Aug. 9, 1960 J. A. BOURNE 2,948,174

HYDRAULIC HAND TOOL HAVING OPPOSED WORK-ENGAGING JAWS

Filed Dec. 12, 1958 2 Sheets-Sheet 1

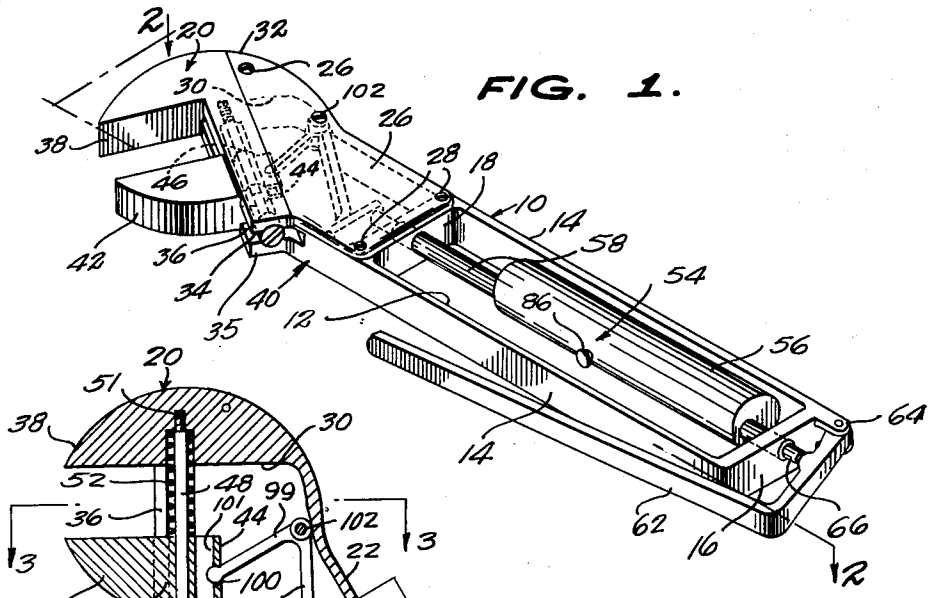

FIG. 1.

