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Pugh et al.

[11] **3,904,212**

[45] **Sept. 9, 1975**

[54] **WELL BLOWOUT PREVENTER HAVING IMPROVED FEED SCREW APPARATUS**

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[73] Assignee: **Dresser Industries, Inc.**, Dallas, Tex.

[22] Filed: **June 4, 1973**

[21] Appl. No.: **367,018**

[52] **U.S. Cl.** **277/126**

[51] **Int. Cl.**[2] **E21B 33/00**

[58] **Field of Search** 277/126–129; 74/25, 27

[56] **References Cited**

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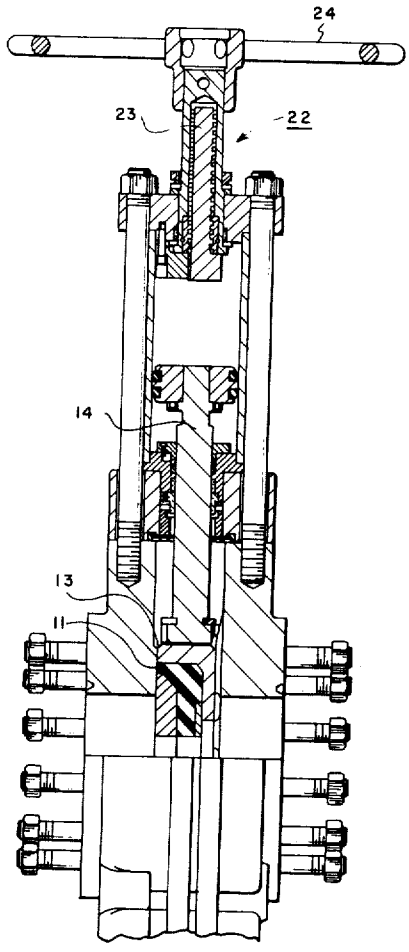
Primary Examiner—Robert I. Smith

Attorney, Agent, or Firm—William E. Johnson, Jr.; Michael J. Caddell

[57] **ABSTRACT**

A well blowout preventer is disclosed having means for either hydraulically or manually activating the rams into position around a well pipe. In the hydraulic embodiment, a mechanical locking apparatus is provided to maintain the rams in position around the well pipe. The mechanical apparatus includes a threaded feed screw having an elongated slot therein which is keyed against rotation with respect to the blowout preventer housing and which thus advances through the housing by the action of a rotated threaded bushing in threaded contact with the feed screw.

