Sept. 4, 1951 A. L. STONE 2,567,039

TONG ASSEMBLY

Filed May 17, 1947 2 Sheets-Sheet 1

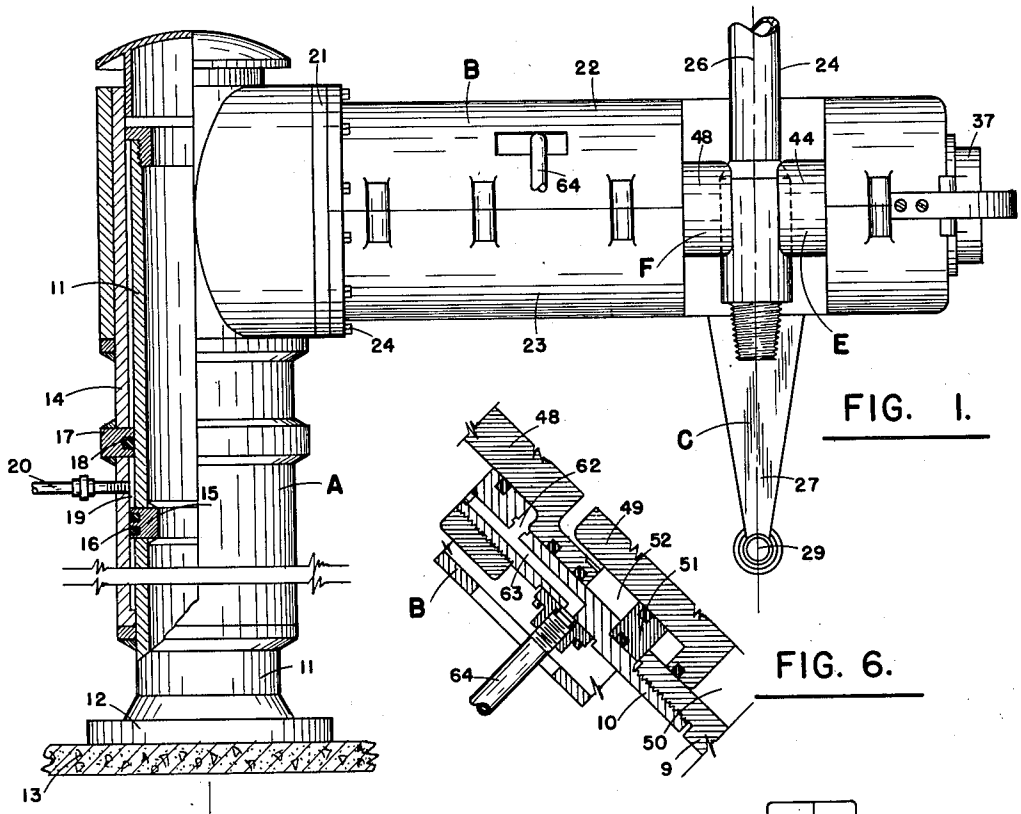


FIG. 1.

FIG. 6.

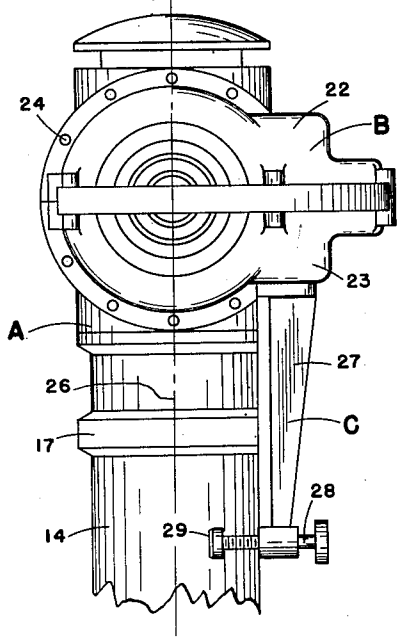
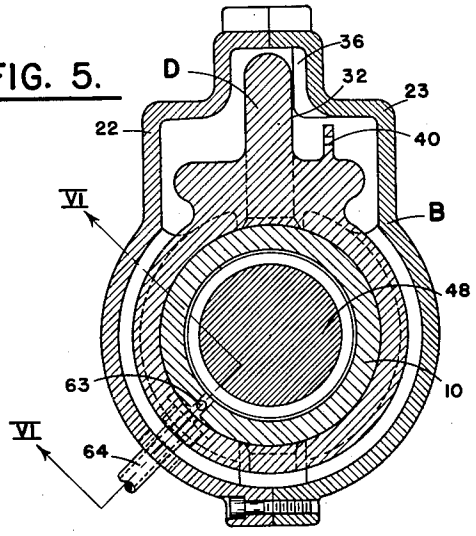


