

April 21, 1931.

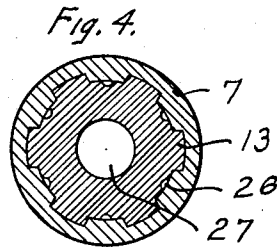
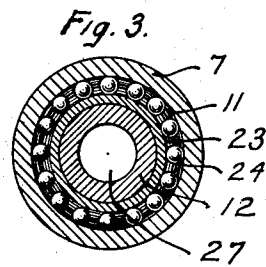
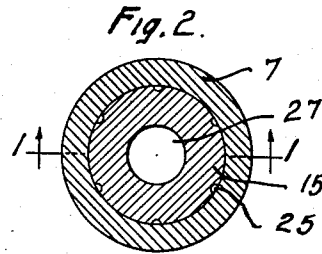
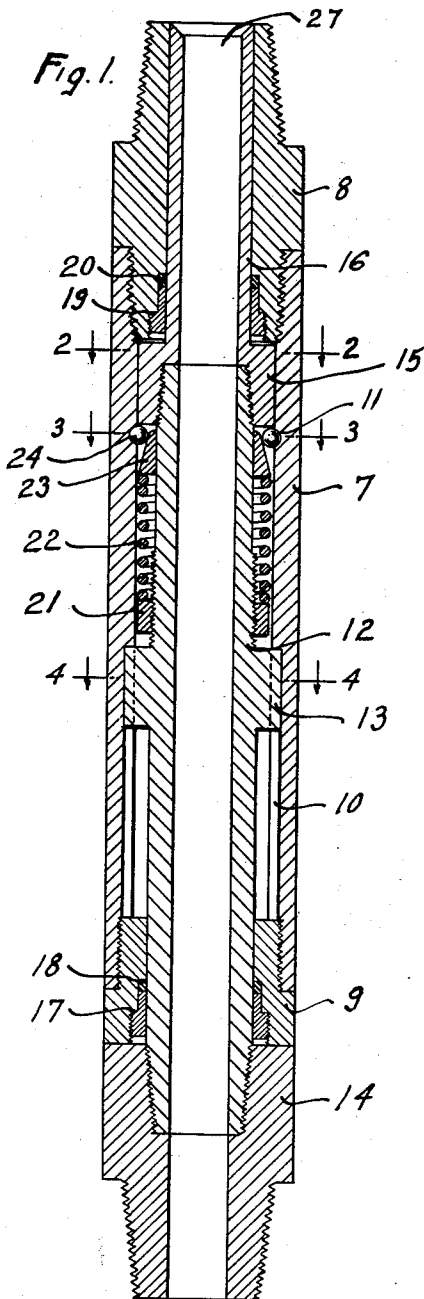
G. S. KNOX

1,801,673

ROTARY DRILLING JAR

Filed March 19, 1930

2 Sheets-Sheet 1



Inventor:

Granville S. Knox.

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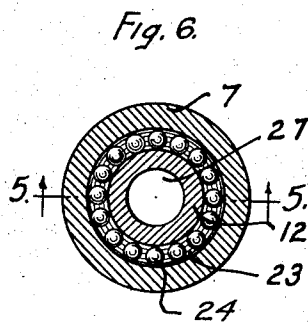
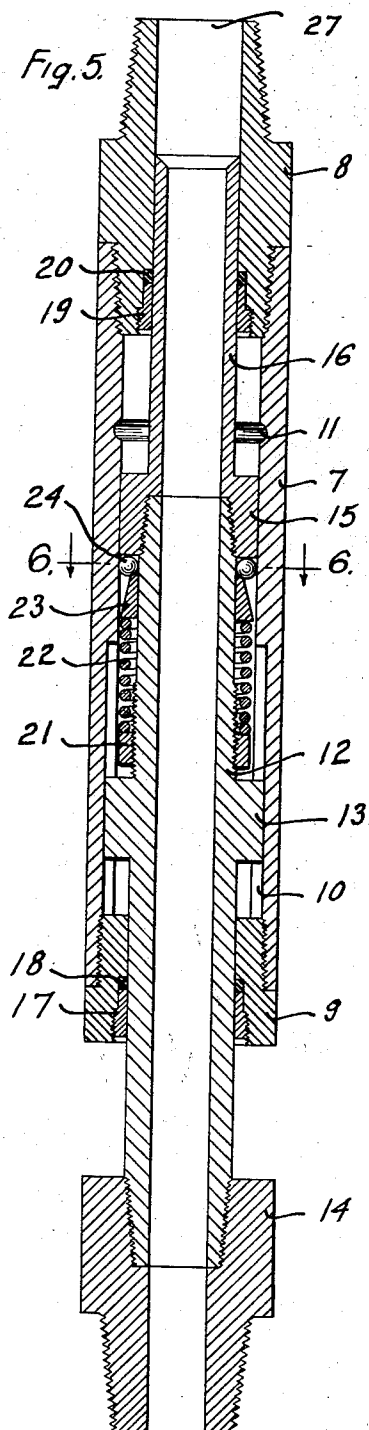
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ROTARY DRILLING JAR