7 Claims, 11 Drawing Figures



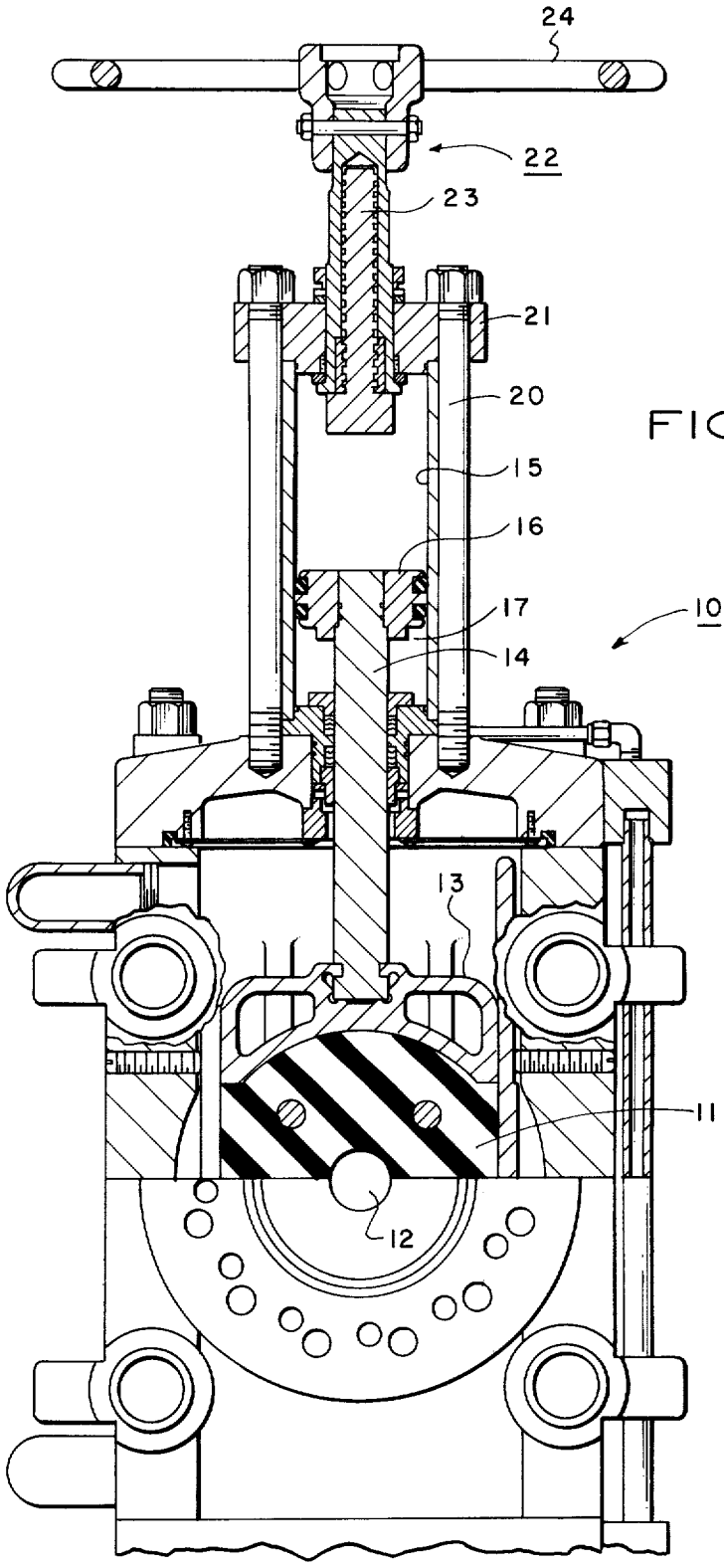


FIG. 1

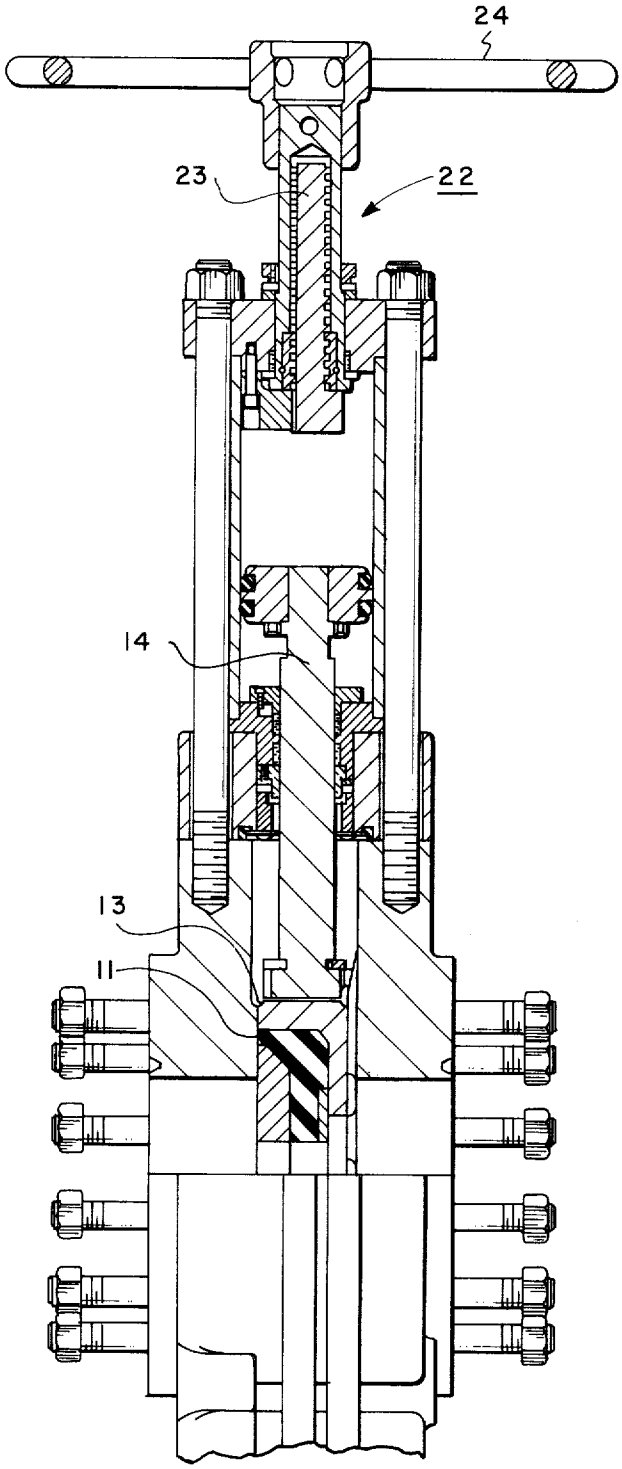


FIG. 2

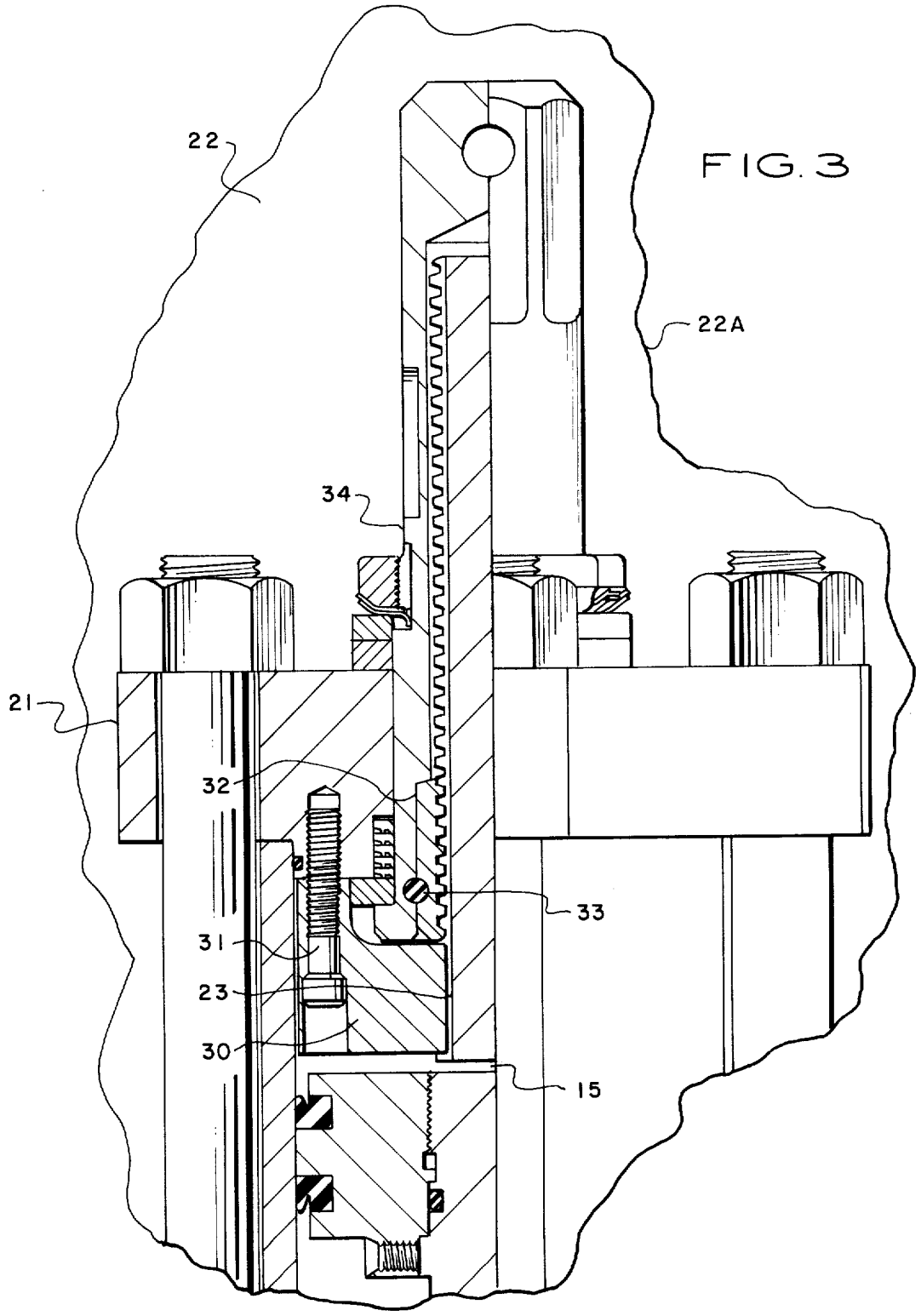


FIG. 3