FIG. 2.

FIG. 5.



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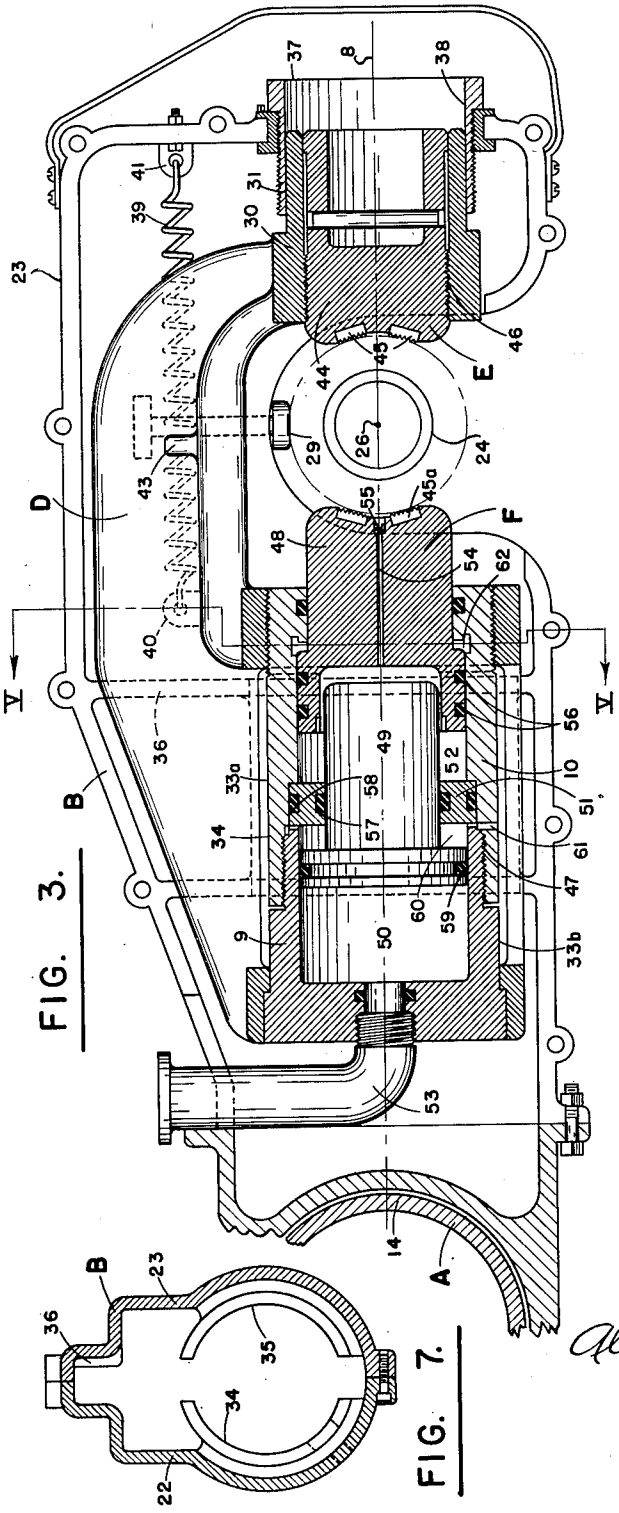


FIG. 3.

