

Sept. 22, 1936.

E. F. RAYMOND

2,055,018

STRAIGHT PULL AUTOMATIC ROTARY JAR

Filed Sept. 11, 1934

2 Sheets-Sheet 1

Fig. 1a.

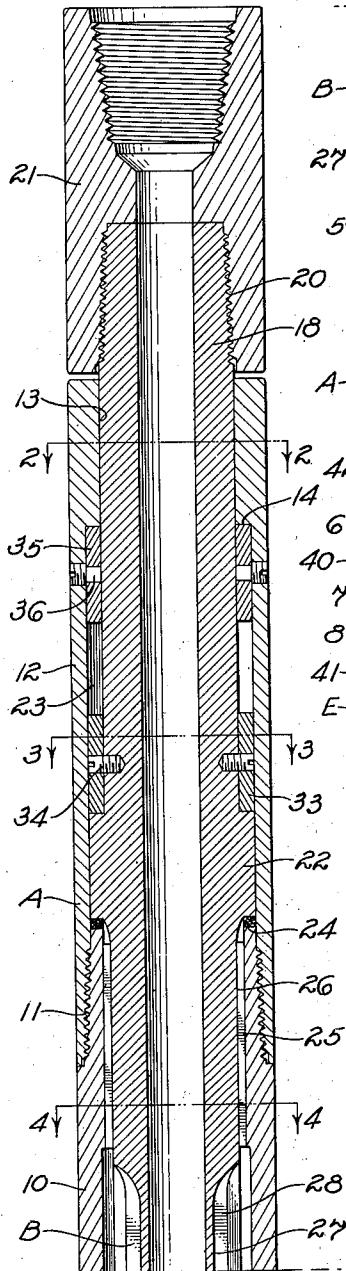


Fig. 1b.

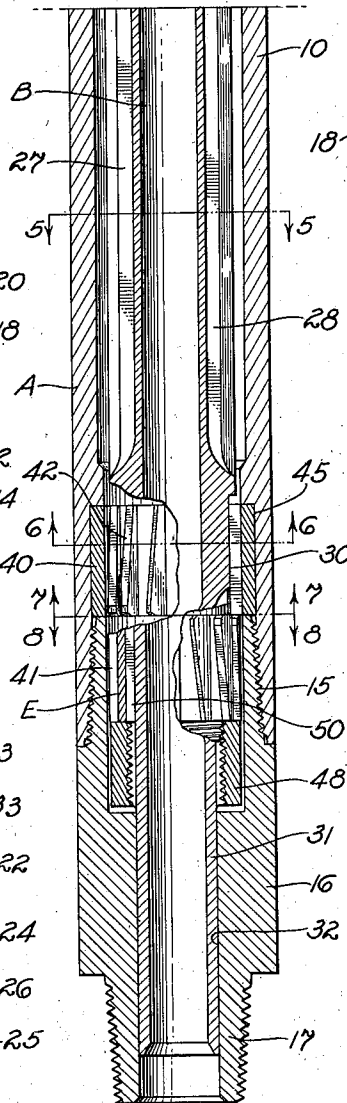


Fig. 2.

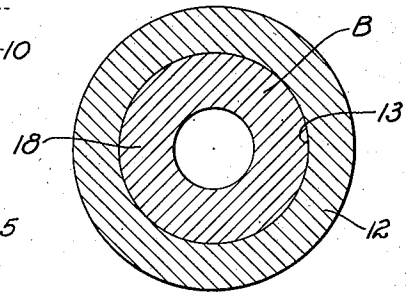


Fig. 3.

