United States Patent [19]

Miceli

[11] **3,773,074**

[45] **Nov. 20, 1973**

[54] **HYDRAULIC CONTROL UNIT**

[75] Inventor: **Marc L. Miceli**, Lyndhurst, Ohio

[73] Assignee: **Meyer Products Inc.**, Cleveland, Ohio

[22] Filed: **Nov. 1, 1972**

[21] Appl. No.: **302,727**

[52] **U.S. Cl.** **137/596**, 91/411

[51] **Int. Cl.** **F16k 11/20**

[58] **Field of Search** 137/596, 596.12, 137/596.13, 596.1, 596.2, 625.68; 91/411, 91/414; 60/52

[56] **References Cited**

UNITED STATES PATENTS

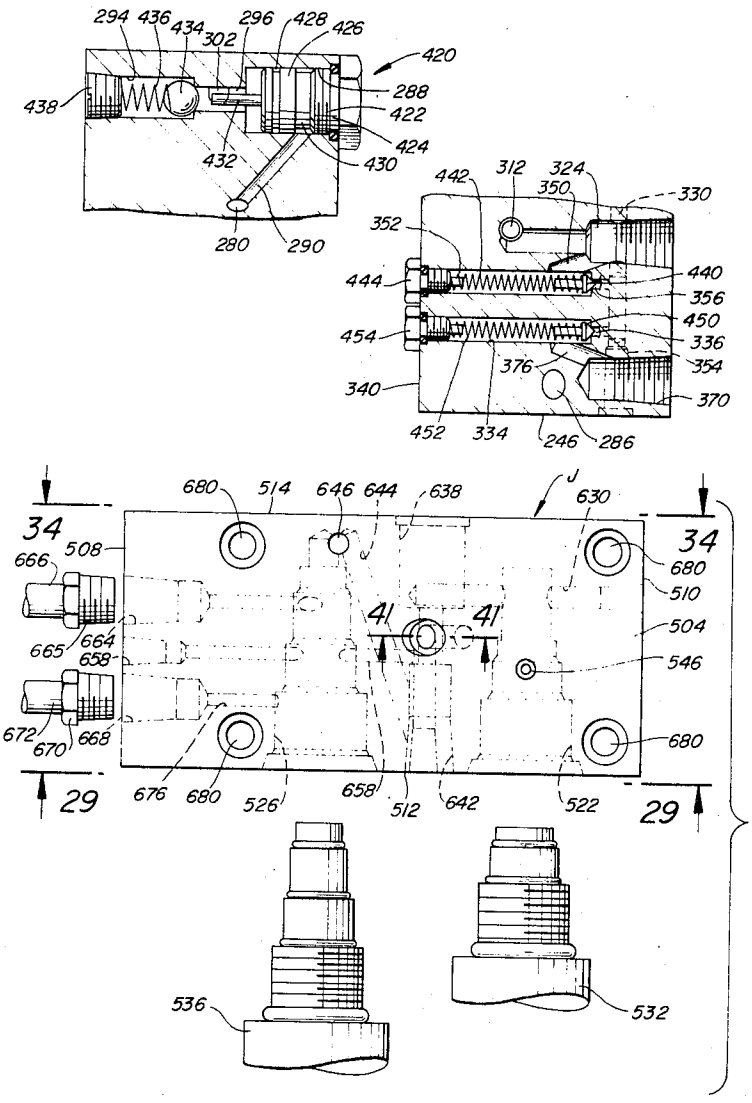
3,513,876 5/1970 Tarbox 137/596

Primary Examiner—Henry T. Klinksiek
Assistant Examiner—Robert J. Miller
Attorney—James H. Tilberry et al.

[57] **ABSTRACT**

A hydraulic control unit for controlling the position of a plow blade or the like includes a one-piece casting defining a common base portion for a selectively variable multifunction power unit. The common base portion is bored to provide passages for flow of hydraulic fluid from a pump. Several different one-piece control blocks are attachable to the common base portion for selectively varying the number of functions which the power unit controls.

