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(71) Applicant *(for all designated States except US)*: **WEIR SPM, INC.** [US/US]; 7601 Wyatt Drive, Forth Worth, TX 76108 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WITKOWSKI, Brian, C.** [US/US]; 101 Stonebridge Lane, Weatherford, TX 76105 (US). **KOTAPISH, Edward, C.** [US/US]; 3308 Camelot Street, Willow Park, TX 76087 (US).

(74) Agent: **DERRINGTON, Keith, R.**; Bracewell & Giuliani LLP, P.O. Box 61389, Houston, TX 77208-1389 (US).

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(54) **Title**: PLUG VALVE INDICATOR

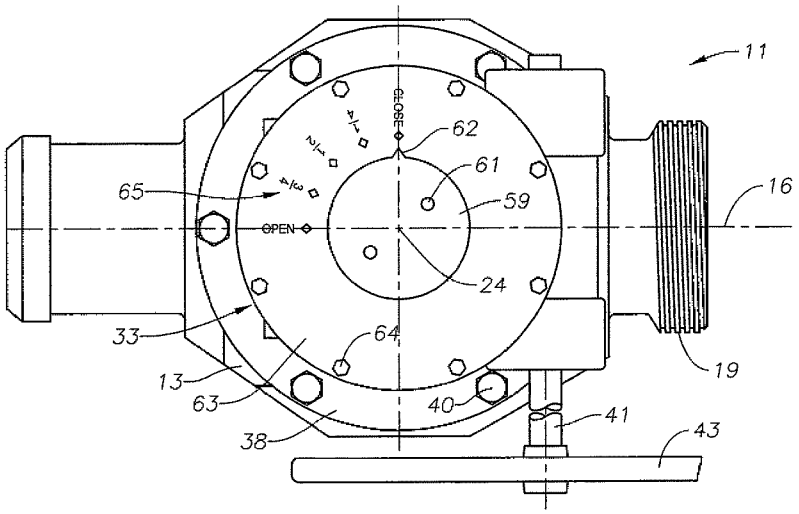

Fig. 1

(57) **Abstract**: A valve has a body having a rotatable valve element. A drive mechanism has a drive input member and a drive output member that are coupled to the valve element for rotating the valve element. A shear member is operatively located within the drive mechanism between the drive input member and the drive output member for shearing in the event the force to rotate the valve element is excessive. The valve has indicia indicating open and closed positions for the valve element An indicator is mounted to output drive member to properly align with the indicia regardless whether the shear member has sheared or not.

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PLUG VALVE INDICATOR

Cross-Reference to Related Application:

This application claims priority to provisional application S.N. 61/183,617, filed June 3, 2009.

Field of the Invention:

This invention relates in general to plug valves for flowlines and in particular to an indicator that indicates the position of the plug.

Background of the Invention:

In hydraulic fracturing of wells, large pumps are connected to a wellhead by temporary flow lines to pump high volumes of fluid into the well. The pressure is selected to be high enough to cause cracks or fracturing of the earth formation. Valves are employed in the flow lines to control the flow.

One type of valve has a body with a flow passage extending through it that intersects a central cavity. A rotatable valve element, such as a cylindrical plug, is mounted in the cavity. The valve element has a passage that aligns with the passage in the body when open. A drive mechanism is used to rotate the valve element between open and closed positions.

The drive mechanism may have a drive sleeve that is rotated by a hand wheel attached to a worm gear. A drive shaft fits within the bore of the sleeve and has an inner end coupled to the valve element. A shear key inserts between mating grooves between the drive shaft and the drive sleeve. Rotating the hand wheel thus causes the drive shaft to rotate the valve element. The drive mechanism may have a face with indicia to indicate the open or closed

position of the valve element. An indicator is mounted to the drive sleeve to align with the indicia.

High fluid pressure within the valve can require considerable force to rotate the hand wheel. If the force is too high, the shear key will shear, allowing the drive sleeve to rotate even though the valve element is not rotating. The indicator may indicate an erroneous position of the valve element because the indicator continues to rotate with the drive sleeve after the shear key shears.

Summary:

The valve of this invention has a body having a body passage therethrough intersected by a central cavity. A valve element having a valve passage therethrough is rotatably carried in the cavity for movement between an open position and a closed position. A drive mechanism having a drive input member and a drive output member is coupled to the valve element for rotating the valve element. A shear member is operatively located within the drive mechanism between the drive input member and the drive output member. The shear member shears in the event the force to rotate the valve element is excessive.