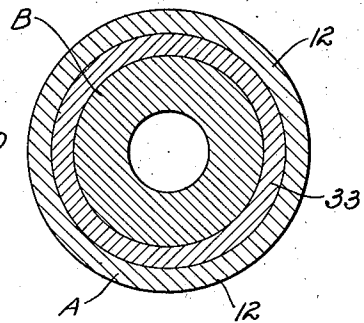
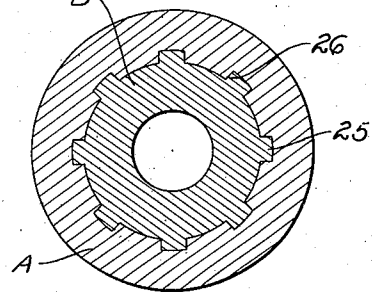


Fig. 4.



INVENTOR
EDWARD F. RAYMOND
By *Fad W. R. R. R.*

ATTORNEY.

Sept. 22, 1936.

E. F. RAYMOND

2,055,018

STRAIGHT PULL AUTOMATIC ROTARY JAR

Filed Sept. 11, 1934

2 Sheets-Sheet 2

Fig. 5.

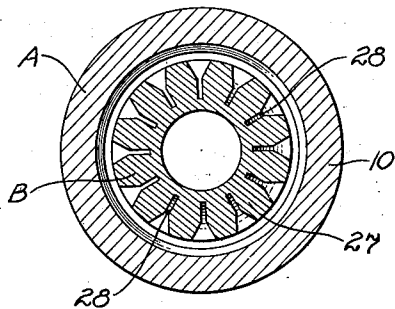


Fig. 7.

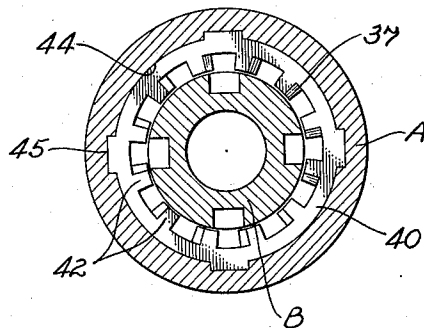


Fig. 6.

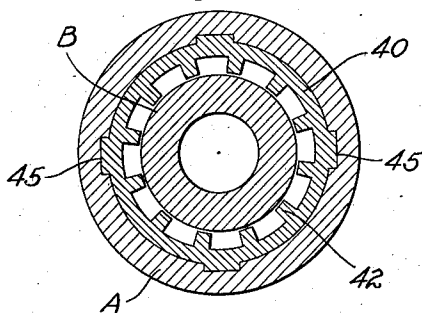


Fig. 8.

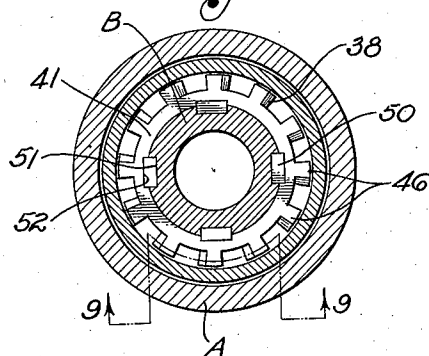


Fig. 9.

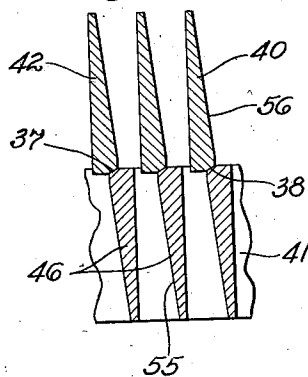
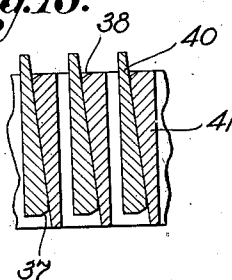


Fig. 10.



INVENTOR
EDWARD F. RAYMOND

By *Forde & Kline*

ATTORNEY

UNITED STATES PATENT OFFICE

2,055,018

STRAIGHT PULL AUTOMATIC ROTARY JAR

Edward F. Raymond, Huntington Beach, Calif.,
assignor to J. S. Beck

Application September 11, 1934, Serial No. 743,518

8 Claims. (Cl. 255—27)

This invention relates in general to rotary jars of the character employed in the well drilling art to loosen tools and pipe which have become stuck in the hole, and the invention relates in particular to rotary jars of the delayed action type whereby a tensional stress built up by taking a pull on the drill pipe automatically releases the jars and causes a jarring blow to be struck.

