

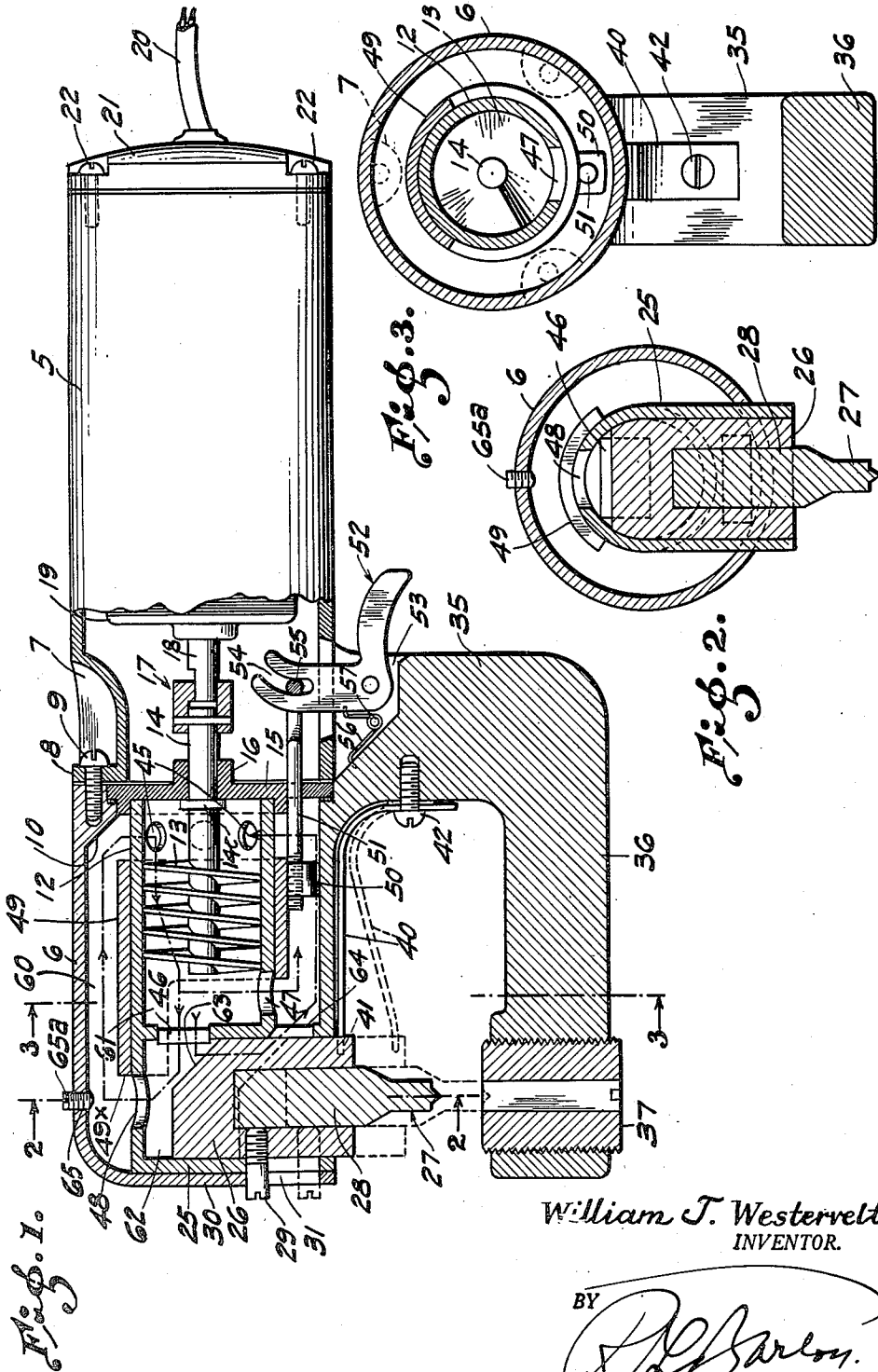
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HYDRAULIC PUNCH

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HYDRAULIC PUNCH

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This invention relates to a hydraulic punch.