Indicia are located on the valve indicating open and closed positions for the valve element. An indicator is cooperatively mounted to valve element so that it is fixed for rotation with the valve element. The indicator points to the correct indicia regardless whether the shear member has sheared or not.

Preferably the indicator is fixed to the drive output member. The indicator may comprise a plate with a pointer, the plate being mounted to an outer end of the drive output member. The drive mechanism includes a housing having a face containing an aperture in one embodiment. The indicia are located on the face of the housing. Preferably, the output drive member comprises a drive shaft having an inner end in driving engagement with the

valve element and an outer end extending through the aperture in the housing. The indicator is fixed to the outer end of the drive shaft.

The indicator may comprise a plate secured to the outer end of the drive shaft, the plate having a pointer thereon. The plate may have a circular periphery with an outer diameter greater than the outer end of the drive shaft. In the preferred embodiment, the indicator is positioned farther from the valve element than the face of the housing.

Brief Description of the Drawings:

Figure 1 is a front elevational view of a plug valve constructed in accordance with this invention.

Figure 2 is a partial sectional view of the plug valve of Figure 1.

Figure 3 is a partial sectional view of a portion of the operator for the plug valve of Figure 1, shown removed from the plug valve.

Figure 4 is another sectional view of the operator of Figure 3, taken along the line 4--4 of Figure 3.

Figure 5 is a sectional view of the drive shaft for the plug valve of Figure 1, shown removed from the operator.

Figure 6 is an end view of the drive shaft shown in Figure 5.

Figure 7 is a back view of the operator of the plug valve of Figure 1, shown detached from the plug valve.

Detailed Description of the Invention:

Referring to Figure 2, in this example, valve 11 is shown as a plug valve. Valve 11 has a body 13 with a flow passage 15 extending through it along an axis 16. A cavity 17 is located in the central portion of flow passage 15. In this example, cavity 17 is cylindrical. Flow passage 15 has opposite ends for securing into a flow line. The ends may be configured in any suitable manner, and in this embodiment, external threads 19 are located on one end and a rotatable coupling sleeve 21 on the other.

A rotatable, cylindrical plug or valve element 23 is located within cylindrical cavity 17. Valve element 23 is a cylindrical member that is rotatable about an axis 24 that is perpendicular to axis 16 of flow passage 15. Valve element 23 has a passage 25 that extends from one side to the other. When in the open position, passage 25 is coaxial with flow passage 15. When in the closed position, passage 25 is perpendicular to flow passage 15, blocking flow through passage 15. Valve element 23 sealingly engages seat rings 27 that are located at each junction of cavity 17 with flow passage 15. Seat rings 27 seal between flow passage 15 and valve element 23. Valve element 23 has a polygonal drive socket 29 on one end. The opposite end of valve element 23 is retained by a retainer plate 31. Retainer plate 31 is secured by fasteners to body 13.

A drive mechanism 33 is employed to rotate valve element 23 between open and closed positions. In this embodiment, drive mechanism 33 has a back side that mounts to an adapter plate 35, which in turn is secured to valve body 13 by fasteners (not shown). Drive mechanism 33 has a housing 37 with a base 38 that secures to adapter plate 35 by fasteners 40, shown also in Figure 7. Referring to Figure 3, drive mechanism 33 has a gear train that in this embodiment includes a worm gear 39. Worm gear 39 is formed on a shaft 41 that extends forward from housing 37. A hand wheel 43 (Figure 2) attaches to shaft 41 for rotating worm gear 39. Worm gear 39 meshes with and rotates a gear segment 45, which in

this embodiment is a fan-shaped member that extends 90°. Gear segment 45 abuts a stop 46 when rotated 90° in one direction. When rotated 90° in the other direction, it will abut another stop (not shown).

As shown in Figure 4, gear segment 45 is integrally formed or otherwise attached to an input member, such as a gear sleeve 47. Gear sleeve 47 is carried within housing 37 for rotation about axis 24 of valve element 23. An output member, such as drive shaft 49, extends into a central cylindrical bore in gear sleeve 47. Drive shaft 49 has an axially extending groove or keyway 51, shown in Figures 2 and 5, that receives a shear key 53 (Figure 2). Key 53 protrudes from keyway 51 into engagement with a keyway 57 (Figures 2 and 7) located in the inner diameter of gear sleeve 47. Key 53 transmits rotation of gear sleeve 47 to drive shaft 49.