To secure such a blow rotary jars of the character herein disclosed are used. These jars ordinarily consist of two tubular elements telescopically mounted with a limited movement relative to one another. They are generally held in the contracted telescopic position by means of a delayed action element which is so constructed as to be released upon a pull of a predetermined magnitude whereupon the two are freed to extend their relative telescopic position. The inner tubular member is provided with exterior abutments and the outer tubular member with internal abutments, which exterior and internal abutments engage each other. The abutments are known as anvils or knocking heads and limit the extension of the tubular members with reference to each other.

A principal object of the invention is to provide a rotary jar which will be simple and positive in its operation and which will operate in response to a direct pull on the string of drill pipe with which it is employed. In a jar of this general character the strength of the jarring blow struck depends upon the extent to which the string of pipe is stretched before the delayed action element releases, and therefore if a heavy jarring blow is to be struck the delayed action element must be capable of resisting a correspondingly heavy pull before it releases and allows the anvils of the device to be brought forcibly together. My present rotary jar provides simple and rugged delayed action means capable of resisting a heavy pull before releasing and contributing to the making of a rotary jar which may be used extensively in the rotary drilling art; whereas, rotary jars have heretofore been more or less delicate and complicated, and consequently their use in the drilling operation has been very limited.

It is an object of this invention to produce a rotary jar with but a limited number of parts.

Another object is to produce a jar in which the elements require no lost motion or slack in order to engage them in the telescoped position, thereby preventing wear between the yieldable elements.

A still further object is to produce a jar which may be easily and economically manufactured

and which will be strong and rugged for severe work.

Another object is to produce a jar in which a tubular element thereof yields to release it for longitudinal movement.

These and other objects will be apparent by reference to the following specification and drawings of a preferred embodiment of the invention which is given by way of illustration and not as a limitation thereof.

Referring to the drawings,

Fig. 1a is a sectional view of the upper part of the rotary jar.

Fig. 1b is a sectional view of the lower part of the rotary jar.

Fig. 2 is a cross-section taken as indicated by the line 2—2 of Fig. 1a.

Fig. 3 is an enlarged cross-section taken as indicated by the line 3—3 of Fig. 1a.

Fig. 4 is an enlarged cross-section taken as indicated by the line 4—4 of Fig. 1a.

Fig. 5 is an enlarged cross-section taken as indicated by the line 5—5 of Fig. 1b.

Fig. 6 is an enlarged cross-section taken as indicated by the line 6—6 of Fig. 1b.

Fig. 7 is an enlarged sectional view looking upwardly from a plane indicated by the line 7—7 of Fig. 1b.

Fig. 8 is an enlarged sectional view looking downwardly from the plane indicated by the line 7—7 of Fig. 1b as indicated by arrows 8—8.

Fig. 9 is a sectional view taken as indicated by the line 9—9 of Fig. 8, showing the delayed action element in latched position.

Fig. 10 is a section similar to Fig. 9, showing the delayed action element in unlatched position.

The preferred embodiment of the rotary jar comprises, as shown in Figs. 1a and 1b, an outer element A of tubular form and an inner element B in the form of a mandrel. The outer element A comprises a tubular body 10 provided with external threads 11 so as to receive a tubular extension 12 having a bore 13 of reduced diameter situated above a downwardly faced shoulder 14. The lower end of the tubular member 10 is provided with internal threads 15 for receiving the upper end of a body 16 which is adapted by the provision of a threaded pin 17 to connect the tubular member A to a coupling of a string of pipe in conjunction with which the rotary jar is to be employed.

