United States Patent [19]

Grenci

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[54] **VALVING MACHINE**

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[51] **Int. Cl.**..... **B25b 17/00,** B25b 21/00, B67b 7/08

[58] **Field of Search**..... 81/57.11, 57.18, 57.2, 81/57.31, 57.34, 57.36, 3.2; 29/240; 53/317, 331.5

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Attorney, Agent, or Firm—Philip M. Hinderstein

[57] **ABSTRACT**

A machine for inserting or removing a valve into or from a cylinder including means for securely holding the cylinder to prevent rotation thereof and a pair of self-adjusting, power actuated, valve tongs pivotable about a pair of parallel, spaced axes to permit one ends thereof to come into contact with opposite sides of the valve. Drive means is operative to rotate the tongs about an axis aligned with the axis of the valve to rotate the valve relative to the cylinder. The same drive means, through a power multiplying, planetary gear arrangement urges the one ends of the tongs into contact with the opposite sides of the valve with a greater torque than that used to rotate the valve whereby the tongs tightly hold the valve during turning thereof relative to the cylinder.

8 Claims, 4 Drawing Figures

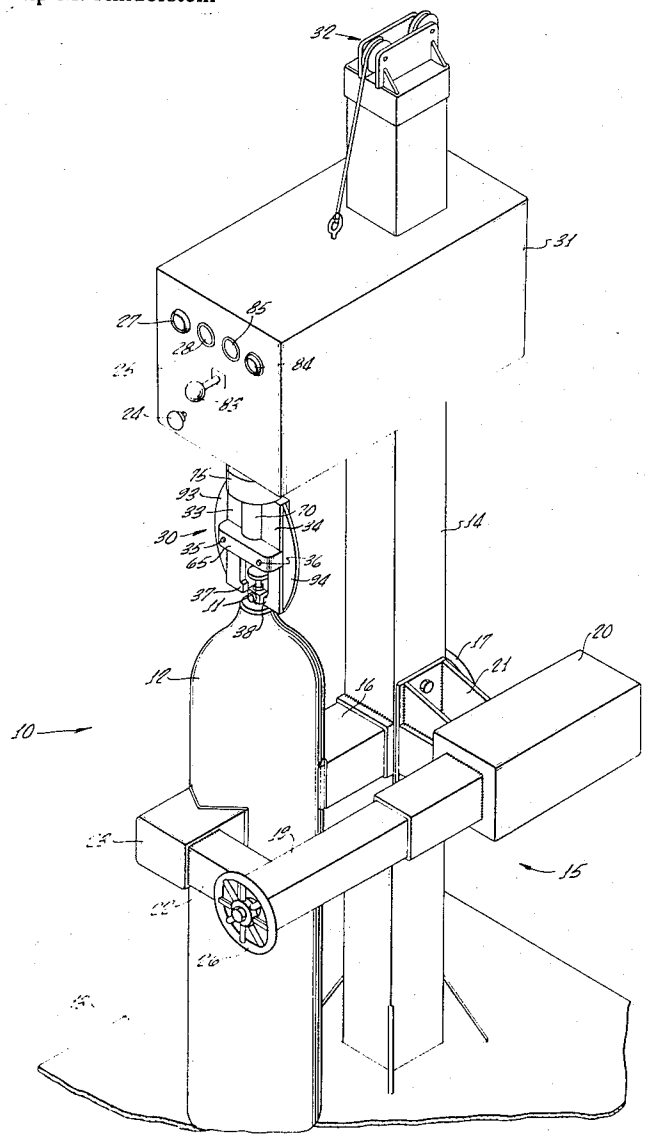

FIG. 1.

