April 16, 1935. W. E. ANNIN 1,998,214

WELL JAR

Filed July 24, 1933

Fig. 1

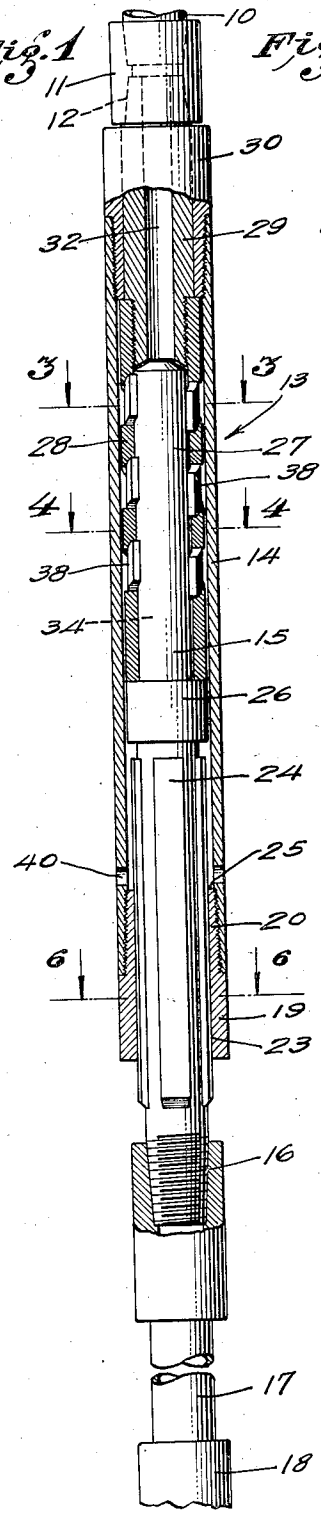


Fig. 2

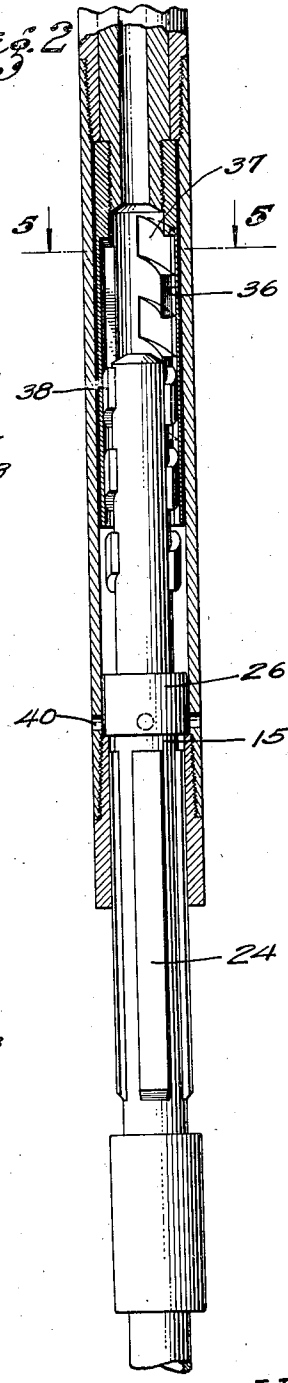


Fig. 3

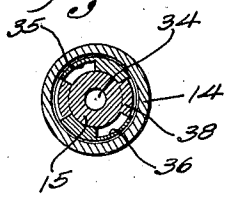


Fig. 4

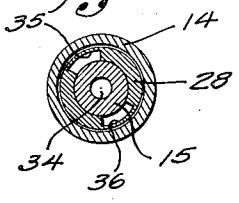


Fig. 5

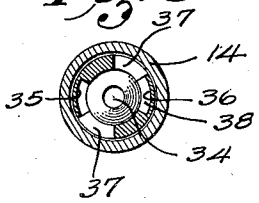
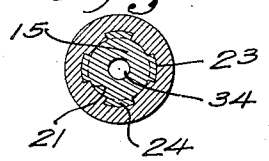


Fig. 6



INVENTOR
WILLIAM E. ANNIN
BY James M. Abbett
ATTORNEY

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WELL JAR

William E. Annin, Huntington Park, Calif.