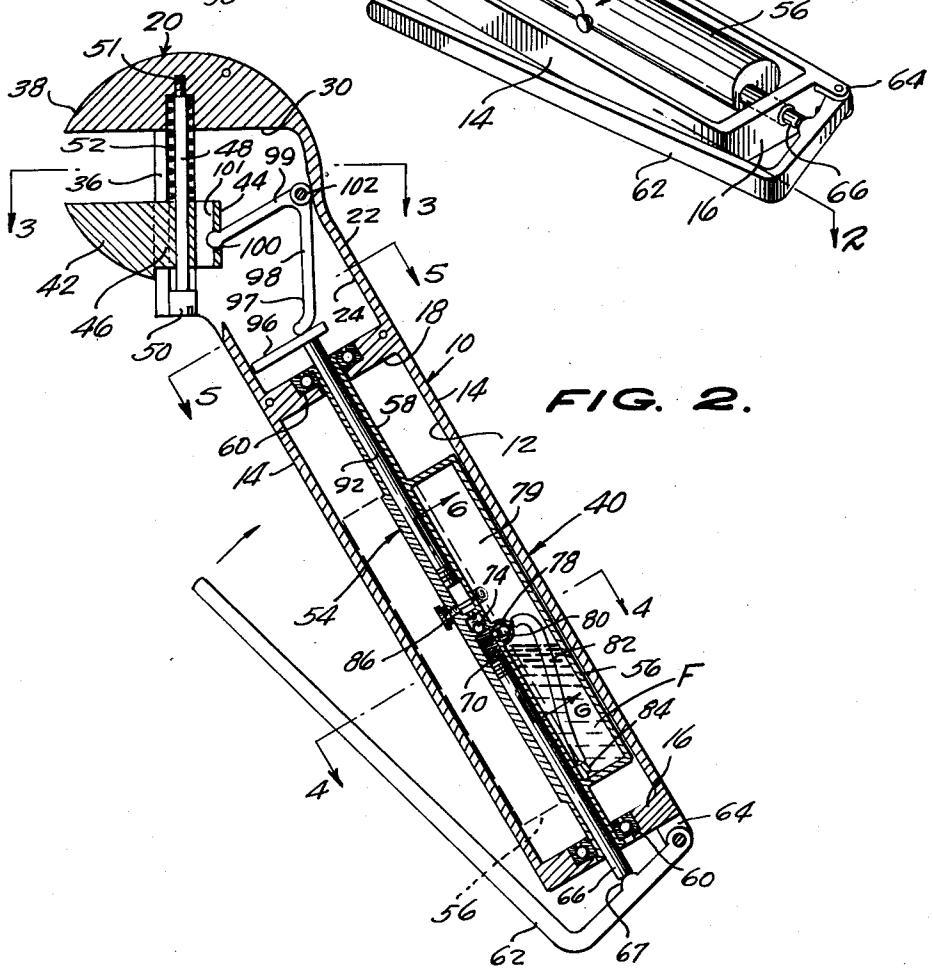

FIG. 2.

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Aug. 9, 1960 J. A. BOURNE 2,948,174

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Filed Dec. 12, 1958 2 Sheets-Sheet 2

FIG. 3.

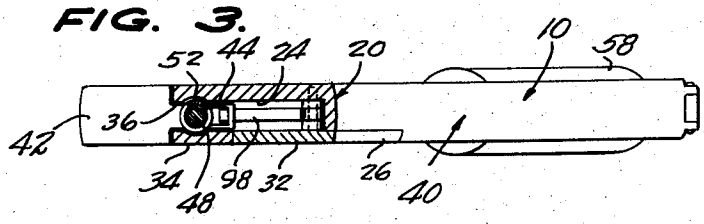



FIG. 4.

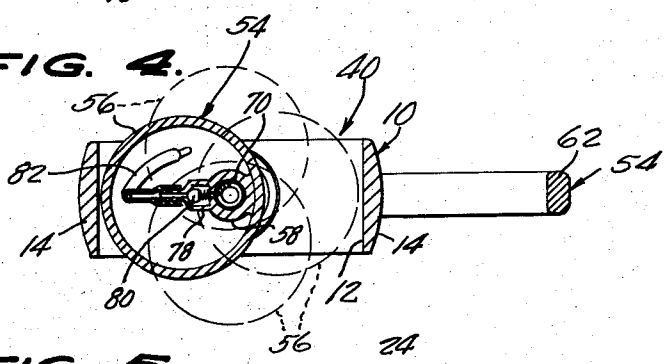



FIG. 5.

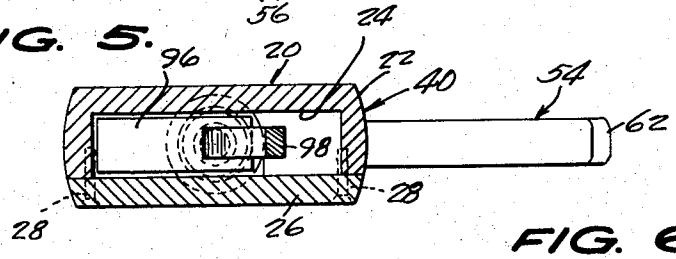



FIG. 6.

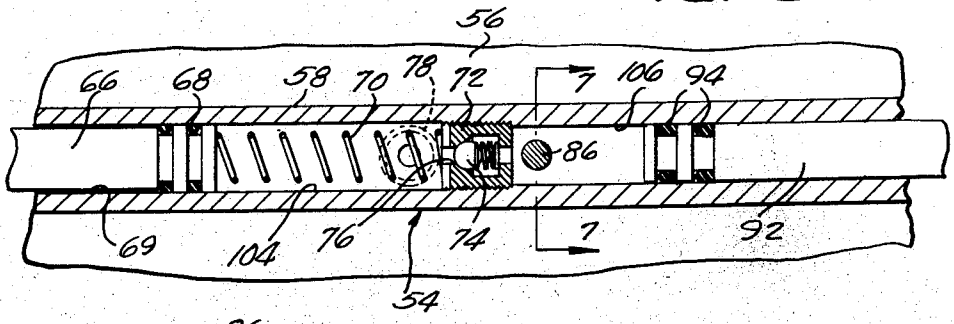
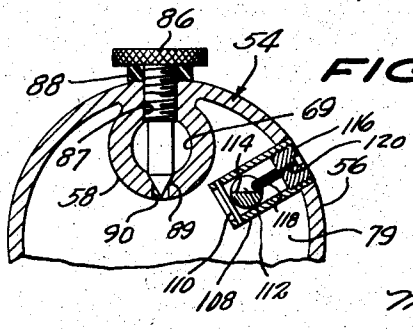



FIG. 7.