42 Claims, 52 Drawing Figures



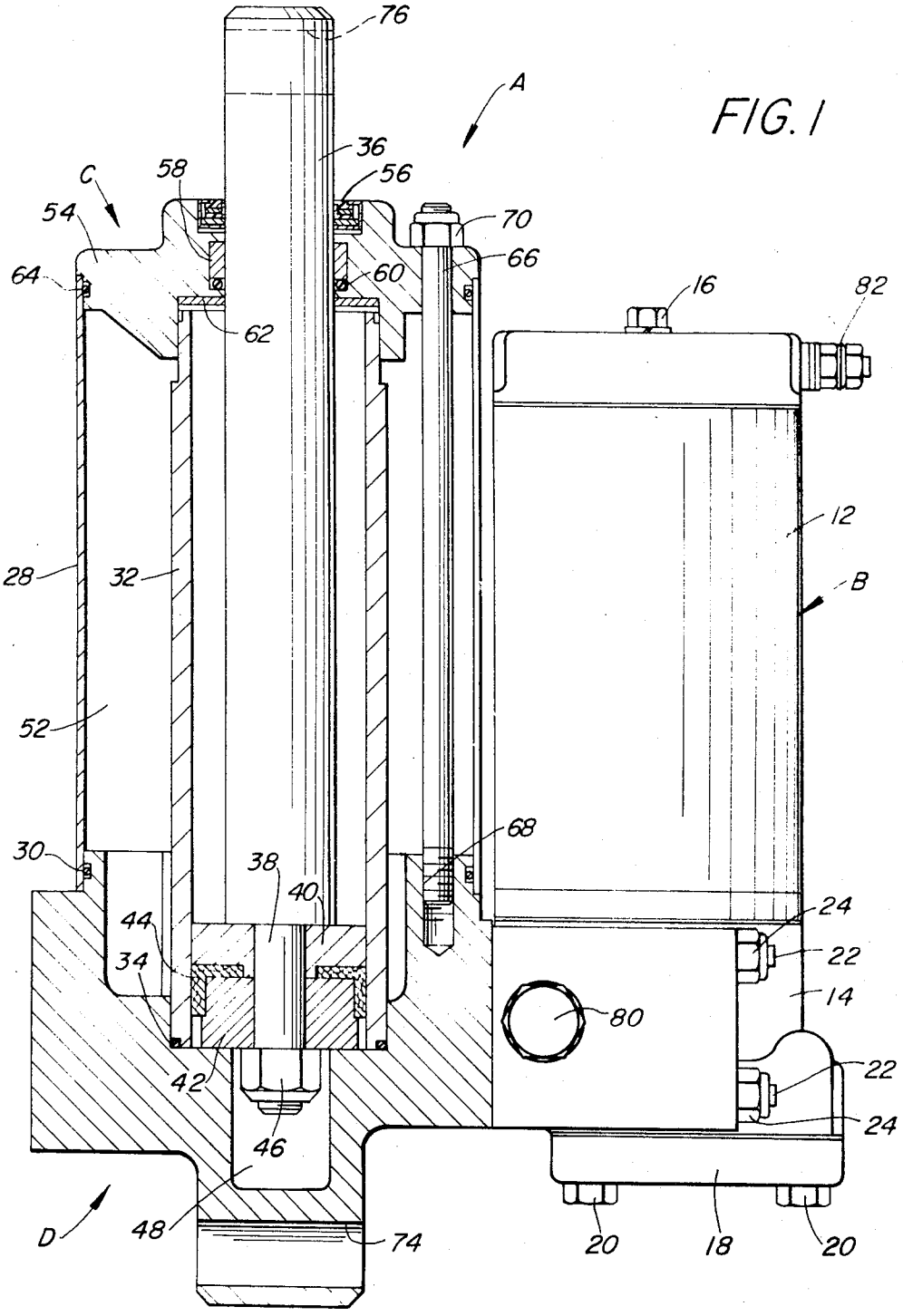

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FIG. 1

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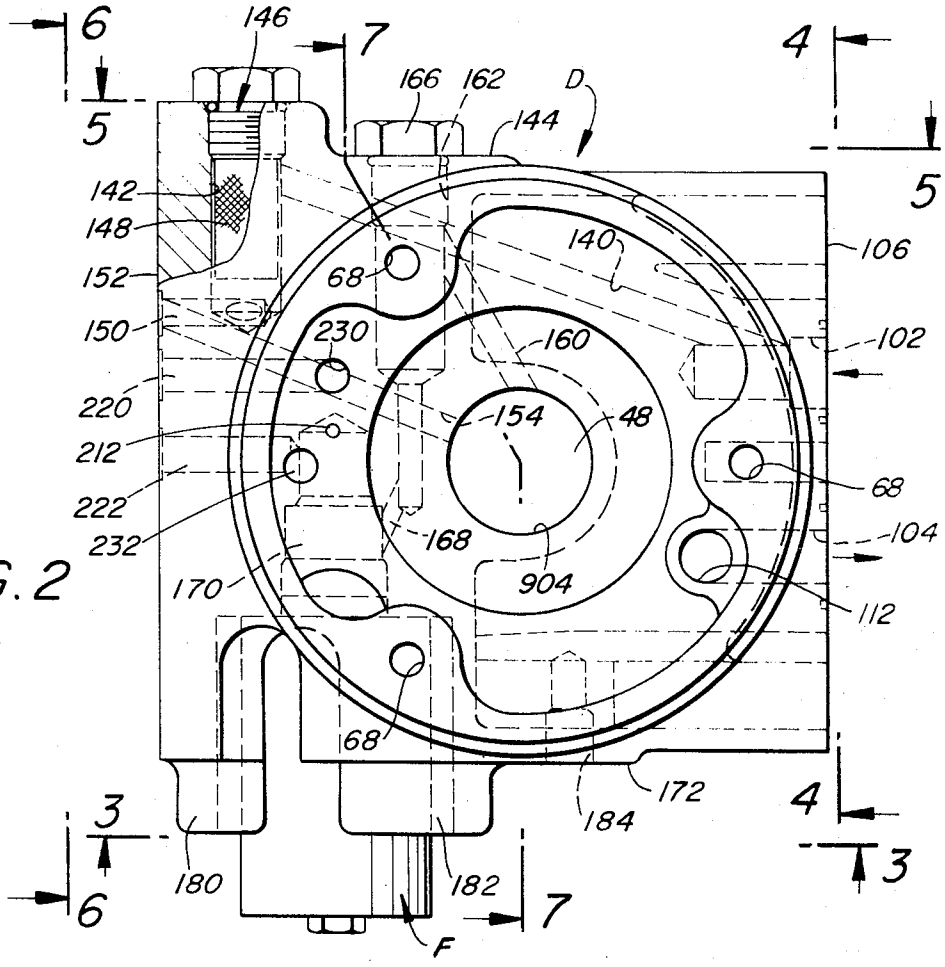
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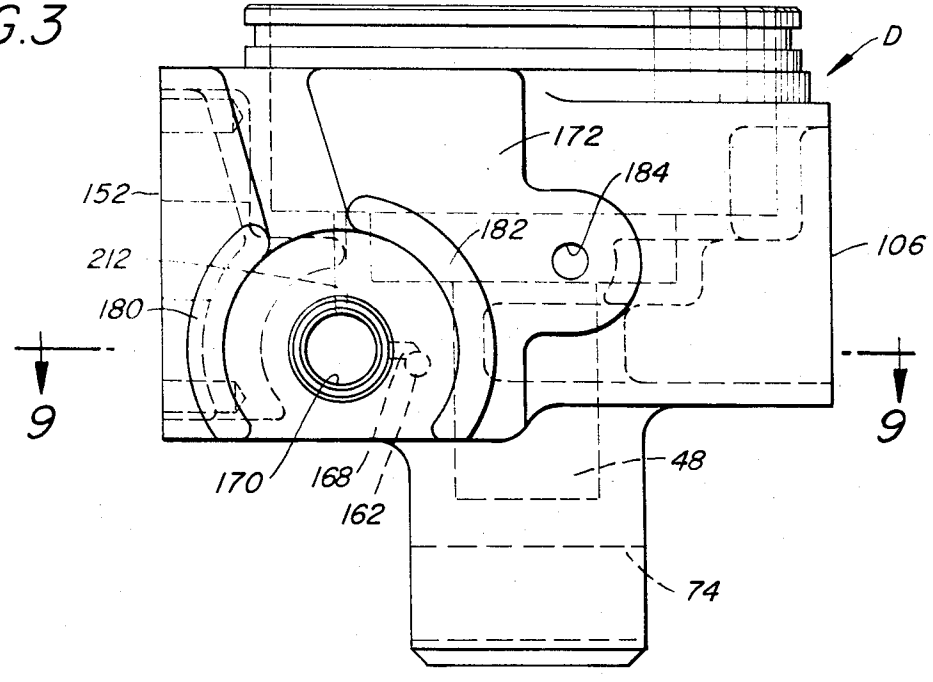
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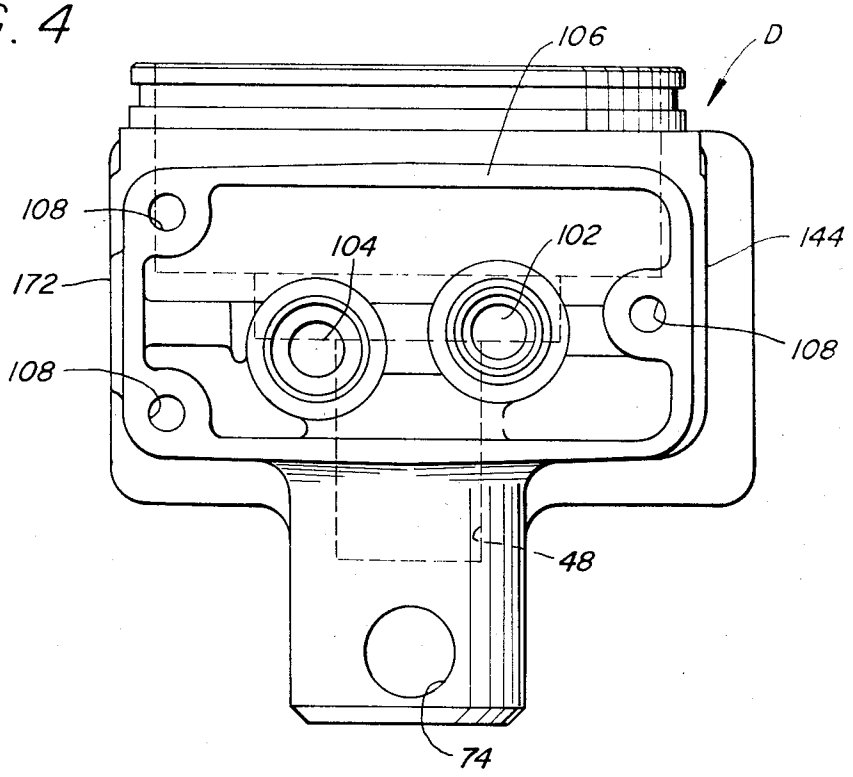

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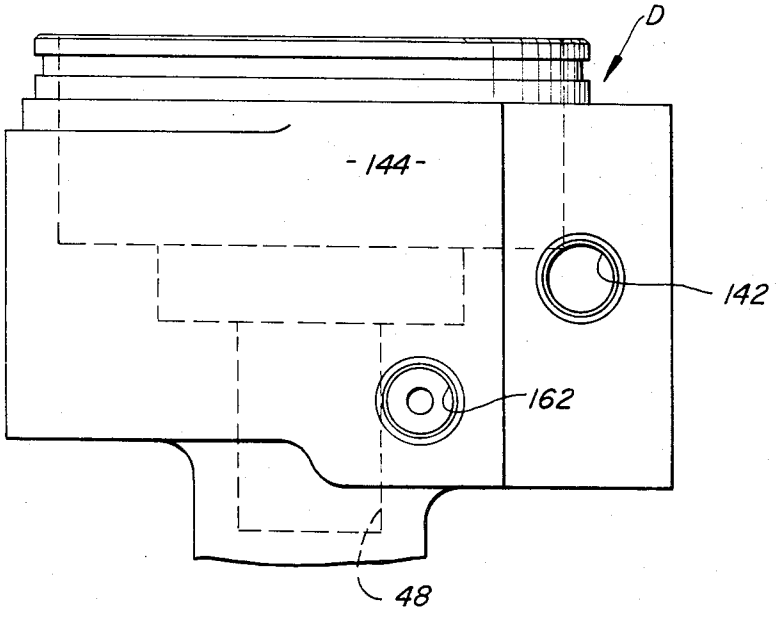