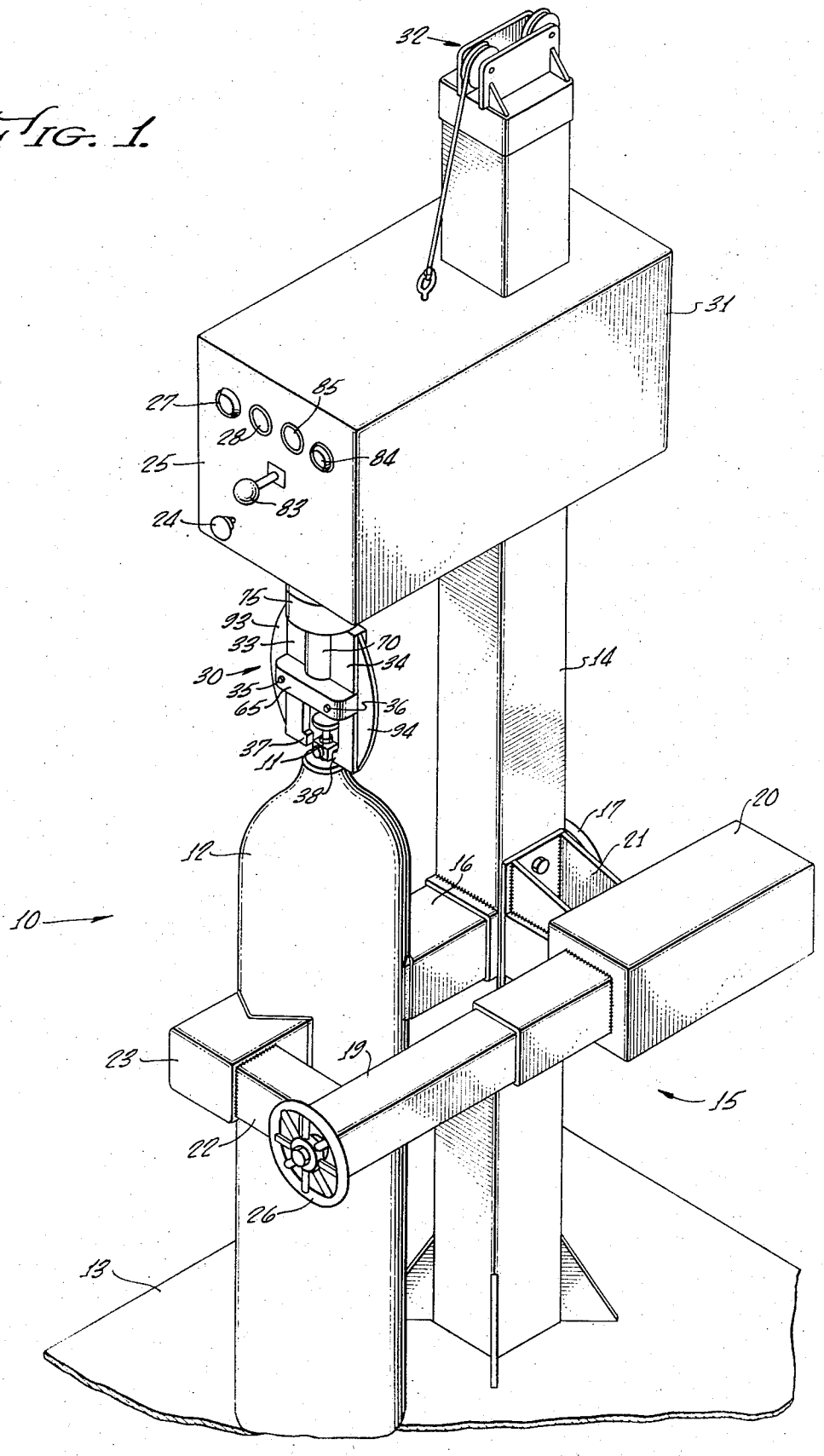
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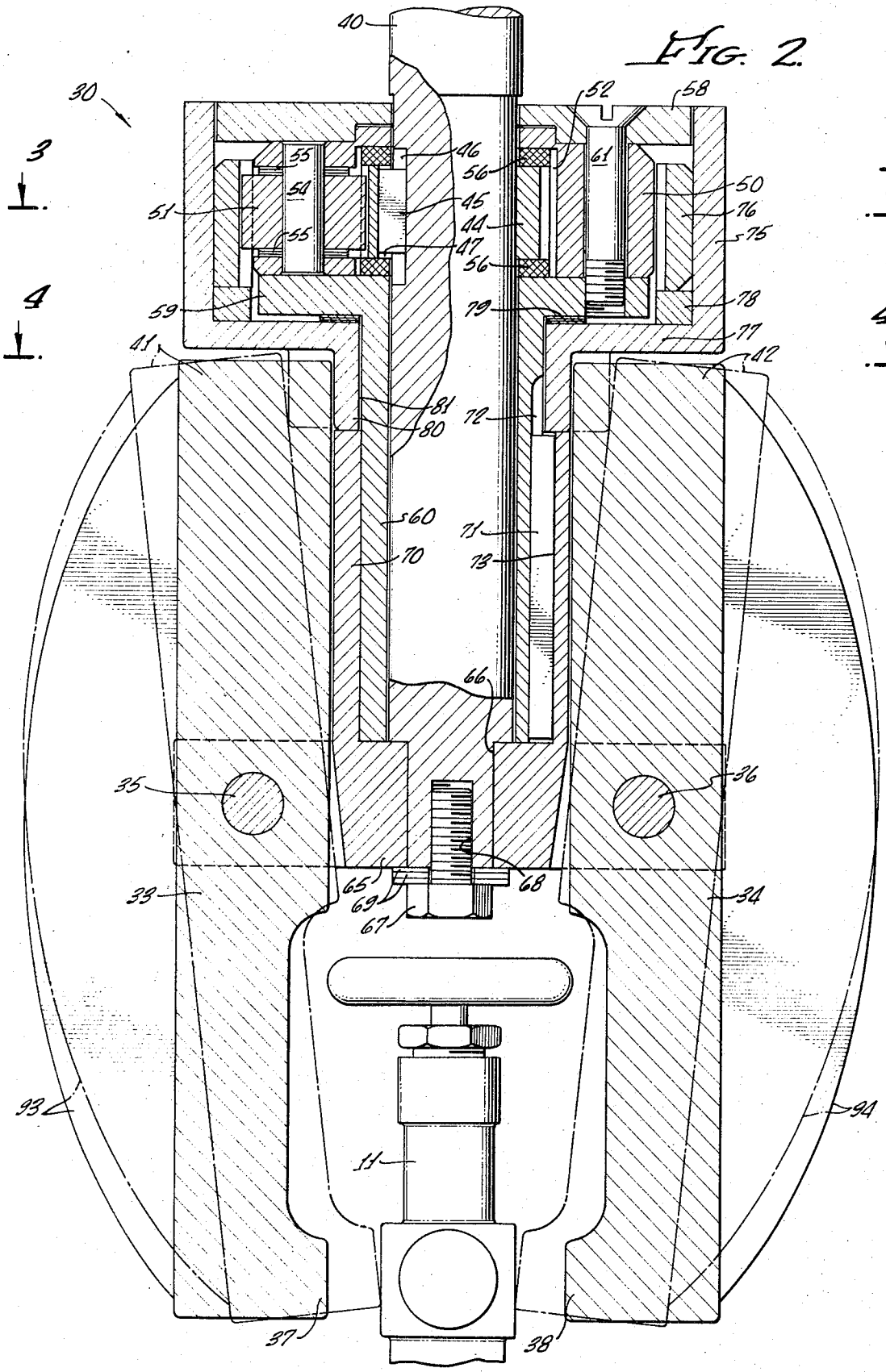
FIG. 2.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