Aug. 17, 1965 R. M. WOMACK 3,200,895

JAR MECHANISM

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Fig. 1

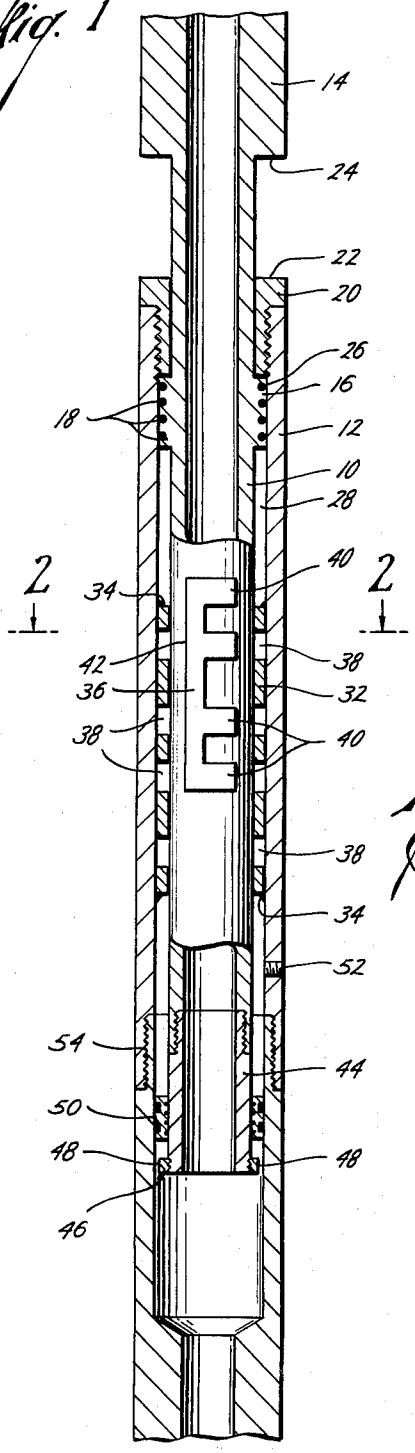


Fig. 2

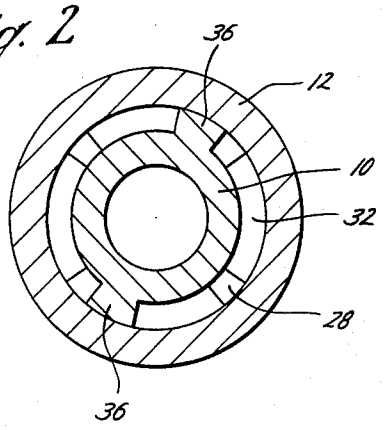
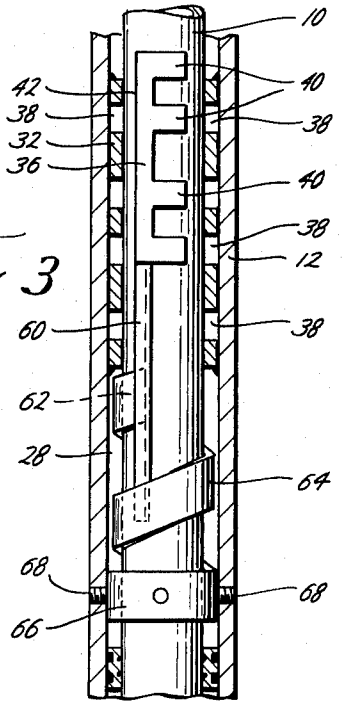


Fig. 3



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JAR MECHANISM

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This invention relates to well jars and more particularly to jar mechanism which is adapted to be connected into a drilling string or other well pipe for use in delivering an impact to the same for the purpose of releasing the pipe in the event that the same should become stuck in a well bore.

The invention has for an important object the provision of jar mechanism for connection into a string of well pipe and through which fluid may circulate through the string at all times during the operation of the mechanism.

Another object of the invention is to provide jarring mechanism for connection into a string of pipe for rotation therewith in a well bore and which is easily operated to deliver either an upward or a downward impact on the string.

A further object of the invention is the provision of jar mechanism having an outer barrel and an inner mandrel which are telescopingly arranged for relative longitudinal sliding movement and wherein the annular space provided between the barrel and mandrel is filled with oil or other liquid to prevent the entrance of mud or foreign matter between the parts when the mechanism is in use.

Another object of the invention is to provide jarring mechanism which is of simple design and rugged construction, capable of withstanding the extreme conditions of hard usage to which equipment of this type is customarily subjected.