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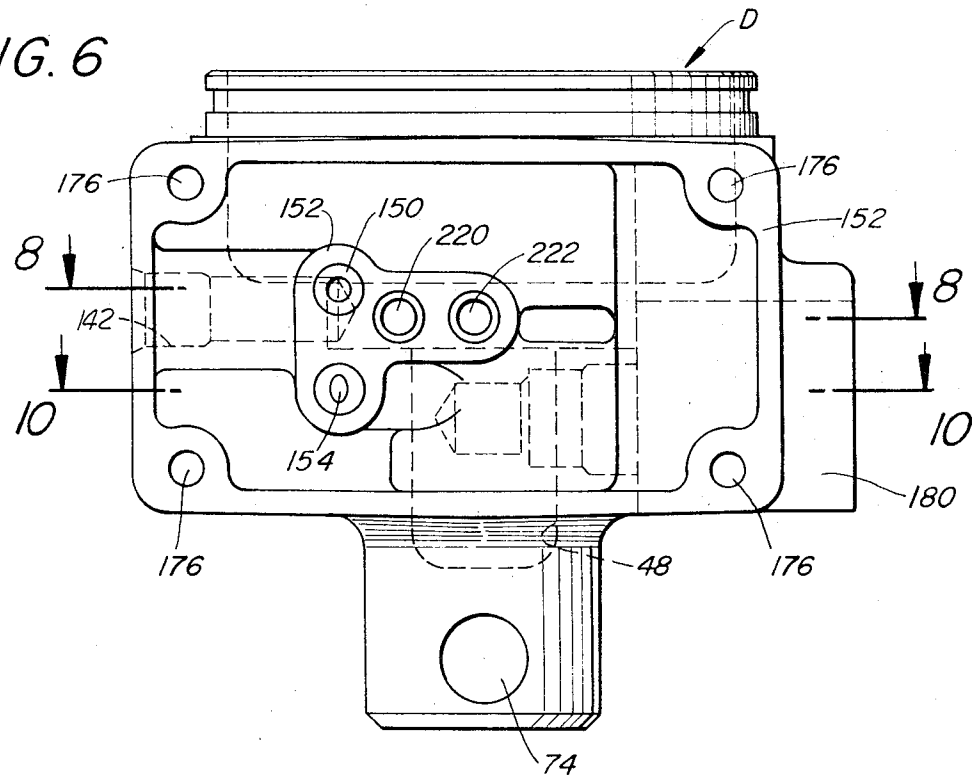
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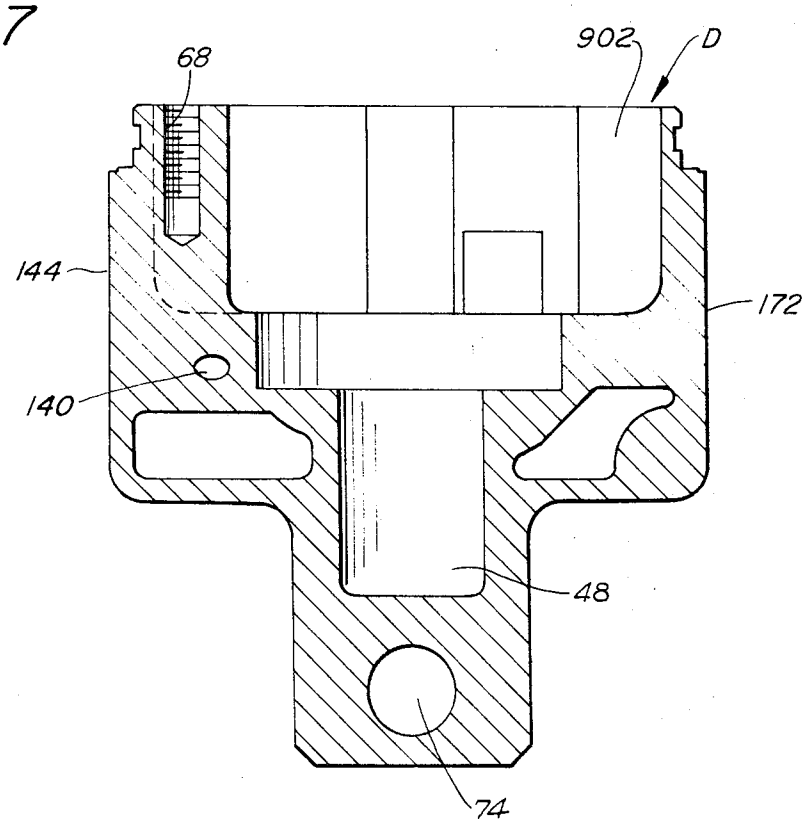
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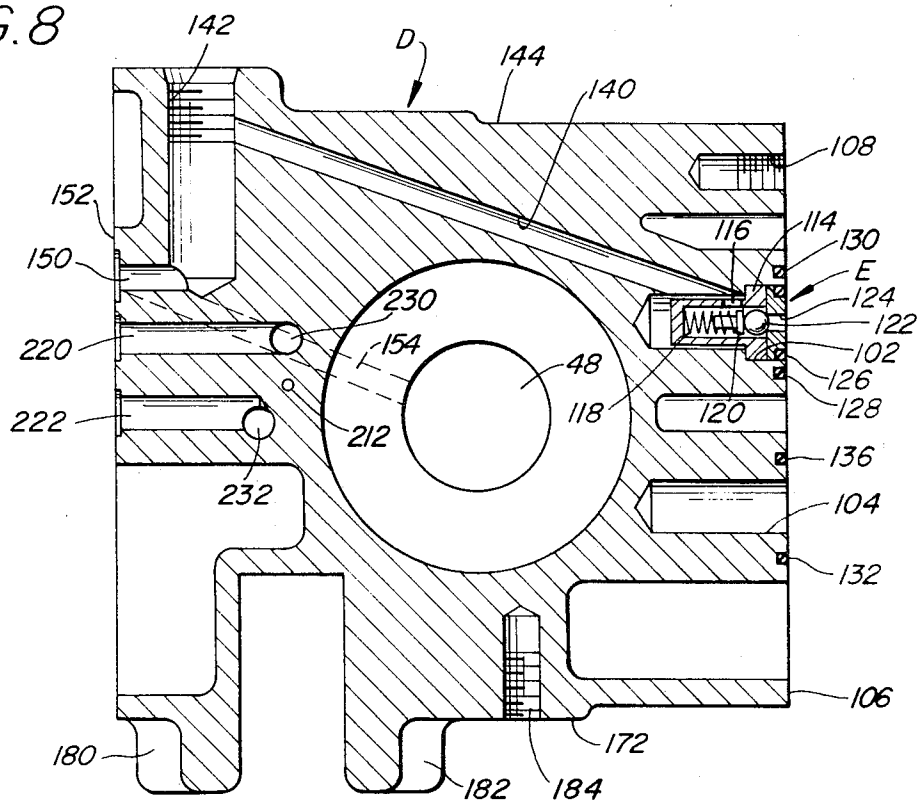
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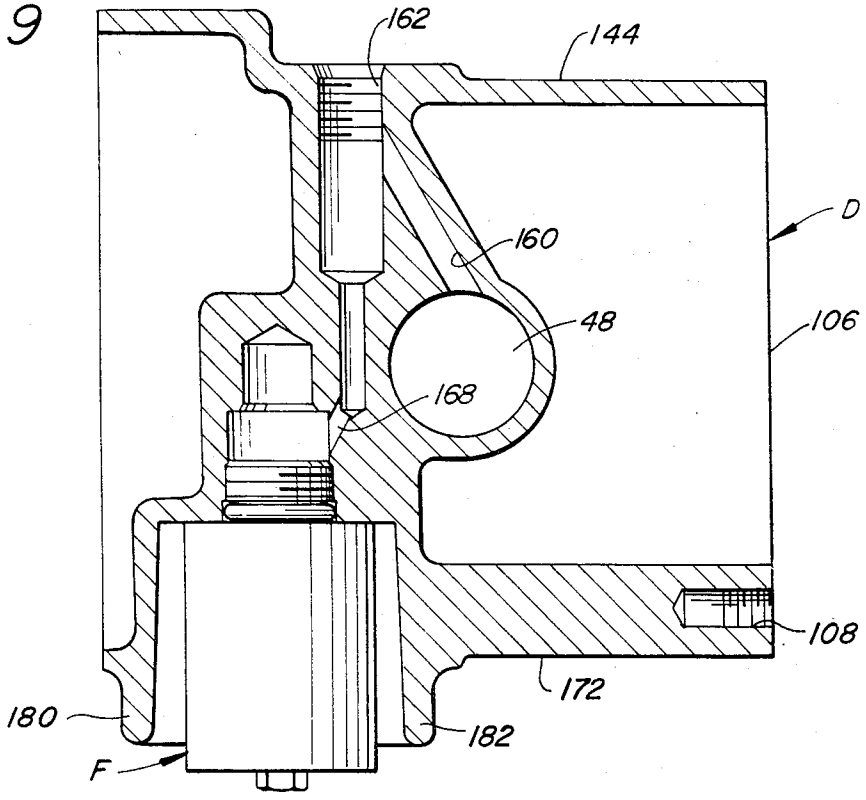
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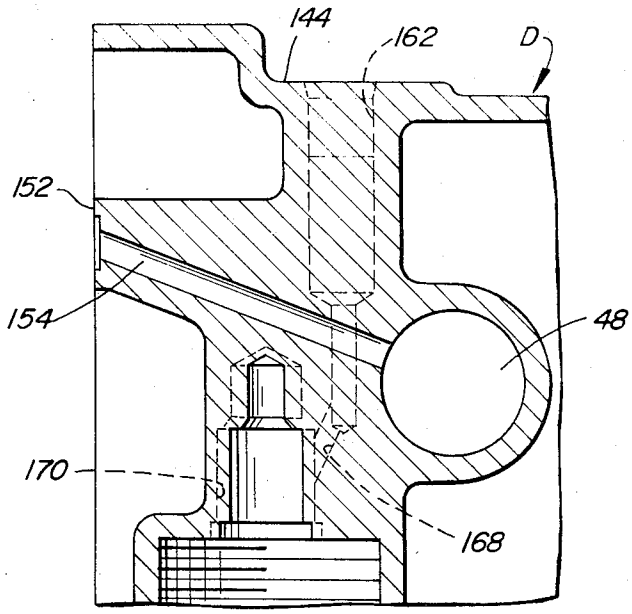