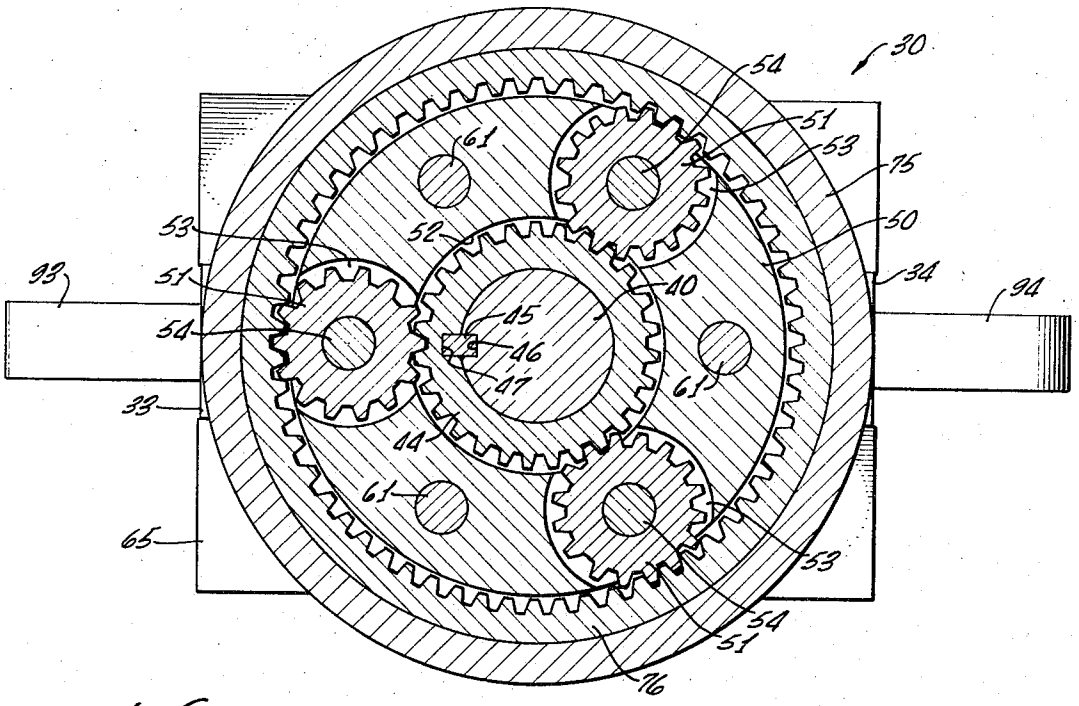
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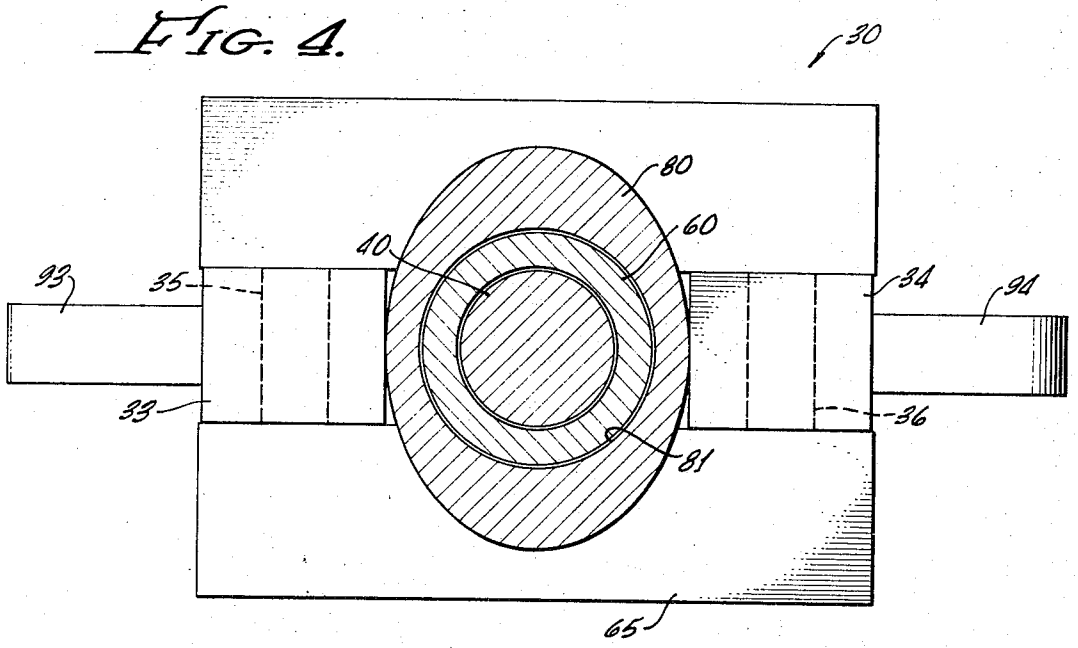
FIG. 3.