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2 Sheets-Sheet 2



Inventor:

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UNITED STATES PATENT OFFICE

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ROTARY DRILLING JAR

Application filed March 19, 1930. Serial No. 437,060.

This invention relates to rotary jars such as used in a drilling string when drilling oil wells, or in fishing for tools which become stuck in the hole, and particularly to a jar which may be placed in a string of drill pipe, to remain there during drilling operations.

Heretofore, rotary jars such as used for the purpose of dislodging drilling tools which become stuck in the hole, have been subject to a certain amount of grooving and shearing of the locking members, should the jar be tripped while the drilling string was under the strain of a very great upward pull. Because of this fact, it has heretofore been impossible to take full advantage of the elasticity of a long string of drill pipe, when tightly stretched from pulling on the fish or lodged tool, to give the tools a sharp upward blow when the jar was tripped, since if the drill pipe was under any very great strain when the jar was tripped there was danger of damaging the locking members so that the jar would cease to function properly should it be necessary to relock the jar again and give the tools several more blows by tripping the jar when the drilling string was under a certain amount of tension.

It is the object of this invention to provide a rotary jar with locking means which will allow the jar to be tripped when the drilling string is at any tension, which may be considered safe for the particular drilling string in which the jar is placed, without damaging effects to the locking means or to any other parts of the jar.

Another object of this invention is to provide a rotary jar with a positive means for automatically locking the jar when it is telescoped, and means to cause the jar to automatically trip when the drilling string has been stretched to the desired tension without the necessity of rotating the drilling string for that purpose, thereby eliminating any possibility of unscrewing the tool joints, or damaging the drill pipe by rotation thereof while in a tightly stretched or strained condition.

Another object of this invention is to provide a rotary jar of the aforementioned

character with several distinct means for varying the strain or tension of the drill pipe which is necessary to cause the jar to automatically trip, so that the jar may be made to trip at any tension of the drilling string over an exceptionally large range with but slight variations within this range.

Another object of this invention is to construct and arrange a rotary drilling jar of the aforementioned character, which comprises but few, strong, simple and compact parts which can not easily get out of order, any of which may be easily replaced when so required, thus maximizing the efficiency of the rotary drilling jar, and minimizing the cost of manufacturing and of maintaining it in an operative condition.

With the above mentioned objects and with other objects in view, my invention consists in the novel construction and combination of parts hereinafter described, illustrated in the accompanying drawings, and set forth in the appended claims, it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims may be resorted to without departing from the spirit, or without sacrificing any of the advantages of, the invention.

In the drawings:

Fig. 1 is a side elevation of the rotary drilling jar in a telescoped and locked position, the view being in section and taken in a plane indicated by the line 1—1 in Fig. 2;

Fig. 2 is a transverse section of the rotary drilling jar taken in a plane indicated by the line 2—2 in Fig. 1;

Fig. 3 is a transverse section of the rotary drilling jar taken in a plane indicated by the line 3—3 in Fig. 1, and shows the locking balls held in the locking groove of the jar housing by the locking cam;

Fig. 4 is a transverse section of the rotary drilling jar taken in a plane indicated by the line 4—4 in Fig. 1, and shows the splined hammer and the splined jar housing;

Fig. 5 is a side elevation of the rotary drilling jar in an unlocked or tripped posi-

tion, the view being in section, and taken in a plane indicated by the line 5—5 in Fig. 6;

Fig. 6 is a transverse section of the rotary drilling jar taken in a plane indicated by the line 6—6 in Fig. 5, and shows the locking balls as being released from the locking groove by the locking cam.