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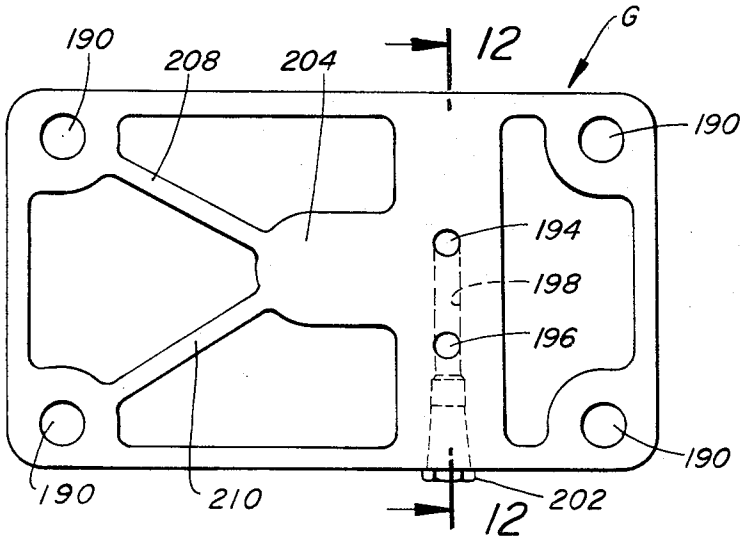

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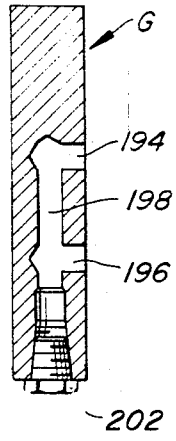

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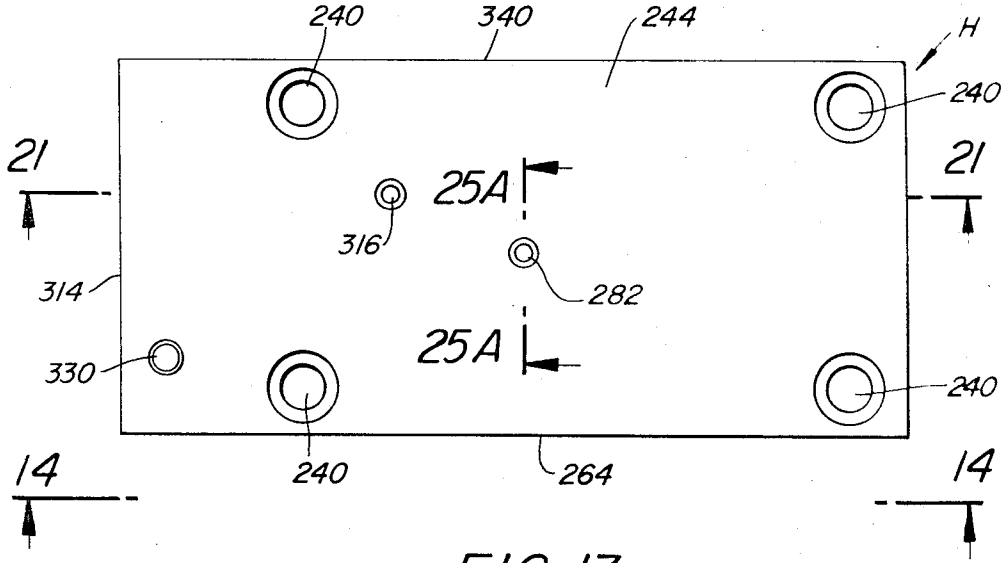
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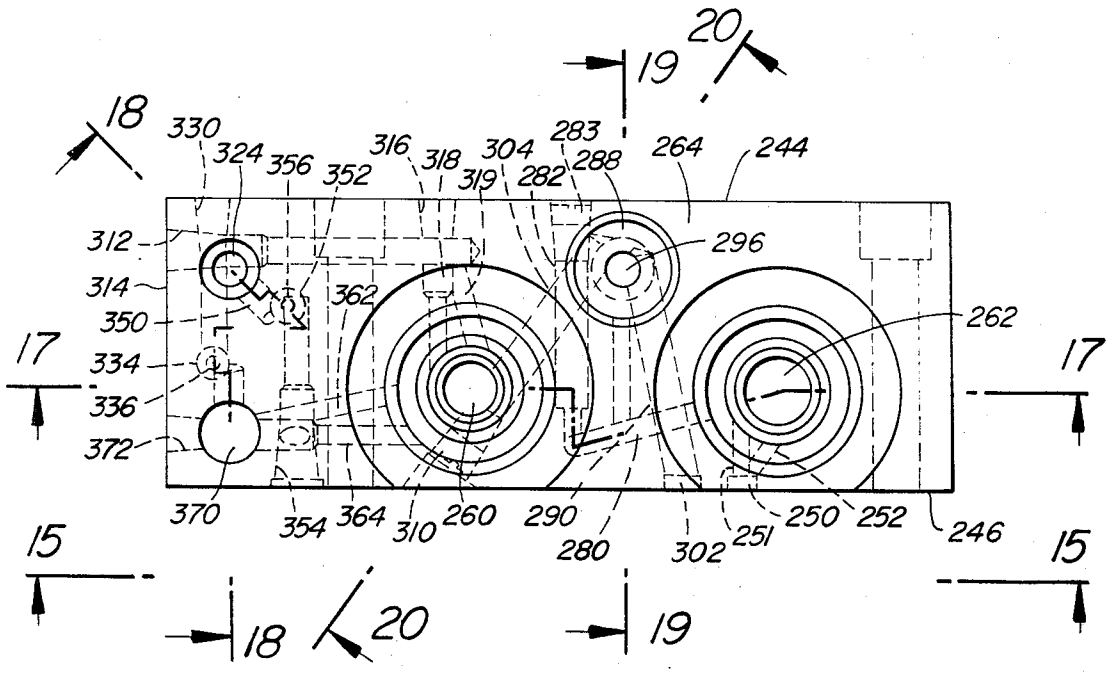
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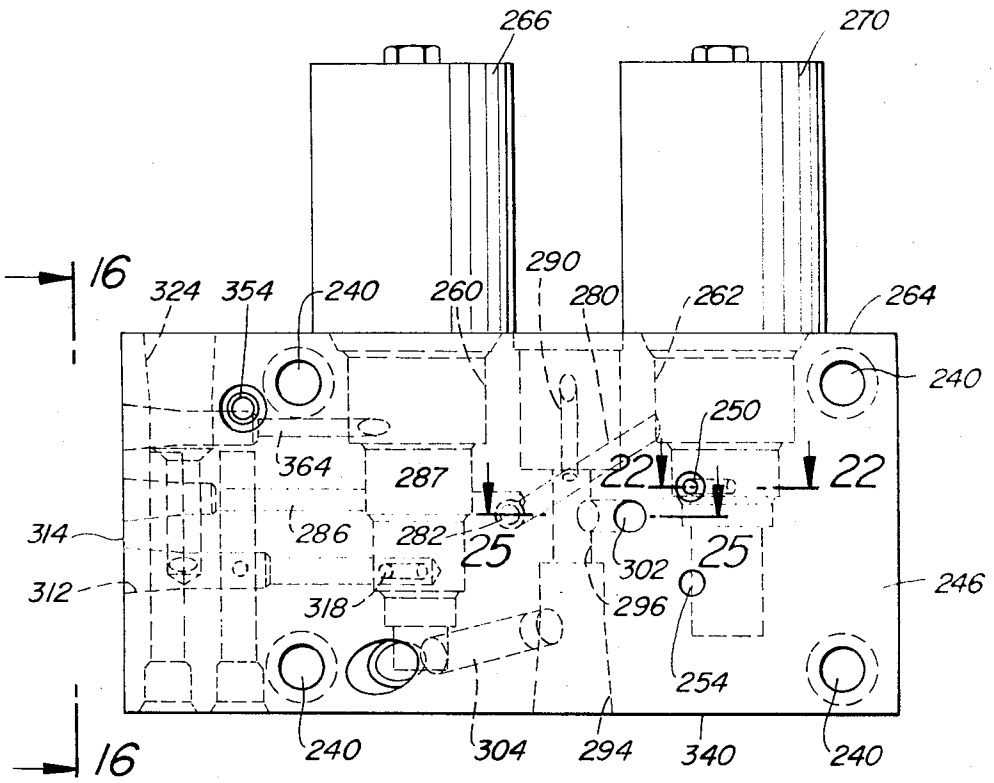
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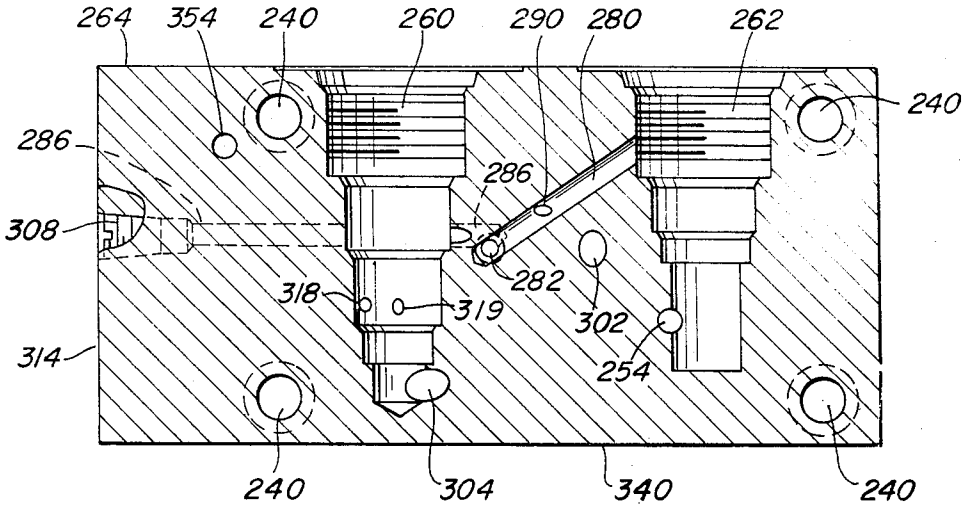
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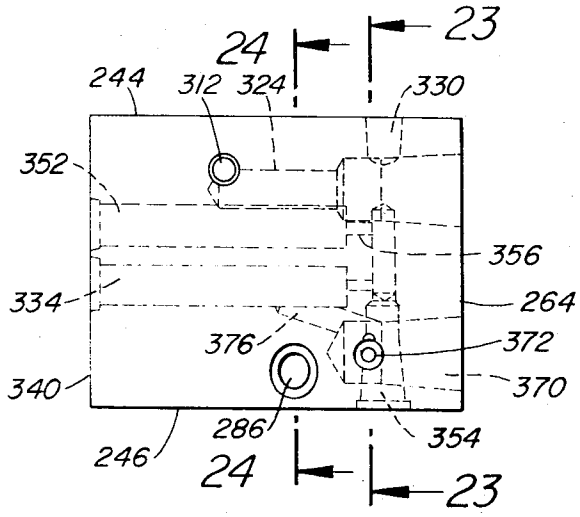