The inner part or mandrel B, which is hollow or tubular in form so that fluid may pass axially therethrough, comprises an upper cylindrical portion 18 which is adapted to extend through the

bore 13 and has threads 20 by which a box fitting 21 may be secured thereto for the purpose of connecting the mandrel B to a coupling of the string of drill pipe previously mentioned. On the upper part of the mandrel B below the cylindrical portion 18 a collar 22 is formed which rests in the cylindrical space 23 within the tubular extension 12 and lying between the shoulder 14 thereof and the upper end face 24 of the tubular member 10. On the mandrel B longitudinal ribs or keys 25 are formed which are adapted to slide vertically in slots or keyways 26 formed in the upper portion of the tubular member 10. The interengagement of the keys 25 with the slots 26 prevents relative rotation of the tubular member or shell A and the mandrel B but permits a longitudinal relative movement thereof. The portion 27 of the mandrel B below the keys 25 may be considered a shank which is structurally and preferably torsionally yieldable. The term "structurally yieldable" is employed to mean that the part changes its form or structural shape under stress, as differentiating from the idea of bodily moving to a different position. The torsional yieldability of the shank 27 is increased by the provision of longitudinal grooves 28 therein. It will be perceived that torsional yieldability of the shank 27 might be readily accomplished by increasing the length thereof, but the preferred construction shown indicates that the length of the shank 27 may be maintained at a minimum and yet be provided with the desired torsional yieldability by the provision of the longitudinal grooves 28 therein. The lower portion of the mandrel B is formed so as to provide a stem 30 having a portion or sleeve 31 closely fitting a bore 32 formed in the body 16 so as to resist leakage of drilling fluid from the bore 32 into the interior of the tubular shell A. The extension 31 is slidable and rotatable in the bore 32.

When the parts of the rotary jar are in collapsed position, as shown in Figs. 1a and 1b, the collar 22 is disposed adjacent the upper end face 24, and as the parts A and B move toward extended relation, the collar 22 moves upwardly toward the shoulder 14. Supplementing the collar 22, a replaceable wear resisting ring 33 of hard metal is secured on the mandrel by means of screws 34, and secured within the tubular extension 12 against the shoulder 14 a replaceable wear resisting ring 35 is secured by means of dog-pointed screws 36. In the jarring action of the device the upper face of the ring 33 is brought into forcible engagement with the lower face of the ring 35 so that the wear of the blow thereby struck will be taken by the respective upper and lower faces of the rings 33 and 35.

So as to delay the upward relative movement of the mandrel B, I provide a delayed action element E which resists such relative upward movement of the mandrel B with a resistance sufficient to produce a relatively high degree of tension in the pipe string in which the jar is connected. Such delayed action element comprises interengaging shoulders 37 and 38 formed on rings 40 and 41 which are respectively connected to the tubular member 10 and to the mandrel B. The shoulders 37 are preferably formed on the lower ends of splines 42 which project inwardly from the ring 40 which is held within a counterbore 44 formed in the lower end of the tubular member 10 above the threads 15, there being a keyed interengagement 45 between the ring 40 and the tubular member 10 for preventing rotation of the ring 40 relative to the tubular member. The