Drive shaft 49 has a polygonal drive member 55, shown in Figures 5 and 6, on its inner end that engages polygonal drive socket 29, as shown in Figure 2. In this embodiment, drive member 55 has two flat sides, providing a generally rectangular configuration with rounded ends. Other shapes are suitable.

Referring to Figure 4, a circular, flat indicator plate 59 is secured to the front or outer end of drive shaft 49 by fasteners 61. Indicator plate 59 thus rotates in unison with drive shaft 49. Indicator plate 59 has a pointer 62, shown in Figure 3, on its circumference. Referring still to Figures 3 and 4, a circular non rotatable cover plate 63 is secured by fasteners 64 to the front end of operator housing 37. Cover plate 63 is flat and forms a face for housing 37. Cover plate 63 has a central aperture through which the outer end of drive shaft 49 extends a short distance. Cover plate 63 has a greater outer diameter than indicator plate 59, which is located on a front side of cover plate 63. The outer diameter of indicator plate 59 is greater than the central aperture within cover plate 63. As shown in Figures 1 and 3, indicia 65 are placed on the front side of cover plate 63 in a 90 degree array relative to plug

axis 24. Pointer 62 points to indicia 65 to inform the operator the particular rotational position of drive shaft 49, and thus the rotational position of valve passage 25 (Figure 2) relative to flow passage 15.

During operation, when valve 11 is in the closed position, pointer 62 will point toward the portion of indicia 65 indicating that the valve is closed, as shown in Figures 1 and 3. When the operator rotates hand wheel 43, worm gear 39 will rotate gear segment 45, causing drive shaft 49 to move from the closed position toward the open position. Indicator plate 59 will rotate in unison with drive shaft 49. If the pressure in flow passage 15 is very high, a significant force may be required to rotate valve element 23 from the open to the closed position. If the force is excessive, key 53 will shear to avoid excessive damage to drive mechanism 33. If key 53 shears, the operator may continue to rotate hand wheel 43, which will continue to cause gear sleeve 47 to rotate. However, drive shaft 49 will not rotate with gear sleeve 47. Indicator plate 59 will not rotate either because it is affixed to drive shaft 49 for rotation therewith. Consequently, the operator will know the exact rotational position of valve element 23 even if key 53 has sheared.

While the invention has been shown in only one of its forms, it should be apparent to those skilled in the art that it is not so limited but is susceptible to various changes without departing from the scope of the invention.

Claims:

1. A valve, comprising:

a body having a body passage therethrough intersected by a central cavity;

a valve element having a valve passage therethrough and rotatably carried in the cavity for movement between an open position with the valve passage and the body passage aligned and a closed position;

a drive mechanism having a drive input member and a drive output member that is coupled to the valve element for rotating the valve element;

a shear member operatively located within the drive mechanism between the drive input member and the drive output member that shears in the event the force to rotate the valve element is excessive, resulting in the drive input member being rotatable relative to the drive output member;

indicia on the valve indicating open and closed positions for the valve element; and

an indicator cooperatively mounted to valve element that aligns with the indicia, the indicator being fixed for rotation with the valve element regardless whether the shear member has sheared or not.

2. The valve according to claim 1, wherein;

the indicator is fixed to the drive output member.

3. The valve according to claim 1, wherein;

the indicator comprises a plate with a pointer, the plate being mounted to an outer end of the drive output member.

4. The valve according to claim 1, wherein:

the drive mechanism includes a housing having a face containing an aperture;

the indicia are located on the face of the housing;

the output drive member comprises a drive shaft having an inner end in driving engagement with the valve element and an outer end extending through the aperture in the housing; and

the indicator is fixed to the outer end of the drive shaft.

5. The valve according to claim 4, wherein the indicator comprises a plate secured to the outer end of the drive shaft, the plate having a pointer thereon.

6. The valve according to claim 5, wherein the plate has a circular periphery with an outer diameter greater than the outer end of the drive shaft.

7. The valve according to claim 5, wherein the indicator is positioned farther from the valve element than the face of the housing.

