United States Patent

[11] 3,626,445

[72] Inventor **Alonzo L. Penix**
New Braintree Road, W. Brookfield, Mass. 01585

[21] Appl. No. **19,295**
[22] Filed **Mar. 13, 1970**
[45] Patented **Dec. 7, 1971**

[54] **HYDRAULIC POWER TOOL**
3 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **60/52 US,** 30/180, 30/228
[51] **Int. Cl.** **F15b 15/18,** B26b 17/00
[50] **Field of Search** ..... 60/52 US, DIG. 2, 52 HF, 52 HC, 52; 140/113; 30/180, 228

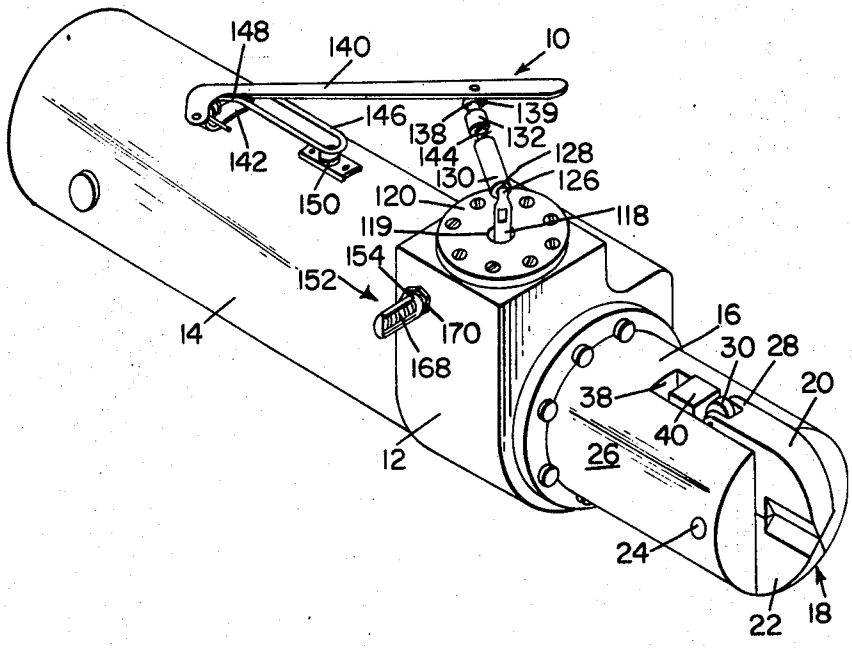
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Primary Examiner—Edgar W. Geoghegan
Attorney—Charles R. Fay

ABSTRACT: A motorized hand tool including a relatively small electric motor arranged to drive a new and improved pump which operates a piston to reciprocate a thrust block to close for instance a pair of jaws, cutters, or the like, in combination with a new and improved hand controlled valve for the pump, including a single handle having means for turning the motor on and off and to control the pump moving the valve between off and on positions.