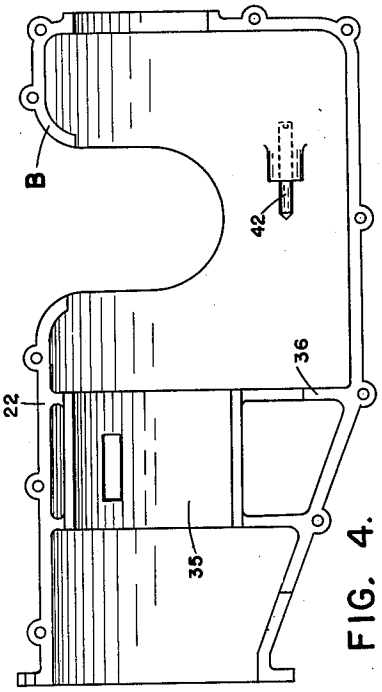


FIG. 4.

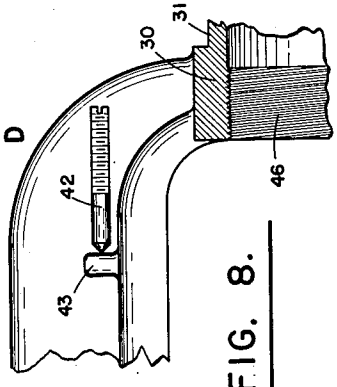


FIG. 8.

FIG. 7.

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UNITED STATES PATENT OFFICE

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TONG ASSEMBLY

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Application May 17, 1947, Serial No. 748,836

5 Claims. (Cl. 255—35)

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The present invention is directed to a tong assembly adapted for gripping a tubular structural member.

In the handling and manipulation of tubular structural members, it is often desirable to provide a device for gripping such a member either for the purpose of preventing rotation thereof or for the purpose of applying a rotative motion thereto.

A common example of an operation requiring the use of one or more tong assemblies is in the handling of sections of pipe used to form the drill stem in a conventional rotary drilling rig. In such operations, it is necessary or desirable to provide a tong member or members to grip the pipe when making up a joint or when breaking a joint.

It may also be mentioned that in the operation of handling a drill pipe in a derrick, it may at times be desirable to provide a means supporting a vertical section of pipe from its lower end and when so supported to move the pipe either vertically or horizontally or both. Methods of handling pipe in a derrick where it is desirable to support the pipe from the lower end during at least a portion of such handling is disclosed in my copending application Serial No. 690,944 entitled "Method for Stacking Drill Pipe" filed August 16, 1946; and in my copending application Ser. No. 753,591, entitled "Method for Handling Vertical Sections of Pipe in a Derrick" filed June 9, 1947.

It is an object of the present invention to devise a tong assembly for gripping a tubular structural member.

It is another object of the present invention to devise a tong which may be mounted for movement about a fixed point and which is provided with means for centering the gripping portion of the tong with respect to the tubular member to be gripped.

It is another object of the present invention to devise a tong having the gripping means actuated by hydraulic controls.

Still another object of the present invention is to devise a tong with gripping means actuated by hydraulic controls whereby the pressure exerted by the gripping means is substantially greater than the pressure supplied through the hydraulic system.

Other objects and advantages of the present invention may be seen from the following description taken in conjunction with the drawing in which

Fig. 1 is a side elevation, partly in section,

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showing an embodiment of the present invention secured to a suitable mounting means;

Fig. 2 is an end elevation of a portion of the device of Fig. 1;

Fig. 3 is a top view of the tong portion of the assembly with the upper portion of the frame removed and parts shown in section to show details of the construction thereof;

Fig. 4 is a view of that part of the frame which was removed from Fig. 3;

Fig. 5 is a view taken along line V—V of Fig. 3;

Fig. 6 is a view taken along line VI—VI of Fig. 5;

Fig. 7 is a view taken along line V—V of Fig. 3 but with the slidable assembly removed to show more clearly the configuration of the frame assembly; and

Fig. 8 is a fragmentary view showing a portion of the slidable assembly of the tong and the positioning screw secured to the frame assembly.