The above and other important objects and advantages of the invention will be apparent from the following detailed description, constituting a specification of the same, when considered in conjunction with the annexed drawings, wherein:

FIGURE 1 is a fragmentary, central, longitudinal, cross-sectional view illustrating the jar mechanism of the invention and showing the parts in extended position at the time of the delivery of an upward impact with the jar;

FIGURE 2 is a cross-sectional view, on an enlarged scale, taken along the line 2—2 of FIGURE 1, looking in the direction of the arrows; and

FIGURE 3 is a fragmentary, central, longitudinal, cross-sectional view, similar to that of FIGURE 1, illustrating a somewhat modified form of the invention.

Referring now to the drawings in greater detail, the jarring mechanism of the invention comprises inner and outer, telescopingly arranged tubular parts 10 and 12, respectively, of which the outer part is a barrel, while the inner part forms a mandrel. The inner part 10 is formed at its outer end with an externally enlarged portion 14 which is suitably threaded, not shown, for attachment to the lower end of an upper section of a tubular drilling string or other well pipe, while the outer part or barrel is provided at its lower end with a threaded portion, not shown, for connection to the upper end of a lower section of such drilling string. The threaded end portions of the mandrel and barrel may conveniently take the form of the usual internally threaded box, not shown, on the mandrel and an externally threaded pin, not shown, on the barrel.

The externally enlarged portion 14 of the mandrel and the barrel 12 will usually be of the same external diameter as the sections of the drilling string. The mandrel 10 is slidably extended into the barrel 12 through the upper end thereof, and within the barrel the mandrel has an externally enlarged portion 16, mediate its ends, forming a piston in the barrel, which may be provided with external annular grooves for the reception of suitable sealing means, such as O rings 18, to form a fluid tight seal between the barrel and mandrel. At its upper end the barrel has a bushing 20, threadably connected thereto, and whose upper end forms an impact face 22, positioned for engagement with an impact face 24 formed on the lower end of the upper end portion 14 of the mandrel, and whose lower end forms an impact face 26, within the barrel, against which the upper end of the piston 16 may deliver an impact.

Above and below the piston 16 the mandrel 10 is of somewhat reduced external diameter, smaller than the internal diameter of the barrel 12, to form an internal chamber 28 in the barrel, which may be filled with a suitable liquid, such as oil, to lubricate the parts and to exclude drilling mud or other foreign matters from the chamber.

The barrel 12 is provided mediate its ends, beneath the piston 16 of the mandrel, with an internal sleeve-like element 32, which may be formed in two parts, suitably attached to the barrel, as by means of welding, as indicated at 34. The element 32 may be formed in two separate parts, whose longitudinal side edges are spaced apart to form longitudinal slots in which external projections 36, formed on the mandrel may move. Each of the parts of the sleeve-like element 32 are formed with longitudinally spaced recesses or notches 38 positioned to receive peripherally extending, longitudinally spaced teeth 40, formed on the lugs 36 of the mandrel, upon rotation of the mandrel to the left, or counterclockwise, looking downwardly from above, to hold the mandrel and barrel against relative longitudinal movement, the teeth 40 being disengageable from the notches 38 by rotation of the mandrel to the right, or clockwise, looking down from above, to position the lugs 36 in the longitudinal slots between the parts of the sleeve-like element 32, to allow the mandrel and barrel to move longitudinally relative to each other.

The lugs 36 have continuous edge portions 42, extending longitudinally from end to end of the lugs, opposite the edges in which the teeth 40 are formed, which edge portions 40 are engageable with adjacent edge portions of the parts of the element 32 to cause the barrel and mandrel to rotate together upon rotation of the mandrel to the right, or clockwise, as viewed from above, when the teeth 40 are disengaged from the notches 38.

The mandrel 10 has a lower end extension 44, threadably connected thereto, which carries at its lower end an external annular ring 46, threadably attached thereto and which is formed with cutaway portions 48 in its outer periphery, through which fluid in the barrel may flow into and out of the lower end of the chamber 28, and within the chamber, surrounding the extension 44, above the ring 46 an annular piston 50 is slidably disposed on the mandrel, which piston is provided with internal and external seal forming means to form a fluid tight seal between the mandrel and barrel.

The chamber 28 is filled with liquid about the floating piston, and in the event that any of the fluid in the chamber should escape the floating piston 50 may move inwardly to prevent the entrapment of air or the entrance of foreign matter into the chamber. The barrel 12 may be provided with a suitable opening 52, into the chamber 28, which may be closed by a screw-threaded plug, or the like, and through which the chamber may be filled with liquid.