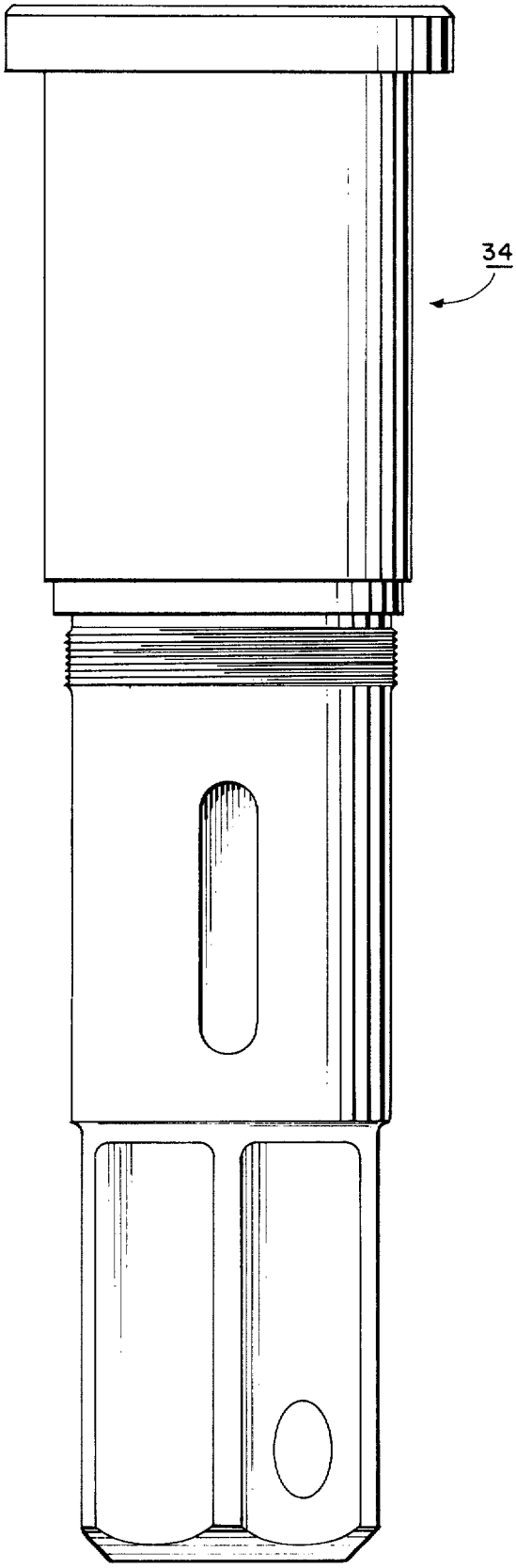


FIG. 4

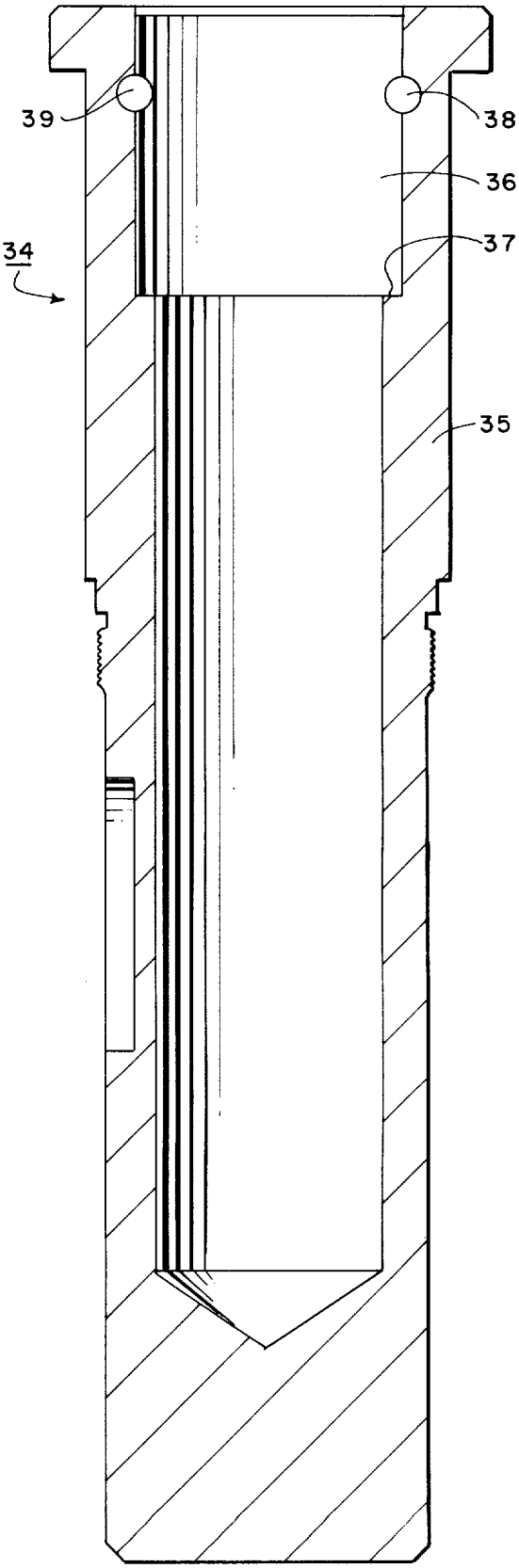


FIG. 5

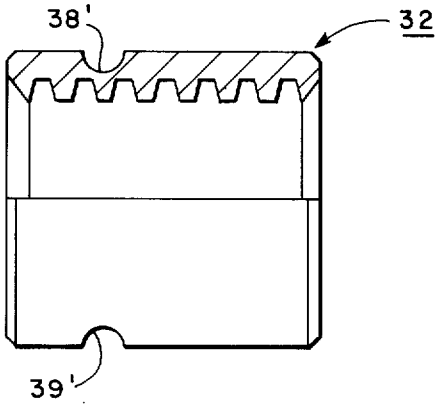


FIG. 6

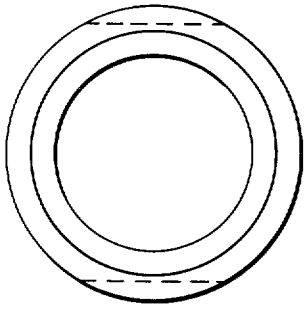


FIG. 7

