Jan. 12, 1943. W. M. HAMON 2,307,927

JAR

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Fig. 1.

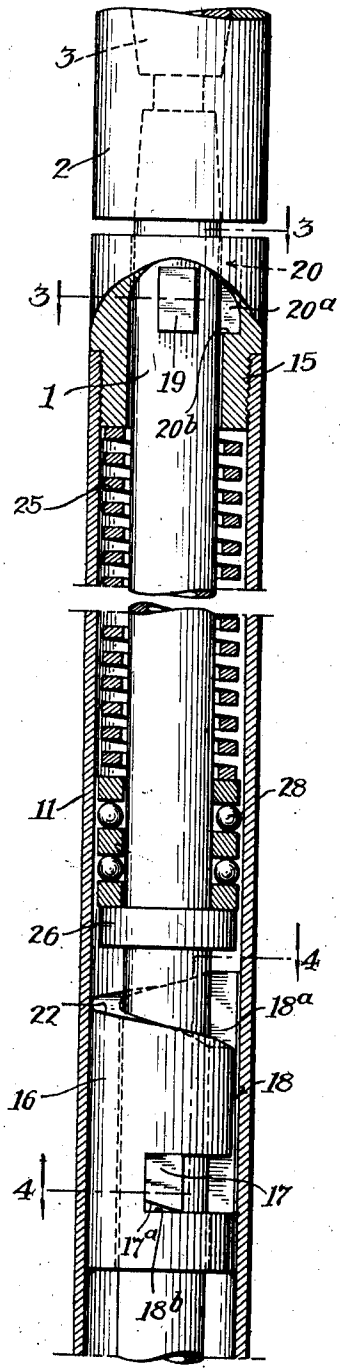


Fig. 2.

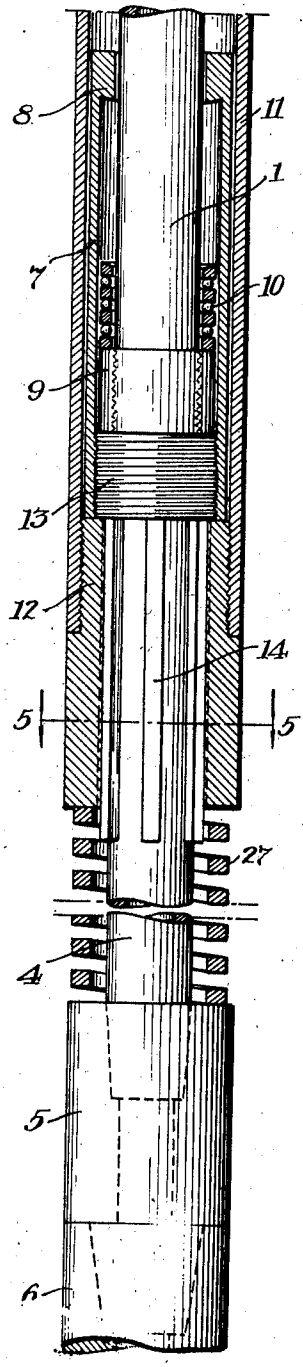


Fig. 3.

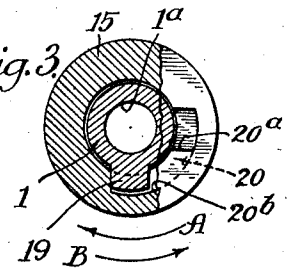


Fig. 4.

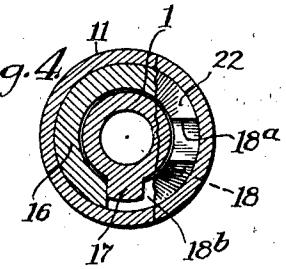
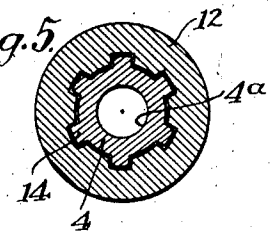


Fig. 5.