While it is more particularly the object of the invention to provide a punching device adapted to punch holes in sheet or other fabricated material, whether metallic or non-metallic in character, yet, without departing from the spirit of the claimed invention, the device may be adapted for various other uses, such for example, as peening hollow rivets, and for various other operations where two die elements are arranged in a cooperative relation to each other.

Heretofore it has been common practice in the art to which this invention pertains, to equip even the smaller and more portable kind of punching devices with fittings whereby they are placed into communication with flexible tubes or conduits which supply to them, from a pressure producing source, an operating fluid, for example air, oil or water. Such means for supplying the driving power adds appreciably to the weight of the device and renders it less portable and usually not so convenient for being manually supported and manually operated.

By the present invention the device is constructed in such a manner as to be operable by an electric motor with current supplied from flexible wire conductors which detract far less from portability and convenient manual handling and operating than do fluid supplying conduits.

Among the objects of the invention are: to provide a more durable punch-operating structure and one wherein jamming and breakage will be reduced to the minimum; to provide such a structure wherein no gears or clutches are used; to provide a more complete and graduated manual control of the movements of the punch proper; and to provide a punching device that will operate in a smoother, less noisy manner.

A more specific object of the invention is to provide, within a portable rotary impelled punching device, an improved combination of motor, motor driven liquid circulating means, and punch proper operated by said liquid when the latter is diverted by a manually controlled means into the proper channel to operate the punch proper.

Another specific object of the invention is to provide, in a hydraulic means for operating a punch, a safety bypass port so positioned as to relieve the impact of the liquid against a punch-carrying piston as soon as the punch-operating movement of the piston has been completed.

Other objects, advantages and features of invention will hereinafter appear.

Referring to the accompanying drawing, which illustrates what is at present deemed to be a preferred embodiment of the invention,

Fig. 1 is a view of the completed device, showing the same partly in side elevation and partly in vertical mid section.

Fig. 2 is a cross section taken on line 2-2 of Fig. 1.

Fig. 3 is a cross section taken on line 3-3 of Fig. 1.

Referring in detail to the drawing, the generally cylindrical casing of the device is made up of a motor housing 5 and closed-in tank section 6 wherein is confined the operating fluid. The attached end portion of the housing 5 is shown having three peripheral depressions 7, these depressions each having an end wall 8 (see Fig. 1) through which passes a screw 9 that screws into an anchoring boss 10 in the casing section 6, thereby securely fastening together the two axial sections of the casing.

Mounted axially within the casing section 6 is a pump cylinder 12 within which is workably fitted a spiral pump blade 13 carried by the pump shaft 14. Clamped in place between the two sections of the casing is a plate 15 which forms a closure head for the adjacent end of the pump cylinder 12 and is provided with a central bearing boss 16 through which the shaft 14 passes with a fluid tight working fit. A coupler 17 detachably connects pump shaft 14 with the shaft 18 of the motor 19 that receives current through a cable 20 led in through the head or cap 21 attached to the housing section 5 by cap screws 22.

The pump cylinder 12 is furnished at its outer end with an extension 25 which houses a piston 26 fitted within said extension with a working fit to reciprocate at right angles to the pump cylinder 12. The punch proper 27 has a shank or body portion 28 fitted within a bore in said piston and secured by a set screw 29. The housing section 6 has an outer end wall 30 furnished with a slot 31 along which said screw travels as the plunger reciprocates.

Cast integral with or otherwise secured to one side of the casing section 6 is a bracket 35 having an arm 36 which carries an adjustable die 37.

An L-shaped leaf spring 40 is provided to retract the punch, said spring having a free end portion contained in a recess 41 provided for it in the punch piston 26 and having its opposite end portion secured to the bracket by a screw 42.