shoulders 38 are formed on the upper ends of splines 46 which project outwardly from the ring 41 which is held on the lower portion of the mandrel B by use of a threaded collar 48. Rotation of the ring 41 relative to the mandrel B is prevented by keys 50 which rest in keyways 51 and 52 formed respectively in the mandrel B and in the inner wall of the ring 41. As shown in Fig. 9, the shoulders 37 and 38 are sloped spirally with respect to the longitudinal axis of the device, and the rings 40 and 41 are so positioned that when the mandrel B is in collapsed relation to the shell A, as shown in Figs. 1a and 1b, the shoulders 37 and 38 will be opposed so that upward movement of the splines 46 relative to the splines 42 cannot occur unless the splines 46 move in rightward or clockwise direction relative to the splines 42. This rotation of the splines 46 is resisted by the torsional strength of the portion 27 of the mandrel B. When an upward pull is transmitted to the splines 46 through the lower portion of the mandrel B, the shoulders 38 tend to slide rightwardly on the shoulders 37 due to the slope thereof, and a torsional force is applied to the lower end of the mandrel B which tends to twist the same. This torsional force, due to the sloping engagement of the shoulders 37 and 38, is resisted by the torsional strength of the lower part of the mandrel B below the ribs or keys 25 which engage the shell A so as to prevent rotation of the upper part of the mandrel B relative to the upper part of the shell A; therefore, the upward movement of the mandrel B will be delayed until the pull exerted thereon is sufficient to produce a tangential or torsional component of force due to the angle of slope of the shoulders 37 and 38, which component of force will be equal to or slightly greater than the torsional resistance of the lower part of the mandrel B. As the upward pull on the mandrel B is increased, the pipe string is being stretched or placed under tension so that when the shank portion 27 of the mandrel B finally torsionally yields sufficiently to permit the shoulders 38 to pass the shoulders 37, the contraction of the pipe string will cause the members 33 and 35 to be brought together with great force so that a heavy blow and consequently an effective jarring action are produced. When the mandrel moves upwardly after release of the delayed action element E, the splines 46 pass into the spaces between the splines 42, as shown in Fig. 10.

Although the splines 42 and 46 may be made of constant cross-section throughout their entire length, I prefer to taper such splines in the manner shown in Figs. 1b, 9, and 10 so that as the splines 46 move upwardly they may at the same time move leftwardly so as to release the torsional strain on the lower portion of the mandrel B.

Return of the parts of the jar to their normal operating position, as by lowering the mandrel within the shell A, causes the sloping faces 55 of the splines 46 to move downwardly and rightwardly over the sloping faces 56 of the splines 42. When the splines 42 and 46 are brought into the respective positions thereof shown in Figs. 1b and 9, the untwisting of the lower part of the mandrel B will carry the shoulders 38 into positions below the shoulders 37 so that the delayed action element is again latched so as to hold the shell A and the mandrel B in the relatively collapsed position of the jar, in which position these parts will be held under ordinary use of the string of drill pipe in which the

jar is connected and until a jar actuating tension is again applied to the drill pipe string.

My invention provides an adjustment means for varying the pull which will be required to release the delayed action element E. This adjustment means is embodied in the keys 50 by which relative rotation of the ring 41 and the lower end of the mandrel B is prevented. If it is desired to decrease the desired force which will release the delayed action element E, the keys 50 are replaced by narrower keys whereby a slight rightward rotation of the ring 41 on the lower end of the mandrel B is permitted, so that a smaller torsional movement of the lower end of the mandrel B is required to permit the shoulders 38 to pass the shoulders 37. Should increased resistance be required in the delayed action element E, offset keys may be employed in the place of the keys 50 so as to rotate the ring 41 in leftward direction so that a greater rightward movement of the splines 46 will be required to permit the shoulders 38 to pass the shoulders 37.

In the action of the device opposing torsional strains are placed in the mandrel B and in the shell A. Naturally, both of these parts yield torsionally in opposite directions under such strains, but in the preferred operation of the device I prefer to employ greater yieldability in the mandrel than in the shell and therefore have placed the grooves 28 in the shank 27 of the mandrel.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

I claim as my invention:

1. A jar of the character described, for use with a well string, including: a pair of cooperating parts in longitudinal sliding engagement so as to move between collapsed and extended positions, one of said parts being torsionally resilient, there being attachment means at the outer ends of said parts and means for connecting them to the adjoining parts of said well string; movement delay means operative to resist relative longitudinal movement of said parts, said means being releasable in response to the yielding of said torsionally resilient sliding part under longitudinal force tending to move said parts into extended position; and means remote from said movement delay means for preventing relative rotation of said sliding parts.