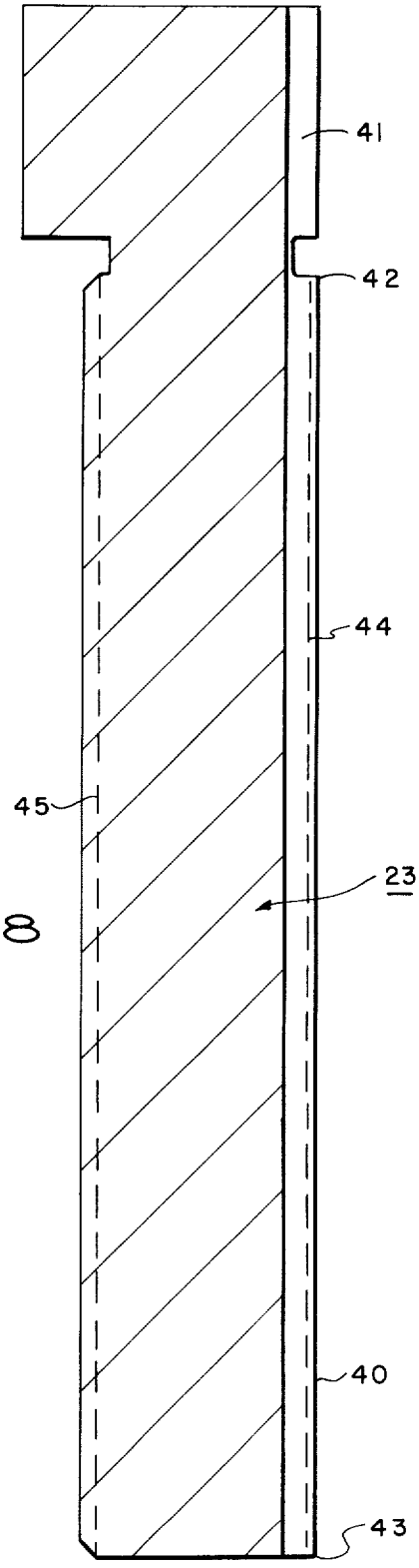


FIG. 8

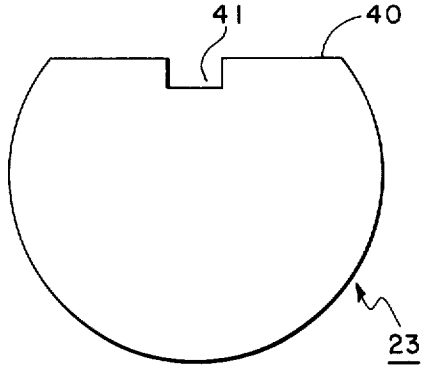


FIG. 9

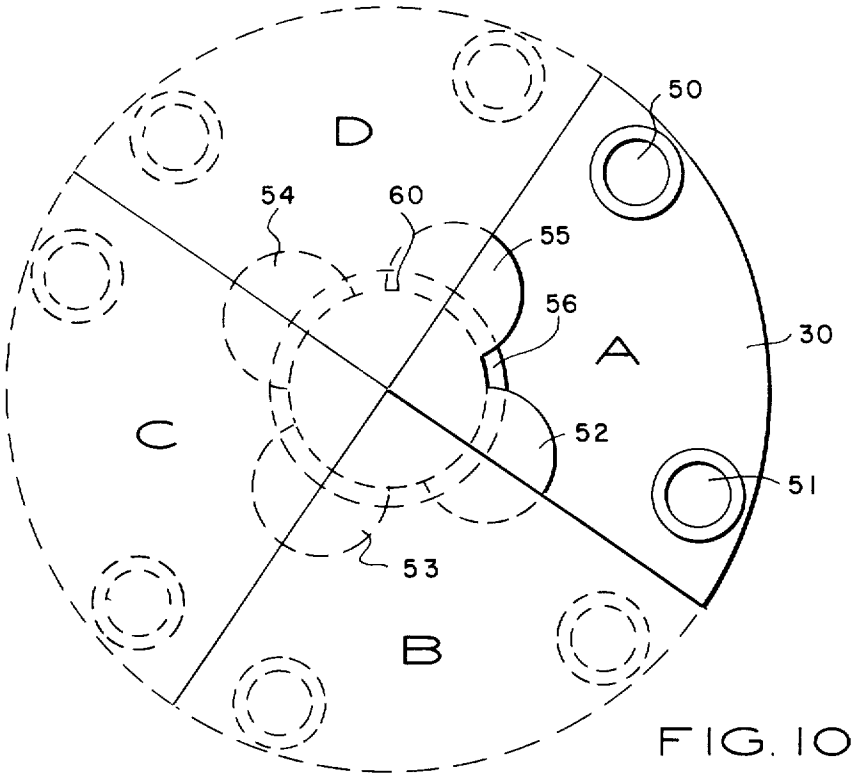


FIG. 10

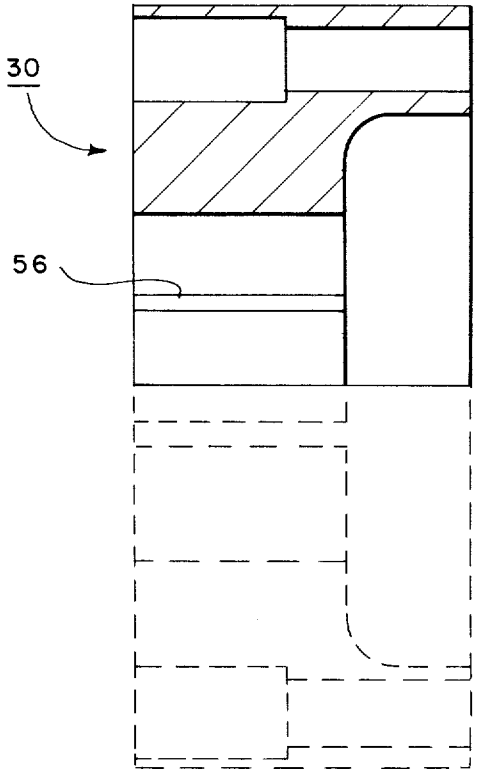


FIG. 11

WELL BLOWOUT PREVENTER HAVING IMPROVED FEED SCREW APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to a blowout preventer to be used on an oil or a gas well to confine and control the pressure therein.

