



US 20070068669A1

(19) **United States**

(12) **Patent Application Publication**

**Lesko**

(10) **Pub. No.: US 2007/0068669 A1**

(43) **Pub. Date: Mar. 29, 2007**

(54) **PIPE GRIPPING RAM**

**Publication Classification**

(76) Inventor: **Gerald Lesko, Alberta (CA)**

(51) **Int. Cl.**  
*E21B 19/18* (2006.01)

(52) **U.S. Cl.** ..... 166/77.51; 166/85.1

Correspondence Address:  
**DINSMORE & SHOHL, LLP**  
**1900 CHEMED CENTER**  
**255 EAST FIFTH STREET**  
**CINCINNATI, OH 45202 (US)**

(57) **ABSTRACT**

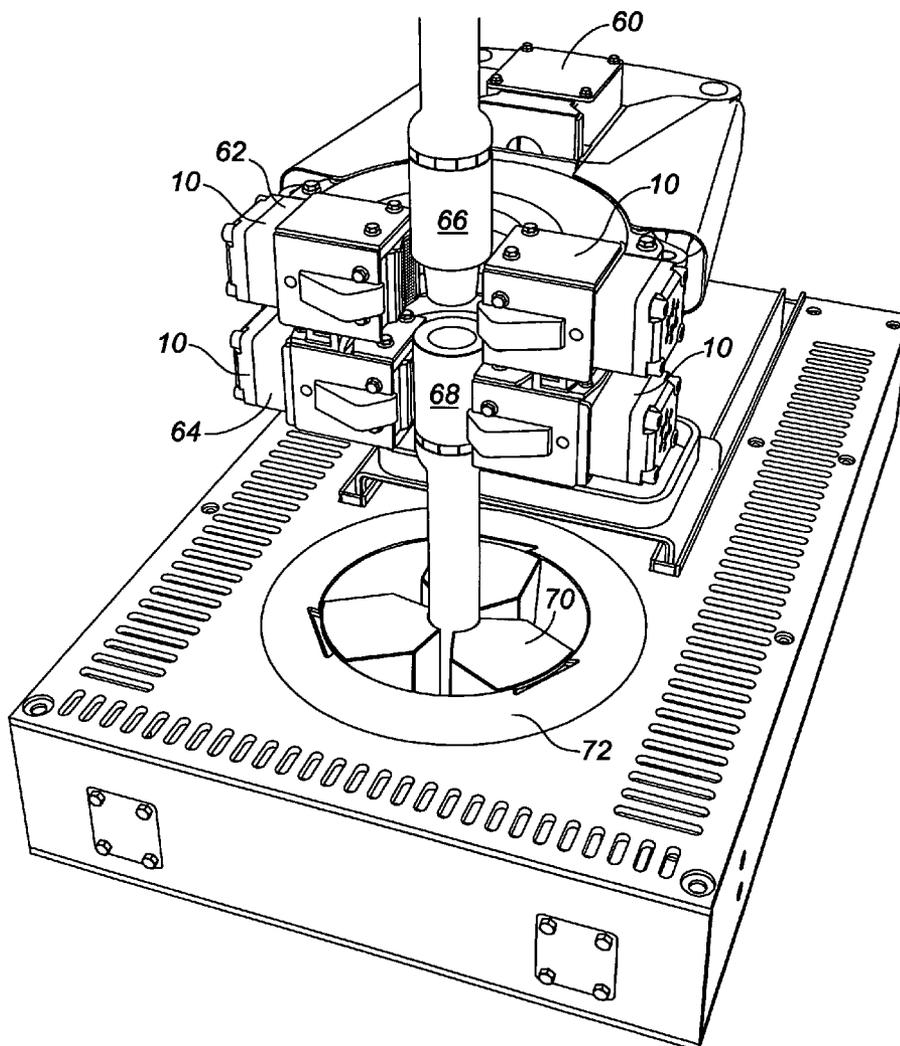
A ram is provided for use in the live and dead heads of an iron roughneck. The ram grips sections of pipe as connections are made or broken between the pipe sections. The ram includes a cylinder block having a bore and a fixed piston centered therein forming an annulus. An annular piston slides in and out of the cylinder block in the annulus. A tong mounted on the end of the annular piston for gripping pipe includes a tong shoe and a tong die within the shoe. The tong die is capable of moving side-to-side within the shoe to self-center itself when gripping pipe. Pressurized gas or hydraulic fluid systems can be used to extend and retract the annular piston within the cylinder block.