The apparatus of the present invention may be described briefly as including a frame member adapted to be permanently attached to a suitable mounting means. Carried by the frame member is a gripping assembly slidable with respect to the frame member whereby the center of the tubular structural member to be gripped may shift without requiring the frame member to be shifted. An additional feature of the tong assembly is a stop assembly carried by the frame assembly which positions the gripping assembly preparatory to engagement with a section of drill pipe.

Another feature of the invention is a hydraulic actuating means arranged to exert a substantially greater pressure against the gripping means than is supplied by the hydraulic power system. The assembly is preferably arranged so that the mounting means allows vertical movement of the frame member and rotation of the frame member about a fixed axis.

In the arrangement of the present invention the frame member has slidably mounted thereon a gripping assembly comprising a bridge member, a first gripping means mounted on the bridge member and a second gripping means mounted on the bridge member. The first and second gripping means are arranged to cooperate in gripping a tubular structural member.

The arrangement of the present invention allows the first gripping means to come into contact with the cylindrical structural member and thereupon the second gripping means may be shifted to bring it into contact with the cylindrical structural member. It is to be noted

that this arrangement is particularly advantageous when the end of the tong is pivoted about a fixed point. The axis of the portion of the drill pipe which projects above the rotary table may not coincide with the center line of the borehole because of variations in the way the slips are set and such variations in the position of the axis of the drill pipe are compensated by the centering arrangement of the assembly of the present invention.

The device of the present invention will now be described specifically in conjunction with the drawing which shows an embodiment thereof. In the drawing letters are used to designate assemblies or important members and numerals are used to designate parts making up the assemblies or portions of important members.

Column assembly A has frame assembly B secured thereto. An adjustable stop or positioning assembly C is mounted on frame assembly B. Slidably mounted on frame assembly B is a gripping assembly comprising bridge member D, gripping means E and gripping means F.

Column assembly A includes a post member 11 having its lower end secured to base 12. It will be understood that any suitable means for anchoring column assembly A may be used. In the drawing, base 12 is indicated as secured to foundation member 13; it will be understood that any suitable anchoring members may be employed as foundation 13. Slidably mounted on post 11 is outer cylinder 14. It will be seen that post 11 is provided with an outwardly extending circular ledge 15 provided with packing means 16 and cylinder 14 is provided with an inwardly extending circular ledge 17 having a packing means 18. A reservoir 19 is defined between the inner surface of the cylinder 14, the outer surface of post 11 and the ledges 15 and 17. Inlet line 20 passes through the wall of cylinder 14 and communicates with reservoir 19. It will be understood that inlet 20 may be fluidly connected to a suitable source of fluid pressure and a valving arrangement, not shown, to move cylinder 14 upwardly with respect to post 11, by use of such pressure, and to allow the cylinder to move downwardly under the influence of gravity.

The upper end of cylinder 14 defines a boss 21. The upper and lower portions 22 and 23 which form frame B are secured to boss 21 by suitable means such as bolts 24. It will be seen that members 22 and 23 define a slotted portion which will allow the tong to be engaged with and disengaged from a section of drilling pipe designated on the drawing as 25 by angular movement of the tong member about a vertical axis while the axis of pipe 24 is vertical and the pipe is held stationary. In the drawing the axis of the pipe is shown by a dashed line designated as 26. The longitudinal axis of the frame B is shown by dashed line 8.

An adjustable stop or positioning assembly C is carried by frame B, said stop member including a downwardly extending structural member 27 arranged to carry the horizontal extending member 28 which defines a surface 29 adapted to bear against the drill stem in the borehole to stop the tong with the center of the borehole coinciding with the center line of the gripping assembly of the tong. It will be seen that member 28 is adjusted relatively with respect to member 27 by means of screw threads with which the members are secured together.