It is well known in the art to provide a blowout preventer which is essentially a valve designed to be attached to the upper end of the casing of an oil well for the purpose of closing off the pressure about a drill stem or tubing or other well pipe carried within the casing. Such a device provides a seal to prevent the pressure within the casing from escaping. An example of such prior art is fully disclosed in U.S. Pat. No. **2,749,078** to Thomas B. Losey, assigned to the assignee of the present invention.

The prior art has included mechanically-actuated blowout preventers, hydraulically-actuated blowout preventers and combinations of both types. With a combination hydraulically set and mechanically locked blowout preventer, the hydraulic force is first used to close the rams around the well pipe and then a feed screw is used to hold the rams in place should the hydraulic pressure be lost. The prior art has used various means to cause the feed screw to advance on opposite ends of the blowout preventer.

The primary object of the present invention is to provide a new and improved apparatus for advancing a feed screw;

Another object of the invention is to provide a new and improved apparatus for advancing a feed screw in a well blowout preventer; and

Still another object of the invention is to provide a new and improved well blowout preventer.

The objects of the invention are accomplished, generally, by the provision of a feed screw having an elongated slot therein which is keyed against rotation with respect to a housing and which thus advances through the housing by the action of a rotated threaded bushing in threaded contact with the feed screw. As an additional feature of the invention, well blowout preventers are provided utilizing the advancement of such feed screw to lock and to close the rams against a well pipe.

These and other objects, features and advantages of the present invention will be more readily appreciated from a reading of the following detailed specification and drawing, in which:

FIG. **1** is a plan view, partly in cross section, of the blowout preventer according to the invention;

FIG. **2** is an elevated view, partly in cross section, of the blowout preventer according to the invention;

FIG. **3** is an expanded view, partly in cross section, of a portion of the feed screw apparatus according to the present invention;

FIG. **4** is a pictorial representation of the feed screw nut body according to the invention;

FIG. **5** is an elevated view, in cross section, of the feed screw nut body as illustrated in FIG. **4**;

FIG. **6** is an elevated view, partly in cross section, of the threaded bushing according to the present invention;

FIG. **7** is a plan view of the threaded bushing illustrated in FIG. **6**;

FIG. **8** is an elevated view, in cross section, of the feed screw according to the present invention before the milling of the threads;

FIG. **9** is a top plan view of the unthreaded feed screw according to FIG. **8**;

FIG. **10** is a plan view of the locking keys according to the invention; and

FIG. **11** is an elevated view, in cross section, of the locking keys according to FIG. **10**.

Referring now to the drawing in more detail, especially to FIG. **1**, there is illustrated in plan view a well blowout preventer according to the present invention, such preventer being designated generally by the numeral **10**. Since well blowout preventers are generally quite known in the prior art, for example, as described with respect to the aforementioned U.S. Pat. No. **2,749,078**, only the basic parts of the apparatus will be described with respect to FIG. **1**. As is known in the art, the resilient valve heads **11** are brought into place around the well pipe (not shown) which would be inside the hole **12** formed between the resilient members **11**. The resilient members **11** are connected to a ram **13** driven by a hydraulic piston **14** within a cylinder **15** which, through the action of hydraulic pressure introduced above the piston head **16** as is well known in the art, causes the resilient members **11** to close around the well pipe. When it is desired to remove the resilient members **11** from around the well pipe, hydraulic pressure is introduced within the cylinder **15** beneath the piston head **16**, in the area of the cylinder identified generally by the numeral **17**, to drive the piston in the reverse direction and thus cause the release or inactivation of the well blowout preventer.

A housing **20**, being substantially cylindrical, surrounds the cylinder **15**. Attached to the upper end of the housing **20** is an end plate **21**. An assembly **22**, shown and described in greater detail hereinafter, has a feed screw **23** which through the action of the rotation of the wheel **24**, is advanced against the piston rod **14** to lock the resilient members **11** into place around the well pipe whenever the well blowout preventer is to be closed.

Referring now to FIG. **2**, an elevational view of the well blowout preventer according to FIG. **1** is illustrated for purposes of illustrating in greater detail another view of the apparatus **22** which is utilized through the action of the wheel **24** for advancing the feed screw **23** against the piston **14** to maintain the resilient members **11** in locked position around the well pipe.