The rotary jar comprises a cylindrical housing 7 which is threaded internally at one end to receive a coupling pin 8, and threaded internally at the other end to receive an anvil member 9. The end of the cylindrical housing 7 which is to receive the anvil member 9 has splines 10 formed in its inner diameter, and at some distance from the other end of the cylindrical housing 7 there is a groove 11 formed around its inner circumference.

Within the cylindrical housing 7 there is a hammer member 12 having a splined head 13 slidably mounted in the splines 10. One end of the hammer member 12 extends through the anvil member 9 and is free to slide therethrough. A coupling pin 14 is screwed to the end of the hammer member 12 which extends through the anvil member 9. The other end of the hammer member 12 is screwed into a cylindrical head 15 of a wash pipe 16. The wash pipe 16 is slidably mounted within the coupling pin 8. To prevent fluid from entering the housing 7 between the hammer member 12 and the anvil member 9, a stuffing box 17, containing a packing 18, is provided in the anvil member 9. To prevent fluid from entering the housing 7 between the wash pipe 16 and the coupling pin 8, a stuffing box 19, containing a packing 20, is provided in the coupling pin 8. For convenience the stuffing boxes are shown as the screw type, however the bolted flange type may be used if desired.

Threaded to the hammer member 12, between the hammer head 13 and the wash pipe head 15, is a spring compressing nut 21 which regulates the pressure of the spring 22 against a locking cam 23 which holds the locking balls 24 in the locking groove 11.

In the wash pipe head 15 there are formed several shallow, axial grooves 25 which allow the air within the housing 7 to pass from one side of the head to the other as it moved upward or downward within the cylindrical housing 7. Similar grooves 26 are formed in the splined hammer head 13 for the same purpose.

A bore 27 extends through the wash pipe 16, the hammer member 12, and the coupling pins 8 and 14 for the purpose of allowing the circulating fluid which is pumped through the drill pipe to pass therethrough.

Assuming that the jar has been assembled and locked in a telescoped position as shown in Fig. 1, and secured between the drill bit and the drill pipe, then the drilling tools are

ready to be lowered into the hole and drilling commenced.

In normal drilling operations the jar remains securely locked in a telescoped position as shown in Fig. 1, and the splined hammer head 13 engaging the splines 10 in the jar housing 7 causes the drill bit to rotate with the jar and drill pipe. The fluid pumped down the drill pipe, while drilling, passes freely through the bore 27 which extends throughout the jar.

Should the drill bit become stuck, an upward pull is given to the drill pipe which may in itself loosen the bit. If the drill bit is not dislodged, the drill pipe will be stretched, and the tension will increase as the upward pull is continued until the jar is tripped. When the jar is tripped, the elasticity of the stretched drill pipe causes the hammer head 13 and the anvil 9 to fly forcibly together, thereby giving a sharp upward blow to the lodged drill bit which tends to jar the bit loose.

The jar is normally held in a telescoped position by a ring of locking balls 24 which are held in the groove 11 in the jar housing 7 by a locking cam 23, and movement of the jar housing 7 upon the hammer member 12 is prevented by the cylindrical head 15, of the wash pipe 16, which engages the balls 24 which are held in the groove 11. A pull upon the ends of the jar tends to force the balls 24 out of the groove 11 and inward against the locking cam 23. Because of the angle at which the balls engage the locking cam 23 there is a tendency to force the cam away from the cylindrical head 15, of the wash pipe 16, and back against the force of the partially compressed spring 22. When the pressure of the balls 24 against the cam 23 becomes great enough, the cam is forced back, and further compresses the spring 22. When the cam is forced back a short distance the balls 24 meet the locking cam 23 at a different angle, which offers very little resistance to the inward movement of the balls, and they fly quickly inward, taking a position between the cam 23 and the cylindrical head 15, as shown in Fig. 5. When the balls take this position the jar housing is free to move upward upon the hammer member 12 until the anvil 9 strikes the hammer head 13.