FIG. 4.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VALVING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a valving machine and, more particularly, to a valving machine including self-adjusting, power actuated, valve tongs that provide a positive, non-slip hold on a valve no matter how tight it is.

2. Description of the Prior Art

Many machines are presently on the market for inserting or removing valves into or from pressure cylinders. Such machines are required to initially insert the valves into the cylinders with the required torque to insure a fluid-tight seal. Such machines are also required thereafter to remove the valves for normal maintenance thereof and periodic hydrostatic testing of the cylinders.

The cylinder has an internally threaded opening at the upper end thereof which receives the externally threaded stem of the valve. The body of the valve includes flats on opposite sides thereof which may be engaged for rotating the valve relative to the cylinder.

Prior art valving machines are of two general types, the crow-foot type and the mechanically adjusted clamp-tong type. The crow-foot type is characterized by a generally C-shaped member having a slot in the lower end thereof defining a pair of spaced arms for receiving the valve. Since the spacing between the arms is fixed, spacers are required for different sizes of valves.

Such valving machines have a number of disadvantages associated therewith. In the first instance, since the spacing between the arms is fixed, a certain amount of slack is required to fit the valve between the arms. However, this amount of slack can cause the arms to slip and damage the valve if the valve is exceptionally tight. Also, valves vary considerably in size from manufacturer to manufacturer as well as from new as compared to previously used valves and it is difficult to provide a firm hold.

Another problem results from the recent trend in the industry of valve manufacturing. The valves are ordinarily made from brass, but because of the expense of metals, lighter and lighter sections are being used. When using a wrench, as a crow-foot type valving machine essentially is, if the wrench slips, it can easily deform or damage the outlet connection or the safety device. Furthermore, as the wrench starts to turn, the valve material slightly deforms and no provision is made for taking up this slack.

The mechanically adjusted clamp-tong type valving machine was developed to at least partially solve these problems. This type of valving machine is characterized by a pair of tongs which are pivotable about a pair of parallel, spaced axes adjacent one ends of the tongs to permit the other ends of the tongs to be brought into contact with opposite sides of the valve body. Once the cylinder, valve, and tongs are positioned, the tongs are mechanically and manually tightened and locked to the valve body.

While this type of valving machine represents an improvement over the crow-foot type of machine, many of the problems still remain. More specifically, once the machine starts to operate and the tongs cause deformation of the valve body, there is no provision for taking up the slack created by such deformation. Furthermore, the forces on the tongs cause wear and distortion that precludes a positive grip. Thus, there is still the possibility that the tongs will slip thereby deforming or damaging the outlet connection or the safety device made integral with the valve.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a valving machine which solves the problems encountered heretofore. The present valving machine includes a pair of tongs pivotable about a pair of parallel, spaced axes so that one ends of the tongs may be brought into contact with opposite sides of the valve. With the present valving machine, the valve tongs are power actuated and self-adjusting so that a force urges the one ends of the tongs into contact with the opposite sides of the valve at all times during rotation of the tongs. Furthermore, the torque tending to urge the valve tongs into contact with the valve is greater than the torque rotating the tongs to insure that the tongs tightly hold the valve during turning thereof relative to the cylinder thereby preventing slipping thereof and potential damage to the valve.