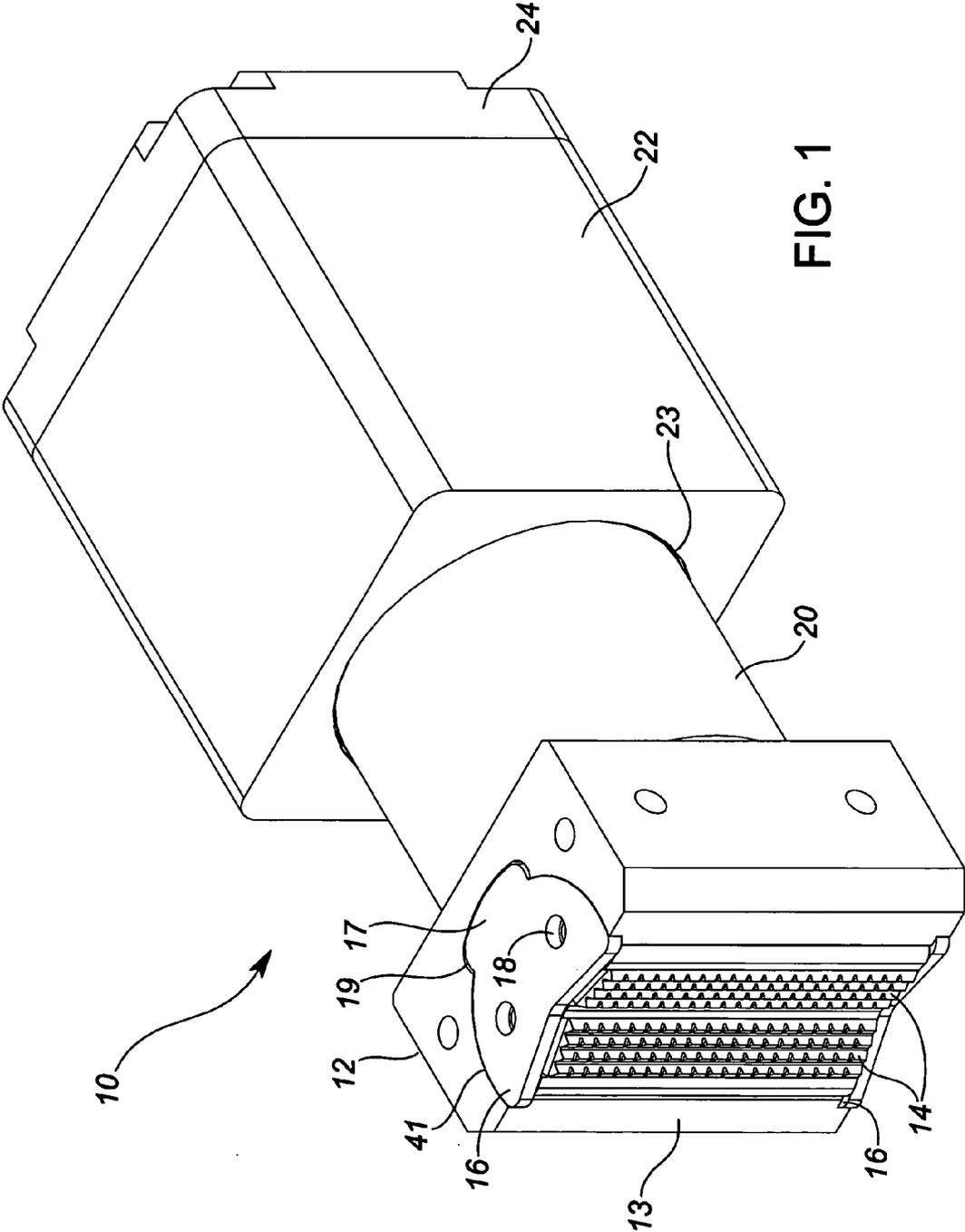
(21) Appl. No.: **11/371,383**

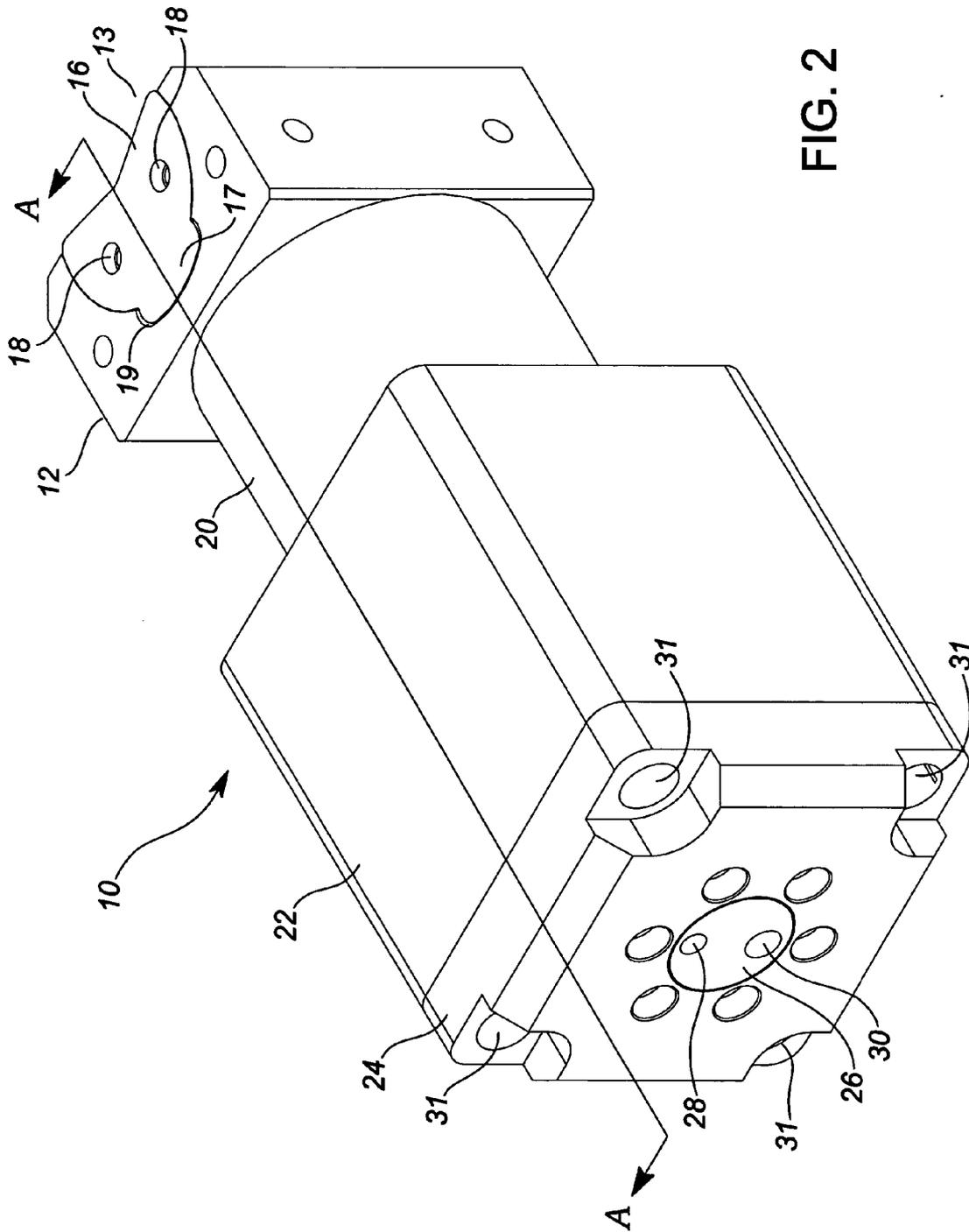