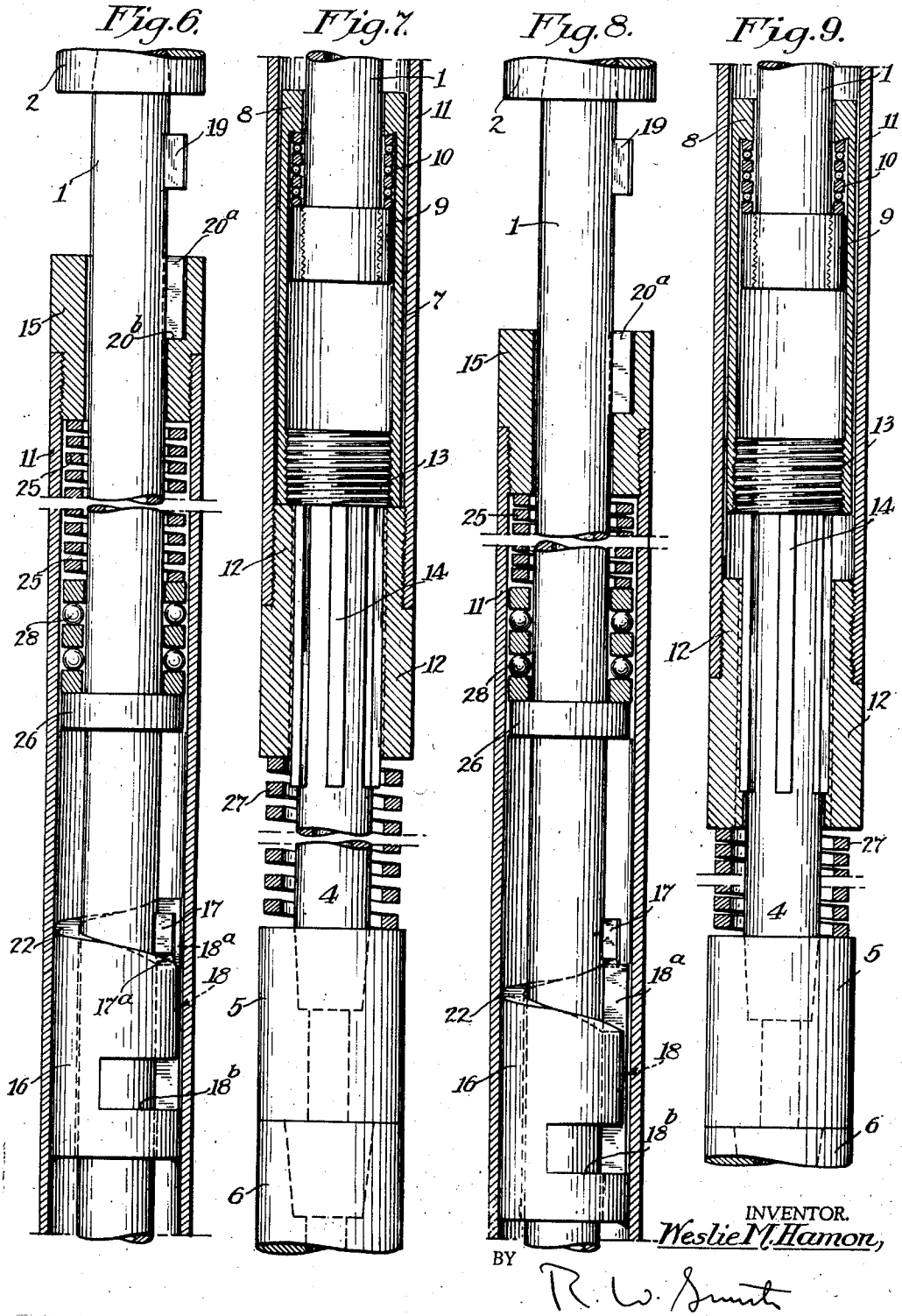
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Jan. 12, 1943. W. M. HAMON 2,307,927

JAR

Filed Nov. 6, 1940 2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,307,927

JAR

Weslie M. Hamon, East Los Angeles, Calif.

Application November 6, 1940, Serial No. 364,513

4 Claims. (Cl. 255—27)

This invention is a jar for a well tool string, and has for an object to longitudinally tension the tool string in the event of its lower portion becoming stuck in the well, and to maintain this tension while jarring the tool string.