8. A valve, comprising:

a body having a body passage therethrough intersected by a cavity;

a valve element having a valve element passage and rotatably carried in the cavity for movement between an open position with the valve element and body passages aligned and a closed position;

a drive mechanism having an input sleeve with a bore;

an output shaft located within the bore of the input sleeve, the output shaft having an inner end cooperatively coupled with the valve element for rotating the valve element in response to rotation of the output shaft;

a shear member and keyway located between the input sleeve and the output shaft, the shear member allowing rotation of the input sleeve relative to the output shaft if the shear members shears;

a housing enclosing the drive mechanism, the housing having a face with an aperture surrounding an outer end of the output shaft;

indicia on the face adjacent the aperture indicating open and closed positions for the valve element; and

an indicator on the outer end of the output shaft that aligns with the indicia to indicate the position of the valve element.

9. The valve according to claim 8, wherein:

the outer end of the input shaft protrudes through the aperture past the face.

10. The valve according to claim 8, wherein:

the indicator comprises a plate secured to the outer end of the output shaft, the plate being substantially parallel with the face of the housing, the plate having a pointer thereon.

11. The valve according to claim 8, wherein:

the aperture in the face of the housing is circular; and

the plate has a circular periphery with an outer diameter greater than an outer diameter of the aperture.

12. The valve according to claim 8, wherein the indicator is positioned farther from the valve element than the face of the housing.

13. In a valve having a body with a body passage therethrough intersected by a cylindrical cavity, and a cylindrical valve element having a valve element passage and rotatably carried in the cavity for movement between an open position with the valve element and body passages aligned and a closed position, an improved drive mechanism, comprising:

a worm gear and a hand wheel for rotating the worm gear;

an input sleeve having exterior gear teeth that mesh with the worm gear, the input sleeve having a bore;

an output shaft located within the bore of the input sleeve, the output shaft having an inner end cooperatively coupled with the valve element for rotating the valve element in response to rotation of the output shaft;

a shear member located in mating keyways between the input sleeve and the output shaft, the shear member allowing rotation of the input sleeve relative to the output shaft if the shear members shears;

a housing enclosing the worm gear, input sleeve and output shaft, the housing having a face with an aperture through which an outer end of the output shaft extends;

indicia on the face adjacent the aperture indicating open and closed positions for the valve element; and

an indicator fixed to the outer end of the output shaft, the indicator aligning with the indicia to indicate the position of the valve element.

14. The valve according to claim 13, wherein:

the indicator comprises a plate secured to the outer end of the output shaft, the plate being substantially parallel with the face of the housing, the plate having a pointer thereon.

15. The valve according to claim 13, wherein:

the aperture in the face of the housing is circular; and

the plate has a circular periphery with an outer diameter greater than an outer diameter of the aperture.