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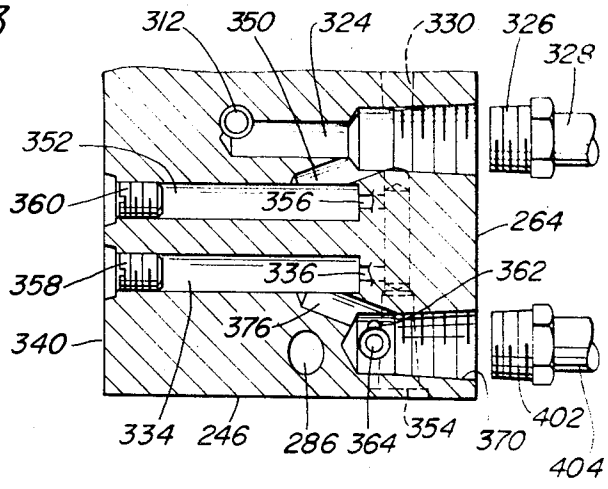

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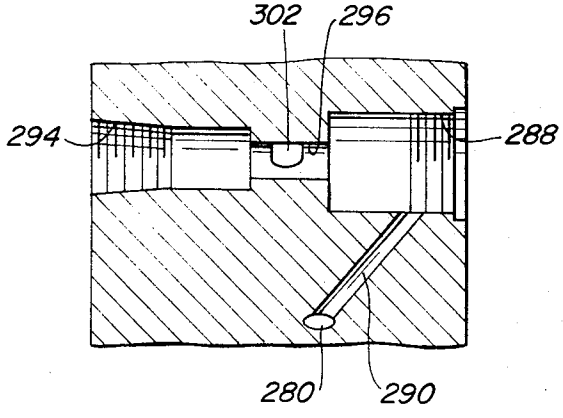

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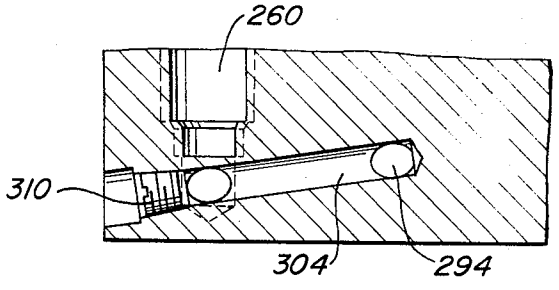

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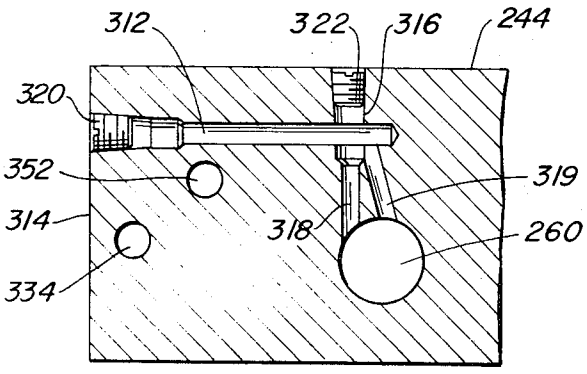

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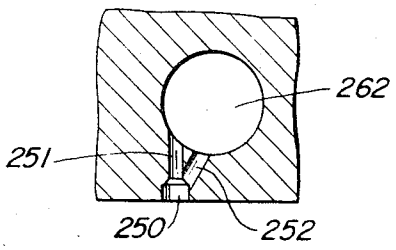

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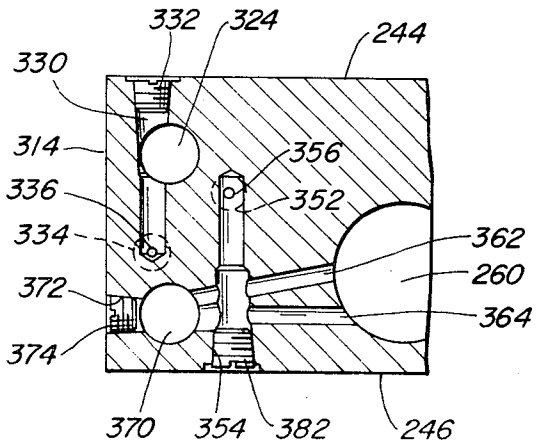