Although only one side of the well blowout preventer is illustrated in any great detail in FIG.'s **1** and **2**, it should be appreciated that the apparatus is substantially symmetrical on opposite sides of the hole **12** between the resilient members **11** and thus only one side of the apparatus is described in any great detail. Thus, in actual practice, a wheel **24** is on each end of the apparatus and opposing pistons are used to drive the resilient members **11** into place around the well pipe. Likewise, in conjunction with the use of two wheels, as with the wheel **24**, an assembly corresponding to the assembly **22** would be located on the other end of the apparatus to aid in locking a corresponding resilient member into contact with the other side of the well pipe.

Referring now to FIG. **3**, an expanded view, shown generally by the numeral **22A**, illustrated in greater detail portions of the assembly **22** utilized for advancing the feed screw **23** within the cylinder **15**. A locking key member **30**, illustrated in greater detail in FIG.'s **10** and **11**, is bolted into the end plate **21** such that the locking key member **30** is anchored firmly in place by the bolt

31. A threaded bushing 32, shown in greater detail in FIG.'s 6 and 7, is threadedly engaged with the threads of the feed screw 23. The threaded bushing 32 is pinned by pin 33 to a feed screw nut body 34 such that the feed screw nut body 34 and the threaded bushing 32 will rotate as a unit.

Referring now to FIG. 4, there is pictorially illustrated the feed screw nut body 34 according to the invention. The same device 34 is illustrated in a sectional view in FIG. 5 wherein there is illustrated a substantially cylindrical body 35 having an enlarged upper chamber 36 as defined by the shoulder 37. The lower end of the body 34 is closed. A pair of pin holes 38 and 39 are provided on opposite side walls of the chamber 36 for purposes of pinning the threaded bushing 32 in place, such bushing being shown in greater detail in FIG.'s 6 and 7.

Referring now to FIG. 6, there is illustrated in greater detail the threaded bushing 32. This bushing is substantially cylindrical in shape and has an internal thread dimensioned to threadedly engage the external threads on the feed screw 23. Intermediate the ends of the threaded bushing 32, there is provided a pair of pin holes 38' and 39' which are sized to mate with the pin holes 38 and 39 in FIG. 5 whenever the threaded bushing 32 is inserted within the chamber 36 in the feed screw nut body 34. After the threaded bushing 32 is in place within the chamber 36, a pin 33 is inserted within the pin holes 38 and 38' and a similar such pin is inserted within the pin holes 39 and 39'. A plan view of the threaded bushing 32 is illustrated in FIG. 7.

Referring now to FIG. 8, there is illustrated the feed screw 23 in an intermediate fabrication process prior to the body of the feed screw being threaded. As is best illustrated in FIG. 9, which illustrates a plan view of the upper end of the feed screw of FIG. 8, the feed screw 23 is originally a solid rod-like member which has one of its sides milled off to result in a flat surface 40. A groove 41 is formed, as by milling, in the surface 40 along the entire length of the feed screw 23. Between the points 42 and 43 along the length of the feed screw 23, the body is then threaded to depth as indicated by the dotted lines 44 and 45 to result in the device as illustrated in FIG. 3. Although the groove 41 need not necessarily be formed along the entire length of the feed screw 23, it is important that the groove 41 be of a sufficient length to enable the desired movement of the feed screw within the cylinder 15 illustrated in FIG. 1.

Referring now to FIG. 10, there is illustrated in plan view a locking key member during its various stages of fabrication. The locking key member 30 is formed from round bar stock and as such, there are fabricated four distinct locking key members. For purposes of illustration, only the quadrant of the round stock illustrated in FIG. 10 and designated by the numeral A will be described in any detail. The other quadrants B, C and D can be utilized either in the opposite end of the blowout preventer or in other blowout preventers. Mounting holes 50 and 51 are drilled in the A quadrant for mounting the locking key member 30 to the end plate 21 by the bolt 31 as illustrated in FIG. 3. A hole 60 is first drilled and the four holes 52, 53, 54 and 55 are then drilled in the round bar stock to result in a tab member 56 which is sized to reside within the groove 41 in the feed screw member 23. Since only one of the quadrants, for example, quadrant A of the apparatus illustrated in FIG. 10, is used on one end of the well blowout preventer, it should be appreciated that after all the holes are drilled in the bar stock of FIG. 10, the bar stock is cut into four distinct sections to result in the quadrants A, B, C and D and, for purposes of illustration, the quadrant A then bolted in place to the end plate 21 with the tab 56 in place within the groove 41 in the feed screw 23.

FIG. 11 illustrates a side elevational view of one of the quadrants A, B, C or D illustrated in FIG. 10. Although part of the locking key member 30 in FIG. 11 is shown as a sectional view, the tab member 56 is shown pictorially for purposes of better illustrating the means for using the tab 56 to lock the feed screw member 23 against rotation.

During the fabrication of the assembly 22, the threaded bushing 32 is inserted within the chamber 36 in the feed screw nut body 34 and pinned in place by one or more pins 33. The feed screw 23 is threadedly engaged with the threaded bushing 32 as illustrated in FIG. 3. The tab 56 of the locking key member 30 is inserted within the elongated groove 41 and the locking key member 30 is bolted by the bolt 31 to the end plate member 21.