Slidably mounted on frame B is an assembly including bridge member D, gripping means E and gripping means F. Bridge D defines a circular portion 30 having an outer cylindrical surface 31. The lower portion of bridge D defines a flat machined surface 32. Gripping means F includes a cylinder consisting of two sections 9 and 10, the outer surfaces of which define cylindrical machined surfaces 33*a* and 33*b*. The upper section 22 of frame B defines an arcuate machined surface 34, and the lower section 23 defines an arcuate machined surface 35 and a flat machined surface 36. A ring 37 is carried by section 23 of frame B and defines an inner cylindrical surface 38. It will be seen that the gripping assembly is provided with the machined surfaces 31, 32, 33*a* and 33*b* while the frame B is provided with machined surfaces 34, 35, 36, and 38. These machined surfaces allow the gripping assembly to slide freely with respect to the frame B.

The gripping assembly is biased to an initial position by spring 39 having one end secured to a lug 40 of the bridge D and the other end secured to a lug 41 of section 23 of frame B. An adjustable screw 42 is secured to upper section 22 of frame B. Bridge D is provided with a lug 43 arranged to cooperate with screw 42. The arrangement of spring 39, adjusting screw 42 and lug 43 insures that the gripping assembly will be returned to a fixed position when no other force is acting to move the gripping assembly with respect to the frame assembly.

The first gripping means E is carried by bridge D, said gripping means including a ram member 44 provided with dies 45. Ram 44 is mounted within the circular portion 30 of bridge member D and is secured thereto by suitable means such as screw threads 46.

Bridge D also has mounted thereon the second gripping means F. Gripping assembly F includes a cylinder formed by sections 9 and 10 secured together by screw threads 47, a ram 48 and a piston ram 49. Ram 48 is provided with dies 45*a*. Piston ram 49 and cylinder section 9 cooperate to define a reservoir 50 and piston ram 49, ram 48, cylinder section 10, and ring 51 define a reservoir 52. A conduit 53 communicates with reservoir 50.

Reservoir 52 may be filled with fluid through passage 54 in ram 48, a threaded plug 55 being provided to close the passage and maintain the fluid in reservoir 52 during normal operation of the device. Reservoir 52 is sealed by packing member 56 mounted on ram 48 and packing means 57 and 58 mounted on ring 51. Reservoir 50 is sealed by packing ring 59 mounted on piston ram 49.

It will be understood that in the operation of the device hydraulic fluid may leak from reservoir 50 past sealing ring 59 into space 60. In order to prevent fluid pressure from building up in space 60, port 61 passes through the wall of cylinder section 10 to discharge fluid from space 60 into the lower section 23 of frame assembly B. Similarly, fluid may leak from reservoir 52 into space 60 where it may drain as previously described or it may leak past seals 56 into space 62 where it may drain through passage 63 and be discharged through conduit 64 as shown in detail in Fig. 5.

The hydraulic system including space 62, passage 63 and conduit 64 may be used, if desired, for disengaging ram 48 from pipe 24. When used for this purpose fluid under pressure may be supplied from a suitable source not shown and discharged through conduit 64 thence to passage 63 and finally into space 62 where it exerts a pres-

sure against the shoulder of ram 48 to move it away from pipe 24.

As stated heretofore, reservoirs 50 and 52 contain fluid. If bridge D is held against movement and ram 48 is free to move, an increase in pressure in reservoir 50 causes piston ram 49 to move toward pipe center 26 and this in turn increases the pressure in reservoir 52 and causes ram 48 to move toward pipe center 26. In the embodiment shown in the drawing, the area of piston ram 49 defining a wall of reservoir 50 is greater than the area of that portion of the piston ram 49 passing through ring 51 into reservoir 52. Accordingly, the pressure exerted by piston ram 49 in reservoir 52 is greater than the pressure exerted thereon by the fluid in reservoir 50, the pressure in the two reservoirs being inversely proportional to the areas of piston ram 45 forming wall portions of the reservoirs. For example, if the area of piston ram 49 defining a wall of reservoir 50 is twice the area passing through ring 51, the pressure exerted by the piston ram 49 in reservoir 52 is twice as great as the pressure in reservoir 50. With such a proportioning of parts if a pressure of 1000 pounds per square inch be applied to reservoir 50, piston ram 49 will cause a pressure of 2000 pounds to be built up in reservoir 52 and this pressure exerted against ram 48 will cause dies 45a to grip the pipe with a force twice as great as could be obtained by applying the pressure from conduit 53 directly to ram 48.