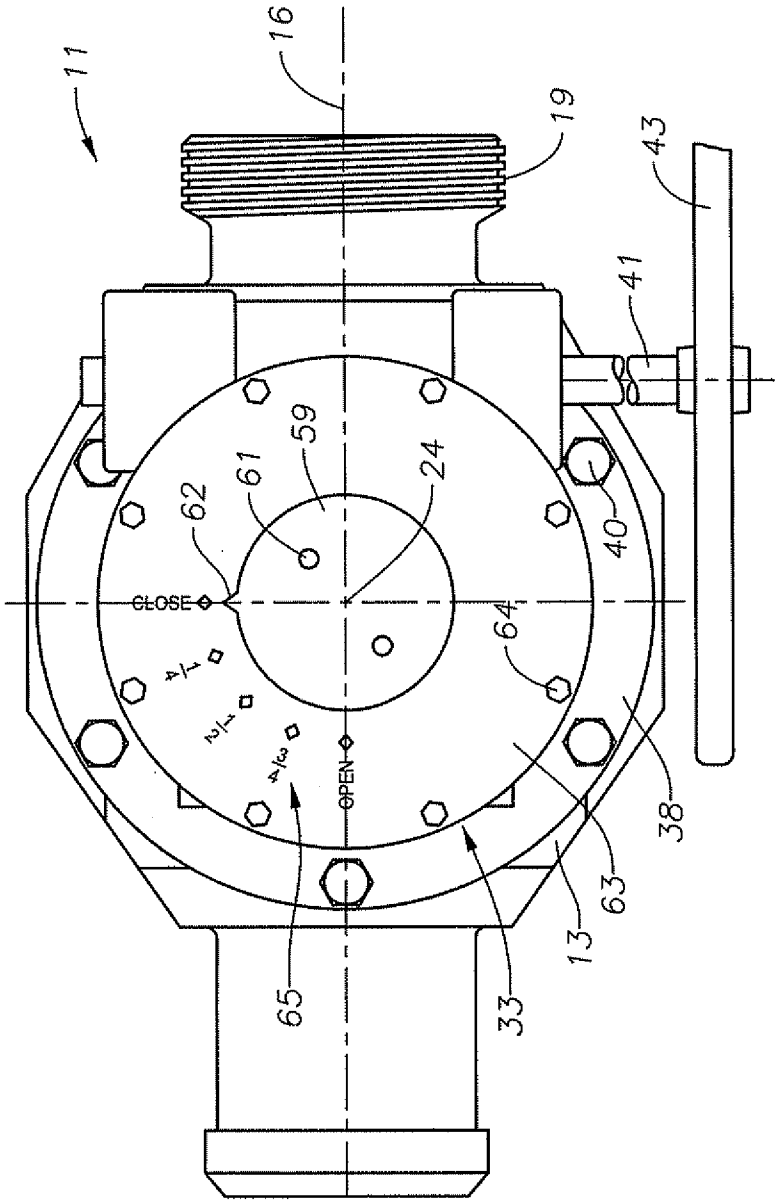

Fig. 1

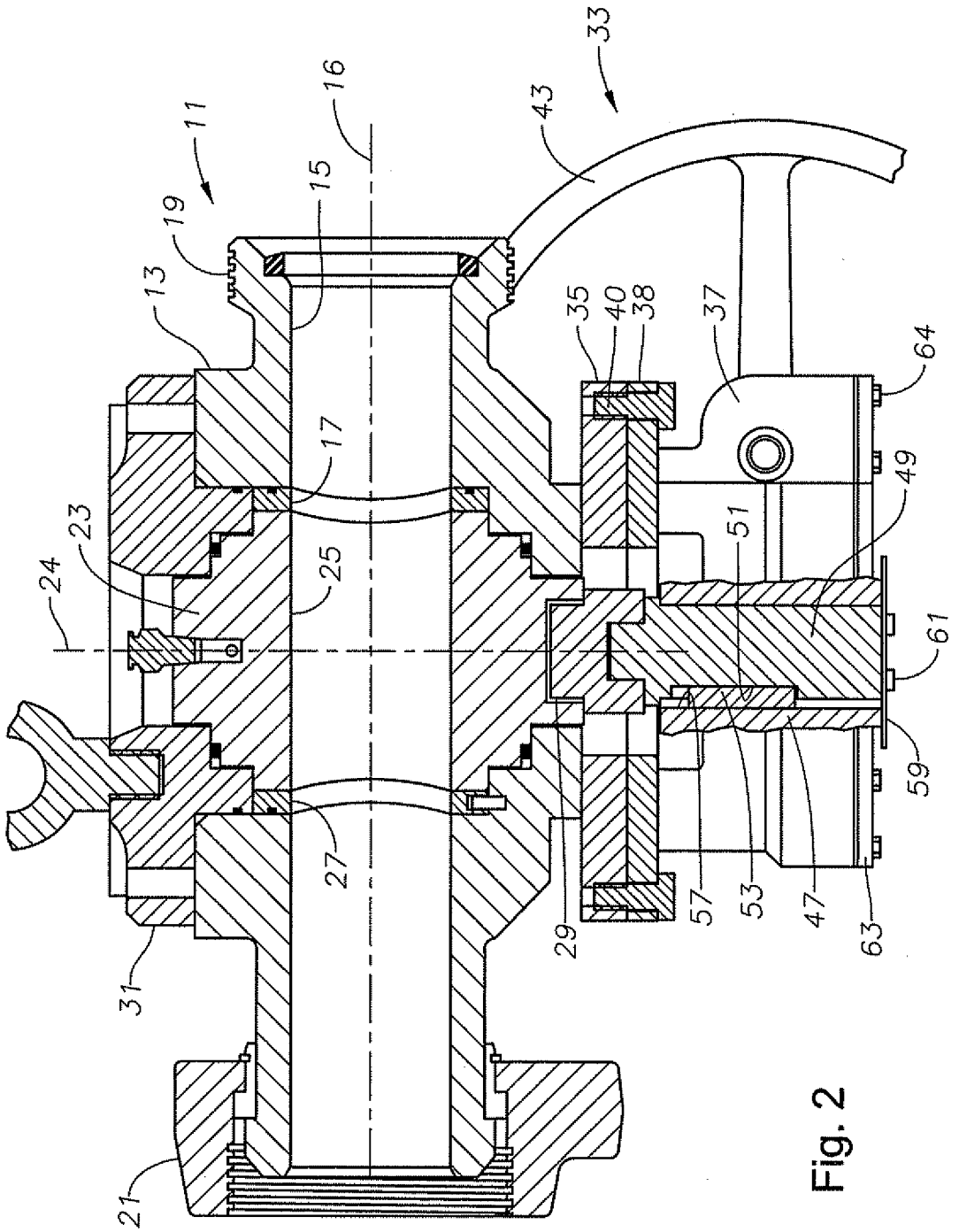
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Fig. 2