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6 Claims. (Cl. 255—27)

This invention relates to an oil well tool and particularly pertains to a well jar. In the drilling of oil wells it often becomes necessary to apply a violent jarring action to parts of the drilling equipment in order to loosen members which have become lodged in the well bore. Various devices have been provided for accomplishing this purpose, most of said structures being characterized by having a hammer and an anvil which are interposed in the drill string between the member which is to be dislodged and the portion of the drill string above the well, and which members are brought into forcible contact with each other by placing a predetermined tension upon the drill string and then suddenly releasing the elements of the jar to cause the hammer and the anvil to strike each other and create an upward blow tending to loosen the object fastened in the hole. Such structures require an excessive degree of tension to be applied to the drill string, and it is the principal object of the present invention to provide a well jar apparatus in which the degree of impact force created between the hammer and the anvil will be directly proportional to the amount of torque given the drill string as distinguished from the amount of tension usually set up to produce the same force.

Another object of the present invention is to provide means permitting a circulation of fluid within the jar as the parts reciprocate which will act to maintain the jar free from an accumulation of sand, silt, and other extraneous matter.

The present invention contemplates the provision of a cage fixed to the portion of the drill pipe by which the device is suspended, a mandrel reciprocably mounted therein and fixed to the portion of the drill pipe below the jar and attached to the fish, said cage and mandrel being fitted with means whereby said elements may be temporarily locked together by torsion and separated by tension in direct proportion to the amount of torsional force with which the parts are locked.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in vertical section and elevation showing the parts of the jar in their locked positions.

Fig. 2 is a view similar to Fig. 1 showing the jar with its parts in their impact positions.

Fig. 3 is a view in transverse section through the well jar as seen on the line 3—3 of Fig. 1.

Fig. 4 is a view in transverse section through the well jar as seen on the line 4—4 of Fig. 1.

Fig. 5 is a view in transverse section through the well jar as seen on the line 5—5 of Fig. 2.

Fig. 6 is a view in transverse section as seen on the line 6—6 of Fig. 1.

Referring more particularly to the drawing, 10 indicates the upper portion of a drill string, the lower section of which is formed with a box coupling 11 to receive a pin 12. The pin forms the lower connection for a well jar structure 13 which structure includes a cage 14 and amandrel 15. The mandrel is formed at its lower end with a tapered threaded portion 16 which connects with the length of drill tubing 17 carrying a fishing tool 18. This tool is used in common practice to engage a piece of casing or tubing which has become fastened in the hole and which must be jarred loose. The lower end of the cage 14 is fitted with a sub 19 which is threaded on to the end of the cage by an extending portion 20. A central cylindrical passageway 21 is formed longitudinally of the sub. As shown in Fig. 6 of the drawing, a plurality of keyways 23 are formed longitudinally of the inner wall of the sub and receive splines 24 formed upon the mandrel 15 and extending longitudinally thereof. Due to this arrangement the mandrel and the cage may have a desired vertical reciprocation with relation to each other without interrupting the rotary driving connection between the parts. The upper end of the sub 19 provides an anvil face 25 within the cage. Formed as part of the mandrel 15 at a point above the length occupied by the splines 24 is an enlarged hammer portion 26 which may be brought into forcible contact with the anvil face 25 to produce the jarring action required in the operation of the present invention. The mandrel portion above the hammer 26 provides a cylindrical lock stem 27, which reciprocates within a lock sleeve 28. This sleeve is threaded at its upper end to receive a tubular extension 29 which extends upwardly through a sub 30 and is there secured by being threaded to the pin 11. This pin abuts against the upper face of the sub 30 and holds the upper face of the lock sleeve 28 in fixed relation to the inner end of the sub 30. Extending upwardly through a central opening 31 is the member 29 having a central circulating passageway extending therethrough. The lower end of the member 29 communicates with the upper end of the mandrel 15, it being understood that a central circulation opening 34 extends entirely through the mandrel 15 to permit circulation of fluid through the well jar from the section of tubing 10 to the section of tubing 11 and vice versa. The lock sleeve 28 is formed with diametrically opposite keyways 35 and 36 and in a plane at right angles to the median line of said keyways is formed a plurality

of lock openings 37 which are spaced one from the other throughout the length of the lock sleeve 28. These openings communicate with the longitudinal keyways 35 and 36 as particularly indicated in Fig. 5 of the drawing. It will also be seen that the openings have upper and lower parallel walls inclined with relation to the transverse plane of the jar. The upper extension 27 of the mandrel is formed with a plurality of diametrically opposed lock lugs 38. These lugs in side elevation agree in contour with the perimeter of the openings 37. In transverse section these lugs agree with the sectional formation of the vertical keyways 35. It is to be understood that the vertical keyways extend the entire length of the sleeve 28 from a point directly below the tubular member 29 to its lower end, and that the angular faces of the lugs 38 and the openings 37 are such as to insure that when the uppermost lug 38 reaches a point adjacent the uppermost opening 37, the sleeve 28 will tend to rotate and cause the lugs to move into the opening. The angle of the upper and lower faces of all of the lugs and sleeves is uniform and bears such a relation to the jar as to insure that tension applied to the jar will cause the annular faces of the lugs 38 and the openings 37 to move relative to each other under tension until these members become disengaged and the lugs 38 are free to move downwardly along the opposite keyways 36. An analysis of the structure will show that the greater the amount of torsion applied to the drill stem the greater amount of tension will be required to disengage the parts.

