14, there is provided a pressure or bearing ring 60 whose upper face is beveled to provide an annular resistance seat 62 for the correspondingly beveled lower ends of all of the release levers 44. The pressure ring 60 is normally urged upward by resetting springs 63 whose ends are countersunk in the upper connecting ring member 50 and the pressure ring 60 as shown.

The upper ends of the release levers 44 cooperate with a hardened compression sleeve 65, which constitutes stop means for engagement by adjacent ends of the release levers 44 and which in part slidably bears upon the outer wall of the inner mandrel 12 but has its lower portion recessed annularly to receive a positive trip ring 66. The trip ring 66 is non-slidably mounted upon the inner mandrel 12, this being accomplished through the medium of an annular retaining rib 67 integrally formed upon the outer wall of the inner mandrel 12. The trip ring 66 is split longitudinally for installation upon the rib 67 and when installed is retained in position by the overhanging portion of the compression sleeve 65. The lower end of the positive trip ring 66 is beveled to provide a cam face 68 adapted to be engaged by correspondingly beveled edges 70 on the upper ends of the respective release levers 44. The upper ends of the levers 44 and the lower annular edge of the compression sleeve 65 are provided with correspondingly curved and inter-fitting faces 72. These curvatures are approximately as indicated in Fig. 12, and are such that engagement between them is maintained, regardless of any pressure applied through the release levers 44, until there

has been sufficient upward movement of the beveled edges 70 of the levers 44 to contact the annular cam face 68 so that the latter positively forces the upper ends of the levers 44 outward until the heels of the curved faces 72 on the levers 44 pass the center line of the curve of the annular face 72 on the lower end of the compression sleeve 65, the upper ends of the levers 44 then automatically completing disengagement from the compression sleeve 65 under the force applied longitudinally to the release levers 44.

The upper end of the hardened compression sleeve 65 bears upon the corresponding lower end of a relatively softer spring-receiving barrel 75 which is formed with an internal annular opening 76 which receives a spring 77 (Figs. 3 and 10) referred to herein as an auxiliary spring. The lower end of the auxiliary spring 77 bears upon an internal annular seat 78 within the barrel 75, and the upper end of the auxiliary spring 77 bears against an annular auxiliary piston 80 slidably disposed upon an elongated skirt 81 of a compression piston 82 disposed around the upper portion of the inner mandrel 12 adjacent the place where the latter is received in the head 28 of the wash pipe 26. The seat 78 also receives the lower end of the skirt 81 of the compression piston 82. An annular packing 83 seals the piston 82 upon the inner mandrel 12, and an annular packing 84 seals the outer wall of the piston 82 upon the inner wall of an outer cylinder 85 having at its upper end a head 86 provided with an elongated upper extension 87. The cylinder head extension 87 is of reduced diameter with respect to the head 86 and extends upward within the body joint 20 into engagement with the lower face of the head 28 of the wash pipe 26 affixed to the upper end of the inner mandrel 12 as above described. The cylinder 85, its head 86, and the extension 87 are continuously urged upward against the wash pipe head 28 and away from the compression piston 82 by means of a plurality of power springs 88 disposed between the piston 82 and the head 86 and suitably countersunk to maintain their respective positions.

The annular space between the compression piston 82 and the cylinder head 86 and within the cylinder 85 constitutes a high-pressure fluid chamber 90 for hydraulic liquid, such as oil, used in the system. Below the piston 82, an annular low-pressure fluid supply chamber 92 is provided between the skirt 81 and the cylinder 85, and above the auxiliary piston 80. This piston 80 serves as a sort of follower and acts both to retain the oil in the system and automatically to adjust itself to the oil volume, thus compensating for any oil loss and thereby insuring against entrance of drilling mud.

For the purpose of venting a small portion of the hydraulic liquid upon the initial stroke of the apparatus, whereby to prevent hydraulic lock, the auxiliary piston 80 is provided with a ball check valve 93 controlling a passage 94 and pressed by a spring 95 held by a vented plug-like retainer 96. The auxiliary piston 80 is provided with packings 98 working upon the adjacent walls of the skirt 81 and the cylinder 85 whereby to retain oil in the supply chamber 92 against pressure imparted thereto.