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# HYDRAULIC HAND TOOL HAVING OPPOSED WORK-ENGAGING JAWS

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9 Claims. (Cl. 81—129)

This invention relates generally to hand tools, and more particularly has reference to a hydraulically operated tool falling into the category of work-gripping mechanisms. In this general category would fall wrenches of the slidable jaw type, pliers, tongs, clamps, various tools of the type having one or both jaws pivotally mounted, etc. The invention, hereinafter, will be described with particular reference to its adaptability for incorporation in a wrench of the type having a slidable jaw movable toward and away from a fixed jaw. Such a wrench, for example, might be a Stillson wrench, this being a type of tool in which a particularly strong clamping force must be exerted upon the work by the opposed jaws. Nevertheless, it will be apparent that this is merely one example of the invention, and the principles thereof could obviously be adapted for any of various other tool constructions, such as those touched upon above.

One important object is to provide an improved hydraulically operated hand tool, which will be characterized by its comparatively simple construction, considering the advantages to be obtained from the use thereof.

Another object is to provide a tool as stated which will be particularly compact, and light, thus to permit it to be grasped by a worker with a minimum of difficulty, easily maneuvered, moved into and out of cramped quarters, and otherwise handled with maximum ease.

Still another object of importance is to overcome a difficulty which has been noted in connection with hydraulic tools of the charatcer stated, through the provision of a cylinder which is freely rotatable relative to the body of the tool. By reason of this arrangement, it is proposed to permit the cylinder to gravitate to a lowermost position, during the ordinary manipulation of the tool when it is in use, whereby to locate the fluid contained in the reservoir of the cylinder in an area of the reservoir from which it can be pumped.

Still another object is to provide, in combination with the freely rotatable cylinder, a weighted, flexible tube within the cylinder, the weighted portion of which constitutes the inlet of the tube and is automatically movable into the lower portion of the cylinder, as the cylinder rotates by gravitational action. In this way, it is proposed to insure to the maximum, by a coaction between the freely rotating cylinder and the movements of the weighted tube, that fluid in the reservoir will at all times be available for passage through the tube into the bore of the pump assembly of the device.

Another object is to provide a generally improved pumping mechanism, wherein the means carrying the cylinder will not only be journalled in the body of the device to provide the above mentioned rotatable mounting of the cylinder, but also will serve to provide the bore of the pump mechanism.

Yet another object is to provide a device of the class described wherein the means mentioned immediately



above will support for reciprocating movement a pump rod, as well as a hydraulically advanced ram.

Still another object is to provide, in combination with the ram, a motion-translating means extending between the ram and the movable jaw, such that straight line movement of the ram in a particular direction will be translated into straight line movement of the movable jaw in a path angular to that along which the ram is moved.

Another object is to so design the motion-translating means that extends between the ram and movable jaw as to produce a mechanical advantage at the location of the movable jaw, designed to provide a particularly great clamping force against the work-piece.

Still another object of importance is to provide means extending between the fixed and movable jaws of the device, so designed as to normally bias the movable jaw away from the fixed jaw, with said means not only serving to tend to shift the movable jaw toward a work-disengaging position, but also serving to return the ram to a normally retracted position within its associated bore of the cylinder-supporting rod of the device.

A further object is to provide a tool as stated which will be rugged, substantially trouble-free in operation, comparatively inexpensive, and possessed of considerable strength in relation to its lightness.

