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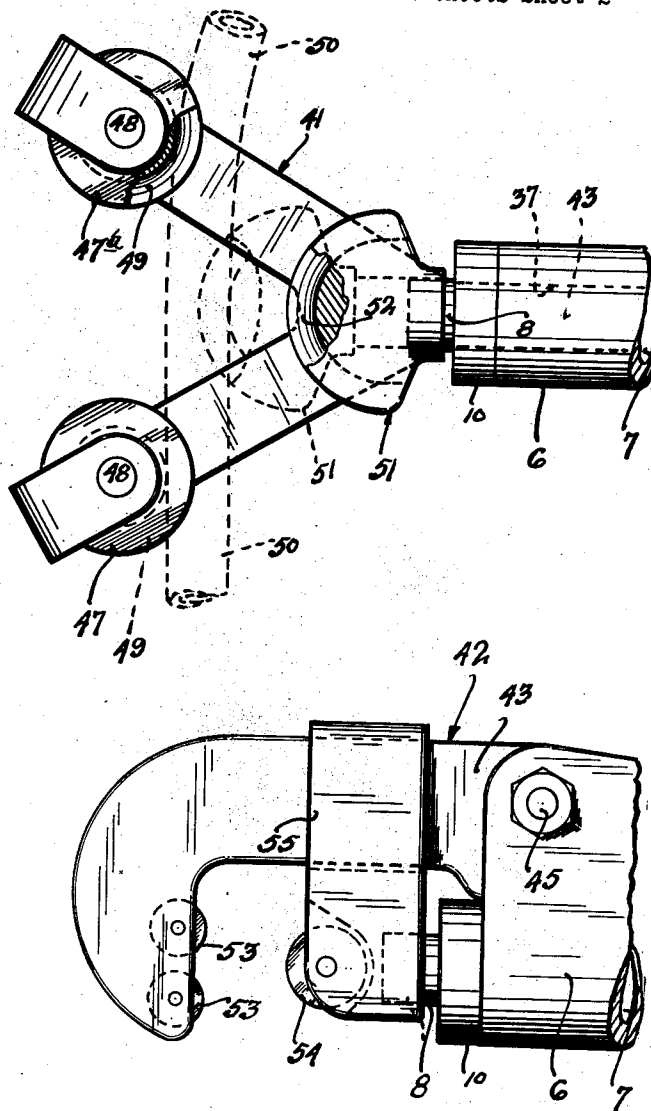
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HYDRAULIC PRESSURE TOOL

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Fig. 4



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HYDRAULIC PRESSURE TOOL

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7 Claims. (Cl. 60—52)

My invention relates to manually-operated hydraulic pressure tools and, generally stated, consists of the novel devices, combinations of devices and arrangement of parts hereinafter described and defined in the claims. The primary object of the invention is the provision of a hydraulic tool capable of producing high pressure for the bending of various metallic objects such as automobile axles, spring leaves, bumper bars, hollow pipes, shafts and the like. The improved tool, however, is capable of various analogous uses and as an important feature includes detachable and interchangeably usable abutment-forming elements for co-operation with the plunger or movable element of the tool.

In the accompanying drawings, wherein like characters indicate like parts throughout the several views, the tool is illustrated primarily as a bending device, and one modification adapting the use as a pipe cutter is also indicated.

Referring to the drawings:

Fig. 1 is a view in side elevation with some parts broken away, some parts shown in axial section and some parts on the section line shown in full, illustrating the improved tool as it appears when provided with detachable abutments adapting it particularly for bending solid members;

Fig. 1a is a fragmentary detail view illustrating a portion of the tool shown in Fig. 1 with certain additional parts broken away and shown in section;

Fig. 2 is a detail sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary bottom view of the tool shown in Fig. 1;

Fig. 4 is a fragmentary view, similar to Fig. 3, but illustrating the tool as being provided with abutments and associated detachable elements adapting it particularly for use in bending hollow tubes or the like; and

Fig. 5 is a fragmentary view, similar to Figs. 3 and 4, but illustrating the tool as being provided with a cutting wheel-equipped abutment and certain other detachable and interchangeable elements converting it into a pipe cutting device.

The main body of the tool is preferably a casting, indicated by 6, formed or bored to afford a relatively large pressure cylinder 7. Working in and through one end of the cylinder 7 is a pressure plunger 8 provided at its inner end with a piston-forming head 9. The outer end of the pressure cylinder is normally closed by a plug-like head 10 that is screw-threaded into the cylinder and serves as a guide bearing for the outer end of the plunger 8. For maintaining the pressure

plunger 8 normally retracted, a quite heavy coiled compression spring 11 is applied around the plunger 8 and compressed between the piston head 9 thereof and the cylinder head plug 10.