If the first jar on the lodged bit fails to loosen it, the drill pipe is lowered and the jar is again telescoped. When the groove 11 in the housing 7 reaches a position opposite the balls 24, the locking cam 23 forces the balls outward and into the groove 11, and the jar is relocked as before. Another upward blow may then be given to the lodged tool by raising the drill pipe until the jar trips again. This action may be repeated until the bit is loosened, then drill-

ing may be resumed or the bit pulled from the hole.

The jar can be made to trip while the drill pipe is under a light or heavy strain by changing the position of the spring compressing nut 21. If it is desired to have the jar trip while the drill pipe is under a light strain the spring compressing nut 21 is screwed away from the spring 22, thereby allowing the spring to expand so that it exerts less pressure against the locking cam 23. If it is desired to have the jar trip while the drill pipe is under a greater strain the spring compressing nut 21 is screwed towards the spring 22, thereby compressing the spring and causing it to exert a greater pressure against the locking cam 23. Further variations may be made by using locking cams with different angles, and by using springs of different sizes. In this way the jar can be made to trip when the drill pipe is at any desired tension over a still greater range.

With a jar of this kind a great number of blows may be given to the lodged tool in a very short time, as it is only necessary to pull upward on the drill pipe until the jar automatically trips, and then lower the drill pipe to automatically relock. Furthermore, since the jar may be made to trip at different tensions of the drill pipe, it is possible to use several jars in the drilling string and thereby give the lodged tool a number of upward blows upon each upward pull on the drill pipe.

The jar may be used in fishing for lost tools in a like manner, the fishing tool being secured to the lower coupling pin.

The jar may be used in a position opposite that shown in the drawings, that is, the ends may be reversed so that the hammer member is fastened to the drill pipe and the housing fastened to the drill bit. When the jar is used in this position, it is possible to introduce enough lubricant into the jar housing to completely cover the locking members without the said lubricant acting as a shock absorber between the hammer and the anvil when the jar is tripped.

It should be noted that the lock which normally holds the jar in a telescoped position is not a friction lock, and that it does not depend upon friction between any of the members to hold the jar in a telescoped position. A jar having a lock of the kind which I have herein described has considerable advantage over a jar having a friction lock to normally hold it in a telescoped position, because of the wear or grooving action to which a friction lock is subjected, when the jar is tripped by a heavy pull. Furthermore, in a jar locked with a friction lock the wear upon the members causes the jar to trip under a lighter pull each time the jar is tripped. In a jar having the locking

means which I have described, any wear upon the locking members will not effect the tripping action of the jar, as the spring causes the locking cam to engage the locking balls tightly each time the jar is telescoped, even though considerable wear should take place. Therefore the jar will trip at the same strain over a long period of time without any adjustments being necessary.

I claim as my invention:

1. A rotary jar adapted to be coupled between the lower tool joints of a fishing or drilling string, comprising a tubular hammer member having a splined hammer head formed thereon; a coupling pin fastened to one end of said hammer member and a wash pipe, having a head formed thereon, fastened to the other end; a housing slidably mounted around the tubular hammer member and wash pipe, splines in the housing to engage the considerably shorter splined hammer head so that at any position of the members rotation of one causes rotation of the other; a coupling pin fastened to one end of the housing and an anvil member fastened to the other end; a locking assembly to automatically lock the tubular hammer member and the housing in a telescoped position, and means to cause the locking assembly to automatically unlock the said members at any desired strain or pull upon the coupling pins, thereby allowing the hammer head and anvil to strike forcibly together so as to impart a jar to the tools connected to the said coupling pins.