Other objects will appear from the following description, the claims appended thereto, and from the annexed drawings, in which like reference characters designate like parts throughout the several views, and wherein:

Figure 1 is a perspective view of a hydraulic tool according to the present invention;

Figure 2 is a slightly enlarged longitudinal sectional view through the tool, taken substantially on line 2—2 of Figure 1;

Figure 3 is a transverse sectional view through the head of the tool, on the same scale as Figure 2, taken substantially on line 3—3 of Figure 2;

Figure 4 is a still further enlarged transverse sectional view through the tool, substantially on line 4—4 of Figure 2, showing the handle and the jaw-operating mechanism of the device;

Figure 5 is a transverse sectional view through the base portion of the head, on the same scale as Figure 4, taken substantially on line 5—5 of Figure 2;

Figure 6 is a still further enlarged, detail longitudinal sectional view through the pump structure, taken substantially on line 6—6 of Figure 2; and

Figure 7 is a transverse sectional view, on substantially the same scale as Figure 6, taken on line 7—7 of Figure 6, showing the means for returning fluid from the pump bore to the reservoir.

Referring to the drawings in detail, generally designated at 10 is an elongated, straight, substantially flat handle in the form of an open center, rectangular frame having over the major part of its area a longitudinal opening 12. Opening 12 opens upon opposite faces of the handle as clearly seen in Figure 1, and defines longitudinal walls 14 upon the handle, integral at their opposite ends with an outer end wall 16 and an inner end wall 18 of the handle.

Generally designated at 20 is a head, including a hollow, generally flat base part 22 which in effect constitutes an extension of the inner end portion of the handle. Base part 22 is provided, in one face thereof, with a recess 24. Thus, the inner end wall 18 of the handle comprises a transverse partition, separating the recess 24 from the longitudinal opening 12 of the handle.

A cover plate 26 normally closes the recess (see Figure 5), being secured to the opposite sides of the head through the medium of screws 28.

Recess 24 is provided with an extension 30 (see Figures 1 and 2), said extension extending forwardly into the head and being normally covered by an extension

portion 32 of the cover plate 26. The extension portion is progressively reduced in width in a direction toward the head end of the tool, as shown in Figure 1.

Designated at 34 is a cross member of the head, said cross member extending across the head end of the recess extension 30. The cross member 34 is spaced from the bottom wall 35 of the head, thus defining between said bottom wall 35 and cross member 34 an elongated guide slot 36 opening into the recess extension 30 (see Figure 2).

Projecting forwardly from the cross member is a nose-like formation comprising a fixed jaw 38.

The handle and head, having the construction described above, are integrally connected in the illustrated embodiments, so that together they constitute a body 40 of the device, said body supporting the several movable components to be described hereinafter.

Designated at 42 is a movable jaw which is in confronting relation to the fixed jaw 38, thus to permit a work-piece, not shown, to be securely gripped therebetween responsive to advancing of the movable jaw toward the fixed jaw. The movable jaw is slidable in a straight line toward and away from the fixed jaw, in the guide slot 36, through the provision of a guide tongue 44 integrally formed upon the inner end of the movable jaw. The guide tongue is of generally rectangular configuration (see Figures 2 and 3). However, it has a cylindrically shaped enlargement or guide rib 46, freely slidable in a complementarily shaped portion of the guide slot 36. In this way, the movable jaw is maintained in proper position relative to the work and fixed jaw, during its advancement toward the fixed jaw and its retraction out of engagement with a work-piece.

Designated at 48 is a support stem for the movable jaw, on which the movable jaw is guided during the above mentioned movement thereof. The stem 48 comprises an elongated screw having a head 50 at one end, and a reduced, threaded axial extension 51 at its other end. The extension 51 engages in a complementarily threaded recess provided in the fixed jaw 33.

Circumposed about the stem 48 is a compression spring 52, abutting at its opposite ends against the movable and fixed jaws, so as to normally bias the movable jaw away from the fixed jaw.

Generally designated at 54 is an operating mechanism for the movable jaw. This includes a hydraulic assembly, in which is incorporated a hydraulic cylinder 56. Cylinder 56 is of elongated form, extending longitudinally within the opening 12.

The cylinder 56 contains a quantity of hydraulic fluid, not shown, and is so mounted as to be bodily rotatable to any of a plurality of positions in respect to the body 40 of the device. Thus, as shown in Figure 4, the cylinder can move to any of the four positions shown in this figure of the drawings, one of these positions being shown in full lines and the remaining positions being shown in dotted lines. Of course, the cylinder is movable to any of a large number of other positions, since it is freely swingable through 360 degrees about the axis defined by an elongated support rod 58 rigid with the cylinder.