It is a further object of the invention to normally lock the jar against actuation, and in the event of the lower portion of the tool string becoming stuck in the well, to release the jar for actuation by turning the upper portion of the tool string relative to its stuck lower portion, and to them longitudinally tension the tool string and maintain this tension while actuating the jar, with the jar actuated by rotating the upper portion of the tool string in the direction opposite to that initially employed for releasing the jar ready for actuation.

It is a still further object of the invention to provide a simple and reliable assembly, normally maintaining the tool string telescopically contracted and adapted for normal rotation of the entire string (e. g. right-hand rotation) for operating a drill or other tool which is suspended from the tool string or for connecting the tool string to an element which has been lost in the well; and in the event of the lower portion of the tool string becoming stuck in the well, to cause relative expansion and longitudinal abutment of cooperating elements of the jar by reversely turning and then elevating the upper portion of the tool string relative to its stuck lower portion, thereby tensioning the entire tool string, with a hammer element of the jar then adapted for reciprocation relative to an anvil element of the longitudinally tensioned tool string, by again rotating the upper portion of the tool string in the first mentioned direction.

Further objects of the invention will be readily understood from the following description of the accompanying drawings, in which:

Fig. 1 is an axial section through the upper portion of the jar, suspended from the upper portion of a tool string and in normal inoperative position.

Fig. 2 is an axial section through the lower portion of the jar, with the lower portion of the tool string suspended therefrom and with the jar in normal inoperative position.

Figs. 3 and 4 are transverse sections on the lines 3—3 and 4—4 respectively of Fig. 1.

Fig. 5 is a transverse section on the line 5—5 of Fig. 2.

Figs. 6 and 7 are views similar to Figs. 1 and 2 respectively, showing the jar released from normal inoperative position, ready for actuation.

Figs. 8 and 9 are views similar to Figs. 1 and 2 respectively, showing actuation of the jar.

The jar is incorporated in a tool string which is adapted for reception in a well bore, and comprises an upper mandrel 1 which may be suspended by a sub 2 from the upper portion 3 of the tool string which extends to the earth's surface, and a lower mandrel 4 from which (by means of a sub 5) the lower portion 6 of the tool string is suspended. This lower portion of the tool string is provided at its lower end with an element (not shown) which may be a drilling tool or the like, or which may be a spear, socket or other tool adapted to engage an element which has been lost in the well.

The mandrels 1—4 are normally telescopically contracted and locked against relative rotation and longitudinal expansion during normal rotation of the tool string, and are adapted for release of the locking means for relative rotation and for limited relative expansion of the mandrels in the event of the lower portion of the tool string becoming stuck in the well.

As an instance of means permitting limited relative expansion of the mandrels, a sleeve 7 is fixed to and projects upwardly from the mandrel 4 for telescopic reception of the lower end of the mandrel 1, and an abutment 8 is provided at the upper end of this sleeve and cooperates with an abutment 9 at the lower end of the mandrel 1. Anti-friction bearings 10 are preferably provided between the cooperating abutments 8—9, and are supported on the abutment 9 in longitudinally spaced relation below the abutment 8 when the mandrels are in normal telescopically contracted position (Fig. 2) but are adapted to engage the abutment 8 for limiting relative longitudinal expansion of the mandrels (Fig. 7), with the bearings providing anti-frictional engagement.

The means for releasably locking the mandrels 1—4 against relative expansion and rotation, is shown as comprising abutment, e. g. dogs 17 and 19, on the mandrel 1 and cooperating abutment means e. g. bayonet slots 18 and 20, fixed against rotation relative to the mandrel 4. With the parts in normal position (Fig. 1) these cooperating means longitudinally and circumferentially abut when the upper portion of the tool string (and the mandrel 1) are rotated in one direction, thereby similarly rotating the mandrel 4 (and the lower portion of the tool string), and also fixing the upper and the lower portions of the tool string against relative longitudinal expansion. When the upper portion of the tool

string (and the mandrel 1) are turned in the opposite direction relative to the mandrel 4 (and the lower portion of the tool string), the cooperating abutments are disengaged so that elevation of the upper portion of the tool string (Fig. 6) relatively longitudinally expands the mandrels to the limit of movement permitted by the longitudinal abutment at 8—9—10 (Fig. 7), with the upper portion of the tool string (and the mandrel 1) then free for rotation relative to the mandrel 4 (and the lower portion of the tool string).