2. A jar of the character described, for use with a well string, including: a pair of jarring members telescopically mounted for limited longitudinal movement and so that one of such members will not rotate relative to the other; attachment devices for connecting said members in a well string; and movement delay means operative between said members, said means having parts held in engagement by the torsional strength of said jarring members, at least one of said jarring members being so formed as to yield torsionally under stress and release said parts of said movement delay means.

3. A jar of the character described, for use with a well string, including: a pair of jarring members telescopically mounted for limited longitudinal movement and so that one of such

members will not rotate relative to the other; attachment devices for connecting said members in a well string; and movement delay means operative between said members, said means comprising cooperating parts, at least one of which is torsionally yieldable connected to said members so as to be relatively non-rotatable, held in movement delaying engagement by the torsional strength of said parts, and being so formed as to release in response to torsional yieldability of at least one of said parts.

4. A jar of the character described, for use with a well string, including: a pair of jarring members telescopically mounted for limited longitudinal movement and so that one of such members will not rotate relative to the other; attachment devices for connecting said members in a well string; and movement delay means operative between said members, said means comprising a pair of shoulder bodies having faces engaging in a plane spirally disposed with relation to the longitudinal axis of said telescopically mounted members, and parts connecting said shoulder bodies respectively to said members so as to hold said faces in engagement by the torsional strength of said parts, at least one of said parts being torsionally yieldable in response to longitudinally applied force so as to permit disengagement of said shoulder bodies, there being means operative between said jarring members for resisting relative rotation of said jarring members by the torsional reaction of said parts.

5. A jar of the character described, for use with a well string, including: a pair of jarring members telescopically mounted for limited longitudinal movement and so that one of such members will not rotate relative to the other; attachment devices for connecting said members in a well string; movement delay means operative between said members, said means comprising a pair of shoulder bodies having faces engaging in a plane spirally disposed with relation to the longitudinal axis of said telescopically mounted members, and parts connecting said shoulder bodies respectively to said members so as to hold said faces in engagement by the torsional strength of said parts, at least one of said parts being torsionally yieldable in response to longitudinally applied force so as to permit disengagement of said shoulder bodies; and adjustment means for relatively moving said shoulder bodies independently of the movement of said parts so as to change the extent of engagement of said faces of said shoulder bodies.

6. A jar of the character described, for use with a well string, including: a pair of jarring members telescopically mounted for limited longitudinal movement and so that one of such members will not rotate relative to the other; attachment devices for connecting said members in a well string; and movement delay means operative between said members, said means comprising a pair of shoulder bodies having faces engaging in a plane spirally disposed with relation to the longitudinal axis of said telescopically mounted members, and parts connecting said shoulder bodies respectively to said members so as to hold said faces in engagement by the torsional strength of said members, at least one of said members being torsionally yieldable in response to longitudinally applied force so as to permit disengagement of said shoulder bodies and release of said movement delay means.

7. In a jar, a body and a relatively longitudinally movable mandrel, striking shoulders which

are brought into engagement by relative longitudinal movement of the body and mandrel in one direction, a pair of interengaging members carried by the body and mandrel respectively and
5 restraining the body and mandrel against relative movement in said direction, said members being releasable by relative rotation about the body axis to free the body and mandrel for relative movement in said direction, and a connection be-
10 tween the body and mandrel holding them against substantial relative rotation during said relative releasing movement of the members.

8. In a jar, a body and a relatively longitudinally movable mandrel, striking shoulders which
15 are brought into engagement by relative longi-

tudinal movement of the body and mandrel in one direction, interengaging lugs integral with the body and mandrel and restraining the said body and mandrel against relative movement in said direction, said lugs being releasable by mandrel torsion and relative rotation along engaging surfaces of comparatively small angularity and being reengageable in their restraining positions by relative rotation in an opposite direction along engaging surfaces of comparatively great angularity, and a connection between the body and mandrel holding them against substantial relative rotation during said relative rotational movements of the body and mandrel lugs.

EDWARD F. RAYMOND. 15