An important function of stabbing assembly C is to position the tong when using it for supporting a section of pipe preparatory to adding the section to a drill string in a borehole. With a section of pipe gripped by the assembly and the assembly positioned so that its upper end is above the drill stem but with surface 29 in position to contact the drill stem, the entire tong assembly may be swung through an arc until surface 29 contacts the upper end of the drill stem which assures that the center of the pipe carried by the tong coincides with the center of the drill stem whereupon the tong may be lowered so that the threads of the section of pipe and the threads of upper end of the drill string engage whereupon the joint may be made up by spinning and tonging.

The device of the present invention is particularly adapted to be used for gripping and supporting sections of drill stem when adding such sections to or removing them from the drill stem. That is to say, the column assembly A may be firmly anchored in position and slight changes in the position of the center line drill pipe in the borehole may be compensated for automatically by slidable movement of the gripping assembly which may shift along axis 8 of frame assembly B.

The action of the assembly in a typical operation will now be described. It will be assumed that rams 44 and 48 are spread apart so that dies 45 and 45a can pass over the surface of the pipe to be engaged. Frame assembly B may be rotated about column assembly A until longitudinal axis 8 of the tong coincides with axis 26 of the drill pipe to be engaged with the tong. The tong is stopped in this position by contact of surface 29 of stabbing assembly C with the drill pipe. The tong may then be engaged by increasing the pressure in reservoir 50 by means of a suitable hydraulic system, not shown in the drawing. The pressure in reservoir 50 causes movement of piston ram 49 toward the center line 26 of the pipe which in turn increases the pressure in reservoir 52 and moves ram 48 until

dies 45a contact the drill pipe. When dies 45a come in contact with the drill pipe further, movement of ram 48 is prevented and additional force applied by hydraulic fluid in reservoir 50 causes bridge D and gripping means E to slide in frame B until dies 45 are brought into contact with the drill pipe. The force exerted in reservoir 50, which in turn is transmitted to reservoir 52, will cause the dies 45 and 45a to grip the drill pipe and this gripping action will be maintained as long as fluid pressure is maintained in reservoir 50. With the drill pipe gripped by dies 45 and 45a the tong may be employed as desired either for breaking the joint or for supporting the pipe and moving it horizontally with the axis of the pipe maintained vertically. The tong may be released from the pipe by releasing the pressure in reservoir 50. The release of pressure on the hydraulic fluid in reservoir 50 allows spring 39 to slide bridge D and gripping means E with respect to frame B until lug 43 is in contact with screw 42. This action takes dies 45 out of contact with the surface of the drill pipe. Since the fluid pressure has been released, arcuate movement of frame B about column A will allow dies 45a to slide over the surface of the drill pipe and force ram 48 away from center line 26 of the drill pipe, thereby allowing the tong to be released from the pipe.

It will be seen that the tong assembly of the present application embodies several advantages. The arrangement allows the end of the tong to be firmly fixed against shifting horizontal movement and at the same time provides the means whereby a horizontal shrifting of the pipe to be engaged may be accommodated for by the movement of parts of the tong. Another substantial advantage of the design of the present invention is that the actual force exerted against the die members in gripping the tong is substantially greater than could be obtained by the use of a given hydraulic pressure applied to the area available in a given size tong body.

While I have described a specific embodiment of the present invention, it will be obvious to a workman skilled in the art that various changes in the size, shape and dimension of the parts of the assemblies forming the device of the present invention may be changed without departing from the scope of the invention.