(22) Filed: **Mar. 9, 2006**

(30) **Foreign Application Priority Data**

Sep. 23, 2005 (CA) ..... 2,520,927







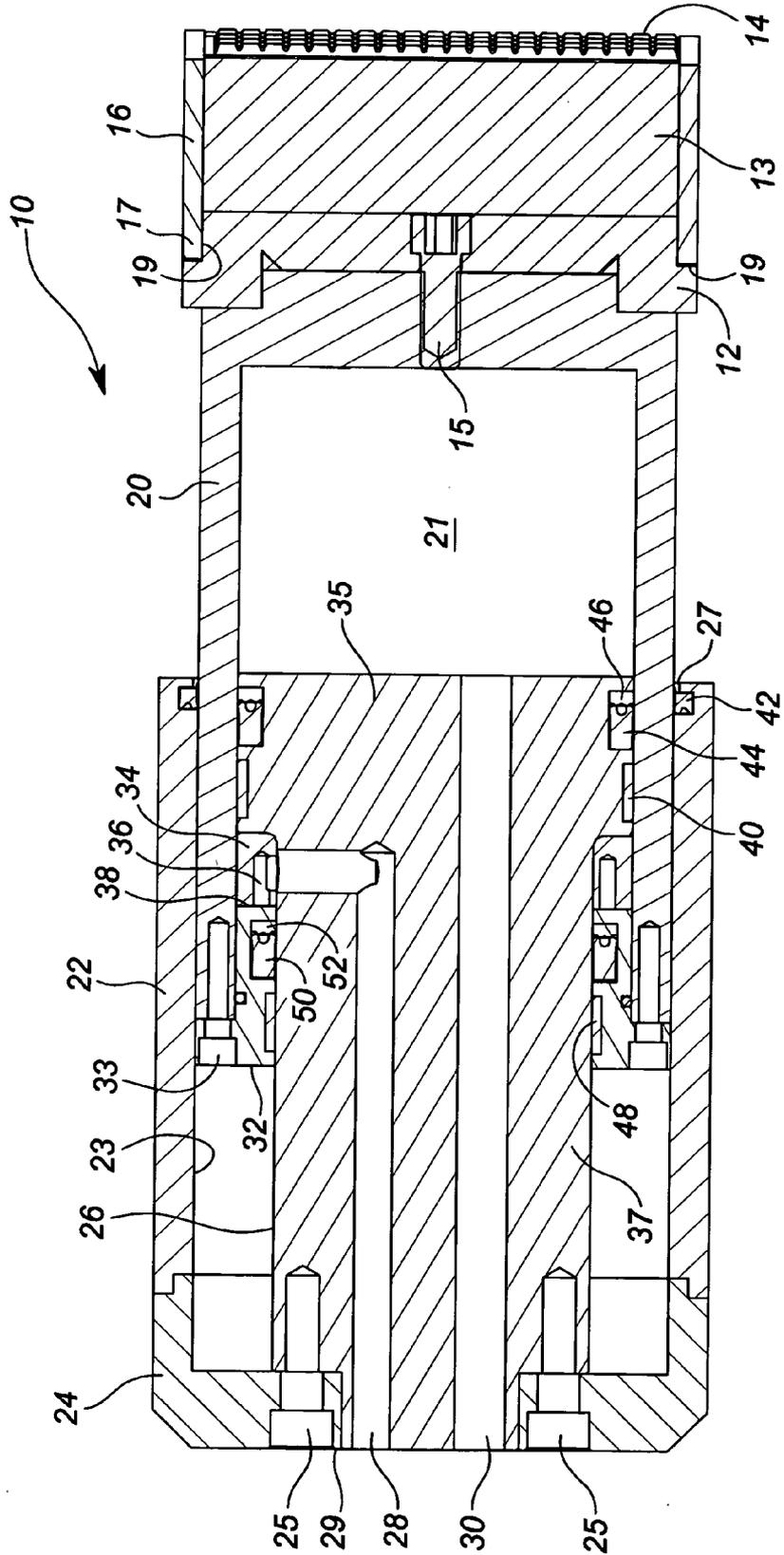


FIG. 3a

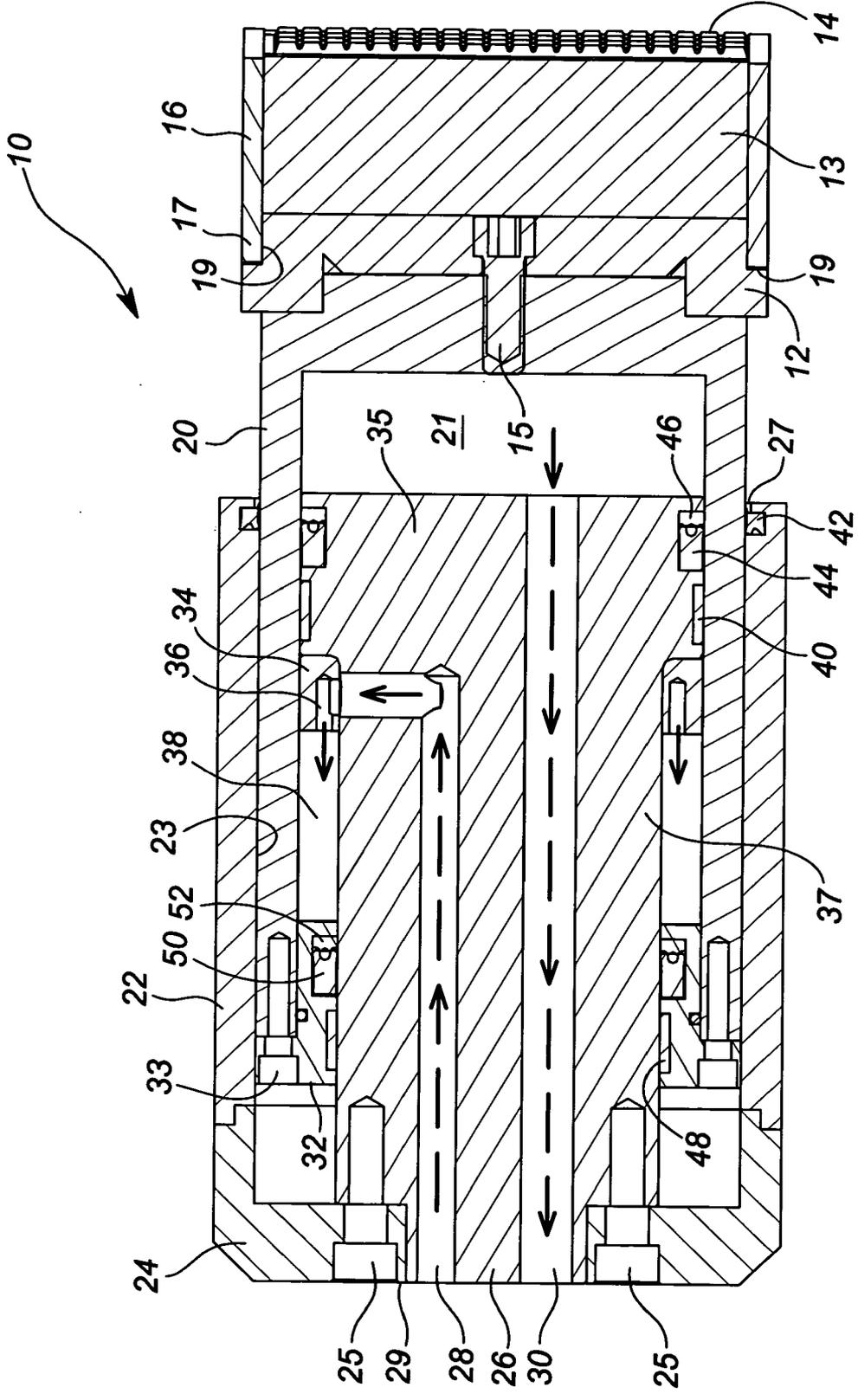