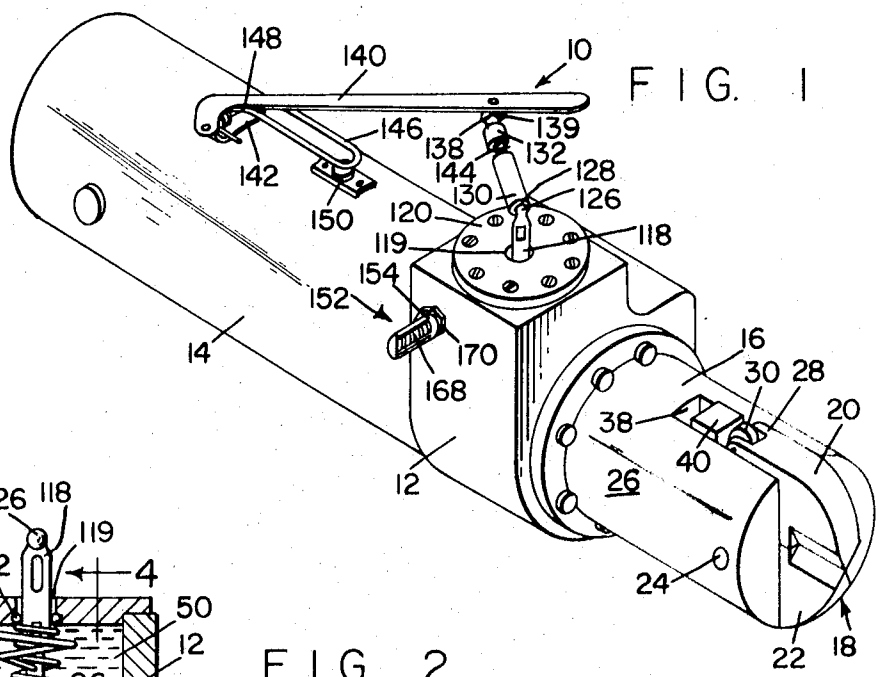


FIG. 1

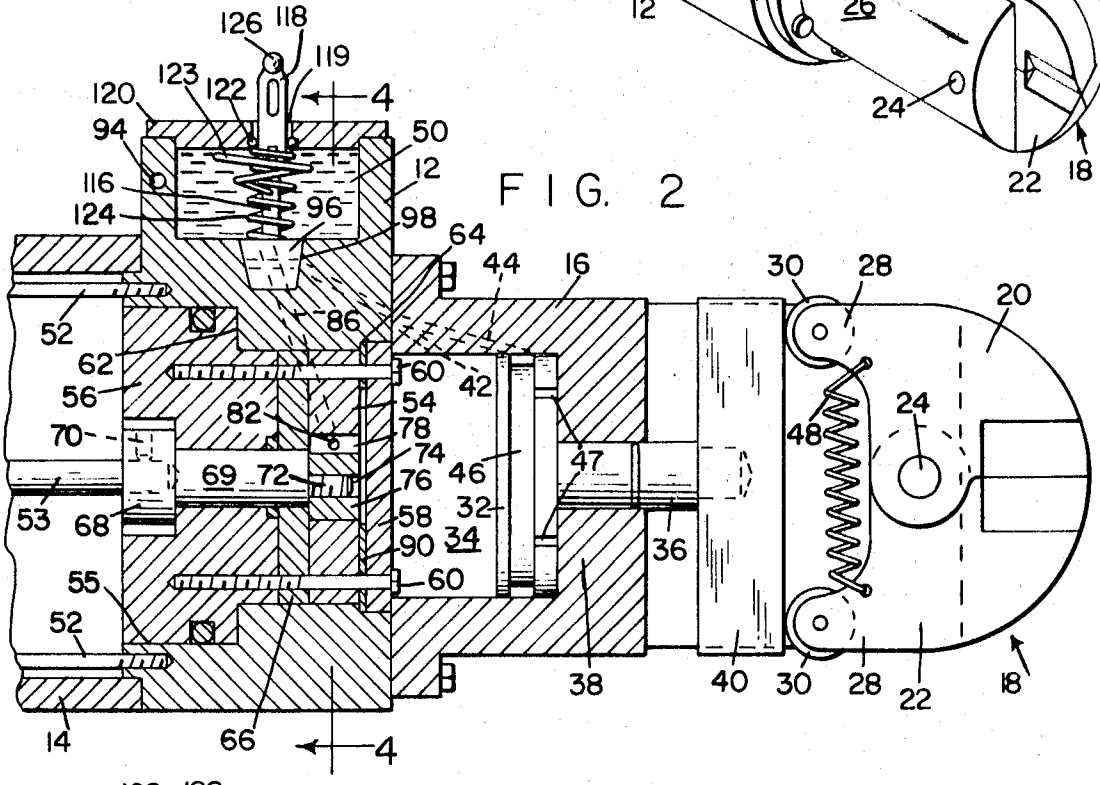


FIG. 2

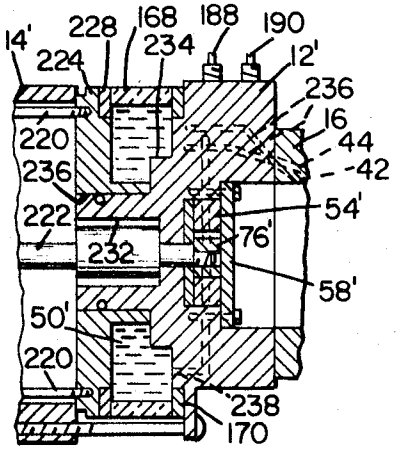


FIG. 6

INVENTOR
ALONZO PENIX