Extending rearwardly from the main tool body 6, in co-axial alignment with the pressure cylinder 7, is a tubular fluid reservoir 12 that is screw-threadedly applied to the body 6 at 13 and serves as a handle for the complete tool. The fluid stored in the reservoir 12 and employed in operation of the tool is preferably viscous and may be such as engine lubricating oil. This fluid is indicated by *y*.

For forcing reservoir fluid into the pressure chamber under very high pressure to project the plunger 8, I provide a manually-operated pressure pump comprising a pump cylinder 14 of very small diameter, as compared to that of the pressure cylinder 7, formed in the main tool body 6 intermediate the pressure cylinder and reservoir, a pump plunger 15 working in and projecting through one end of the pump cylinder 14, check valve-equipped fluid passages 16 and 17 connecting the pump cylinder to the reservoir and high pressure cylinder, respectively, and a lever 18 that is pivoted to the body 6 at 19, has slot and pin engagement with the projected end of the pump plunger 15 at 20 and projects over and in spaced relation to the handle-acting reservoir 12. The plunger 15 is provided at its inner end with a leak-proof head 15^a, preferably of rubber or other resilient material applied thereto by means of a screw or the like 21. The conventional packing nut 22 and packing gland 23 are provided to prevent leakage of fluid past the plunger 15.

With reference to the drawings, particularly Fig. 1a, it will be seen that the inner end portion of the lever 18 is forked to receive the upper end of the pump plunger and is provided with a pin 24 that extends through and between opposite prongs thereof and works in a slot or notch 25 in the upper end of the pump plunger.

The check valves in the fluid passages 16 and 17 each comprise a ball 26 that is yieldingly pressed against a co-operating seat 27 by means of a light compression spring 28. The check valve in the passage 16 opens inwardly to permit passage of fluid from the reservoir into the pump cylinder 14 but positively prevents reverse flow thereof through said passage and the check valve in the passage 17 opens outwardly from the pump cylinder and permits flow of fluid under pressure from the pump cylinder into the pressure cylinder but prevents reverse flow through said passage 17. Between the pressure cham-

ber 17 and reservoir 12 is a fluid return passage 29 that opens axially into the reservoir and is provided, adjacent the reservoir, with a normally closed manually-operated relief valve 30 comprising a ball 31 that seats inwardly against a seat 32, and an axially movable operating stem 33. The stem 33 works with clearance in an enlarged ball-retaining portion of the passage 29 outward of the seat 32 and ball 31, extends axially through the reservoir 12 and at its outer end is axially anchored to and for common movement with an operating head 34. This valve stem operating head 34 is axially screw-threaded into the outer end of the reservoir so that rotary movements thereof will produce axial movements of the stem. This head 34 serves also as a closure for the outer end of the reservoir.

The ball 31 is normally pressed firmly against its seat 30 by the stem 33 so as to maintain the valve closed but opening of the valve 30 is readily and conveniently accomplished by screwing the head 34 slightly outward, thereby moving the stem 33 axially outward and allowing the ball 31 to move off of its seat and fluid to pass thereby and the stem into the reservoir.

So that the tool will be operative in all positions regardless of the quantity of fluid in the reservoir, the inner end portion of the reservoir, adjacent the passage 16, should be maintained full of fluid and for this purpose I provide the tubular reservoir with a follower-acting piston 35 that is bored axially at 36 to receive and work axially slidably over the stem 33. This follower 35 is yieldingly pressed by a spring 36^a against the fluid *y* and maintains the same under light pressure and at a constant level. Since the follower 35 embraces the stem 33, it serves the further very useful and important function of maintaining the free inner end of the stem 33 in true axial alignment with the valve seat 32 and ball 31 of valve 30. It will, of course, be understood that while the follower 35 must be freely slidable over the stem 33 it must also fit the stem sufficiently close to prevent leakage of fluid therebetween and the stem. However, little or no trouble will be encountered from leakage at this point if oil is employed in the tool and the bore 36 made long, for example, as illustrated in the drawings. Obviously, suitable packing could be employed as an assurance against leakage between the follower and stem 33, if desired, but this has not proven necessary in most instances.

For attachment of different abutment elements to the body 6 of the tool, the body is provided, above the pressure cylinder 7, with a channel 37 that extends longitudinally of the cylinder. This channel 37 is open at its front but is closed and undercut at its rear end portion 38. Opposite walls of the channel 37, near the outer end thereof, are provided with aligned bolt or pin-receiving apertures 39.

The abutment device of Figs. 1 to 3, inclusive, is indicated as an entirety by 40. The abutment device of Fig. 4 is indicated as an entirety by 41 and the abutment device of Fig. 5 is indicated as an entirety by 42. These several abutment devices each include a like anchoring arm 43 that is shaped to fit snugly into the channel 37 including the undercut portion 38 thereof and provided with an aperture 44 for registration with the apertures 39 and reception of a lock-bolt 45.