The inner end portion of the pump cylinder 12 has through it a plurality of ports 45 and a spa-

cious port 46 affords communication between said pump cylinder and the extension 25 thereof. Also a port 47 is provided at one side of the pump cylinder 12, and a port 48 in the pump cylinder extension 25, the two latter ports being controlled by a sleeve valve 49 having a working fit around the pump cylinder 12. The inner end portion of said sleeve valve carries an external lug 50 into which is screwed one end of an eye bolt 51. A manually operable trigger 52 is pivotally mounted in a recess 53 in the bracket 35. This trigger has a curved slot 54 which loosely contains end portion 55 of the eye bolt. A wire spring 56, coiled between its ends around a pin 57, has one end in engagement with the bracket and its opposite end in engagement with the trigger to retract the latter together with the eye bolt 51 and the sleeve valve 49, normally to hold the latter in the position shown in Fig. 1 wherein it uncovers ports 47 and 48.

Because of the pump cylinder 12 having an external diameter which is considerably less than that of the internal diameter of the casing section 6, an annular chamber 60 results around said cylinder, this chamber at all times communicating with the pump chamber 61 through the aforementioned ports 45 and being at times in communication with the piston containing extension 25 through port 48.

The inner side of the upper part of the piston 26 is recessed or beveled at 63, and when the piston is in its fully extended position this bevel registers with a safety pressure relief port 64 which affords communication between the lower portions of the piston chamber 62 and annular bypass chamber 60.

A small filling opening 65 is provided for the oil or other liquid used to operate the piston 26, this opening normally being sealed by a screw plug 65a. After the parts have been assembled as shown in Fig. 1, except for the insertion of said plug, a suitable quantity of liquid, preferably oil, will be introduced through the hole 65 to fill to the required capacity the chambers 60, 61 and 62, whereupon said plug will be screwed into place.

When the device is in use the motor 19 will be kept in operation, rotating the spiral pump blade 13 and thereby normally maintaining a circulation of the liquid through the aforesaid three chambers, during which circulation the liquid enters the pump cylinder through the ports 45 and passes out through the upper part of the piston cylinder without operating the piston 26. But whenever the operator actuates the trigger 52 against the opposition of its spring 56 he will slide the sleeve valve 49 to a position wherein it will close ports 47 and 48 thus compelling the liquid to act upon the punch-carrying piston 26 and perform the desired punching operation. Upon releasing pressure on the trigger the spring 56 will retract the trigger, together with the rod 51 and sleeve valve, thus opening ports 47 and 48, which will relieve the liquid pressure against the piston and allow its spring 40 to restore it to normal position.

The sleeve 49 is constructed with an extension 49x which, as viewed in Fig. 1, is located at that end of its upper part which is adjacent to the port 48 and overlies an extended part of the side wall of the pump cylinder 12. The sleeve 49x is necessary in order that port 48 will be closed simultaneously with port 47 when the sleeve is manually operated against the opposition of the retracting spring 56.

In the operation of the device endwise thrust of the pump shaft 14 against the motor shaft 18 is prevented by a collar 14c which is shown as made integral with said shaft 14.

What is claimed is:

1. In a hand tool of the kind described, a casing structure including a pump cylinder, a spiral pump blade within said cylinder, means for mechanically rotating said blade to create a flow of liquid through said cylinder, a piston cylinder in direct communication with said pump cylinder, a piston within the latter cylinder, a punch proper carried by said piston, bypass means including ports, and manually operable valvular means at times to open and close said ports to cause fluid ejected from said pump cylinder to exert a force upon said piston and punch proper causing punching.

2. In a device of the kind described, a pump cylinder having at one end an extension which contains a piston cylinder one end of which is formed by a longitudinal extension of a part of the side wall of said pump cylinder, a casing in a spaced relation to said pump cylinder and to its said side wall extension thereby forming a bypass, there being ports which normally afford a circulation of liquid through said chambers and bypass, one of said ports affording communication between said two chambers and one of said ports leading from said piston cylinder into said bypass through said side wall extension of said pump cylinder, there being other bypass ports located in the side wall of each end portion of said pump cylinder, a spiral pump blade within said pump cylinder located between its ported end portions, a sleeve valve slidably surrounding said pump cylinder, said valve having an end portion positioned to open and close the aforesaid port between said piston cylinder and bypass, another part of said valve being positioned simultaneously to close the aforesaid bypass port which is located in that end portion of the pump cylinder which is adjacent to the aforesaid piston cylinder, a punch-carrying piston in said piston cylinder, and manually controllable means to operate said sleeve valve thereby to interrupt the flow of fluid through the aforesaid bypass and actuate said piston.