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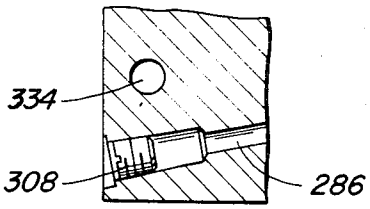

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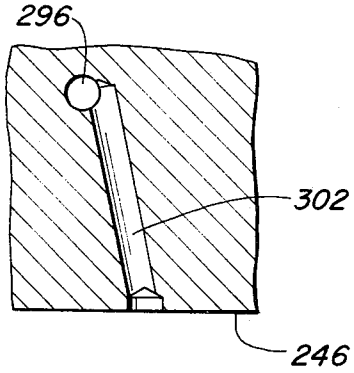

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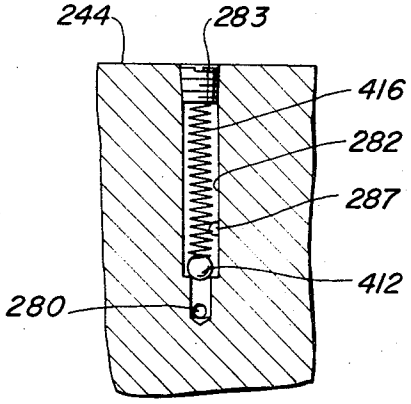

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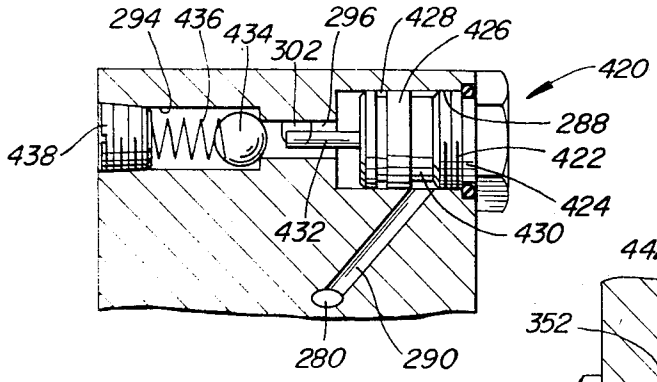

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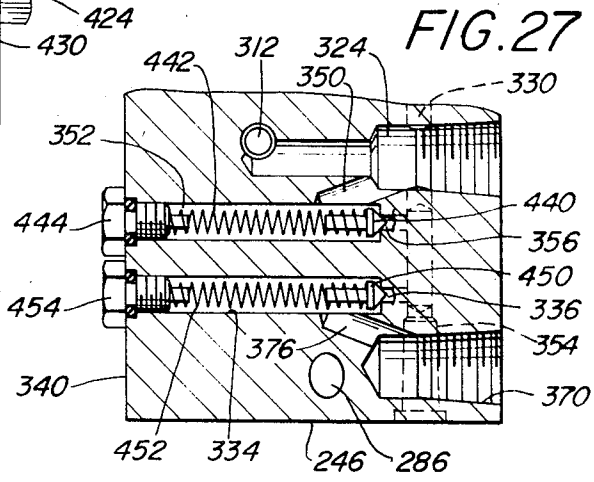

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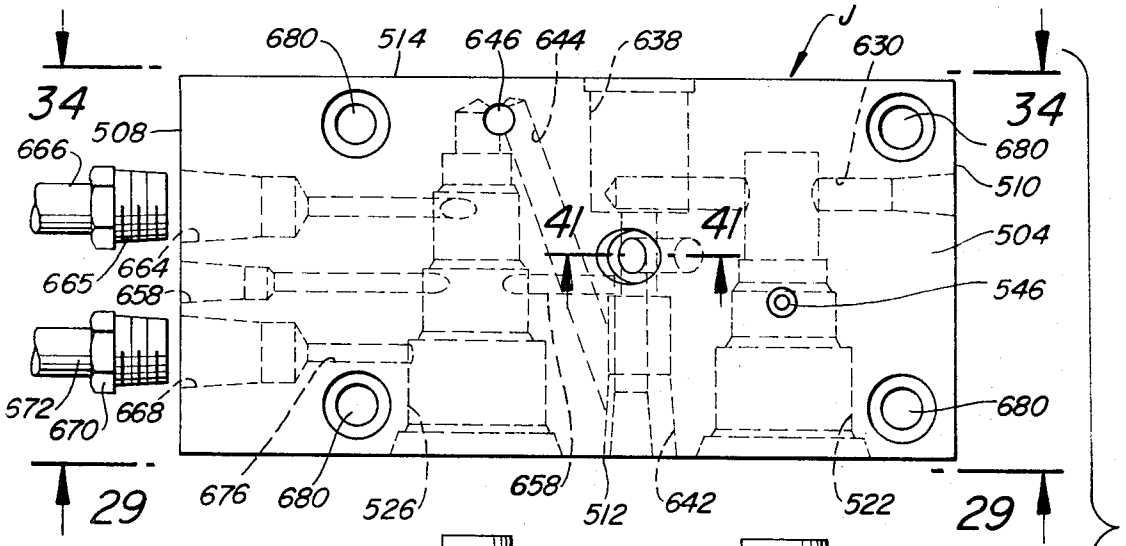

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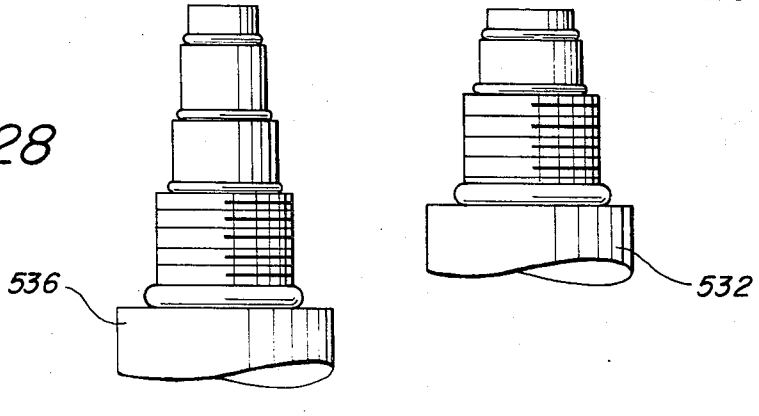