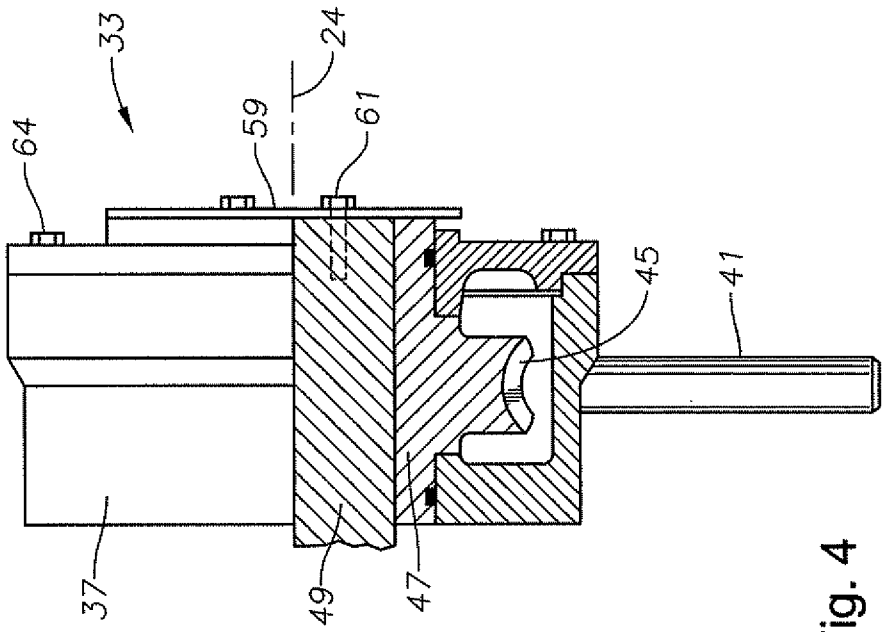
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Fig. 4

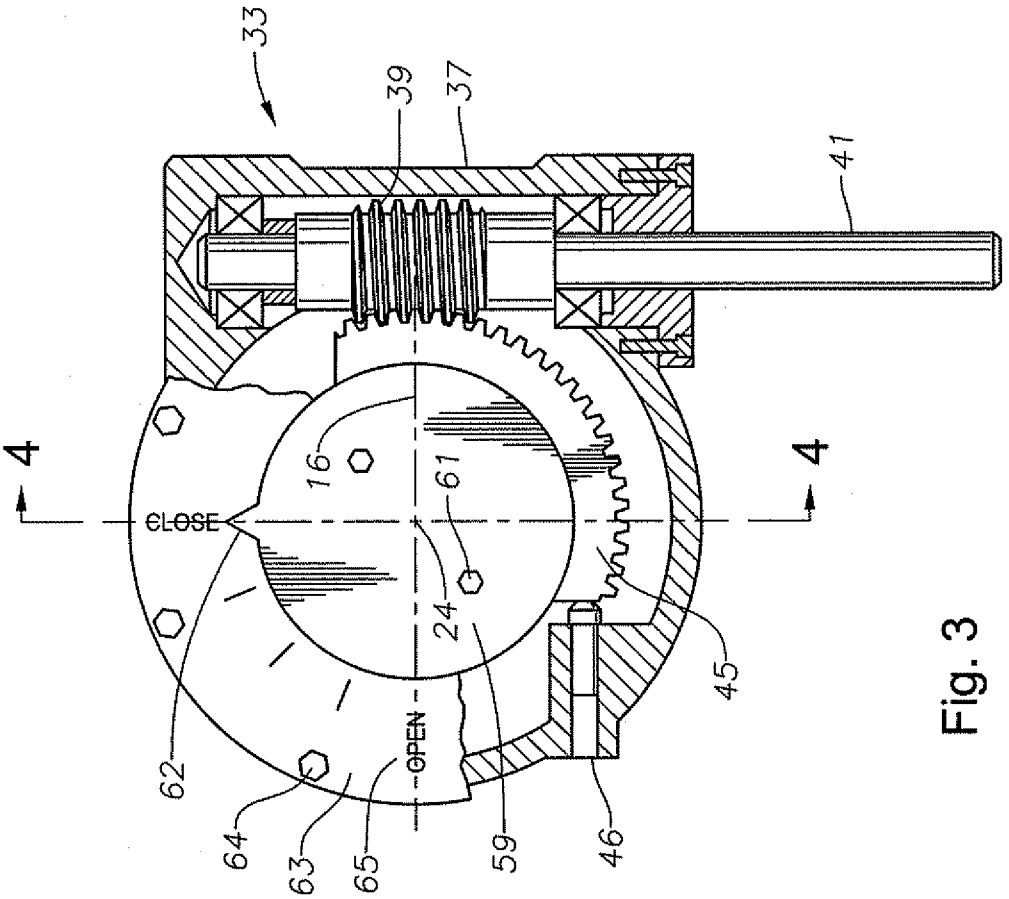
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Fig. 3