Having fully described and illustrated a preferred embodiment of the present invention, what I desire to claim as new and useful and to secure by Letters Patent is:

1. A tong assembly comprising, in combination, an arm member, a gripping assembly carried by the arm member including a first ram member, gripping dies mounted on the first ram member, a housing defining a reservoir slidably mounted on the arm member for movement parallel to the longitudinal axis of said arm member, a piston slidable in the housing with its axis coinciding with the axis of said arm member and defining a surface of given area exposed to said reservoir, packing means arranged in the housing cooperating with the first piston and housing to define a second reservoir a second ram member mounted on said housing with its axis coinciding with the axis of said arm, and gripping dies mounted on the second ram member facing toward and spaced away from the gripping dies mounted on said first ram member.

2. A tong assembly comprising, in combination, an arm member, a gripping assembly

mounted on the arm member for slidable movement along the longitudinal axis thereof including a frame member, a first ram member secured to the frame member with its longitudinal axis coinciding with the longitudinal axis of the arm member, a cylinder secured to the frame member, a piston slidably arranged within the cylindrical member and cooperating therewith to define a reservoir, a second ram member slidably mounted within the cylindrical member with its axis coinciding with the longitudinal axis of the arm member and cooperating with the cylindrical member and with the piston to define a reservoir and packing means carried by the cylinder arranged fluidly to separate the two reservoirs and pipe gripping dies mounted on the first and second ram members facing toward each other and spaced apart for engaging with a pipe to be gripped.

3. A device in accordance with claim 2 in which the area of the piston cooperating to define the first reservoir is substantially greater than the area thereof cooperating to form the second reservoir.

4. A tong assembly comprising, in combination, a column assembly including a post member, a tabular member mounted on the post member for rotative and vertical movement with respect to the post member, a tong assembly comprising an arm member having an end secured to said tubular member for vertical and rotative movement therewith, a gripping assembly slidably mounted on the arm member comprising a frame carried by the arm member and adapted for movement along the longitudinal axis of the arm member, a first ram member secured to the frame member, pipe gripping dies mounted on the first ram member, a cylindrical member secured to the frame member and defining a cylinder having its axis parallel to the longitudinal axis of the arm member, a piston member slidably arranged within the cylindrical member and cooperating therewith to form a reservoir, having a means of communication with the exterior source of hydraulic pressure, an annulus mounted in the cylindrical member defining a packing means cooperating with a portion of the piston member to prevent passage of fluid therethrough, a second ram member slidably mounted in the cylindrical member and cooperating with a portion of the

cylindrical member, the annular member and the piston member to define the second reservoir, the circular area of the first piston exposed to fluid in the first reservoir being substantially less than the circular surface thereof exposed to fluid in the second reservoir and pipe gripping dies mounted on the second ram adapted to cooperate with those carried by said first ram for releasably gripping a section of the pipe.

5. A tong assembly comprising, in combination, a gripping assembly comprising an elongated frame member with a side opening slot, with its axis making a right angle to the longitudinal axis of the frame member for receiving pipe, said frame member having upper and lower bearing surfaces on each side of said slot and the lines generating said bearing surfaces being parallel with each other and with the longitudinal axis of the frame member, diametrically opposed pipe gripping elements mounted on the frame member adjacent said side opening for gripping a section of pipe in the slot, said gripping elements lying on a line parallel with the longitudinal axis of the frame member with at least one of said pipe gripping elements movable along said line toward the other gripping element into gripping position and movable along said line away from said other element to release position, an elongated arm assembly enclosing said gripping assembly, said arm assembly having a slot side opening for receiving a section of pipe coinciding with the slot side opening of the frame member and having upper and lower bearing surfaces on both sides of said slot side opening, said bearing surfaces being parallel with the axis of said arm assembly and parallel with and in slidable contact with said bearing surfaces of said frame member whereby said gripping assembly may slide along the longitudinal axis of the arm assembly.

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