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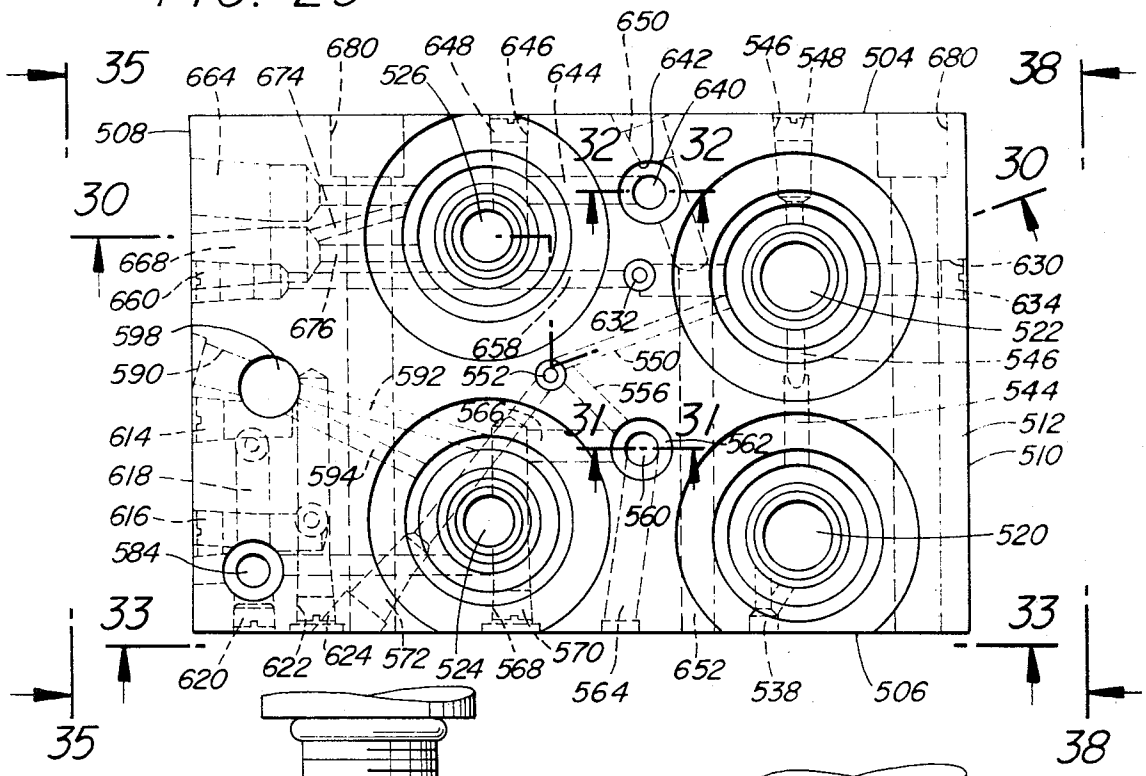
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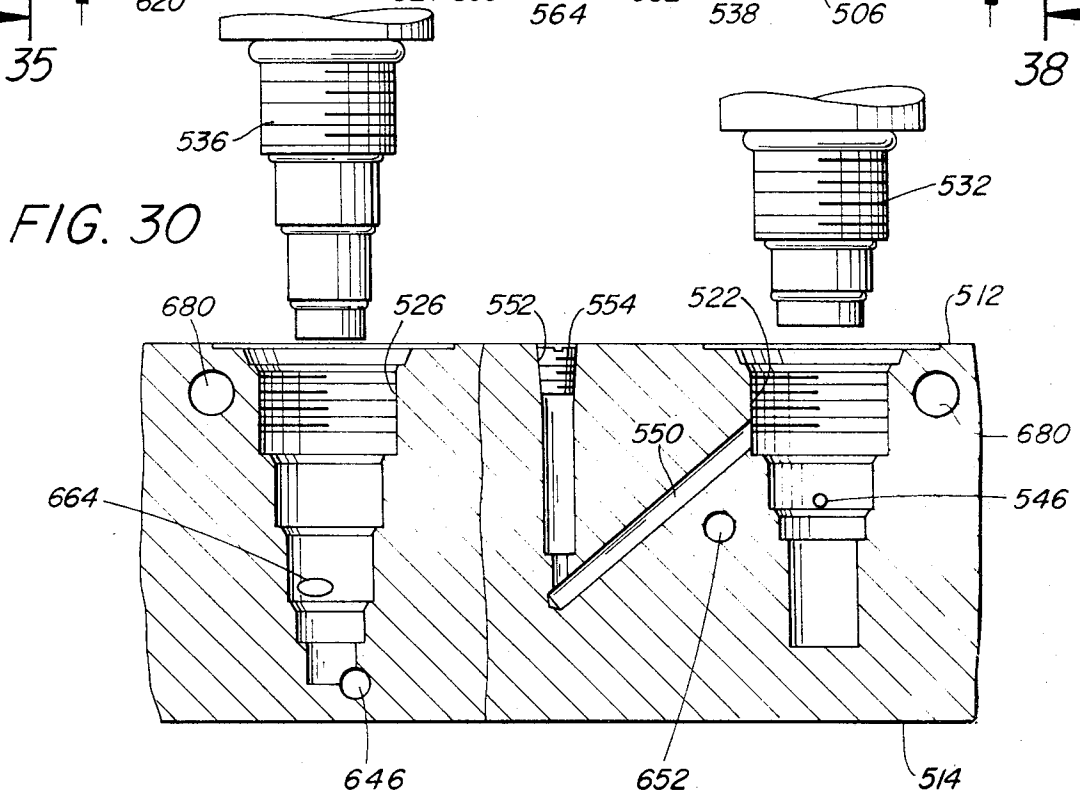
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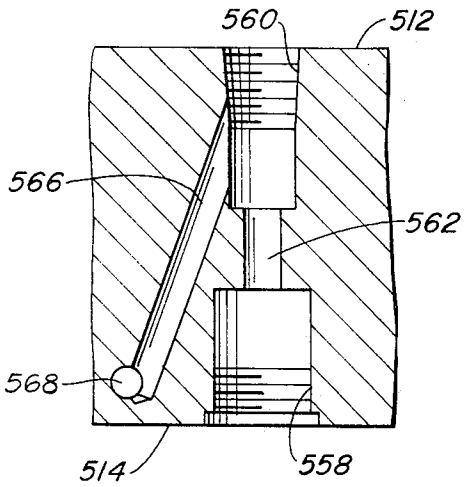

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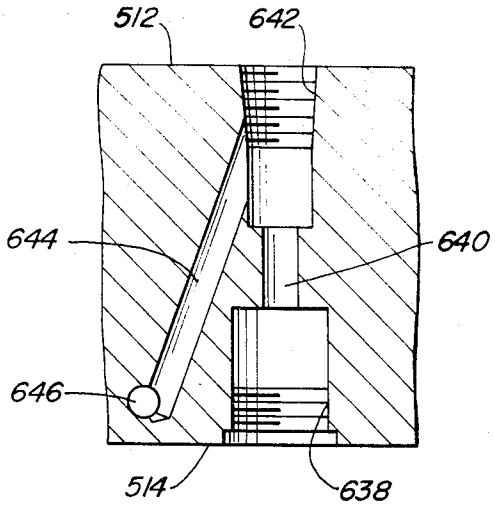

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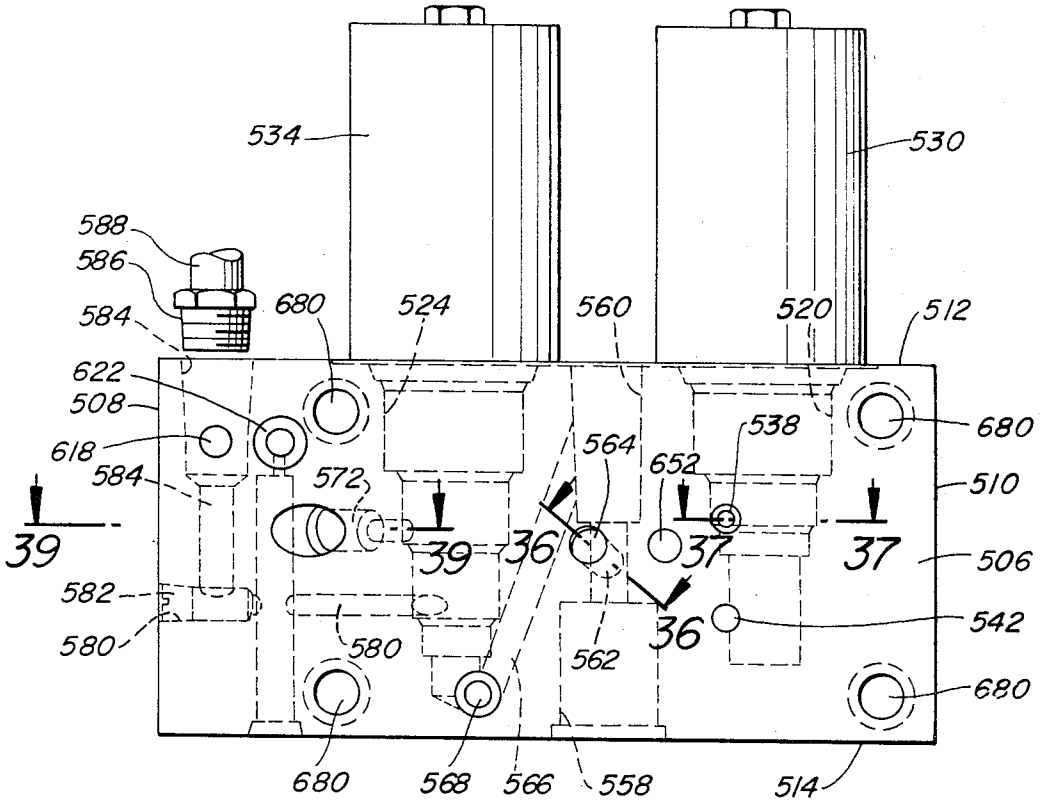