2. A rotary jar adapted to be coupled between the lower tool joints of a fishing or drilling string, comprising a tubular hammer member having a splined hammer head formed thereon; a coupling pin fastened to one end of said hammer member and a wash pipe having a head formed thereon, fastened to the other end; a housing slidably mounted around the tubular hammer member and wash pipe, said housing having a cylindrical bore therethrough, a groove formed around the circumference of the bore near one end, and longitudinal splines formed in the bore at the other end, said splines engaging the considerably shorter splined hammer head so that at any position of the members, rotation of one causes rotation of the other; a coupling pin fastened to one end of the housing and an anvil member fastened to the other end; a locking assembly mounted upon the hammer member having means to engage the groove in the housing so as to automatically lock said housing and the tubular hammer member in a telescoped position, and means to cause the locking assembly to automatically unlock the said members at any desired strain or pull upon the coupling pins, thereby allowing the hammer head and anvil to

strike forcibly together so as to impart a jar to the tools connected to the said coupling pins.

3. A rotary jar adapted to be coupled between the lower tool joints of a fishing or drilling string, comprising a tubular hammer member having a splined hammer head formed in a central position thereon; a coupling pin fastened at one end of said hammer member and a wash pipe having a cylindrical head formed thereon, fastened to the other end; a cylindrical housing slidably mounted around the tubular hammer member and wash pipe, said housing having a cylindrical bore therethrough, a groove formed around the circumference of the bore near one end, and longitudinal splines formed in the bore at the other end, said splines engaging the considerably shorter splined hammer head so that at any position of the hammer member within the cylindrical housing, rotation of one causes rotation of the other; a coupling pin fastened to one end of the cylindrical housing and having a cylindrical bore therethrough, allowing axial and rotary movement of the wash pipe therein, a stuffing box in said coupling pin to pack the wash pipe therein; an anvil member fastened to the other end of the cylindrical housing and having a cylindrical bore therethrough, allowing axial and rotary movement of the tubular hammer member therein, a stuffing box in said anvil to pack the tubular hammer member extending therethrough; a locking assembly mounted upon the tubular hammer member having means to engage the groove in the housing so as to automatically lock said housing to the tubular hammer member in a telescoped position, and having a plurality of means whereby the locking assembly may be adjusted to automatically unlock the cylindrical housing and tubular hammer member at any desired strain or pull upon the coupling pins, thereby allowing the hammer head and the anvil to strike forcibly together, and thereby imparting a jar to the tools connected to the said coupling pins.

4. A rotary jar adapted to be coupled between the lower tool joints of a fishing or drilling string, comprising a tubular hammer member, a splined hammer head formed in a central position thereon and having a shallow axial groove formed at the bottom of the splines; a coupling pin fastened to one end of said hammer member, a wash pipe fastened to the other end, said wash pipe having a cylindrical head with axial grooves formed thereon, a bore throughout said hammer member, coupling pin, and wash pipe, to allow fluid to circulate through the jar; a cylindrical housing slidably mounted around the tubular hammer member and wash pipe, said housing having a cylindrical bore therethrough, a groove

formed around the circumference of the bore near one end, and longitudinal splines formed in the bore at the other end, said splines engaging considerably shorter splines in the hammer head so that at any position of the hammer member within the cylindrical housing rotation of one causes rotation of the other; a coupling pin fastened to one end of the cylindrical housing and having a cylindrical bore therethrough, allowing axial and rotary movement of the wash pipe therein, a stuffing box in said coupling pin to pack the wash pipe therein; an anvil member fastened to the other end of the cylindrical housing and having a cylindrical bore therethrough, allowing axial and rotary movement of the tubular hammer member therein, a stuffing box in said anvil to pack the tubular hammer member extending therethrough; a locking assembly mounted upon the tubular hammer member, comprising a locking cam slidably mounted over the tubular hammer member, a ring of locking balls adapted to engage the groove in the cylindrical housing, a spring engaging the locking cam, and a spring compressing nut screwed upon the tubular hammer member for the purpose of varying the force exerted against the locking cam by said spring; said locking assembly being adapted to automatically lock the cylindrical housing and the tubular hammer member in a telescoped position, and to automatically unlock the said members at any desired strain or pull upon the coupling pins, thereby allowing the hammer head and the anvil to strike forcibly together, and thereby causing a jar to be given to the tools connected to the said coupling pins.

Signed at Los Angeles this 15th day of March 1930.

GRANVILLE S. KNOX.

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