Briefly, the present machine for inserting or removing a valve into or from a cylinder comprises means for securely holding the cylinder, a pair of tongs pivotable about a pair of parallel spaced axes, drive means, means operatively coupled between the drive means and the tongs for rotating the tongs with a torque T_1 about an axis spaced halfway between and perpendicular to the pair of axes, and power multiplication means operatively coupled between the drive means and the tongs for urging one ends of the tongs into contact with opposite sides of the valve with a torque T_2, where T_2 is greater than T_1 and the tongs tightly hold the valve during turning thereof relative to the cylinder.

OBJECTS

It is therefore an object of the present invention to provide a valving machine.

It is a further object of the present invention to provide a valving machine including self-adjusting, power actuated, valve tongs that provide a positive, non-slip hold on a valve no matter how tight it is.

It is a still further object of the present invention to provide a valving machine which prevents damage to valve parts.

It is another object of the present invention to provide a valving machine including a pair of valve tongs that automatically take up the slack between the gripping surfaces thereof and the valve body.

Still other objects, features, and attendant advantages of the present invention will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiment constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a valving machine constructed in accordance with the teachings of the present invention;

FIG. 2 is an enlarged, sectional view taken along the longitudinal axis of the drive shaft of the machine of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 in FIG. 2; and

FIG. 4 is a sectional view taken along the line 4—4 in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and, more particularly, to FIG. 1 thereof, there is shown a valving machine, generally designated **10**, for inserting or removing a valve **11** into or from a cylinder **12**. Cylinder **12** is of conventional construction including an internally threaded hole at the upper end thereof which receives the threaded stud of valve **11**. Thus, insertion or removal of valve **11** into or from cylinder **12** is achieved by holding cylinder **12** stationary and rotating valve **11**, as known in the art.

Valving machine **10** includes a base **13** on which is rigidly mounted a support column **14**. Intermediate the upper and lower ends of support column **14** is mounted apparatus, generally designated **15**, for securely holding cylinder **12** and for preventing rotation thereof. Movably mounted adjacent the top of support column **14** is apparatus, generally designated **30**, for engaging the opposite sides of valve **11** and for rotating valve **11** relative to cylinder **12**.

Cylinder holding means **15** includes a first arm **16**, one end of which has a generally V-shape to engage one side of cylinder **12**. The other end of arm **16** is mechanically connected to support column **14** so as to be movable axially relative thereto under control of a first hand wheel **17**. Arm **16** is movably connected to support column **14** in any suitable manner to provide for different sizes of cylinder **12**. Thus, as the diameter of cylinder **12** increases, hand wheel **17** may be rotated to decrease the length of arm **16** and as the diameter of cylinder **12** decreases, hand wheel **17** may be rotated to increase the length of arm **16**.

Cylinder holding means **15** also includes a second arm **19**, one end of which is movably connected to a power application unit **20** which is rigidly connected to support column **14** by bracket means **21**. The other end of arm **19** is connected by means **22** to an arm **23** positioned coaxially with arm **16**. The end of arm **23** facing arm **16** has a generally V-shape to engage the side of cylinder **12** opposite from arm **16**.

Power application unit **20** may be a conventional air driven unit for pulling in or pushing out arm **19** under control of a manual actuator **24** positioned on a control panel **25**. Thus, upon manipulation of actuator **25**, arm **19** is extended from unit **20** to separate arms **16** and **23** and to permit removal of cylinder **12**. A second hand wheel **26** may be provided to adjust the extended position of arm **19**. On the other hand, actuator **24** may be manipulated to cause power application unit **20** to withdraw arm **19**, bringing arms **23** and **16** into contact with the opposite sides of cylinder **12** to securely hold cylinder **12** relative to base **13** and support column **14**. Control panel **25** may also include a regulator **27** for controlling the force applied by application unit **20** to arm **19** and a gauge **28** to provide a readout of such force.

Valve rotating means **30** is supported on a head **31** which is movably mounted on support column **14**. Head **31** may be moved vertically by a counterbalanced cable and pulley arrangement, so as to adjust the position of valve rotating means **30** relative to base **13** for different sizes of cylinder **12**. Head **31** supports control panel **25** and the operating controls for valving machine **10**.

Valve rotating means **30** includes a pair of jaw tongs **33** and **34** which extend vertically downwardly from head **31** and are pivotable about a pair of parallel, horizontal, spaced axes defined by pins **35** and **36**, respectively. Pins **33** and **34** permit ends **37** and **38** of jaw tongs **33** and **34**, respectively, to contact the opposite sides of valve **11** to hold valve **11** while it is being rotated to insert or remove same from cylinder **12**.