In the operation of well jars the relative movement of the jar parts is often accommodated by a partial circulation of liquid through the jar. In wells where sand and silt is suspended in the fluid within the well such material is liable to accumulate within the jar structure and prevent proper relative movement of the parts and a proper functioning of the tool. In the present instance, means have been provided to eliminate such an objection by the provision of circulation ports 40 through the wall of the cage 14 and preferably directly above the anvil face 25. Due to this arrangement relative reciprocation between the anvil and the cage will permit fluid to be drawn into the cage on an upstroke of the mandrel and expelled therefrom on the downstroke of the mandrel. This will force the fluid from the cage and prevent it from accumulating therein.

In operation of the present invention a well jar is mounted at the lower end of a section of drill string 10 and above a section of drill string 17 which last named section carries a fishing tool 18. The drill string and the well jar are then lowered into the well until the fishing tool encounters the fish. During this time the mandrel is at its lowermost position and in contact with the anvil 25. It will also be evident that the splines 24 will be vertically slidable in the keyways 23 of the sub 19. When the fishing tool has been properly anchored the upper section of the drill string 10 is rotated in a clockwise direction to create a condition of torsion, and this upper section is drawn upwardly while the lugs 38 move along the splineways 36 in the sleeve 28 and until the uppermost lug encounters an inclined face of the uppermost opening 37, at which time the torque on the upper tubing section will cause the lugs 38 to move from the splineways 36 into the openings 37. At this time a drill string is placed under a desired amount of torsion in a clockwise direction and at the same time is placed under tension. The force of the blow which will be delivered subsequently by the hammer to the anvil will be in direct proportion to the amount of torsion imposed upon the drill string. It will be evident that the more twist given to the drill string the more tension will be required in producing a reaction sufficient to cause the inclined faces of the lugs 38 and the openings 37 to slip with relation to each other and to move the lugs 38 into the longitudinal splineways 36 and cause the relative tension on the drill string to be used as impact between the hammer and the anvil. When the mandrel telescopes within the cage any fluid within the cage will be expelled through the ports 40. The force of this action is sufficient to clear the cage of sand and other solid particles which might have been suspended in the liquid and would tend to clog the structure so that it would operate inoperatively or imperfectly at the least. By the arrangement here shown, it will be seen that the sleeve 28 and the anvil 29 are readily renewable. Furthermore, the openings 37 formed through the sleeve 28 may be conveniently machined without requiring expensive machine work as would be the case if these openings were milled into the inner face of the cage 14 of the jar.

It will thus be seen that the structure here shown provides simple and effective means for creating a desired jarring action between the parts of a well jar, the degree of said action being directly controlled by the amount of torsion imposed upon the drill string, and the device being further provided with features of design whereby a sufficient flow of fluid will be maintained within the jar and in and out through the wall of the body as to maintain the parts clear of an accumulation of solid particles which might otherwise obstruct and interfere with the operation of the jar.

While I have shown the preferred form of my invention, as now known to me, it will be understood that various changes may be made in the construction, combination, and arangement of parts by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A well jar comprising a tubular cage secured to a drill string section, a tubular mandrel adapted to reciprocate in said cage and secured to another drill string section, means for permitting relative longitudinal movement between the two parts without allowing relative rotation of the parts, a plurality of inclined lugs on the mandrel, a lock sleeve carried with the cage, a central bore through said sleeve, keyways extending longitudinally thereof and along which the lock lugs may move, openings in the sleeve into which the lock lugs may move from the keyways when in register therewith and whereby tension and torsion may be applied to the drill string supporting said jar to cause the lock lugs to become disengaged from the sleeve openings when a predetermined tension has been exerted with the result that the hammer and the anvil will come together with impact.

2. A well jar comprising a tubular cage secured to a drill string section, a tubular mandrel adapted to reciprocate in said cage and secured to another drill string section, means for permitting relative longitudinal movement between the two parts without allowing relative rotation of the parts, a plurality of inclined lugs on the mandrel, a lock sleeve carried with the cage, a central bore

through said sleeve, keyways extending longitudinally thereof and along which the lock lugs may move, openings in the sleeve into which the lock lugs may move from the keyways when in register therewith and whereby tension and torsion may be applied to the drill string supporting said jar to cause the lock lugs to become disengaged from the sleeve openings when a predetermined tension has been exerted with the result that the hammer and the anvil will come together with impact.