As an instance, a bowl 11 surrounds the sleeve 7 and the mandrel 1 in radially spaced relation from the mandrel. At its lower end the bowl is connected to a hammer 12 which is adapted for reciprocation on the mandrel 4 with its upward movement limited by its engagement with an anvil 13 at the upper end of the mandrel; and the reciprocating hammer is fixed against rotation relative to the mandrel 4, as for example by splines 14. A collar 15 is connected to the upper end of the bowl 11 and a collar 16 is fixed in the bore of the bowl below the collar 15 and above the sleeve 7, with these collars surrounding the mandrel 1. The collars 15—16 and the bowl 11 are longitudinally slidable relative to the mandrel 1 and the mandrel is rotatable relative to the collars and the bowl.

A dog 17 on the mandrel 1 cooperated with a bayonet slot 18 in the collar 16, and preferably a second dog 19 on the mandrel 1 cooperates with a bayonet slot 20 in the collar 15. The bayonet slots 18—20 comprise longitudinal slots 18*a*—20*a* extending downwardly from the upper ends of the collars 16—15 respectively, and terminating in arcuate slots 18*b*—20*b*.

When the mandrel 1 is in its normal position telescopically contracted relative to the bowl 11 and the mandrel 4 (Figs. 1 and 2) the dogs 17—19 are received in the arcuate slots 18*b*—20*b*, thereby locking the parts against relative longitudinal expansion, and as long as the lower portion of the tool string is not stuck in the well bore, rotation of the upper portion of the tool string (and the mandrel 1) in one direction, e. g., the direction indicated by arrow A, causes circumferential abutment of the dogs 17—19 against the ends of the arcuate slots 18*b*—29*b*, for similarly rotating the bowl 11 (and the hammer 12), thereby also rotating the mandrel 4 (and the lower portion of the tool string) by the splined engagement 14.

If the lower portion of the tool string becomes stuck in the well so that it (and the mandrel 4) are held against elevation or rotation, the hammer 12 (and the bowl 11) are also fixed against rotation by the splined engagement 14 and are held against elevation by the hammer 12 engaging the anvil 13. When the upper portion of the tool string (and the mandrel 1) are then turned relative to the bowl 11, in the opposite direction to that indicated by arrow A and as shown at arrow B, the dogs 17—19 aline with the longitudinal slots 18*a*—20*a*, whereby the upper portion of the tool string (and the mandrel 1) may be elevated relative to the bowl 11 (and the mandrel 4 and the stuck lower portion of the tool string), to the limit of movement permitted by the abutment at 8—9—10 (Figs. 6 and 7).

As a result of this longitudinal abutment at 8—9—10, elevation of the upper portion of the tool string longitudinally tensions the entire string; and this tension is maintained while jarring the tool string. In order to jar the tensioned tool string, the bowl 11 is depressed relative to the mandrels 1—4, and is then spring-elevated relative to the mandrels so that the hammer 12 strikes the anvil 13 a jarring blow. This alternate depression and elevation of the hammer is accomplished by rotating the upper portion of the tool spring (and the mandrel 1) relative to the bowl 11 (and the mandrel 4 and the lower portion of the tool string).

As an instance, a circumferential cam surface 22 is provided at the upper end of the collar 16, and the lower end of the dog 17 is a cooperating cam surface 17*a*. With the parts in the position shown at Figs. 6 and 7, rotation of the upper portion of the tool string (and the mandrel 1) relative to the bowl 11 circumferentially shifts the dog 17 clear of the slot 18*a* and engages its cam surface 17*a* with the cooperating cam surface 22, and then moves the cam surface 17*a* around the cooperating cam surface 22 for depressing the bowl 11 relative to the mandrels 1—4. When nearly a complete rotation of the mandrel 1 has been made and just before the dog 17 again alines with the slot 18*a*, the parts are in the position shown at Figs. 8 and 9, with the hammer 12 depressed relative to the anvil 13; and as rotation of the mandrel 1 is then continued so that the dog 17 again alines with the slot 18*a*, the bowl 11 and the hammer 12 are elevated, as permitted by reception of the dog 17 in the slot 18*a*, thereby striking the hammer against the anvil 13 and returning the parts to the position shown at Figs. 6 and 7, ready for repeating the jarring action by again rotating the upper portion of the tool string.