The anchoring arm 43 of the abutment device 40 of Figs. 1 to 3, inclusive, is formed outward of

the body 6 to afford a laterally spaced pair of abutment surfaces 46, which surfaces, when the device is anchored to the tool body 6, are located outward and in the axial plane of the plunger 8. These surfaces 46 project outward from other portions of the abutment device to provide ample space for reception of work, such as shown by dotted lines at 47 in Figs. 1 and 3 and which may be assumed to be a spring leaf bumper bar or the like, positioned as during the process of being bent to a desired shape. When the tool is equipped with the abutment device 41 of Figs. 1 to 3, inclusive, it is particularly adapted for bending of solid members such as bumper bars, axles, wheel spindles, automobile frame members and the arching of spring leaves, in which last noted use bending pressure is exerted on the spring leaf at close intervals.

The abutment device of Fig. 4 is particularly adapted for bending of hollow or tubular members, such as pipe, and for this purpose is provided with laterally spaced abutment rollers journaled at 48 to the free ends of diverging branches of the anchoring arm 43. The peripheries of these rollers 47^a are formed with cross-sectionally rounded grooves 49 for reception of tubular members such as the pipe 50 indicated by dotted lines. For use in connection with the abutment device 41 the plunger 8 is provided with a head 51 having a semi-circular cross-sectionally rounded groove 52 in its outer end for reception of a tubular member being bent. This head is provided with a suitable socket for reception of the free end of the pressure plunger and is freely applied or removed therefrom.

In the arrangement shown in Fig. 5 which converts the tool into a pipe cutter, the abutment device 42 extends forward and downward from the anchoring arm 43 thereof and is provided, forward of the pressure plunger, with a pair of pivoted cutting wheels 53 which co-operate with a third and movable cutting wheel 54. This latter noted cutting wheel is journaled on a member 55 that works over and is guided by the intermediate portion of the abutment device 42 and receives and is adapted to be moved forward by the plunger 8.

From the foregoing it will be evident that the pressure plunger is extended by reciprocating the pump plunger 15. Obviously, during outward movements of the pump plunger 15, fluid from the reservoir will pass into and fill the cylinder 14, under the combined action of suction produced in the pump cylinder and pressure exerted by the spring 36^a on reservoir fluid, and under inward movements of the plunger 15 fluid will be forced under high pressure from the pump cylinder into the pressure cylinder 7 through the passage 17 and cause slight forward movement of the pressure plunger 8.

The power which can be exerted on the pressure plunger 8 and therethrough to work, by manual manipulation of the lever 18, is tremendous due to the great power increase ratio afforded, firstly, by lever 18 on plunger 15 and, secondly, to the very great difference in diameters of the pump plunger and piston head 9 of the pressure plunger 8. Projection of the pressure plunger 8 is, therefore, slow but easy even when subject to great resistance. Retraction of the pressure plunger 8 is effected by the spring 11 when the relief valve 30 is open by manipulation of the head 34. The pressure plunger retracting spring is, of course, more powerful than the follower compressing

spring 36^a and will, therefore, return fluid to the reservoir against the action of the spring 36^a.

When the reservoir 12 is empty or nearly so, the follower 35 will come to rest against a shoulder 57 on the stem 33, which shoulder is provided for the purpose of limiting inward movements of the follower under the action of the spring 36^a. Filling of the reservoir can be accomplished in the following manner, to wit: when the filler plug 56 is removed the space in the reservoir between the inner extremity thereof and the forwardly moved follower may be completely filled, then this may be pumped into the pressure chamber by manipulation of the pump plunger. This operation of filling the relatively small space between the follower and the inner end of the reservoir and pumping that fluid into the pressure chamber may be repeated until the desired amount of fluid has been emptied into the tool or the pressure plunger is completely extended, at which time the relief valve 30 may be opened to permit the fluid to flow from the pressure chamber into the fluid reservoir under the action of the spring 11.

Filling of the reservoir may also be accomplished by unscrewing the head 34 and by means thereof and the shoulder-equipped end of the stem withdrawing the follower 35 to a point near the outer end of the reservoir and then filling the reservoir to the desired extent through the opening normally closed by plug 56.

Spring 36^a acting through the follower 35 preferably will maintain the fluid under such pressure as is required to automatically project the pump plunger to an outer position.