The support rod 58 extends longitudinally and centrally of the handle, within the opening, and at its opposite ends is journalled in ball bearings 60 carried by the end walls 16, 18 of the handle.

As will be noted, the support rod 58 is eccentrically disposed in respect to the cylinder (see Figure 4), said rod extending in parallel, spaced relation to the longitudinal median line of the cylinder. This causes the cylinder to be rotatable about an axis eccentric to the circular cross sectional configuration of the cylinder.

Designated at 62 is an angular handle, of L-shape having a long leg extending in fairly close proximity to one of the side walls 14. The handle 62, at one end, is pivoted upon ears 64 projecting outwardly from the end wall 16. Thus, one grasping the handle can shift the pump handle 62 toward and away from the main handle 10 of the device.

Designated at 66 is an elongated pump rod, having an outer end bearing against a projection 67 provided upon the pump handle. The projection merely contacts the pump rod 66, so that responsive to pivotal movement of the pump handle, the rod 66 will be shifted in a straight line within the tubular support rod 58.

Referring to Figure 6, at its inner end the pump rod 66 is provided with gaskets 68.

The tubular formation of the support rod defines a longitudinal bore 69 therein, in which the pump rod is reciprocable. A compression spring 70 bears against one end of the pump rod, within the bore 69, bearing at its other end against a check valve housing 72 threadedly engaged in bore 69. A spring loaded check ball 74 within housing 72 normally seats in position preventing flow through a passage 76 of the housing.

Designated at 78 is a laterally projecting check valve housing rigid with the supporting rod 58, and communicating with a fluid reservoir 79 defined by the cylinder exteriorly of the support rod. The housing 78 has a tubular projection to which is connected one end of an elongated flexible tube. Within the housing 78 there is provided a spring loaded check ball 80 controlling flow from the reservoir into the bore 69.

The flexible tube has been designated 82. Housing 78 is disposed medially between the opposite ends of the cylinder, with tube 82 being of a length such as to extend from housing 78 into close proximity to either end of the cylinder, depending upon the direction in which the tube happens to extend during a particular use of the tool.

Tube 82, at its distal end, is provided with a tubular weight 84, through which fluid F flows from the reservoir into the tube. The weight causes the distal end of the tube to seek the lowermost portion of the cylinder, regardless of the position of the tool. This assures that at all times, the weighted end of the tube will be immersed in fluid F, to assure against interruption of flow of fluid into the tube, during the pumping action.

Referring to Figures 2 and 7, a screw 86 is threadedly engaged in an opening 87 formed in the wall of the cylinder and communicating with the bore 69. Screw 86, when threaded inwardly to its maximum extent, compresses a sealing gasket 88 to prevent leakage about the shank of the screw. Even when the screw has been backed out of the opening to a predetermined extent from its normal, Figure 7 position, gasket 88 remains sufficiently compressed to prevent leakage about the screw shank.

The screw, at its inner end, has a conical tip 89, which normally seats in an aperture 90 communicating between bore 69 and reservoir 79. Thus, when the screw is in closed position, flow through the aperture is prevented. This is the screw position during a pumping action intended to pump fluid from the reservoir into the bore.

When the screw is backed off in the manner described above, flow is permitted through aperture 90 from bore 69 to reservoir 79, to return fluid to the reservoir after the pumping action, at a time when it is desired to eliminate fluid pressure within the bore and, consequently, eliminate the clamping action of the jaws upon the work-piece. In these circumstances, as previously noted, the backing off of the screw still leaves gasket 88 sufficiently compressed to prevent leakage. However, any fluid that was previously pumped into the bore 69 about the screw is now free to flow back into the reservoir 79.

Designated at 92 is a ram, provided (Figure 6) with gaskets 94 at its inner end. Ram 92 is slidably reciprocable within support rod 58, and when fluid is pumped into the bore 69 through passage 76, it causes the ram to be extended under fluid pressure in a direction toward the head of the tool.