Spring tension is preferably employed for thus elevating the depressed bowl and hammer for striking the jarring blow. As an instance, a spring 25 may surround the mandrel 1 between the collar 15 and a cooperating collar 26 on the mandrel, and/or a spring 27 may surround the mandrel 4 between the hammer 12 and the sub 5. Anti-friction bearings 28 are preferably provided between the spring 25 and the collar 26.

In operation, the dogs 17—19 by their reception in the arcuate slots 18*b*—20*b* normally lock the parts in the position shown at Figs. 1 and 2, thereby providing a tool string which is rigid throughout its length and which is adapted for rotation as a unit when turned in that direction which causes abutment of the dogs against the ends of the arcuate slots and which is the normal direction of rotation of the tool string. The threaded connections between the various parts of the jar and between the lengths of the tool string are preferably such as to tighten these threaded connections when the tool string is rotated in this normal direction. For example, in the illustrated embodiment wherein the normal direction of rotation is right-hand rotation as indicated by arrow A, these various threaded connections have right-hand threads.

When the lower portion of the tool string becomes stuck in the well bore so that it (and the bowl 11) cannot be elevated or rotated, the upper portion of the tool string is turned in the opposite direction relative to the now non-rotatable bowl as indicated by arrow B. The dogs 17—19 being thus alined with the slots 18*a*—20*a*, the upper portion of the tool string (and the mandrel 1) are elevated relative to the bowl 11 which is now held against elevation, thereby positioning the parts as shown at Figs. 6 and 7, with the abutment at 8—9—10 maintaining any desired ten-

sion on the entire tool string. This elevation of the mandrel 1 partially tensions the spring 25 and elevates the dogs 17—19 so that the dog 19 is clear of the collar 15 and the dog 17 is in position ready to engage the cam surface 22.

With the desired tension then maintained on the tool string, the upper portion of the string (and the mandrel 1) are rotated for engaging the dog 17 with the cam surface 22.

The cam surfaces 17*a*—22 are preferably arranged so that this rotation is in that direction which will tighten the threaded connections throughout the length of the tool string. For example, in the illustrated embodiment, the rotation for actuating the jar is in the direction indicated by the arrow A. During this rotation of the mandrel 1, the cam engagement at 17*a*—22 depressed the bowl 11 and the hammer 12 relative to the mandrels 1—4, thereby increasing the tension of the spring 25 and also tensioning the spring 27, and spacing the hammer 12 below the anvil 13 (Figs. 8 and 9); and as rotation of the mandrel 1 is continued the dog 17 realines with the slot 18*a*, whereupon the tensioned springs 25—27 elevate the bowl 11 and the hammer 12 so that the latter strikes the anvil 13 a sudden jarring blow, thereby jarring the tensioned tool string and returning the parts to the position shown at Figs. 6 and 7, ready for repeating the jarring by again rotating the upper portion of the tool string in the direction of the arrow A.

When the stuck lower portion of the tool string has been jarred loose, the tool string may be returned from its position shown at Figs. 6 and 7 to its normal position shown at Figs. 1 and 2, by lowering the upper portion of the tool string (and the mandrel 1) for telescoping the mandrel in the sleeve 7 and lowering the dogs 17—19 through the slots 18*a*—20*a*, and then rotating the upper portion of the tool string in the direction of arrow A for circumferentially abutting the dogs against the ends of the arcuate slots 18*b*—20*b*.

The mandrels 1—4 preferably have bores 1*a*—4*a* communicating with one another and with the usual bore of the well string 3—6, for circulating a usual washing fluid during the jarring operation.

By employing the dog 19, in addition to the dog 17, adequate abutment surface is assured for locking the tool string in normal position for normal rotation; and by employing both the spring 25 and the spring 27, the hammer 12 may be properly tensioned for striking an adequate jarring blow against the anvil 13. By employing the anti-friction bearings 10—28 the mandrel 1 may be readily rotated relative to the non-rotatable bowl 11 and the non-rotatable sleeve 7, while the longitudinal abutment at 8—9—10 maintains any desired tension on the tool string throughout the jarring action.