The piston 82 is a control piston provided with means for regulating the time interval determining release of the release levers 44 of the latch mechanism 18. The means carried by the control piston 82 comprises (Fig. 10) a hydraulic

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fluid feed means 100 having a ball check feed valve 101, a delayed action mechanism 102 including a bleeder or metering pin 103, and hydraulic fluid return means 104 including a ball check valve 105 (Fig. 2).

The fluid return ball check valve 105 is pressed into position by a spring 106 retained by a vented retainer plug 107, the ball check valve 105 controlling flow through a passage 108 between the high pressure chamber 90 and the low pressure chamber 92. The low end of the metering pin 103 of the delayed action mechanism 102 is tapered in conformity with a correspondingly tapered portion of a bore 110 which communicates through a by-pass 111 with the high-pressure chamber 90, whereby liquid under high pressure in the chamber 90 passes from the bore 110 into the low-pressure chamber 92. The metering pin 103 has an adjustable threaded connection 112 with the piston 82, and a lock sleeve 113 (Fig. 10) is threadedly secured upon the metering pin 103 and extends upward into a bore 114 in the reduced extension 87 of the cylinder head 86. The lock sleeve 113 also serves as a guide for the metering pin 103. For the purpose of adjustment, the upper end of the metering pin 103 is provided with a wrench-receiving terminal 103a, and access to this terminal is obtained by means of a sealed removable plug 115, which closes the upper end of the bore 114 during operation, and in addition to providing for adjustment of the metering pin 103 serves as a means for venting air from the system during filling.

Respecting the fluid feed means 100 and the ball check feed valve 101, another bore 116 similar to the bore 114 is provided in the cylinder head extension 87, this bore receiving a removable fluid feed plug 118 threadedly secured within the upper end of a fluid feed tube 120 whose lower end is normally closed by the ball check valve 101 under the influence of a spring 122 seated against a shoulder 123 provided in a stepped passage 124 leading into the low-pressure fluid supply chamber 92. The upper end of the fluid feed plug 118 is provided with a tool-receiving terminal 118a whereby to install and remove the plug. The bore 116 is normally closed by a removable sealed plug 125 which, together with the plug 115, is pressed against the underside of the wash pipe head 28. As shown, the cylinder head extension 87 is annularly packed at 128 upon the outer wall of the inner mandrel 12.

The construction just described, namely that comprising the piston 82, its skirt 81, the auxiliary piston 80, the cylinder head 86, and associated parts, constitutes a dash-pot whereby the passage of hydraulic fluid under high pressure from the high-pressure fluid chamber 90 to the supply chamber 92 is regulated by the metering pin 103, fluid being restored past the ball check valve 105 upon each return movement of the piston 82.

#### Assembly

In order that the hammer 15 may be assembled upon the lower end of the main mandrel 10 between the anvil 34 and the enlarged exposed lower portion of the main mandrel 10, the hammer 15 is initially split longitudinally to form two-semi-cylindrical parts. Assembling of the hammer 15 upon the mandrel 10 includes welding the two members of the hammer 15 together while positioned upon the mandrel 10 below the anvil 34. After welding, the hammer 15 is machined and its upper end threaded for the purpose of com-

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pleting the threaded joint 33 with the lower end of the body member 14.

However, before threading the hammer member 15 into position in the body member 14, with incidental positioning of the main mandrel 10, the latch mechanism 18 and associated members are first installed in the top of the body member 14, and this is accomplished before the body joint 20 is threaded into place. To accomplish such positioning of the latch mechanism 18, the upper ring member 50 and the pressure ring 60, together with the resetting springs 63, are placed upon the thrust sleeve 45 and the lock pin 58 is inserted to insure retention of the desired relationship. The parts thus assembled are then introduced part way into the upper end of the body member, and the release levers 44 are mounted upon the annular head 45 of the thrust sleeve 46, whereupon these assembled portions are then further introduced into the upper end of the body member 14. This operation may be carried out with the mentioned parts assembled on the lower end of the inner mandrel 12, or the inner mandrel 12 may be later inserted into the thrust sleeve 46. At such time, the split positively acting trip ring 66 will be positioned about the retaining rib 67, and the compression sleeve 65, the spring receiving barrel 75, the auxiliary spring 77 and the compression piston 82, with associated parts, installed. At an appropriate time, the outer cylinder 85, with its head 86 and extension 87, is installed upon the upper portion of the inner mandrel 12. The inner mandrel 12, carrying the parts thus assembled thereon, is introduced into the body member 14 to the operative position shown in Figs. 2, 3, and 4.