BY Charles R. Fay

ATTORNEY

FIG. 4

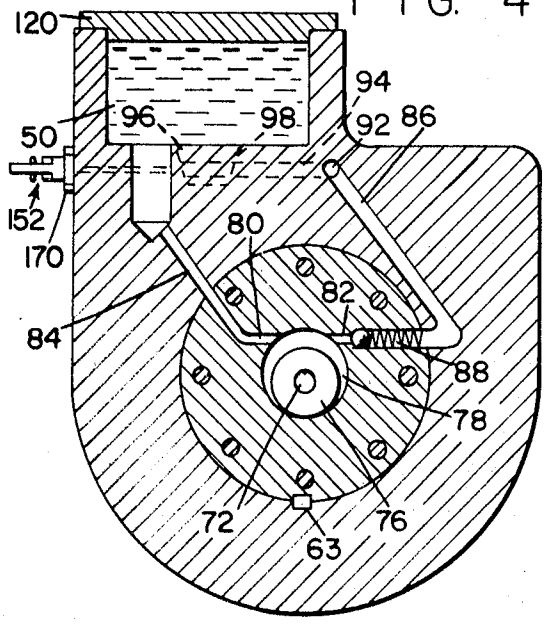


FIG. 3

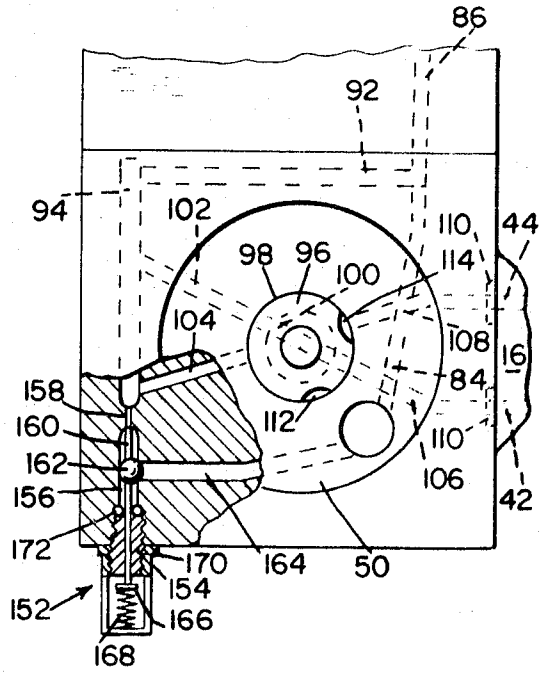
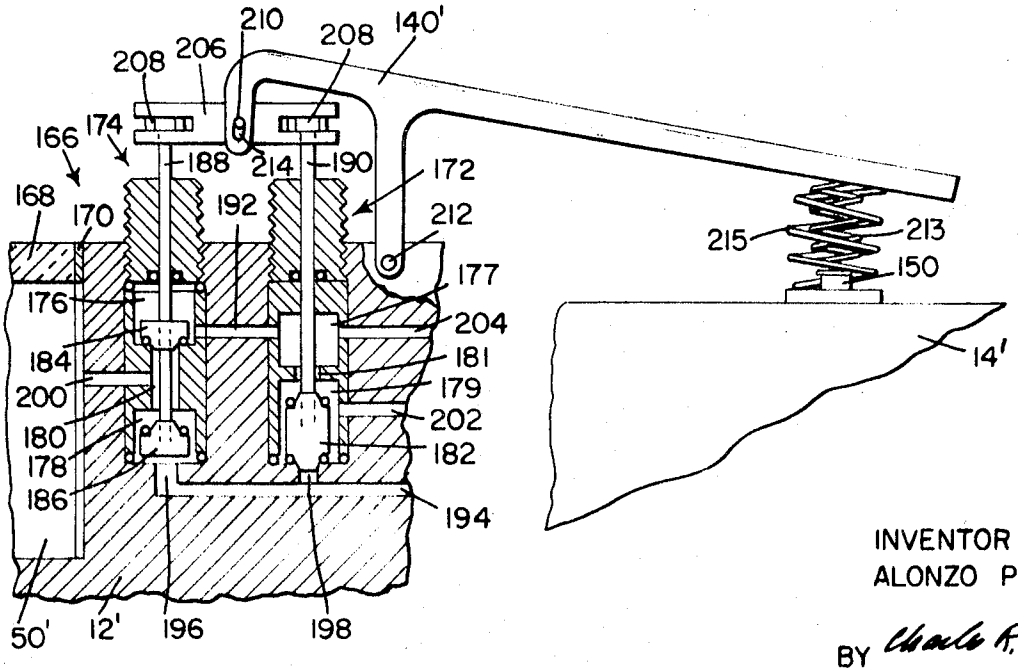