At its head-adjacent end, the ram is provided with a laterally projecting pusher foot **96**. Slidably contacting the pusher foot is the rounded distal end of the longer leg **97** of a bell crank **98** of acute-angular shape. The bell crank also has a shorter leg **99**, providing a mechanical advantage at the location of the movable jaw. The shorter leg has a rounded distal end loosely engaging in an aperture **100** formed in guide tongue **44** and communicating with a bore **101** of the guide tongue.

The bell crank is pivoted, at the juncture of its legs, on a pivot pin **102** mounted within the recess extension **30**.

By reason of this arrangement, when the pump handle is operated, fluid will be pumped from the reservoir into the bore, in back of the ram. This results from the fact that each time the pump handle is swung toward the body **40** of the device, from its normal, outwardly moved position, shown in Figure 2, the pump rod **66** moves upwardly in Figure 2 against the restraint of spring **70**. Then, spring **70** tending to expand shifts the pump rod downwardly in Figure 2, back to its initial position. This creates a suction within the bore **69**, downstream from valve housing **72** (Figure 6). On the next pressure stroke of the pump handle and pump rod, fluid will have already entered the bore **69** downstream from the valve housing **72**, by reason of the suction action described immediately above, and will now be forced through the valve housing **72**, with check valve ball **74** unseating at this stage of the operation. Said fluid will, as the pumping action continues, shift the ram **92** upwardly in Figure 2 to cause the movable jaw **42** to be moved toward fixed jaw **38** into a work-gripping position. The operation of the check balls **74**, **80**, will be readily understood, it being apparent that check ball **80** will permit flow only from the reservoir into the pump chamber, that is, into the bore **69** downstream from valve housing **72**, during the pumping action. Check ball **74** permits flow only from the pump chamber, which has been designated at **104** in Figure 6, into the pressure chamber **106**, said chambers being parts of the bore **69**. Subsequently, at such time as the work is to be released, one merely backs off screw **86** slightly from its normal position. Fluid previously pumped into the pressure chamber **106** will now be free to flow back into the reservoir, awaiting the next use of the device. The screw is then returned to its Figure 7 position, before the device is used again.

A very important feature resides in the adaptability of the entire cylinder **56** to freely rotate bodily about an axis defined by the tubular support rod **58**. The cylinder thus seeks its lowermost position, by gravitational action, during the ordinary manipulation of the wrench. This causes the fluid to be disposed in an area of the cylinder, at all times, such as to locate the fluid properly for pumping of the same into the pump chamber.

There is a coaction between this free rotational movement of the cylinder, about an axis eccentric thereto, and the use of a flexible, weighted tube **82**. As previously noted, the cylinder tends to rotate bodily about its axis defined by support rod **58**, to a lowermost position. At the same time, the tube **82** tends to move toward the lowermost part of the cylinder, being of a highly flexible material and being properly weighted, as at **84**. The inlet end of the tube is thus always disposed in the fluid, by reason of the coactive relationship of the rotating cylinder and the flexible, weighted tube.

It may be desirable to provide communication between the interior of the reservoir and atmosphere, in order to insure positively against the formation of a partial vacuum within the reservoir during the pumping of fluid out of the reservoir into the pump chamber.

Any of various means might be employed for this purpose, and in Figure 7, by way of example, there is shown one venting means that could be used to advantage.

This venting means includes a small diameter tubular member **108**, having an outer end sealably engaged in an opening formed in the side wall of the reservoir. Preferably, the member **108** is disposed as close to the mid-length point of the reservoir as possible, although as shown it can be to one or the other side of the mid-length point to a slight extent.



In any event, the member **108** is either press-fitted or otherwise fixedly engaged in the opening formed in the reservoir wall. Member **108** extends radially inwardly of the reservoir, having an open inner end across which extends a stop pin **110**, against which seats a ball element **112** freely rotatable within the member **108** and having a diametrically extending slot **114**. The provision of the slot causes the ball element to be overbalanced to one side of its center, as a result of which the ball element will at all times tend to gravitate to a position such as shown in Figure 7, that is, a position in which its solid portion is at the lower side and the slotted portion at the upper side of the ball element.