Referring now to FIGS. **2–4**, head **31** supports a drive shaft **40**, the axis of which is spaced halfway between and perpendicular to the axes of pins **35** and **36**. Furthermore, the axis of drive shaft **40** is adapted to be aligned with the common axis of valve **11** and cylinder **12**. The upper end of drive shaft **40** is connected to air driven power means, not shown, within head **31**. Drive shaft **40** is adapted to be operatively coupled to jaw tongs **33** and **34**, by means to be described hereinafter, for rotating tongs **33** and **34** around shaft **40** to insert or remove valve **11** into or from cylinder **12**. Drive shaft **40** is also adapted to be operatively coupled to the other ends **41** and **42** of jaw tongs **33** and **34**, respectively, to rotate tongs **33** and **34** about pins **35** and **36**, respectively, to urge ends **37** and **38** of tongs **33** and **34**, respectively, into contact with opposite sides of valve **11**.

More specifically, and referring primarily to FIGS. **2** and **3**, drive shaft **40** is surrounded by a sun gear **44** which is driven with shaft **40** by means of a key **45** positioned within opposing slots **46** and **47** in the outer surface of shaft **40** and the inner surface of sun gear **44**, respectively. Sun gear **44** is surrounded by an annular shaped planetary gear housing **50** which supports a plurality of identical planetary gears **51**. More specifically, housing **50** includes a central chamber **52** in which sun gear **44** is mounted and a plurality of outer chambers **53** in which planetary gears **51** are mounted in such a manner that the teeth on planetary gears **51** engage the teeth on sun gear **44**. Each of planetary gears **51** is mounted on a shaft **54**. Shims **55** may be positioned between gears **51** and housing **50** for spacing and support of gears **51**. In addition, bearings **56** may be positioned between sun gear **44** and housing **50** to provide axial support thereof.

Planetary gear housing **50** is mounted between an upper, disc-shaped plate **58** and a lower, disc-shaped flange **59** made integral with or connected to a drive tube **60** which is positioned around drive shaft **40**. Planetary gear housing **50** may be connected to plate **58** and flange **59** by means of a plurality of screws **61** which extend through mating holes in plate **58**, housing **50**, and flange **59**, such holes being spaced between chambers **53** in housing **50** so as not to interfere with the operation of planetary gears **51**. It should be noted that drive shaft **40** passes through central openings in plate **58**, flange **59**, and drive tube **60** and is not connected thereto.

Mounted at the lower end of drive shaft **40** is a generally H-shaped block **65**, the plane of which is perpendicular to the axis of drive shaft **40**. H-block **65** has a hole **66** passing through the central portion thereof through which the lower end of shaft **40** extends. A bolt **67** extends into an internally threaded bore **68** in the bottom of shaft **40**, the head of bolt **67** supporting a plurality of washers **69** which support H-block **65** for

rotational movement relative to shaft **40.** It is significant to note that there is no connection between H-block **65** and drive shaft **40** other than the rotatable support provided by washers **69.**

H-block **65** supports pins **35** and **36** on which jaw tongs **33** and **34,** respectively, are pivotably mounted. Thus, rotation of H-block **65** about the axis of hole **66** will rotate tongs **33** and **34,** as described previously.

H-block **65** includes a drive tube **70** made integral with or connected to the central section thereof, drive tube **70** having an inner diameter approximately equal to the outer diameter of drive tube **60,** drive tube **70** being mounted coaxially with and surrounding drive tube **60.** Drive tube **70** is driven with drive tube **60** by means of a key **71** positioned within opposing slots **72** and **73** in the outer surface of drive tube **60** and the inner surface of drive tube **70,** respectively. Thus, rotation of planetary gear housing **50** about the axis of drive shaft **40** causes rotation of drive tube **60** which, through the intermediary of key **71,** causes rotation of drive tube **70** and H-block **65** around drive shaft **40.** In this manner, the rotation of drive shaft **40** is transmitted to tongs **33** and **34,** as will be described more fully hereinafter.

Planetary gears **51** and planetary gear housing **50** are surrounded by an annular shaped cam drive housing **75** which supports a ring gear **76.** Ring gear **76** is connected to the inner surface of cam drive housing **75** in any suitable manner. The upper end of cam drive housing **75** is spaced from and surrounds the circumference of plate **58.** The lower end of cam drive housing **75** is connected to or made integral with a disc-shaped plate **77** which extends beneath flange **59** of planetary drive tube **60.** A spacer **78** positioned between plate **77** and ring gear **76** supports ring gear **76** in contact with planetary gears **51,** as shown most clearly in FIG. **3.** A bearing **79** positioned between the bottom surface of flange **59** and the top surface of plate **77** permits rotation of cam drive housing **75** relative to planetary gear housing **50.**

The inner circumference of plate **77** is spaced slightly from the outer surface of planetary drive tube **60.** Positioned beneath plate **77** is an elliptically shaped jaw cam **80,** shown most clearly in FIG. **4,** the plane of cam **80** being perpendicular to the axis of drive shaft **40.** Cam **80** has a hole **81** passing through the center thereof through which planetary drive tube **60** passes. Jaw cam **80** is connected to or made integral with plate **70** of cam drive housing **75** so as to be rotatable with cam drive housing **75** and ring gear **76.** Furthermore, cam **80** is position so as to be adjacent ends **41** and **42** of jaw tongs **33** and **34,** respectively, which terminate adjacent plate **77.**

The minor diameter of jaw cam **80** is equal to or less than the spacing between tongs **33** and **34** when tongs **33** and **34** are parallel, as shown in solid lines in FIG. **2.** On the other hand, the major diameter of cam **80** is substantially greater so that as cam **80** rotates relative to H-block **65,** ends **41** and **42** of tongs **33** and **34,** respectively, are driven outwardly, forcing ends **37** and **38** of tongs **33** and **34,** respectively, towards each other.