FIG. 5



INVENTOR
ALONZO PENIX

BY Charles R. Fay,

ATTORNEY

HYDRAULIC POWER TOOL

BACKGROUND OF THE INVENTION

A need is evident for a small motorized hand tool constructed to perform many different types of operations. It is the purpose of the present invention to convert the rotational energy of a small hand held electric motor into a very powerful thrust which can be applied to many different operations such as cutting, shearing, crimping, punching, etc. With proper tools applied this tool can squeeze citrus fruit, or a tube of paint, decorating material, etc.

SUMMARY OF THE INVENTION

A hand held motor drives a small hydraulic pump forcing hydraulic fluid through holes drilled in a pump body and directed to a valve changing the flow of the fluid from one end of a cylinder to the other end thereof and at the same time also permitting the fluid from the end not receiving pressure to release its fluid back into a small reservoir in the pump body.

There is a piston which is operated in a reciprocatory motion by the pump and this moves a thrust block in a reciprocatory manner and transmits thrust very powerfully as for instance to a pair of spaced rollers on e.g., a pair of jaws forcing the jaws together.

A pressure relief valve is also included, this valve preventing overload and being adjustable, controlling the amount of fluid supplied at the work end of the tool should this be desired.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the invention as applied to a cutting tool;

FIG. 2 is a fragmentary longitudinal section of the application of the invention shown in FIG. 1;

FIG. 3 is a plan view of the pump with parts broken away;

FIG. 4 is a vertical section on line 4—4, in FIG. 2;

FIG. 5 is a fragmentary view of a modified valving arrangement; and

FIG. 6 is an exploded sectional view of the pump assembly therefor.

DETAILED DESCRIPTION

Referring to FIG. 1, the motorized hand tool embodying the present invention is generally indicated at 10. This tool includes a pump body 12 attached to an electric motor 14 and a thrusting cylinder 16. The tool to be operated, which in this case is a cutter generally indicated at 18, is attached to the thrusting cylinder in a manner appropriate to the type of tool which is to be operated. In the disclosure herein e.g., the cutter to be operated, 18, comprises a pair of upper and lower cutter blades 20 and 22 respectively pivoted as by a pin 24 between a pair of forwardly extending portions 26 of cylinder 16. Blades 20 and 22 each have a rearwardly extending arm 28 each of which pivotally mount a roller 30, see FIG. 2.

Referring particularly to FIG. 2, a piston 32 is located within a cylindrical cavity 34 in cylinder 16. A shaft 36 is connected to one end of this piston and extends through and beyond the forward wall 38 of the thrusting cylinder. A portion of shaft 36 which extends beyond wall 38 is threaded into a thrust block 40.

The position of piston 32 is hydraulically controlled from pump body 12 through a pair of fluid lines 42 and 44 which open into the cavity 34. The introduction of pressurized fluid through line 42 causes piston 32 to be forced to the right as shown in FIG. 2 thereby moving block 40 against rollers 30 to force blades 20 and 22 to their closed position, as shown in that figure. Pressurized fluid introduced through line 44 enters into cavity 34 and into a central groove 46 formed in piston 32 and through apertures 47 to the right side of piston 32 when the piston is in the forward position. This causes the piston to move toward the left, thereby moving block 40 away from rollers 30. A spring 48 returns the jaws 20 and 22 to their open position. Valving means are provided in pump body 12 which

not only changes the flow of fluid between lines 42 and 44 but also permits the fluid from the line not receiving pressurized fluid to release its fluid back into a reservoir 50 in pump body 12. A reservoir is necessary because the volumes of fluid on opposite sides of the piston are not equal, due to the presence of shaft 36 at one side of the piston. The reservoir must have a capacity of volume at least equal to the difference in volume of fluid displaced by the portion of shaft 36 which enter cavity 34.