The barrel 12 may be formed with upper and lower sections which are threadably connected together as indicated at 54 to facilitate the assembling of the jar.

The parts of the internal sleeve-like element 32 are of sufficient length, and provided with a sufficient number of recesses 38, so that all of the teeth 40 of the lugs 46

will be positioned in some of the recesses of the element when the mandrel is at either of the extremes of its longitudinal movement in the barrel.

In making use of the jarring mechanism of the invention, the mandrel is connected at its upper end to the lower end of the upper end of a drilling string and the lower end of the barrel 12 is connected to the upper end of the lower end of the string, to permit the circulation of drilling fluid through the stem during the drilling operation. With the jar thus connected into the string the string is lowered in the well bore and rotated therein, the edge portions 42 of the lugs 36 being in engagement with the adjacent edges of the parts of the internal sleeve element 32 to cause the barrel to rotate with the mandrel during the drilling operation.

In the event that the drill string should become stuck, or that it should be desired for some other reason, to perform a jarring operation on the string, the mandrel may be lowered in the barrel, until the impact face 24 of the external enlargement 14 of the mandrel engages the impact face 22 of the bushing 20, whereupon the teeth 40 of the projections 36 will be in position to enter the lowermost four of the recesses 38 of each of the parts of the internal sleeve element 32, so that upon counterclockwise rotation of the mandrel the teeth will enter the recesses to lock the mandrel and barrel relative to longitudinal movement. With the parts thus locked against relative longitudinal movement, an upward pull may then be exerted on the mandrel, and the mandrel may then be rotated clockwise to cause the teeth 40 to disengage from the recesses 38, whereupon the mandrel will move upwardly suddenly in the barrel to engage the upper end of the piston 16 with the impact face 26 of the bushing 20, to deliver an upward impact to the string.

Should it be desired to deliver a downward impact to the string, the mandrel may be moved upwardly to engage the upper end of the piston 16 with the impact face 25 of the bushing 20, to position the teeth 40 to enter the three uppermost notches 38 of each of the parts of the internal sleeve element 32, whereupon the mandrel may be rotated counterclockwise to move the teeth 40 into the recesses to lock the parts against relative longitudinal movement. With the parts thus locked a downward force may be exerted on the mandrel and the mandrel then rotated clockwise to disengage the teeth 40 from the recesses 38, whereupon the mandrel will move downwardly suddenly to engage the impact face 24 of the enlargement 14 with the impact face 22 of the bushing 20, to deliver a downward impact to the string.

It will be apparent that due to the proportioning of the parts the parts will be automatically positioned to be locked together by counterclockwise rotation of the mandrel when the mandrel is in its uppermost position and also to be locked together by such rotation of the mandrel when the mandrel is in its lowermost position in the barrel, thus facilitating the operation of the mechanism, since it is only necessary to exert an upward pull on the mandrel and rotate the same counterclockwise to assure locking up of the parts, after which a downward jarring action may be exerted by exerting a downward force on the mandrel and rotating the same clockwise to release the parts, while an upward jarring action may be accomplished by exerting a downward force on the mandrel to move the mandrel downwardly whereupon the mandrel may be rotated counterclockwise to lock the parts after which an upward pull may be exerted on the mandrel and the mandrel then rotated clockwise to release the parts.

A somewhat modified form of the invention is illustrated in FIGURE 3 wherein one of the projections 36 of the mandrel is formed with a downwardly extending projection 60, which is slotted longitudinally along one edge to receive one end 62 of a coil spring 64, preferably formed of spirally wound flat strip material, the other end of the spring being formed with an annular ring shaped portion or collar 66, disposed in the barrel 12 and suitably secured thereto, as by means of screws 68, extending through internally threaded openings in the barrel and threaded into corresponding internally threaded openings in the ring, to hold the ring against rotation or longitudinal movement in the barrel. The end 62 of the spring 64 is slidable in the longitudinal groove of the extension 60, to permit the mandrel to move longitudinally relative to the spring, and the spring co-acts with the barrel and mandrel to yieldingly urge the mandrel toward a position of rotation in which the teeth 40 will be in engagement in the recesses 38 of the parts of the internal sleeve-like element 32.

The operation of this form of the jarring mechanism is similar to that described above in connection with the form of the invention illustrated in FIGURE 1, the mandrel being rotatively urged toward locking position, so that the parts will be automatically locked together when the mandrel reaches either of its extreme positions of longitudinal movement in the barrel preparatory to the exertion of a clockwise rotative force on the mandrel to unlock the parts against the resistance of the spring 64.