In the operation of the apparatus according to the present invention, hydraulic pressure is applied within the cylinder 15 to drive the piston 14 and the rams 13 in such a manner as to cause the resilient members 11 to close around the well pipe. Thereafter, the wheel 24 which is attached to the feed screw nut body, is rotated to cause the feed screw 23 to rotate into engagement with the piston head 16 of the piston 14. This happens because of the unique character of the present invention which because of the tab 56 riding in the groove 41 of the feed screw, prevents the feed screw 23 from rotating. Since the threaded bushing 32 is rotating, the feed screw must then advance towards the end of the piston 14.

To reverse the operation, the wheel 24 is rotated in the reverse direction and pulled out of engagement with the end of the piston 14. Thereafter, hydraulic pressure is applied within the chamber 17 of cylinder 15 to force the piston 14 upwards and cause the rams 13 and resilient members 11 to come out of contact with the well pipe.

Thus there has been illustrated and described herein the preferred embodiment of the present invention wherein a vastly improved apparatus has been described for advancing a feed screw into locking engagement with a hydraulic piston used for closing the rams in a hydraulic blowout preventer. Although the preferred embodiment contemplates the use of a hydraulically actuated well blowout preventer in conjunction with mechanical means for locking the rams in place, the device can also be used to mechanically lock the rams into engagement with the well pipe. This is accomplished in the same manner as is the locking operation, i.e., the feed screw is caused to be run against the piston 14 and the feed screw and piston combination travel as a unit in forcing the rams into place.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for advancing a feed screw, comprising:

a housing;

an indexing tab secured to said housing;

a threaded feed screw having an elongated groove along at least a portion of its peripheral longitudinal surface, said tab being located within said groove, whereby said feed screw is secured against rotation with respect to said housing;

a threaded bushing threadedly engaging said threaded feed screw; and

means to rotate said bushing to thereby advance said feed screw with respect to said housing.

2. The apparatus according to claim **1** wherein said threaded feed screw is substantially cylindrical in shape except for having at least one flat surface along at least a portion of its length and said groove is formed in said at least one surface.

3. A well blowout preventer apparatus, comprising:

a housing;

resilient means within said housing for resiliently sealing a well pipe to the casing surrounding said well pipe;

means to sealingly engage said resilient means with said well pipe; and

means to lock said resilient means in place against said well pipe, said means including:

an indexing tab secured to said housing;

a threaded feed screw having an elongated groove along at least a portion of its peripheral longitudinal surface, said tab being located within said groove, whereby said feed screw is secured against rotation with respect to said housing;

a threaded bushing threadedly engaging said threaded feed screw; and

means to rotate said bushing to thereby advance said feed screw with respect to said housing, whereby said feed screw is advanced into engagement with said means to sealingly engage said resilient means with said well pipe.

4. The apparatus according to claim **3** wherein said threaded feed screw is substantially cylindrical in shape except for having at least one flat surface along at least a portion of its length and said groove is formed in said at least one surface.

5. A well blowout preventer apparatus, comprising:

a housing;

resilient means within said housing for resiliently sealing a well pipe to the casing surrounding said well pipe;

means to sealingly engage said resilient means with said well pipe; and

means to close said resilient means in place against said well pipe, said closing means including:

an indexing tab secured to said housing;

a threaded feed screw having an elongated groove along at least a portion of its peripheral longitudinal surface, said tab being located within said groove, whereby said feed screw is secured against rotation with respect to said housing;

a threaded bushing threadedly engaging said threaded feed screw; and

means to rotate said bushing to thereby advance said feed screw with respect to said housing, whereby the advancement of said feed screw causes said resilient means to sealingly engage said well pipe.

6. A hydraulic blowout preventer having auxiliary mechanical locking feature, said blowout preventer comprising:

housing means adapted to be placed around a conduit string;

head means slidable in said housing means and arranged to sealingly engage the conduit string;

head actuating means movably located in said housing means in abutting relationship with said head means;

hydraulic actuating means in said housing means on said head actuating means and arranged to respond bidirectionally to fluid pressures introduced into said housing means; and,

feed screw means, including:

elongated feed screw means in said housing means having an elongated groove along at least a portion of its peripheral longitudinal surface;

indexing tab means secured inside said housing means and engaging in said elongated groove thereby securing said feed screw means against rotation in said housing means;

threaded bushing means about said feed screw means and threadedly engaged therewith; and,

means for rotating said bushing means to axially move said feed screw means with respect to said housing means.

7. The blowout preventer of claim **6** wherein said housing means comprises two substantially identical, opposed housing assemblies, said head means comprises a generally semi-circular, slidable ram head in each of said housing assemblies, said head actuating means comprises a piston rod abutting each said ram head, said hydraulic actuating means comprises a hydraulically actuated piston on each said piston rod, and said feed screw means comprises an elongated, partially cylindrical, threaded feed screw rotationally held in each said housing assembly and arranged to abut each said piston rod.

* * * * *