The housing of motor 14 is secured to pump body 12 by a pair of screws 52. The shaft 53 of motor 14 extends partly into pump body 12. An annular pump plate 54 is located in a chamber 55 in pump body 12 and is held in place between an annular back plate 56 and an annular front plate 58. A plurality of screws 60 extend from the front plate and into the back plate and hold these plates against back and front shoulders 62 and 64 respectively within chamber 55. An annular wear plate 66 is located between back plate 56 and pump plate 54.

A crank 68 is fastened to the extending portion of shaft 53 by a setscrew 70 and has an extension 69 in a central aperture in both plates 56 and 66. The extension 69 of crank 68 extends just up to pump plate 54. A longitudinal crank-pin 72 is eccentrically located in the forward end of extension 69 and extends into a central aperture 74 in a rotary pump member 76 located within a bore 78 of pump plate 54, see FIG. 4.

As seen in FIG. 4, pump plate 54 has an inlet port 80 and an outlet port 82 opening into bore 78. Rotation of shaft 53 causes the eccentrically located pin 72 to drive pump member 76 around the periphery of bore 78 and cause fluid to be pumped from inlet port 80 to outlet port 82. Fluid is introduced to port 80 from reservoir 50 through a line 84 and pumped through a line 86 from port 82. A ball and spring check valve 88 is located at port 82 and prevents fluid from flowing back into bore 78. A key 63 prevents pump plate 58 from rotating and maintains its alignment with fluid holes 84 and 86. A gasket 90 is located between front plate 58 and pump plate 54. Gasket 90 seals the front end of chamber 55 and provides clearance for rotary pump member 76.

Referring particularly to FIG. 3, it can be seen that fluid pumped through line 86 enters lines 92 and 94. An annular tapered switching valve 96 is located in a matching tapered hole 98 at the bottom of reservoir 50. Valve 96 has a hole 100 extending through its tapered side. One side of hole 100 will match, when valve 96 is properly positioned, with one of two branch lines 102 and 104 from line 94. The other side of line 100 will match with either line 106 or 108 when valve 96 is matched with lines 102 and 104 respectively. Lines 106 and 108 are connected to previously described lines 42 and 44 respectively when tool 10 is assembled. O-rings 110 located in appropriate recesses in pump body 12 provide a seal between body 12 and thrusting cylinder 16 where the above described fuel lines connect.

When valve 96 is in the position shown in FIG. 3, hole 100 connects line 102 to line 106 thereby allowing fluid to be pumped from line 94 to line 42 which forces piston 46 to the right as shown in FIG. 2. When valve 96 is positioned so that hole 100 connects line 104 with line 108, fluid is pumped through line 44 from line 94 and piston 46 is forced to the left as shown in FIG. 2. There are two notches 112 and 114 in valve 96. Notch 112 will be aligned with line 106 when lines 104 and 108 are aligned; and notch 114 will be aligned with line 108 when lines 102 and 106 are aligned. These notches allow fluid to be exhausted into reservoir 50 from one side of piston 32 when fluid is being pumped on the other side.

Valve 96 has a stem 116 which extends up into reservoir 50. The upper end of stem 116 is connected to a lever 118 which extends through a hole 119 in a cover plate 120 which is screwed to the top of pump body 12. An O-ring 122 is located in an appropriate recess in the under side of cover plate 120 to prevent leaks around lever 118. One end of a relatively large spring 123 is anchored in the wall of the reservoir and the other end is attached to the valve 96. Spring 123 holds the valve in the position which connects lines 104 and 108 to per-

mit the jaws 20 and 22 to normally remain open. A smaller compression spring 124 surrounds stem 116 and has the dual function of pressing valve 96 in hole 98 and pressing O-ring 122 against cover plate 120.