It will also be noted that the spacing apart of the recesses 38 of the parts of the internal sleeve element 32 and of the teeth 40 of the projections 36 is such that the teeth 40 cannot enter the recesses in any intermediate location of the mandrel in the barrel between the extreme positions of the mandrel therein, thus assuring that the mandrel and barrel cannot be locked against longitudinal movement except when the mandrel is in its uppermost or in its lowermost position in the barrel. Thus, the mandrel may move longitudinally freely in the barrel between its extreme positions when the parts are unlocked from each other, and there is no danger of the teeth 40 becoming accidentally reengaged in the recesses 38 during a jarring movement of the parts. Moreover, the jarring mechanism may be used to rotate the drilling string either clockwise or counterclockwise in any relative positions of the barrel and mandrel.

It will thus be seen that the invention, constructed and operated as described above provides jarring mechanism which is economically constructed and which is easily and effectively operated.

The invention is dislosed herein in connection with certain specific embodiments of the same, but it will be understood that these are intended by way of example only, and that various modifications can be made in the construction and arrangement of the parts, within the spirit of the invention and the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent, is:

1. In a well jar, inner and outer concentrically arranged tubular parts rotatably and longitudinally movable relative to each other, means on the parts forming impact faces positioned for engagement to deliver an impact from one to the other of the parts when the parts reach the limit of their relative longitudinal movement in either direction, interengageable means on the parts positioned for interengagement upon relative rotation of the parts in one direction when the parts are at the limit of their relative longitudinal movement in either direction to hold the parts against relative longitudinal movement and to be disengaged upon relative rotation of the parts in the other direction to allow such relative longitudinal movement, and means on the parts positioned for coaction to prevent interengagement of said interengageable means when the parts are in positions between the limits of their relative longitudinal movement.

2. In a well jar, inner and outer concentrically arranged tubular parts rotatably and longitudinally movable relative to each other, means on the parts forming impact faces positioned for engagement to deliver an impact from one to the other of the parts when the parts reach the limit of their relative longitudinal movement in either direction, interengagaable means on the parts

positioned for interengagement upon relative rotation of the parts in one direction when the parts are at the limit of their relative longitudinal movement in either direction to hold the parts against relative longitudinal movement and to be disengaged upon relative rotation of the parts in the other direction to allow such relative longitudinal movement, means on said interengageable means positioned for coaction to cause the parts to rotate together in said one direction when said interengageable means are interengaged, means on the parts positioned for coaction to cause the parts to rotate together in the other direction when said interengageable means are disengaged and yieldable means positioned for coaction with the parts to yieldingly urge the parts in said one direction of relative rotation.

3. In a well jar, inner and outer concentrically arranged tubular parts rotatably and longitudinally movable relative to each other, means on the parts forming impact faces positioned for engagement to deliver an impact from one to the other of the parts when the parts reach the limit of their relative longitudinal movement in either direction, interengageable means on the parts positioned for interengagement upon relative rotation of the parts in one direction when the parts are at the limit of their relative longitudinal movement in either direction to hold the parts against relative longitudinal movement and to be disengaged upon relative rotation of the parts in the other direction to allow such relative longitudinal movement, means on said interengageable means positioned for coaction to cause the parts to rotate together in said one direction when said interengageable means are interengaged, means on the parts positioned for coaction to cause the parts to rotate together in the other direction when said interengageable means are disengaged, an external longitudinal slot formed in said inner part and a coil spring in said outer part surrounding said inner part and having one end slidably connected to the inner part in said slot, said spring being fixedly connected at its other end to said outer part to apply a force to the parts in all relative longitudinal positions of the parts tending to rotate the parts relative to each other in a direction to interengage said interengageable means.

4. In a well jar, inner and outer concentrically arranged tubular parts rotatably and longitudinally movable relative to each other, means on the parts forming impact faces positioned for engagement to deliver an impact from one to the other of the parts when the parts reach the limit of their relative longitudinal movement in either direction, interengageable means on the parts positioned for interengagement upon relative rotation of the parts in one direction when the parts are at the limit of their relative longitudinal movement in either direction to hold the parts against relative longitudinal movement and to be disengaged upon relative rotation of the parts in the other direction to allow such relative longitudinal movement, means on said interengageable means positioned for coaction to cause the parts to rotate together in said one direction when said interengageable means are interengaged, means on the parts positioned for coaction to cause the parts to rotate together in the other direction when said interengageable means are disengaged and yieldable means positioned for coaction with the parts to yieldingly resist relative rotation of the parts in a direction to disengage said interengageable means when said interengageable means is interengaged.

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