FIG. 3b

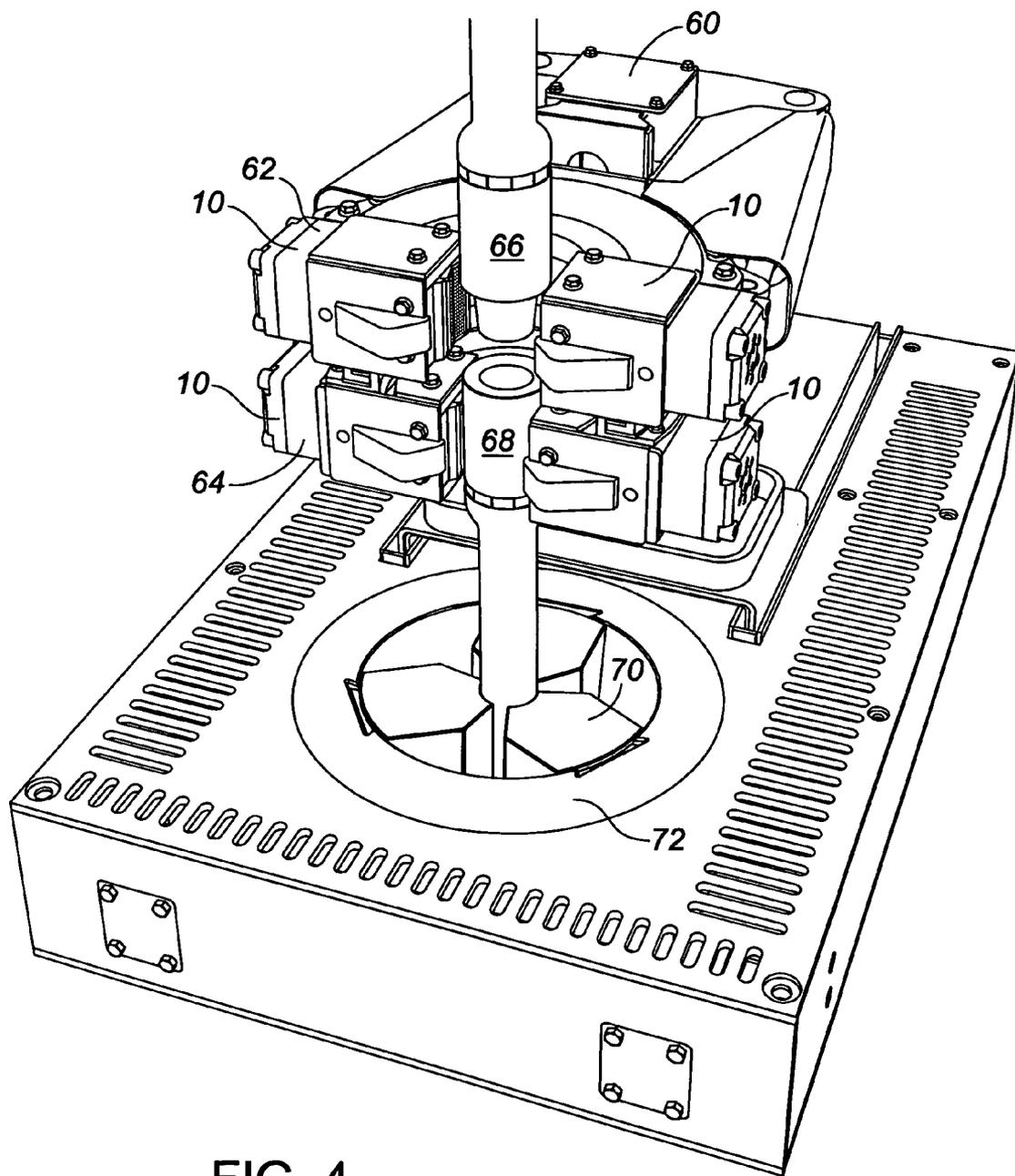
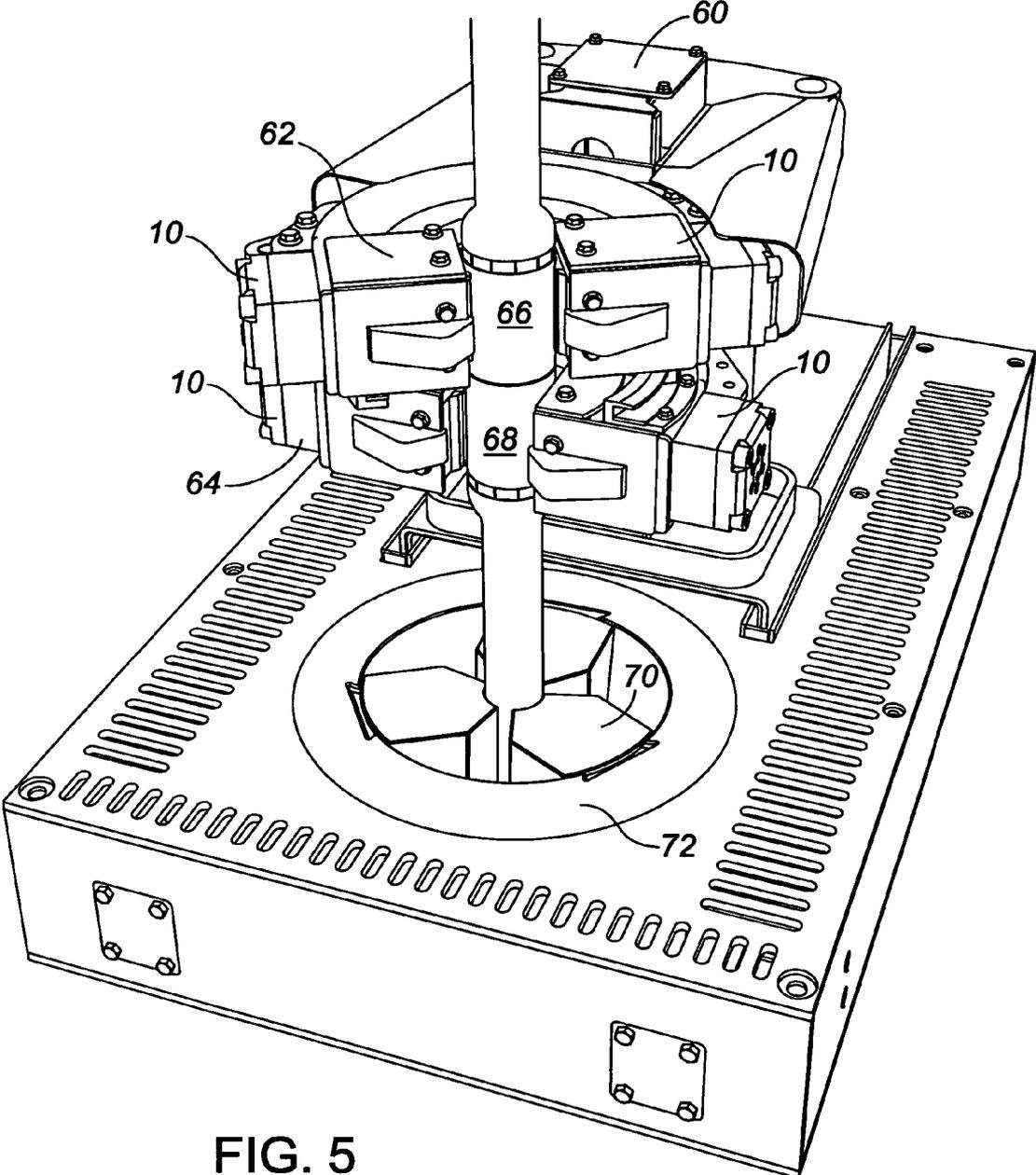