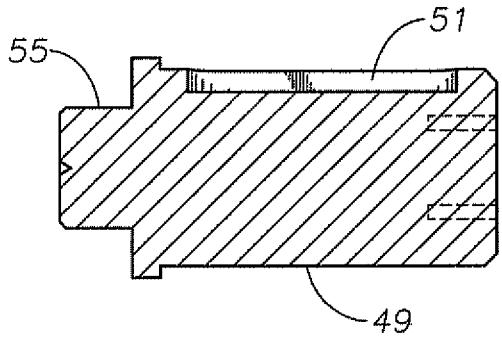

Fig. 5

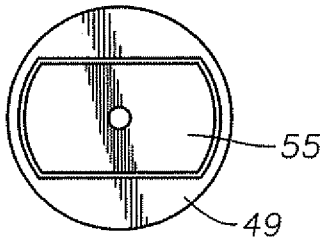

Fig. 6

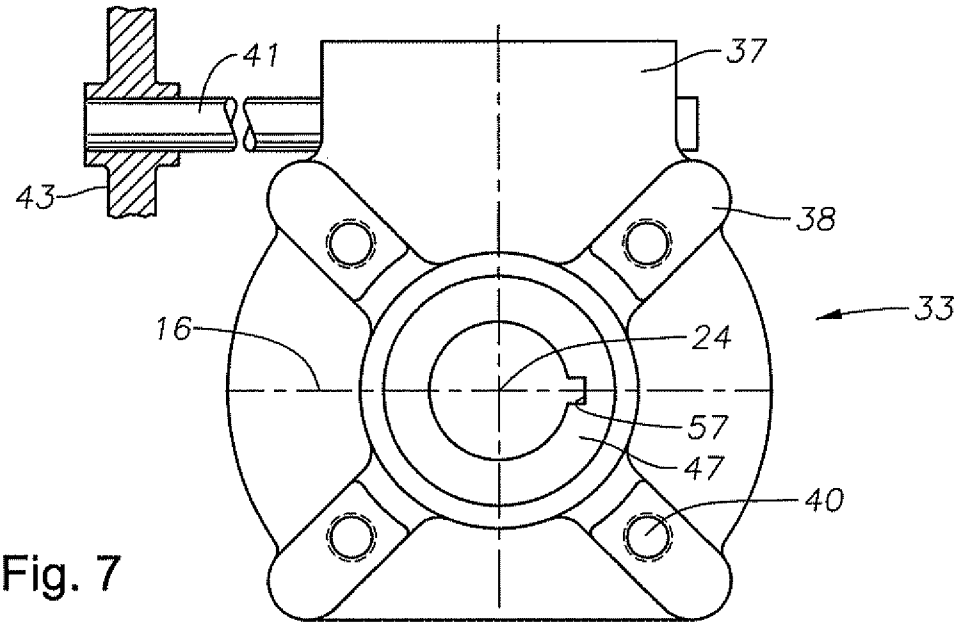

Fig. 7