I claim:

1. In a jar, relatively rotatable and longitudinally telescopic elements, abutments limiting relative longitudinal expansion of said elements, an anvil on one of said elements, a hammer reciprocable relative to said elements and fixed against rotation relative to said one of said elements and adapted to engage the anvil for limiting reciprocation of the hammer in one direction relative to said one of said elements, a locking connection between the hammer and the other of said elements and operative when the telescopic elements are relatively contracted for fixing the hammer against reciprocation in the opposite direction relative to said other of said elements, said locking means being releasable responsive to turning said other of said elements relative to said hammer, for relative longitudinal expansion of said telescopic elements, a cam on the hammer, and a cooperating cam on said other of said elements, said cooperating cam being operatively positioned responsive to relative longitudinal expansion of said telescopic elements, for engaging the cam on the hammer and reciprocating the hammer relative to said one of said elements by rotating said other of said elements, for striking the anvil a jarring blow.

2. In a jar, relatively rotatable and longitudinally telescopic elements, abutments limiting relative longitudinal expansion of said elements, an anvil on one of said elements, a hammer reciprocable relative to said elements and fixed against rotation relative to said one of said elements and adapted to engage the anvil for limiting reciprocation of the hammer in one direction relative to said one of said elements, a spring tensioned by reciprocation of the hammer in the opposite direction relative to said one of said elements, a locking connection between the hammer and the other of said elements and operative when the telescopic elements are relatively contracted for fixing the hammer against reciprocation in the opposite direction relative to said other of said elements, said locking means being releasable responsive to turning said other of said elements relative to said hammer, for relative longitudinal expansion of said telescopic elements, a cam on the hammer, and a cooperating cam on said other of said elements, said cooperating cam being operatively positioned responsive to relative longitudinal expansion of said telescopic elements, for engaging the cam on the hammer and shifting the hammer in direction for tensioning the spring by rotating said other of said elements and for then releasing the hammer for reverse shifting by the tensioned spring for striking the anvil a jarring blow.

3. In a jar, relatively rotatable and longitudinally telescopic upper and lower mandrels, abutments limiting relative longitudinal expansion of the mandrels, an anvil on the lower mandrel, a bowl surrounding the mandrels and having a hammer suspended therefrom below the anvil and fixed against rotation but adapted for reciprocation relative to the lower mandrel, a collar fixed in the bowl and surrounding the upper mandrel, a dog on the upper mandrel, a bayonet slot in the collar adapted for reception of the dog for locking the upper mandrel against rotation in one direction relative to the bowl, and for locking the upper mandrel against longitudinal displacement relative to the bowl, with the mandrels relatively longitudinally contracted and the hammer abutting the anvil, said bayonet slot adapting the dog for movement therein for turning the upper mandrel in the opposite direction relative to the bowl and for relatively longitudinally expanding the mandrels for engagement of said abutments and for positioning the dog so that its lower end transversely alines with the upper end of the collar, and cooperating cam surfaces on the lower end of the dog and on the upper end of the collar, for reciprocating the bowl and the hammer relative to the mandrels by rotating the upper mandrel relative to the bowl so as to engage the cooperating cam surfaces, for striking the hammer against the anvil.

4. In a jar, relatively rotatable and longitudinally telescopic upper and lower mandrels, abut-

ments limiting relative longitudinal expansion of the mandrels, an anvil on the lower mandrel, a bowl surrounding the mandrels and having a hammer suspended therefrom below the anvil and fixed against rotation but adapted for reciprocation relative to the lower mandrel, a collar fixed in the bowl and surrounding the upper mandrel, a dog on the upper mandrel, a bayonet slot in the collar adapted for reception of the dog for locking the upper mandrel against rotation in one direction relative to the bowl, and for locking the upper mandrel against longitudinal displacement relative to the bowl, with the mandrels relatively longitudinally contracted and the hammer abutting the anvil, said bayonet slot adapting the dog for movement therein for turning the upper mandrel in the opposite direction relative to the bowl and for relatively longitudinally expanding the mandrels for engagement of said abutments and for positioning the dog so that its lower end transversely alines with the upper end of the collar, a spring, and cooperating cam surfaces on the lower end of the dog and on the upper end of the collar, for depressing the bowl and the hammer relative to the mandrels by rotating the upper mandrel relative to the bowl so as to engage the cooperating cam surfaces, for tensioning the spring by said depression of the hammer and for then releasing the bowl and the hammer for elevation by the tensioned spring for striking the hammer against the anvil.

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