3. A well jar comprising a tubular cage secured to a drilling string section, a tubular mandrel adapted to reciprocate within the said cage and being secured to another drill string section, means for permitting relative longitudinal movement between the cage and the mandrel without allowing relative rotation of the parts, a tubular lock sleeve supported at its upper end in fixed relation to the upper drill string section and extending downwardly within the cage and terminating in a square lower face, slotted openings formed through the side walls of said sleeve with the upper and lower faces of said openings inclined, longitudinally extending keyways formed in the inner face of said sleeve and with each of which a set of said slotted openings communicate, the aforementioned mandrel being mounted to reciprocate within said sleeve, lugs projecting from the cylindrical surface of the mandrel and being of a circumferential length to move along the longitudinal slots of the sleeve and having angle faces corresponding with the faces of the openings through the lock sleeve whereby relative rotation of the lock sleeve with the mandrel may be effected, and a hammer shoulder formed upon the mandrel and adapted to alternately engage an anvil shoulder occuring at the bottom of the cage and the end face of the lock sleeve at the opposite ends of the stroke of the mandrel with relation to the cage.

4. A well jar comprising a tubular cage secured to a drilling string section, a tubular mandrel adapted to reciprocate within the said cage and being secured to another drill string section, means for permitting relative longitudinal movement between the cage and the mandrel without allowing relative rotation of the parts, a tubular lock sleeve supported at its upper end in fixed relation to the upper drill string section and extending downwardly within the cage and terminating in a square lower face, slotted openings formed through the side walls of said sleeve with the upper and lower faces of said openings inclined, longitudinally extending keyways formed in the inner face of said sleeve and with each of which a set of said slotted openings communicate, the aforementioned mandrel being mounted to reciprocate within said sleeve, lugs projecting from the cylindrical surface of the mandrel and being of a circumferential length to move along the longitudinal slots of the sleeve and having angle faces corresponding with the faces of the openings through the lock sleeve whereby relative rotation of the lock sleeve with the mandrel may be effected, and a hammer shoulder formed upon the mandrel and adapted to alternately engage an anvil shoulder occurring at the bottom of the cage and the end face of the lock sleeve at the opposite ends of the stroke of the mandrel with relation to the cage, said lock sleeve and anvil being characterized as being removable from their working positions.

5. A well jar comprising a tubular cage carried at the lower end of a drill string and mounted in a manner to have rotation with relation to the drill string and around the longitudinal axis thereof, a tubular mandrel extending into the lower end of said cage, an anvil disposed at the lower end of the cage and through which the mandrel reciprocates, complementary splines and keyways formed longitudinally of the anvil and the mandrel to permit relative longitudinal movement without relative rotation, an enlarged collar formed on the mandrel intermediate its ends the under face of which is adapted to be engaged by the anvil, a lock sleeve disposed within the cage and through which the portion of the mandrel above the collar extends, means securing the sleeve at the lower end of the drill string and to rotate therewith, inclined slotted openings being formed through opposite side walls of the lock sleeve, each set of slotted openings terminating at their one ends in longitudinal keyways formed in the inner face of the sleeve, complementary inclined lugs projecting from opposite sides of the mandrel and adapted to move longitudinally in the keyways and upon relative rotation of the lock sleeve and the mandrel to move into and out of the inclined openings of the lock sleeve when in register therewith.

6. A well jar comprising a tubular cage carried at the lower end of a drill string and mounted in a manner to have rotation with relation to the drill string and around the longitudinal axis thereof, a tubular mandrel extending into the lower end of said cage, an anvil disposed at the lower end of the cage and through which the mandrel reciprocates, complementary splines and keyways formed longitudinally of the anvil and the mandrel to permit relative longitudinal movement without relative rotation, an enlarged collar formed on the mandrel intermediate its ends the under face of which is adapted to be engaged by the anvil, a lock sleeve disposed within the cage and through which the portion of the mandrel above the collar extends, means securing the sleeve at the lower end of the drill string and to rotate therewith, inclined slotted openings being formed through opposite side walls of the lock sleeve, each set of slotted openings terminating at their one ends in longitudinal keyways formed in the inner face of the sleeve, complementary inclined lugs projecting from opposite sides of the mandrel and adapted to move longitudinally in the keyways and upon relative rotation of the lock sleeve and the mandrel to move into and out of the inclined openings of the lock sleeve when in register therewith, said lock sleeve being detachably disposed at the lower end of the upper drill string section.

WILLIAM E. ANNIN.