The upper end of lever 118 has a ball 126 which fits into a socket 128 at one end of a link 130, see FIG. 1. A second link 132 has a narrowed stem on one end which fits into a hole at the opposite end of link 130. The other end of link 132 has a ball 138 which fits into a socket 139, in an operating lever 140 which is pivoted to a bracket 142 mounted on motor 14. A spring 144 located between links 130 and 132 helps to maintain balls 126 and 138 in their sockets. A spring 146 is anchored to bracket 142 and has a portion 148 which bears against lever 140 to hold the lever in its upper position. Spring 146 has a forwardly extending portion which bends away from portion 148 and bears against and depresses a switch 150 on motor 14 when lever 140 is depressed. When switch 150 is thus depressed, motor 14 is turned on. The first slight downward motion of lever 140 causes spring 146 to depress switch 150 to start the motor but does not affect the position of valve 96 which will be in its normal position connecting line 104 to line 108. Fluid is thereby pumped through line 44 which has the effect of opening jaws 20 and 22 if the jaws were in their closed position when the tool was last used. Further downward motion of lever 140 will cause valve 96 to move to the position shown in FIG. 3, thereby allowing fluid to be pumped through line 42 and piston 46 to close jaws 20 and 22 as shown in FIG. 2. Downward motion of lever 140 causes valve 96 to partially rotate because lever 118 is not directly below lever 140 and therefore links 130 and 139 swing in a different plane than lever 140. The motion of links 130 and 139 causes lever 118 to twist and partially rotate valve 96 against the force of spring 123.

Referring again to FIG. 3, there is shown an adjustable pressure relief valve generally indicated at 152 which includes a threaded head 154 screwed into the threaded portion of a hole 156 in body 12 near reservoir 50. Hole 156 communicates with line 94 through a smaller hole 158. A rod 160 extends through head 154 and seats against the opening of hole 158. A ball 162 is attached to rod 160 and blocks the opening of a hole 164 which extends from hole 156 to reservoir 50. A cup 166 is attached to the outer end of rod 160 and bears against a spring 168 which maintains rod 160 and ball 162 in blocking position as shown in FIG. 3. The outer surface of head 154 is also threaded for reception of a lock nut 170 which holds head 154 in its "bottoming" position against a sealing O-ring 172. When the pressure in line 94 exceeds a certain predetermined value, rod 160 will be pushed away from opening 158 against spring 168 and fluid will be allowed to escape into reservoir 50 since ball 162 will be also pushed away from the opening of hole 164. When the proper pressure is reached in line 94, rod 160 will again close the opening from hole 158 and ball 162 will seal the opening to hole 164.

Referring to FIGS. 5 and 6, there is illustrated a modified valving arrangement generally indicated at 166 in FIG. 5. When this type of valving arrangement is used, the pump body is modified somewhat and is indicated at 12'. The reservoir within the pump body is also modified and is indicated at 50'. The reservoir has an annular shape and is enclosed by a ring 168 preferably made of a transparent material which is appropriately sealed by a ring 170. The transparent ring 168 allows the operator to usually check the level of fluid within the reservoir.

Valving arrangement 166 comprises a pair of valves generally indicated at 172 and 174. Valve 174 has upper and lower chambers 176 and 178 respectively and valve 172 has upper and lower chambers 177 and 179 respectively. Chambers 176 and 178 are interconnected by a port 180 and chambers 178 and 179 are interconnected by a port 181. A double acting plunger 182 is located in chamber 179, and single acting plungers 184 and 186 are located in chambers 176 and 178 respectively. A rod 188 is fixed to plungers 186 and 184 and extends out beyond pump body 12'. A rod 190 is fixed to plunger 182 and also extends out beyond pump body 12'. There are sealing rings appropriately located to prevent leaking. Upper chambers 176 and 177 are interconnected by a fluid line 192. Lower chambers 178 and 179 are both connected at their lower ends to a line 194 through ports 196 and 198 respectively. A fluid line 200 connects port 180 to reservoir 50'. A fluid line 202 connects chamber 179 to previously described fluid line 86 through which pressurized fluid is pumped. A fluid line 204 connects chamber 177 to previously described line 44 in the thrusting cylinder 16. Line 194 is connected to line 42 in the thrusting cylinder 16.