Thereupon, the two portions of the lower ring member 52 are inserted from the open lower end of the body member 14 and the cap screws 57 threaded into place with a suitable tool. The annular rubber cushion 56 will have been placed upon the annular actuating rib 55 at any appropriate earlier assembling stage. The cap screws 57 having been secured, the main mandrel 10 is next introduced into the lower end of the body member 14, the guiding splines 36 being received in the splineways 35, and the upper end of the hammer 15 being threaded into place to secure the parts as shown. The inner mandrel 12, carrying the parts retained thereon by the rib 67, is next threaded into position in the upper portion of the main mandrel 10 to make the threaded joint 12a. The final operation resides in placing the wash pipe 26 upon the upper end of the inner mandrel 12 through the medium of the threaded connection 29 and the lock pin 29a, and then passing the body joint 20 over the wash pipe 26 and threading it into operative position by making the threaded connection 19.

The lock pin 13, if used to secure the outer and inner mandrels 10 and 12 against unthreading at the joint 12a, will be installed at any desired stage through a hole which may be filled with a plug 135 or may be left open for passage of drilling fluid to equalize pressures within and without the body member 14. To permit passage of such fluid, and in view of the fact that the ring members 50 and 52 and the annular rubber cushion 56 tends to form a sealed joint, fluid passages 136 are provided through the assembled ring members 50 and 52 and the thrust sleeve 46, as indicated in Fig. 7. In this way the annular chamber housing, the release levers 44 and other parts of the latch mechanism 18 is in communication with the chamber within the body

member 14 enclosing the upper end of the main mandrel 10. The latter has a fit within the body member 14 and the hammer 15 sufficiently loose to pass equalizing fluid whether or not the plug 135 is used, and also to permit free movement of the hammer 15 to the shoulder 16 of the anvil 34.

#### *Filling hydraulic device*

A step preliminary to operation, which step may be performed during initial assembly or at a later time, is the filling with the hydraulic liquid of the high and low pressure chambers 90 and 92 respectively. For this purpose, the body joint 20 and the wash pipe 26 will have been removed. The sealed plugs 115 and 125 and the feed plug 118 are removed. Under these conditions, the power springs 88 separate the compression piston 82 from the cylinder head 86 to the limit of the extension of the springs 88, or about as illustrated in Fig. 2.

A liquid injecting gun is then attached to the feed tube 120 by any suitable fitting, and oil is forced past the ball check valve 101, and through the passage 124, into the low pressure chamber 92 whence, after filling the latter, the oil is moved past the ball check valve 105 into the high pressure chamber 90.

Air in the system vents through the tapered bore 110 and the passage 108 from the lower pressure chamber 92 and through the bores 114 and 116 from the high pressure chamber 90. The metering pin 103 is adjusted to predetermine the bleeding rate of the liquid through the by-pass 111. The auxiliary piston 80 is forced down by the applied liquid pressure against the auxiliary spring 77 as desired, the power of the spring 106 on the ball check valve 105 being sufficient to permit such complete filling and the safety valve spring 95 being strong enough to avoid leakage past the ball check valve 93 in the auxiliary piston 80. All air having been vented, the sealed plug 115 is placed, the filling gun removed, the feed plug 118 restored, and the sealed plug 125 placed.

#### *Operation*

The assembled jar, having attached thereto the lower end of the overshot S, or other appropriate grapple means, as indicated in Fig. 1, is lowered into the well on the line 25 and connection is made in a conventional manner with the stuck bit B or other stuck tool. The parts are now in approximately the positions shown in the drawings.