3. In a hydraulic hand punch of the kind described, a casing structure which includes a pump cylinder and a piston cylinder in direct fluid communication with each other and by pass means normally affording a free circulation of fluid through said two cylinders, a pump of the spiral blade type within said casing structure operable normally to maintain circulation of fluid through said cylinders and bypass means, a punch-carrying piston in said piston-cylinder, and valvular means intermittently to arrest the bypassing of the fluid to cause said pump to transmit a force through the medium of the circulating fluid to said punch-carrying piston causing punching.

4. In a device of the kind described, a pump cylinder having at one end an extension which contains a piston cylinder one end of which is formed by a longitudinal extension of a part of the side wall of said pump cylinder, a casing in a spaced relation to said pump cylinder and to its said side wall extension thereby forming around said pump cylinder an annular bypass chamber a part of which overlies said side wall extension, a punch-carrying piston in said piston cylinder, that end portion of said piston cylinder which is opposite to said side wall extension projecting beyond the opposite side of said pump

cylinder, there being a port to afford communication between said projecting part of said piston cylinder and said annular chamber to relieve fluid pressure against said piston when the latter is at the limit of its outward movement, there being other ports positioned to afford a normally free circulation of fluid through said cylinders and bypass chamber, a screw propeller type of pump blade positioned within said pump cylinder to create a liquid flow therethrough, and valvular means within said casing operable to close certain of said other ports thereby to direct fluid against said piston to operate it together with the punch it carries.

5. In a device of the kind described, a casing structure including within it a pump cylinder surrounded by a generally annular bypass chamber, a piston cylinder in communication with said pump cylinder and furnished with an end port normally open to said bypass chamber, a pump of the spiral blade type mounted within said pump cylinder normally to maintain a circulation of liquid therethrough, there being ports in addition to those aforementioned to complete a path of liquid circulation through said cylinders and bypass chamber for the stream of liquid created by said pump, a valve to control certain of the ports thereby at times to direct an operating liquid pressure against said piston, said valve comprising a longitudinally slidable sleeve surrounding said pump cylinder with a working fit, an operating arm carried by said valve, said arm extending substantially parallel to the axis of said sleeve with a working fit through a hole provided through the liquid-containing portion of the casing structure, and means to operate said arm connected with the projecting portion thereof.

6. The subject matter of claim 5, and said operating means for said arm consisting of a trigger which is manually operable to move said sleeve in one direction and a spring positioned to move said trigger and arm in the reverse direction after their aforesaid manual operation.

7. In a device of the kind described, a housing structure having outer and inner wall portions arranged to define a pump cylinder, a piston cylinder in communication with said pump cylinder and an annular bypass chamber around said pump cylinder, there being ports which normally afford communication between all of said chambers so that liquid may travel along a circuitous path which includes all of said chambers; a cap plate which forms a closure means both for an end portion of said annular chamber and for an end portion of said pump cylinder, an elongated housing having an end portion which abuts against and is closed by the side of said cap plate opposite to said pump cylinder, means to secure said housing to the remaining portion of the casing structure in its aforesaid position, a pumping member comprising a rotatable shaft extending through said cap plate with a working fit and carrying a spiral blade having a working fit within said pump cylinder, said shaft projecting into said housing, a motor in said housing having a shaft aligning axially with said pump shaft and coupled thereonto, a punch-carrying piston in said piston chamber, and valvular means to control certain of the aforementioned ports thereby to direct the liquid current produced by said pump member against said piston to operate the punch carried thereby.

8. In a hydraulic hand punch of the kind described, a piston cylinder, a punch-carrying piston operating in said cylinder, a casing structure

which includes within it said piston cylinder and a liquid circulatory arrangement, a spiral pump blade within said casing structure operable normally to maintain a circulation of liquid through said circulatory arrangement, and a manually controllable valve operable to arrest the circulation of liquid in said circulatory arrangement and direct it into said piston cylinder, and means to operate said spiral pump blade whereby to exert a force upon the liquid to actuate by force the punch upon the workpiece.