What I claim is:

1. In a portable hydraulic hand tool, a pressure cylinder, a pressure plunger working in the pressure cylinder and through one end thereof, a tubular fluid supply reservoir, a follower piston mounted in the tubular fluid reservoir, yielding means maintaining the follower under pressure against fluid in the reservoir, a high pressure pump located between the pressure cylinder and fluid reservoir and operative to force reservoir fluid into the pressure cylinder under high pressure to project the pressure plunger and maintain the same in a projected condition, a fluid passage connecting the pressure cylinder to the fluid reservoir, a relief valve interposed in said fluid passage, and means for manually controlling said relief valve comprising a stem extending from the valve axially through the fluid reservoir and follower piston, said follower being slidable on said valve operating stem and fitting said stem sufficiently close to prevent leakage of fluid therebetween and the stem, and said relief valve control stem being provided with a plug-like hand-piece that projects beyond and has screw-threaded engagement with the free end of the tubular reservoir, said stem being operative under screw-threaded movements of the plug-like hand-piece to open and close the relief valve.

2. In a hydraulic tool, the combination of a pressure cylinder, a pressure plunger working in and through one end of the pressure cylinder, a tubular handle-acting fluid reservoir in co-axial alignment with but spaced from the pressure cylinder, a high pressure pump located intermediate the pressure cylinder and fluid reservoir and including a pump cylinder of small diameter as compared to that of the pressure cylinder, a pump plunger working in and through one end of said pump cylinder, means for operating the pump plunger, and check valve-equipped fluid passages connecting the cylinder to the reservoir

and pressure cylinder, a fluid return passage between the pressure chamber and fluid reservoir opening axially into the reservoir, a valve seat in said passage exposed to said reservoir, inwardly closing valve means co-operating with said valve seat to control flow of fluid through the return passage, and means for operating the inwardly closing valve means including a stem extending therefrom axially through the handle-acting reservoir, and a plug-like hand-piece that is axially screw-threaded into the outer end of the reservoir and to which the outer end of said stem is anchored.

3. The structure defined in claim 2 which further includes a spring-pressed follower-acting piston axially movable in said reservoir, working slidably over said stem and serving as a guide to maintain the inner end of the stem aligned with the relief valve.

4. The structure defined in claim 2 which further includes a spring-pressed follower-acting piston axially movable in said reservoir, working slidably over said stem and serving as a guide to maintain the inner end of the stem aligned with the relief valve, and in further combination with spring means in the pressure cylinder tending to retract the pressure plunger and exerting sufficient retracting force thereon to retract the same and force fluid from the pressure cylinder back into the reservoir against the spring-pressed follower when the relief valve is open.

5. The structure defined in claim 1 in which the said yielding means is in the nature of a coiled compression spring telescoped into the reservoir, working over the stem, and compressed between the follower piston and said plug-like hand-piece.

6. In a portable hydraulic hand tool, a pressure cylinder, a pressure plunger working in the pressure cylinder and through one end thereof, a tubular fluid supply reservoir, a follower piston mounted in the tubular fluid reservoir, yielding means maintaining the follower under pressure against fluid in the reservoir, a high pressure pump located between the pressure cylinder and fluid reservoir and operative to force reservoir fluid into the pressure cylinder under high pressure to project the pressure plunger and maintain the same in a projected condition, a fluid passage connecting the pressure cylinder to the fluid reservoir, a relief valve interposed in said fluid passage, and means for manually controlling said relief valve comprising a stem extending from the valve axially through the fluid reservoir and follower piston, said follower being slidable on said valve operating stem and fitting said stem sufficiently close to prevent leakage of fluid therebetween and the stem, said relief valve control stem being provided with a plug-like hand piece rotatively mounted in and projecting beyond the end thereof, and screw-threaded means associated with the valve stem and operative under rotating movements of the stem to open and close the relief valve.

7. In a hydraulic tool, the combination with a main body having a pressure cylinder formed therein, a pressure plunger working in the pressure cylinder and through one end thereof, a fluid supply reservoir carried by said main body, a pump cylinder formed in the main body and being of materially less diameter than said pressure cylinder, a fluid passage between the reservoir and pump cylinder having interposed therein check valve means permitting flow of fluid from the reservoir to the pump cylinder but pre-

venting reverse flow thereof, a fluid passage between the pump cylinder and pressure cylinder having interposed therein check valve means permitting flow of fluid from the pump cylinder into the pressure cylinder but preventing reverse flow thereof, a fluid passage connecting the pressure cylinder to the fluid reservoir and having interposed therein a manually controlled relief valve, yielding means maintaining the fluid in the reservoir under pressure, yielding means tending to retract said plunger, said last noted yielding means exerting sufficient retracting pressure on the plunger to force the fluid from the pressure cylinder back into the reservoir against the action of the first noted yielding means when the

said manually controlled relief valve is open, and means for operating the said manually controlled relief valve, said means including a stem extending from the said relief valve axially through the reservoir and said means for maintaining the reservoir fluid under pressure, and being provided at its outer end with a plug-like hand-piece that projects beyond and has screw-threaded engagement with the free end of the reservoir, said relief valve being so constructed and operatively associated with the stem that it will be opened and closed by screw-threaded movement of the plug-acting hand-piece.

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