Strain is then applied to the drill pipe 22 through the hoist line 25 to any selected minimum value which it is thought is apt to loosen the stuck tool. Such a value is determined by a weight indicator or similar gauge as conventionally used at the ground surface in well drilling operations. This strain, the value of which might be, for example, 5000 pounds, produces a corresponding "stretch" or elongation in the drill pipe, and thereby stores elastic energy in the drill pipe.

Under these conditions, the release levers 44 bear against the lower edge of the compression sleeve or stop means 65, being there retained by reason of their curved interfitting faces 72. At the same time, the influence of the resetting springs 83 tends to maintain the release levers 44 in the indicated latched position shown by reason of the function of the outwardly inclined annular resistance seat 62 of the bearing ring 60.

The application of strain and the production of stretch in the drill pipe causes oil or other

hydraulic liquid in the pressure chamber 90 to bleed through the by-pass 111 and the tapered bore 110 past the metering pin 103 into the low pressure chamber 92. Such compression upon the body of oil in the high pressure chamber 90 is necessarily produced by reason of the force transmitter from the outer body member 14 through the actuating rib 55, the upper ring member 50, the thrust sleeve 46, the release levers 44 by way of their bearing shoulders 48, to the compression sleeve 65 and thence through the base of the barrel 75 to the skirt 81 and the compression piston 82.

The metering pin 103 is so set as to retard the bleeding operation for a substantial length of time in order that opportunity may be provided to establish any required strain in the drill pipe with a marginal time factor, before the upper ends of the release levers 44 will have been dislodged by the cam action of the positive trip ring 66.

It will be noted that the power in the springs 88 (which may total any appropriate value, such as 1000 pounds) is additive to the hydraulic pressure produced by the elastic energy stored in the drill pipe. It is also to be noted that the amount of elastic energy stored in the drill pipe has no influence on the tripping of the release levers 44, the curved interfitting faces 72 of the engaging portions of the levers 44 and the compression sleeve 65 being of such shape as to prevent such action. On the other hand, the release levers 44 are tripped by the positive displacement action between the beveled edges 70 of the levers 44 and the beveled cam face 68 of the trip ring 66, the position of the latter being fixed on the inner mandrel 12 by the rib 67. Due to the strain imposed upon the drill pipe through the hoist line 25 and the consequent pressure applied to the hydraulic fluid in the high pressure chamber 90, the bleeding of the fluid past the metering pin 103 permits the compression piston 82, and hence the release levers 44 and interposed members 65 and 75, to rise slowly until the trip ring 66 has performed its function of dislodging the upper ends of the release levers 44 from the lower edge of the compression sleeve 65. This condition having developed, the elastic energy stored in the drill pipe causes the release levers 44 to ride up alongside the compression sleeve 65, and the stored elastic energy also causes the annular striking wall 15a of the hammer 15 to produce a severe blow upon the annular anvil shoulder 16 of the anvil 34 carried by the main mandrel 10. This blow is transmitted through the main mandrel 10 to the stuck tool B with which it is connected.

Should the blow applied to the anvil 34 be insufficient to release the stuck tool, a more powerful blow is next applied. This is accomplished by releasing the strain imposed by the hoist line 25, so that the outer body member 14 of the jar mechanism settles down into the initial position shown in the drawings, this action resulting in a relatively upward movement of the main mandrel 10 and its anvil 34 and also of the inner mandrel 12 and its trip ring 66, together with the outer cylinder 35 and its head 86. During these movements, the action of the springs 88 to restore the compression piston 82 and the cylinder head 86 to their relative initial positions causes hydraulic fluid to return from the low pressure chamber 92 to the high pressure chamber 90 past the return ball check valve 105 and against the influence of the spring 106. At the same time, the upper ends of

the release levers 44 move sufficiently below the lower edge of the compression sleeve 65 for the resetting springs 63 and the beveled resistance seat 62 of the pressure ring 60 to restore the release levers 44 to the initial position illustrated.