Drive shaft **40** is preferably driven by an air motor drive under control of a manual actuator **83** mounted on control panel **25.** Thus, movement of actuator **83** to the left will cause rotation of drive shaft **40** in one direction and movement of actuator **83** to the right will cause rotation of drive shaft **40** in an opposite direction. By making cam **80** elliptical, a single unit may be used for tightening or loosening valve **11.** Finally, control panel **25** may include a regulator **84** for controlling the force applied to drive shaft **40** and a gauge **85** to provide a readout of such force.

OPERATION

In order to operate valving machine **10,** actuator **24** is manipulated to release arm **19** so as to separate arms **16** and **23** to permit cylinder **12** to be inserted therebetween. With valve **11** positioned coaxially with drive shaft **40,** hand wheel **17** is manipulated to bring arm **16** into contact with one side of cylinder **12.** The desired force on cylinder **12** is adjusted by means of regulator **27** and manual actuator **24** is manipulated to activate power application unit **20.** Arm **23** is automatically brought into contact with the other side of cylinder **12,** securely holding cylinder **12** and preventing rotation thereof.

The control mechanism within valve rotating means **30** is next activated to bring ends **37** and **38** of jaw tongs **33** and **34,** respectively, into contact with the valve flats on the opposite sides of valve **11.** Assuming that one is inserting valve **11** into cylinder **12,** requiring clockwise rotation thereof, manual actuator **83** is manipulated so as to cause rotation of drive shaft **40** in a clockwise direction, as viewed in FIG. **3.** Rotation of drive shaft **40** in this direction causes counterclockwise rotation of planetary gears **51** about shafts **54.** Rotation of planetary gears **51** will cause one of two results. Either cam drive housing **75** and ring gear **76** will remain stationary and planetary gear housing **50** will rotate in a clockwise direction or planetary gear housing **50** will remain stationary and cam drive housing **75** will rotate in a counterclockwise direction. Initially, since jaw tongs **33** and **34** will be parallel and out of contact with valve **11,** it is desired to prevent the former type of motion and to permit the latter type. Since jaw tongs **33** and **34** are connected directly to planetary gear housing **50** by means of H-block **65,** drive tube **70,** key **71,** drive tube **60,** flange **59,** and screws **61,** the rotation of planetary gear housing **50** may be prevented by simply holding H-block **33** or one of tongs **33** and **34** to prevent rotation thereof. For this purpose and also for the purpose of stiffening tongs **33** and **34,** tongs **33** and **34** include outwardly projecting stiffening members **93** and **94,** respectively. Thus, one of stiffening members **93** or **94** may be held in one hand while actuator **83** is manipulated with the other hand.

With reference to FIGS. **2–4,** the clockwise rotation of drive shaft **40** causes counterclockwise rotation of planetary gears **51** about shafts **54.** Since planetary gear housing **50** is prevented from rotating, ring gear **76** and cam drive housing **75** are driven in a counterclockwise direction. Rotation of cam drive housing **75** causes rotation of cam **80** through the intermediary of plate **77.** Thus, cam **80** rotates relative to drive tubes **60** and **70,** driving ends **41** and **42** of tongs **33** and **34,** respectively, outwardly, tongs **33** and **34** pivoting about pins **35** and **36.** This action continues until ends **37** and **38** contact the opposite sides of valve **11.** When this occurs, cam **80** and cam drive housing **75** can no longer rotate independently of H-block **65** and tongs **33** and **34.** Thus, with cam **80** securely locked against ends **41** and **42** of tongs **33** and **34,** respectively, and with ends **37** and **38** of tongs **33** and **34,** respectively, firmly in

contact with the opposite sides of valve **11**, planetary gear housing **50** and cam drive housing **75** begin to rotate as a unit in a clockwise direction. As explained previously, rotation of planetary gear housing **50** with drive shaft **40** causes rotation of planetary drive tube **60** about the axis of drive shaft **40**. Planetary drive tube **60** drives H-block drive tube **70** by means of key **71** resulting in the rotation of H-block **65** and jaw tongs **33** and **34**. Thus, tongs **33** and **34** rotate valve **11** relative to cylinder **12**.