A plug **116** is threaded, with the member **108** being correspondingly threaded. Plug **116** is engaged in the outer end of the member **108**, and is formed with an axial, small-diameter extension **118**. A bore **120** extends fully from the outer end of the plug to the inner end of the extension, communicating with the slot **114**. Slot **114** is in turn in communication with the interior of the member **108**, and, of course, the member **108** communicates with the interior of the reservoir.

The ball element has a loose fit within the member **108**, so that air can pass the ball element and flow through core **120**.

By reason of this arrangement, during normal use of the device, the fluid level would be such as to be below the mid-length point of the cylinder, that is, the cylinder would be normally less than half full of fluid. Therefore, the fluid will not surround the member **108**, so that during the pumping action air can flow freely through bore **120** into the reservoir to prevent the formation of a partial vacuum.

Subsequently, when fluid is returned to the reservoir from the chamber **106**, it will displace air within the reservoir, said air flowing outwardly through the bore **120** to permit the inflow of fluid.

It is believed apparent that the invention is not necessarily confined to the specific use or uses thereof described above, since it may be utilized for any purpose to which it may be suited. Nor is the invention to be necessarily limited to the specific construction illustrated and described, since such construction is only intended to be illustrative of the principles, it being considered that the invention comprehends any minor changes in construction that may be permitted within the scope of the appended claims.

What is claimed is:

1. In a hydraulic tool of the class described, a body including a fixed jaw; a movable jaw mounted on the body for movement toward and away from the fixed jaw; and an operating mechanism for the movable jaw including a support rod engaged in the body and a hydraulic cylinder eccentrically disposed in respect to the rod and mounted thereon for rotation to a plurality of positions in respect to the body, the eccentric disposition of the cylinder in respect to the rod offsetting the center of gravity of the cylinder from the rod, whereby the cylinder will move to each of said positions by gravitational action.

2. In a hydraulic tool of the class described, the improvement of claim 1, and said hydraulic cylinder extending longitudinally of the body.

3. In a hydraulic tool of the class described, the improvement of claim 2, wherein the cylinder rotates on an axis eccentric to the cylinder.

4. In a hydraulic tool of the class described, the improvement of claim 3, and said body including a handle having a longitudinal opening within which said cylinder is disposed, said axis extending longitudinally and centrally of the opening in the general plane of the handle.

5. In a hydraulic tool of the class described, a body including a fixed jaw; a movable jaw mounted upon the body for movement toward and away from the fixed jaw; and an operating mechanism for the movable jaw including a cylinder having a reservoir for hydraulic fluid, said mechanism further including a support rod carrying the cylinder and engaged in the body, said rod having a bore communicating with the reservoir, pump means working in said bore and adapted to pump fluid thereinto, and means extending between the support rod and said movable jaw adapted for shifting the movable jaw responsive to the pumping of fluid into the bore.

6. In a hydraulic tool of the class described, the improvement of claim 5, said operating mechanism further including a flexible tube connected at one end to the support rod in communication with the bore and having its other end opening into the reservoir to provide said communication between the bore and reservoir, and a weight on said other end of the tube, for movement of said other end of the tube toward the lowermost portion of the cylinder in each position to which the tool is shifted by a user.

7. In a hydraulic tool of the class described, the improvement as in claim 6, said support rod extending longitudinally of the cylinder in eccentric relation thereto, the support rod being freely rotatable in the body and being rigid with the cylinder, for rotational movement of the cylinder by gravitational action to a plurality of positions in respect to the body, said flexible tube being freely movable, at said other end thereof, toward the lowermost portion of the cylinder in each position to which the cylinder gravitates.



8. In a hydraulic tool of the class described, the improvement as in claim 7, wherein the pump means includes inlet and outlet check valves controlling flow of fluid through the bore, a pump rod slidable in the bore and adapted for drawing fluid into the bore responsive to slidable movement of the pump rod, a handle disposed exteriorly of the body and engaged with the pump rod, for moving the same under the control of a user, and a normally closed valve operable by a user to permit return flow from the bore to the reservoir.

9. In a hydraulic tool of the class described, the improvement of claim 8, wherein said means extending between the support rod and movable jaw includes a ram extendible from and slidably mounted within the support rod, said ram being adapted for extension from the support rod responsive to the pumping of fluid into the bore, and a bell crank pivotally mounted upon the body and engaged at its opposite ends with the ram and movable jaw respectively.

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