The operator at the surface of the well now applies through the hoist line 25 a greater strain than previously applied, for example, 7000 pounds. While the hydraulic fluid bleeds from the high pressure chamber 90 past the metering pin 103 somewhat faster under this increased pressure than under the previously employed lower pressure, nevertheless, the setting of the pin 103 is such that, regardless of the strain applied through the hoist line 25, the bleeding action will be slow enough to permit ready attainment of whatever strain is desired before the release levers 44 are tripped by the trip ring 66. It is merely necessary to wait longer for the tripping action to take place when smaller strains are applied than when greater strains are applied.

From the foregoing, it will be apparent that the operator of this jarring mechanism is enabled to start his procedures with the application of a minimum strain through the hoist line 25. If the original estimate of the strain required is insufficient, a successive operation takes place with a somewhat increased strain. In this manner successive small increases may be employed, either until the desired result has been accomplished, or until the capacity of the apparatus has been reached without success. Assuming a successful operation under a low or intermediate strain, it is apparent that undue wear and hardship upon the various pieces of equipment is avoided, thereby saving the surface apparatus to the maximum extent.

Thus, by employment of the jar of the present mechanism, any selected tonnage blow may be applied as required, such selection, as indicated by a strain indicator, being made certain because of the fact that the tripping of the release levers is positively made and is accomplished only after elapse of sufficient time to provide for the application of the selected tonnage. Also, once the metering pin 103 has been set for a given range of operations up to a maximum tonnage to be applied, no mechanical adjustment is required, either at the surface or elsewhere, as the operations proceed. A further important feature is the automatic resetting of the parts by the springs 89, the springs 63 and the ring 60 upon release of the strain through the hoist line 25 between successive jarring operation.

Since improvements will become apparent to those skilled in this art, it is intended to cover all such variations of the generic invention as fall within the scope of the claims.

We claim as our invention:

1. Well jar mechanism comprising in combination: two elongated members, one within the

other and movable longitudinally relative to each other, one being adapted for connection with a drill pipe through which longitudinal strain may be applied; anvil means carried by one of said members; hammer means carried by the other of said members to strike a blow upon said anvil means by reason of longitudinal strain produced through said drill pipe; bearing means carried by one of said members; yielding stop means carried by the other of said members; elongated releasable latch means between and cooperating with said members, opposite ends of said latch means normally engaging said bearing means on said one of said members and said stop means on said other of said members to prevent relative movement between said hammer and anvil means until release of said latch means; latch-releasing means carried by the inner one of said members in position adjacent the respective end of said latch means and in the path of the latter to engage and release the latter; and delayed action means connected with said yieldable stop means to effect actuation of the latter into position for release of said latch means by said latch-releasing means, said delayed action means carrying said stop means and including a hydraulic cylinder carried by the inner one of said members and containing hydraulic fluid, a piston working in said cylinder and carried by the inner one of said members, and bleeder means in one of said cylinder and piston for slowly relieving hydraulic pressure created in said cylinder by said strain.

2. A combination as in claim 1 wherein said bleeder means comprises a metering pin disposed in a bleeder bore in said piston.

3. A combination as in claim 1 wherein said stop means is carried by said piston moving on said inner member, and said latching-releasing means is relatively fixed on said inner member.

4. A combination as in claim 1 including spring loading means carried in said cylinder and piston as auxiliary means to assist said hydraulic pressure in resisting application of said strain to move said piston.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name           | Date           |
|-----------|----------------|----------------|
| 1,530,803 | Anderson       | Mar. 24, 1925  |
| 1,849,879 | McCullough     | Mar. 15, 1932  |
| 1,977,110 | Burns et al.   | Oct. 16, 1934  |
| 2,055,683 | Edwards        | Sept. 29, 1936 |
| 2,122,751 | Phipps         | July 5, 1938   |
| 2,126,241 | Black          | Aug. 9, 1938   |
| 2,166,299 | Kennedy et al. | July 18, 1939  |
| 2,172,480 | Osmun          | Sept. 12, 1939 |
| 2,309,872 | Shaffer et al. | Feb. 2, 1943   |