In their normal positions plungers 182 and 184 block ports 198 and 180 respectively as shown in FIG. 5. During operation of the tool, pressurized fluid enters chamber 179 from line 202, passes through port 181 into chamber 177 and through line 204 to line 44 to move piston 46 to the left in a manner previously described as to FIG. 2. Fluid is exhausted from the left side of piston 46 through lines 42, 194 and 200 back into reservoir 50'. Fluid will pass from line 194 to line 200 through ports 196 and 180 which are both open to chamber 178 when the valves are in their normal position.

The upper ends of rods 188 and 190 are operatively connected to a double yoked member 206 by nuts 208. A lever 140' is connected to member 206 by a pin 210 located intermediate nuts 208 and is pivotally connected at 212 to pump body 12'.

A slight downward motion of the right hand portion of lever 140' will operate switch 150 through a relatively light spring 213 to start the motor 14 and a further downward motion will change the operating positions of valves 172 and 174. The "lost motion" between switch operating and valve operating positions of the valve can be obtained by a slot 214 at the point where pin 210 is connected to lever 140'. A relatively heavy spring 215 maintains lever 140' and valves 172 and 174 in the position shown in FIG. 5. Other "lost motion" devices may of course be used if desired.

When the right hand end of lever 140' is depressed to its lower position, member 206 is lifted thereby lifting rods 188 and 190. When this happens, plunger 182 blocks port 181 and unblocks port 198; plunger 186 blocks port 180 from chamber 178 and plunger 184 unblocks port 180 from chamber 176. When plungers 184, 186 and 182 are thus repositioned, fluid will be pumped into line 194 from line 202 through chamber 179. Line 194 is connected to previously described line 42. Fluid therefore directed to the inner end of cavity 34 which forces piston 46 toward the position shown in FIG. 2 for closing the cutter blades 20 and 22. Since plunger 184 no longer blocks port 180, fluid is exhausted into reservoir 50' from the right side of piston 46 through lines 44, 204, 192 and 200 via chambers 177 and 176 and port 180.

FIG. 5 is diagrammatic in some respects and is drawn out of scale to show clearly the valves at 182, 184 and 186 and their action. These valves are actually very small and are not shown in FIG. 6 but the relative positions of the upper ends of the actuating rods 188 and 190 correspond in these two figures.

The housing 14' mounts the unit as before. Bolts 220, FIG. 6, secure a sub plate 224 which has an opening 236 through which the motor shaft 222 projects driving cam 76' for pump 54' covered by pump cover 58'. A seal 228 ensures against leakage at one side of reservoir 50' and a like seal 170, see also FIG. 5, performs a like function for pump body 12'. This body has a central rear projection 234 with an open ended cylinder 232 that fits into the opening at 236 and is complete with O-ring. The valving 166 of FIG. 5 is arranged in the pump body and has a return at 238 to the reservoir.

I claim:

1. A manually operated tool comprising a housing and an electric motor in the housing, a shaft for said electric motor,

a pump body connected to said housing, a shaft in the pump connected with respect to the electric motor shaft, a rotary pump element driven by said shaft in said pump body upon energization of said electric motor, a cylinder and piston, a valve positionable to direct fluid from one end of

the cylinder to the other end thereof, a thrust block mounted on said pump body,

a free-ended bifurcated member on said pump body providing a guideway, said thrust block being located in said guideway and being reciprocable therein, an operative tool mounted on the outer end of said bifurcated member being operated by said thrust block in its reciprocatory action,

a manually operated handle pivotally mounted on the electric motor, an on and off switch for said electric motor, means associated with said handle for turning said switch on, interconnecting means between said handle and said valve for operating said valve, said valve being reciprocatory, and a lost motion connection for said interconnecting means causing the switch to operate before the operation of the valve.

2. The manually operated tool of claim 1 including a pair of pivoted jaws, means mounting the jaws in the path of the thrust block, said thrust block engaging said jaws causing the same to close, and means for opening said jaws upon retraction of the thrust block.

3. The tool of claim 1 including a reservoir for the pump, a pressure relief valve preventing overload of the hydraulic system, and means to adjust the pressure relief valve controlling the pressure and the degree of thrust of the thrust block.

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