It should be particularly noted that the just described arrangement of sun gear **44**, planetary gears **51**, and ring gear **76** results in a power multiplication of the torque generated by drive shaft **40**. Thus, the torque T_2 urging ends **37** and **38** of tongs **33** and **34**, respectively, into contact with the opposite sides of valve **11** is multiplied with respect to the torque T_1 rotating tongs **33** and **34** about the axis of shaft **40**. This power multiplication insures that any deformation of valve **11**, causing a diminishing of the spacing between the sides thereof, automatically causes slipping of housing **75** relative to housing **50**, resulting in a counterclockwise rotation of cam **80** relative to H-block **65** to pivot tongs **33** and **34** by an amount which will take up such slack. Without this power multiplication, ends **37** and **38** of tongs **33** and **34**, respectively, would be forced to separate and the same problems would be encountered as experienced heretofore.

Many factors influence the power multiplication factor such as the relative diameters of sun gear **44**, planetary gears **51**, and ring gear **76**, the diameter of cam **80**, the length of tongs **33** and **34** relative to the location and spacing of pins **35** and **36**, etc. Suffice it to say that the torque urging ends **37** and **38** of tongs **33** and **34**, respectively, into contact with the opposite sides of valve **11** should be at least twice as great as the torque rotating H-block **65** and tongs **33** and **34**.

After valve **11** has been tightened, actuator **83** is manipulated in the other direction to cause reversal of shaft **40** and pivoting of jaw tongs **33** and **34** in an opposite direction so as to release valve **11**. Actuator **24** may then be manipulated to release arm **23**, permitting removal of cylinder **12**.

As stated previously, both power application unit **20** and valve rotating means **30** are preferably air motor drives. This is preferred since the torque can be adjusted by setting air regulators **27** and **84**. In addition, an air drive slows as the torque reaches the stall point so that brass valve threads have time to cold flow under pressure and conform themselves to the cylinder neck threads, thus reducing the possibility and nuisance of leaks.

It can therefore be seen that in accordance with the present invention, there is provided a valving machine **10** which solves the problems encountered heretofore. Valving machine **10** includes a pair of tongs **33** and **34** pivotable about a pair of parallel, spaced pins **35** and **36**, respectively, so that ends **37** and **38** of tongs **33** and **34**, respectively, may be brought into contact with opposite sides of valve **11**. With machine **10**, tongs **33** and **34** are power actuated and self-adjusting so that a force urges ends **37** and **38**, respectively, into contact with valve **11** at all times during rotation thereof. Furthermore, the torque tending to urge tongs **33** and **34** into contact with valve **11** is greater than the torque rotating tongs **33** and **34** to insure that the tongs tightly hold valve **11** during turning thereof relative to cylinder **12** thereby preventing slipping thereof and potential damage to valve **11**.

While the invention has been described with respect to a preferred physical embodiment constructed in accordance therewith, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrative embodiment, but only by the scope of the appended claims.

I claim:

1. A machine for rotating a first member relative to a second member comprising:
- means for securely holding said second member;
- a pair of tongs pivotable about a pair of parallel, spaced axes;
- drive means;
- means forming a direct, non-friction connection between said drive means and said tongs for rotating said tongs with a torque T_1 about an axis spaced halfway between and perpendicular to said axes; and
- power multiplication means operatively coupled between said drive means and said tongs for urging one ends of said tongs into contact with opposite sides of said first member with a torque T_2, T_2 being greater than T_1 whereby said tongs tightly hold said first member during turning thereof relative to said second member.

2. A machine according to claim **1** wherein T_2 is at least equal to $2T_1$.

3. A machine according to claim **1** wherein said power multiplication means is operatively coupled between said drive means and the other ends of said tongs, said parallel axes intersecting said tongs between said opposite ends thereof.

4. A machine according to claim **1** wherein said drive means comprises:
- a shaft positioned coaxially with said axis; and
- means for rotating said shaft.

5. A machine according to claim **4** wherein said tongs rotating means comprises:
- a sun gear mounted on said drive shaft;
- a planetary gear housing surrounding said sun gear;
- a plurality of planetary gears mounted within said housing and engaging said sun gear; and
- means interconnecting said planetary gear housing and said tongs.

6. A machine according to claim **5** wherein said power multiplication means comprises:
- a cam drive housing surrounding said planetary gear housing;
- a ring gear mounted within and connected to said cam drive housing, said ring gear engaging said planetary gears and being driven thereby; and
- cam means connected to said cam drive housing and being rotatable therewith, said cam means contacting the other ends of said tongs and being operative to pivot said tongs about said spaced axes upon rotation of said cam drive housing relative to said planetary gear housing.

7. A machine according to claim **6** wherein rotation of said drive shaft causes rotation but not translation of said planetary gears, causing rotation of said ring gear and said cam drive housing thereby rotating said cam

means and pivoting said tongs about said spaced axes until said one ends of said tongs contact said opposite sides of said first member, additional rotation of said drive shaft causing rotary translational movement of said planetary gears and said ring gear about said drive shaft axis thereby rotating said tongs while said cam means urges said one ends of said tongs into contact with said opposite sides of said first member.

8. A machine according to claim **4** wherein said means for rotating said shaft comprises:

an air motor.

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