FIG. 4



## PIPE GRIPPING RAM

### FIELD OF THE INVENTION

[0001] The present invention relates to the field of rams for gripping drilling pipe. More specifically, the present invention relates to pipe gripping rams on automated iron roughnecks used on drilling rigs.

### BACKGROUND OF THE INVENTION

[0002] Automated iron roughnecks are used on drilling rigs to perform the often dangerous tasks of making and breaking joints between sections of drilling pipe. An iron roughneck usually has two sets of jaws with pipe gripping tongs positioned in a vertical configuration, one on top of the other. The lower set of jaws or "dead head" holds the box end of the section of pipe connected to the drill string. The upper set of jaws or "live head" grasps the pin end of the section of pipe being joined to or removed from the drill string. The dead head tongs hold the drill string steady while the live head tongs turn the pin end of the pipe section clockwise to make a pipe connection or counter-clockwise to break a pipe connection. Depending on the diameter of the pipe used in the drill string and the amount of force used in turning the drill string to drill a hole, it may take several hundreds of foot-pounds of torque to break a connection between sections of pipe.

[0003] It is, therefore, desirable to have a pipe gripping ram used in the dead head and live head tongs of an iron roughneck that is capable exerting the force required to make and break joints between sections of drilling pipe.

### SUMMARY OF THE INVENTION

[0004] In accordance with an embodiment of the present invention, a ram is provided for use with a live head or dead head tong to grip sections of drilling pipe. Each live head or dead head tong has two rams facing towards each other. When a pipe is grasped by the live head or dead head, the rams extend tong dies towards the pipe until contact is made with sufficient force to keep the tong dies from slipping on the pipe when a joint is made or broken between sections of pipe.

[0005] Each ram comprises a cylinder block having a horizontal bore with a longitudinal axis extending through the block. For ease of manufacturing, the bore can be cylindrical although it should be obvious to those skilled in the art that other cross-sectional shapes (such as elliptical or rectangular) can be used.

[0006] One end of the block has an end cap enclosing the bore from that end. A fixed piston is disposed within the bore and is attached to the end cap. The fixed piston has a head and a neck. The head is larger in diameter than the neck. The neck end of the fixed piston is attached to the end cap such that the piston head is centered within the bore to form a substantially uniform annulus between the fixed piston head and the interior cylinder wall.

[0007] A first end of an annular piston slidably couples with the fixed piston such that the annular piston is capable of linear reciprocal motion along the annulus. The second end of the annular piston has a pipe gripping tong attached to it thereby forming a first chamber within the annular piston between its second end and the fixed piston. An

annular ring or stop is attached to the first end of the annular piston and slides along the neck of the fixed piston. The combination of the fixed piston head, the annular piston and the annular ring forms a second annular chamber disposed about the fixed piston neck. The transition from the neck to the head on the fixed piston acts as a stop for the annular ring and keeps the annular piston from sliding out of the cylinder block as the annular ring contacts the head of the fixed piston.

[0008] To extend the annular piston out from the cylinder block so that the pipe tong contacts the pipe, and to retract the annular piston into the cylinder block to release the pipe from the tongs, a pressurized hydraulic fluid system can be used.

[0009] A first passageway disposed within the fixed piston from the end cap side of the fixed piston provides communication to the first chamber. Hydraulic fluid entering the first passageway will enter into the first chamber extending the annular piston out from the cylinder block. A second passageway also disposed within the fixed piston provides communication to the second annular chamber. Hydraulic fluid entering the second passageway will enter into the second annular chamber and push the annular piston into the cylinder block. When the annular piston is extended, the second passageway acts as an exit pathway for any fluid in the second annular chamber as the annular piston moves outward. When the annular piston is retracted, the first passageway acts as an exit pathway for any fluid in the first chamber as the annular piston moves inward towards the cylinder block. A conventional hydraulic swash-plate mechanism, as well known to those skilled in the art, can be used in the control of hydraulic fluid entering and exiting the fluid passageways. In an alternate embodiment, a pneumatic air or gas system can be used in place of hydraulics for moving the annular piston.

[0010] The pipe-gripping tong mounted on the second end of the annular piston comprises a tong shoe and a tong die mounted within the shoe. The tong die has two surfaces with teeth for gripping a pipe. The two surfaces are at an angle to one another to form a shallow v-shaped groove. The shoe has a partial circular opening that allows the tong die to slide into the shoe and be secured by retainer ears mounted on top and bottom of the tong shoe. The tong shoe opening is slightly wider than the tong die such that the tong die has a small amount of side-to-side lateral movement within the shoe thereby allowing the tong die to self-center on a pipe in the event that the pipe is not exactly centered within the jaws of the live head or dead head tongs.