9. In a hydraulic hand punch of the kind described, a closed-in casing structure which includes a pump cylinder and a piston cylinder in direct fluid communication with each other, a punch-carrying piston in said piston cylinder, a sealed-in operating fluid in said casing structure, bypass means normally affording a free circulation of the sealed-in fluid through said two cylinders, a pump within said casing structure operable normally to maintain circulation of the sealed-in fluid through said cylinders and bypass means, and valvular means intermittently to arrest the bypassing of the sealed-in fluid thereby to require the force from said pump to be the force to actuate said piston causing punching.

10. In a portable hydraulic punch of the kind described, a closed-in casing structure which includes a pump cylinder and a piston cylinder in a fluid communication with each other, a punch-carrying piston in said piston cylinder, a sealed-in operating fluid in said casing structure, bypass means normally affording a free circulation of the sealed-in fluid through said two cylinders, rotary impeller means within said casing structure operable normally to maintain circulation of the sealed-in fluid through said cylinders and by-pass means, valvular means intermittently to arrest the by-passing of the sealed-in fluid thereby to operate said piston, and yieldable means carried by said casing structure and operatively connected to said punch-carrying piston to retract the latter piston.

11. The subject matter of claim 5 and, said operating means for said arm consisting of a manually operable trigger.

12. The subject matter of claim 5 and, said operating arm carried by said valve being adjustably connected thereto.

13. The subject matter of claim 5 and, said operating arm comprising an eye-bolt, a bracket secured to one side of said casing structure, and a manually operable trigger pivotally mounted in a recess in said bracket, said trigger having a curved slot loosely containing an end portion of said eye-bolt.

14. The subject matter of claim 4 and, a bracket secured to one side of said casing, an L-shaped leaf spring to retract said punch, said spring having a free end portion contained in a recess provided for it in said punch-carrying piston and having its opposite end portion secured to said bracket.

15. In a portable hydraulic punch of the kind described, a closed-in casing structure which includes a pump cylinder and a piston cylinder in a fluid communication with each other, a punch-carrying piston in said piston cylinder, a sealed-in operating fluid in said casing structure, bypass means normally affording a free circulation of the sealed-in fluid through said two cylinders, rotary impeller means within said casing structure operable normally to maintain circulation of the sealed-in fluid thereby to operate said

piston, and there being a safety by-pass port in said casing structure positioned to relieve the impact of the fluid against said punch-carrying piston as soon as the punch-operating movement of the punch-carrying piston has been completed.

16. The subject matter of claim 9 and, there being a safety by-pass port in said casing structure positioned to relieve the impact of the fluid against said punch-carrying piston as soon as the work-piece has been punched.

17. A hydraulic hand punch comprising a piston cylinder, a piston carrying a punch, said piston operating in said cylinder, a casing structure which includes within it said piston and a liquid circulatory arrangement, a rotary pump within said casing structure operable normally to maintain a circulation of confined liquid contained in said casing structure through said circulatory arrangement, a manually controllable valve operable to arrest the circulation of liquid in said circulatory arrangement and direct it into said

piston cylinder, and means to operate said pump to exert a force upon the arrested liquid to actuate by force the punch upon the work-piece.

18. In a device of the kind described, a casing structure including within it a pump cylinder surrounded by a generally annular by-pass chamber, a piston cylinder in communication with said pump cylinder and furnished with an end port normally open to said by-pass chamber, a pump of the spiral blade type mounted within said pump cylinder normally to maintain a circulation of liquid therethrough, there being ports in addition to those aforementioned to complete a path of liquid circulation through said cylinders and by-pass chamber for the stream of liquid created by said pump, and a valve to control certain of the ports thereby at times to direct an operating liquid pressure against said piston, said valve comprising a longitudinally slidable sleeve surrounding said pump cylinder with a working fit.

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