[0011] In operation, a pair of rams can be used in each of the live and dead heads on an iron roughneck. Each pair of rams face each other in an opposing manner. When a section of pipe is to be added to a drill string, the drill string is first supported by the slips in the rotary table of the drilling rig. The iron roughneck is then advanced towards the drill string and the dead head rams clamp the box end of the exposed pipe section. A new section of pipe is lowered into position above the drill string where the pin end of the new section is inserted into the exposed box end. The live head rotates counterclockwise so that its rams can clamp the pin end of the new section. The live head then rotates clockwise to torque the connection between the pipe sections. When a connection between sections of pipe is to be broken, the process is reversed.

[0012] Broadly stated, one embodiment of the present invention involves a pipe gripping ram which comprises: a cylinder block having first and second ends and a bore extending therebetween along a longitudinal axis, said bore forming an interior cylinder wall within said cylinder block; an end cap operatively attached to the first end of said cylinder block thereby enclosing said bore at said first end; a fixed piston having a head and a neck disposed within said bore, said head larger in diameter than said neck, said neck operatively attached to said end cap whereby said fixed piston head is longitudinally aligned with said longitudinal axis and thereby forming a substantially uniform annulus between said fixed piston head and said interior cylinder wall, said annulus extending from the second end of said cylinder block at least partially along said bore towards said end cap; an annular piston having first and second ends, the first end of said annular piston being open and adapted to slidably couple with said fixed piston whereby said annular piston is capable of linear reciprocal motion along said annular bore, the second end of said annular piston being closed and forming a first chamber when said annular piston is slidably coupled with said fixed piston, the first end of said annular piston further comprising a stop to prevent said annular piston from sliding off said fixed piston, the combination of said fixed piston and the first end of said annular piston forming a second annular chamber; a pipe gripping tong operatively attached to the second end of said annular piston; and means for moving said annular piston in a linear reciprocal motion within said annular bore.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a front perspective view depicting a ram in accordance with one embodiment of the present invention, wherein the annular piston extended.

[0014] FIG. 2 is a rear perspective view depicting the ram in FIG. 1, wherein the annular piston extended.

[0015] FIG. 3a is a side cross-sectional view depicting the ram of FIGS. 1-2 and taken along section lines A-A in FIG. 2, where the annular piston is extended.

[0016] FIG. 3b is a side cross-sectional view depicting the ram of FIGS. 1-2 and taken along section lines A-A in FIG. 2, wherein the annular piston is retracted.

[0017] FIG. 4 is a perspective view depicting an iron roughneck having a ram in accordance with one embodiment of the present invention, wherein the iron roughneck is preparing to grip a section of pipe.

[0018] FIG. 5 is perspective view depicting the iron roughneck of FIG. 4 wherein the iron roughneck is joining two sections of pipe.

#### DETAILED DESCRIPTION OF EMBODIMENTS

[0019] Referring to FIGS. 1 and 2, a representative embodiment of the present invention is shown. Ram 10 comprises a cylinder block 22, end cap 24, annular piston 20 and tong shoe 12. End cap 24 is fastened to cylinder block 22 by cap screws passing through bolt holes 31. Annular piston 20 slides in and out of bore 23 and cylinder block 22. Tong shoe 12 has a circular opening 41 to receive tong die 13. Tong die retainers 16 are fastened to the top and bottom of tong die 13 to keep it in place within shoe 12. Tong die

13 comprises a pair of die faces 14. Die faces 14 form a shell v-shaped groove for receiving a section of pipe to grip.

[0020] Tong shoe 12 further comprises grooves 19 to receive retainer ear 17 of retainers 16. Groove 19 is slightly wider than ear 17 so as to allow tong die 13 to move laterally side-to-side within opening 41. A combination of shallow v-shaped groove faces 14 and the side-to-side movement of tong die 13 allows tong die 13 to self-center on a section of pipe when gripping it in the event that the pipe is not centered within the live head or dead head jaws of an iron roughneck.

[0021] Referring to FIGS. 3a and 3b, side cross-sectional views of a ram 10 in accordance with one embodiment of the present invention are shown. Fixed piston 26 is attached to end cap 24 by cap screws 25. Fixed piston 26 comprises neck 37 and head 35. Head 35 is shown to be larger in diameter than neck 37. A portion of neck 37 extends through opening 29 to allow the end of neck 37 to be flush with end cap 24. Annulus 27 bore is formed between the cylinder wall of bore 23 and fixed piston 26.

[0022] Tong shoe 12 is bolted to annular piston 20 with cap screw 15. Annular piston 20 slides into the annulus 27 between fixed piston 26 and the cylinder wall of bore 23. Seal 44 and ring 46 in a groove disposed around piston head 35, in combination with wiper ring 42 disposed within a groove around bore 23, provide a liquid-tight seal around annular piston 20. Wear band 40 is disposed about another groove around piston head 35. Piston spacer 34 is situated on fixed piston 26 where neck 37 adjoins piston head 35. Piston spacer 34 further comprises an annular groove 36. Piston end ring 32 is fastened to annular piston 20 with cap screws 33. Wear band 48, seal 50 and ring 52 dispose within grooves on end ring 32 provide a liquid-tight seal between end ring 32 and piston neck 37.

[0023] Disposed within fixed piston 26 are two passageways. Passageway 30 provides communication to chamber 21. Chamber 21 is located between piston head 35 and annular piston 20. Passageway 28 provides communication to annular chamber 38 located between end ring 32 and piston spacer 34.

[0024] Referring to FIG. 3a, pressurized hydraulic fluid entering passageway 30 can enter chamber 21 and push annular piston 20 outward from cylinder block 22. Any fluid in annular chamber 38 is forced out through annulus 36 and passageway 28 until end ring 32 contacts piston spacer 34. The force exerted by tong die 13 as annular piston 20 is extended is a function of the pressure of the hydraulic fluid, the diameter of annular piston 20 and the size of die faces 14 which can be easily determined by those skilled in the art.

[0025] Referring to FIG. 3b, pressurized hydraulic fluid entering passageway 28, can enter annular chamber 38 through annulus 36 and push end ring 32 towards end cap 24. Any fluid in chamber 21 is forced out through passageway 30 until annular piston 20 contacts piston head 35. A hydraulic swash space plate (not shown), as well known to those skilled in the art, can be used to control the flow of pressurized hydraulic fluid into and out of passageways 28 and 30. It should be obvious to those skilled in the art that a ram in accordance with the present invention may be operated with pressurized air or gas instead of pressurized hydraulic fluid. The use of a pressurized hydraulic fluid

system or pneumatics is desirable for use with a ram in accordance with the present invention given the combustible and explosive nature of the substances obtained from oil and gas wells.

[0026] Referring to FIGS. 4 and 5, a ram in accordance with the present invention is shown on iron roughneck 60 situated on a drilling rig platform. Iron roughneck 60 comprises live head 62 and dead head 64. Live head 62 and dead head 64 each have a pair of rams 10. In FIG. 4, pipe 66 is being connected to pipe 68. The rams 10 in dead head 64 grasp pipe 68 to hold it in place which is further supported by slips 70 in rotary table 72. Pipe 66 is being lowered to make a connection with pipe 68.

[0027] In FIG. 5, live head 62 has rotated to grasp pipe 66 with rams 10. Once gripped, live head 62 rotates clockwise to tighten the threaded connection between pipes 66 and 68. To break the connection between the pipes, the procedure is reversed.

[0028] Although embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention. The terms and expressions used in the preceding specification have been used herein as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims that follow.

What is claimed is:

- 1. A pipe gripping ram, comprising:
  - a) a cylinder block having first and second ends and a bore extending therebetween along a longitudinal axis, said bore forming an interior cylinder wall within said cylinder block;
  - b) an end cap operatively attached to the first end of said cylinder block thereby enclosing said bore at said first end;
  - c) a fixed piston having a head and a neck disposed within said bore, said head larger in diameter than said neck, said neck operatively attached to said end cap whereby said fixed piston head is longitudinally aligned with said longitudinal axis and thereby forming a substantially uniform annulus between said fixed piston head and said interior cylinder wall, said annulus extending from the second end of said cylinder block at least partially along said bore towards said end cap;
  - d) an annular piston having first and second ends, the first end of said annular piston being open and adapted to slidably couple with said fixed piston whereby said annular piston is capable of linear reciprocal motion along said annulus, the second end of said annular

piston being closed and forming a first chamber when said annular piston is slidably coupled with said fixed piston, the first end of said annular piston further comprising a stop to prevent said annular piston from sliding off said fixed piston, the combination of said fixed piston and the first end of said annular piston forming a second annular chamber;

- e) a pipe gripping tong operatively attached to the second end of said annular piston; and
  - f) means for moving said annular piston in a linear reciprocal motion within said annular bore.
2. The ram as set forth in claim 1 wherein said bore is substantially cylindrical.
  3. The ram as set forth in claim 1 wherein said means for moving said annular piston comprises a hydraulic fluid system.
  4. The ram as set forth in claim 1 wherein said means for moving said annular piston comprises a pneumatic air system.
  5. The ram as set forth in claim 3 further comprising a first passageway disposed within said fixed piston providing communication to said first chamber for hydraulic fluid to enter said first chamber and move the second end of said annular piston away from said cylinder block.
  6. The ram as set forth in claim 5 further comprising a second passageway disposed within said fixed piston providing communication to said second annular chamber for hydraulic fluid to enter said second annular chamber and move the second end of said annular piston towards said cylinder block.
  7. The ram as set forth in claim 4 further comprising a first passageway disposed within said fixed piston providing communication to said first chamber for pressurized gas to enter said first chamber and move the second end of said annular piston away from said cylinder block.
  8. The ram as set forth in claim 7 further comprising a second passageway disposed within said fixed piston providing communication to said second annular chamber for pressurized gas to enter said second annular chamber and move the second end of said annular piston towards said cylinder block.
  9. The ram as set forth in claim 1 wherein said tong further comprises a tong shoe and tong die for gripping a pipe disposed within said tong shoe, said tong die capable of lateral movement within said tong shoe.
  10. The ram as set forth in claim 6 further comprising a swash plate mechanism for controlling the direction of hydraulic fluid into and out of said first and second passageways.
  11. The ram as set forth in claim 8 further comprising a swash plate mechanism for controlling the direction of pressurized air or gas into or out of said first and second passageways.

\* \* \* \* \*