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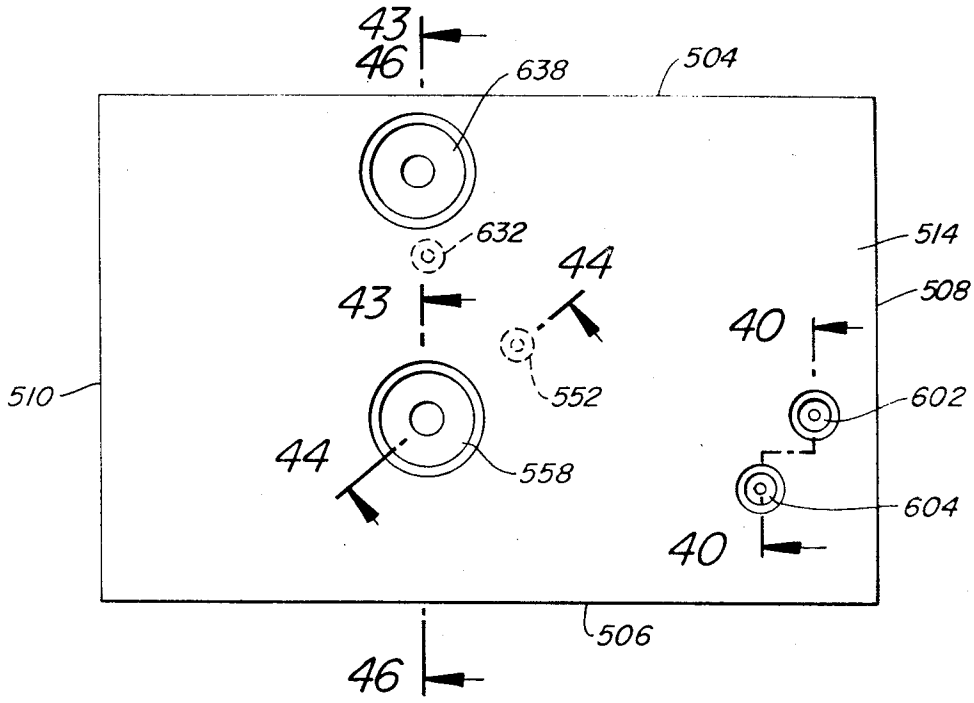

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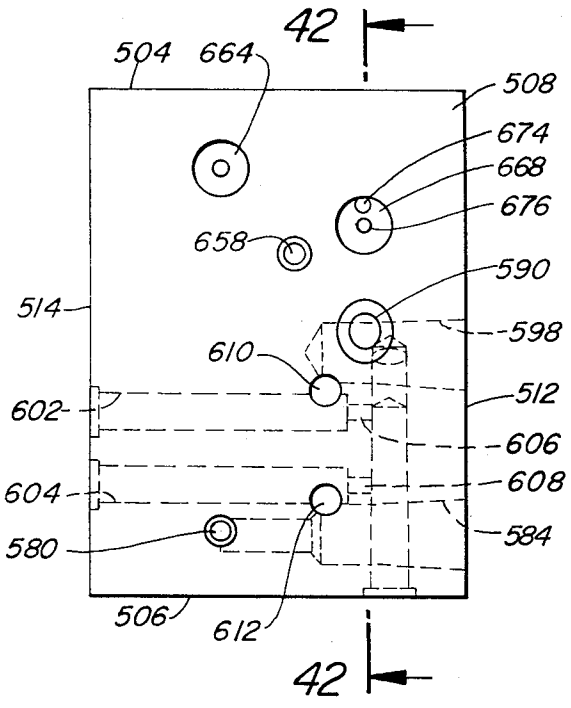

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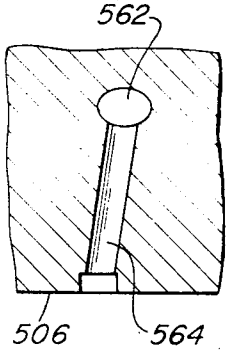

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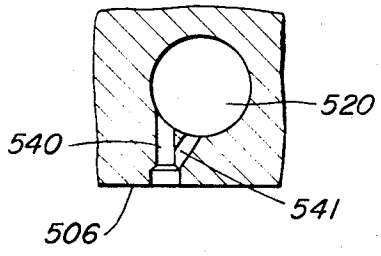

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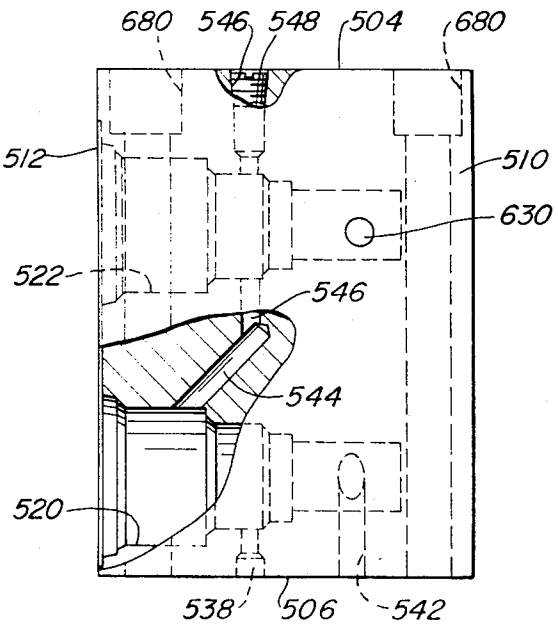

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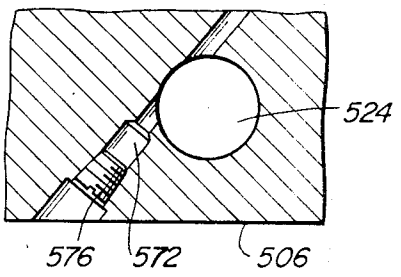

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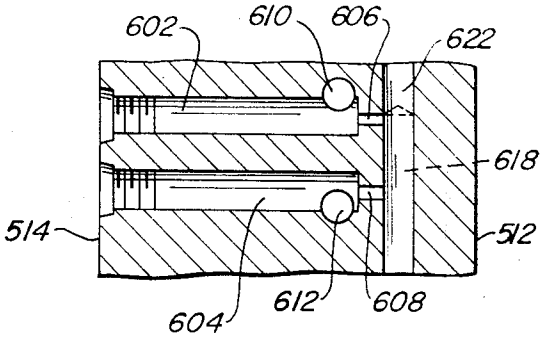

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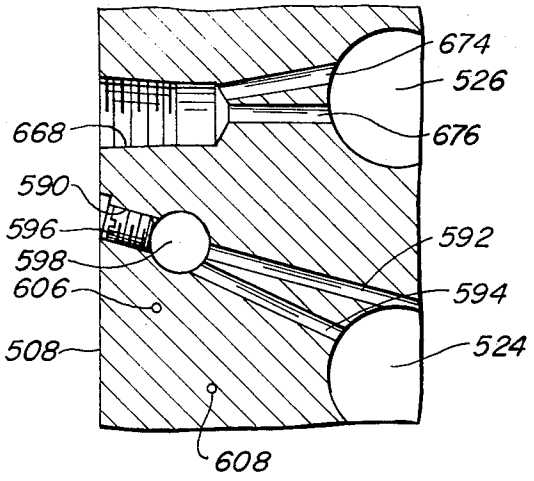

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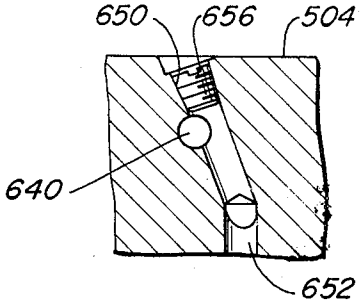

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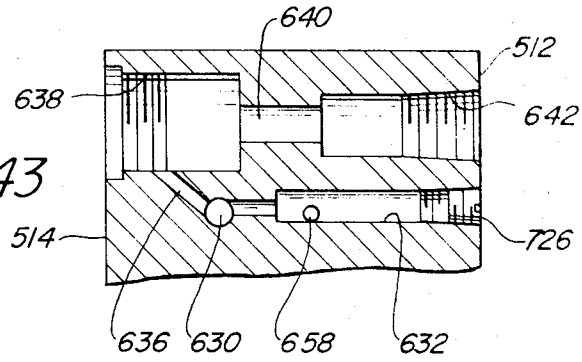

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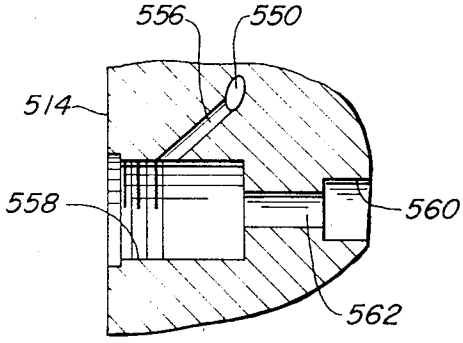


FIG. 44

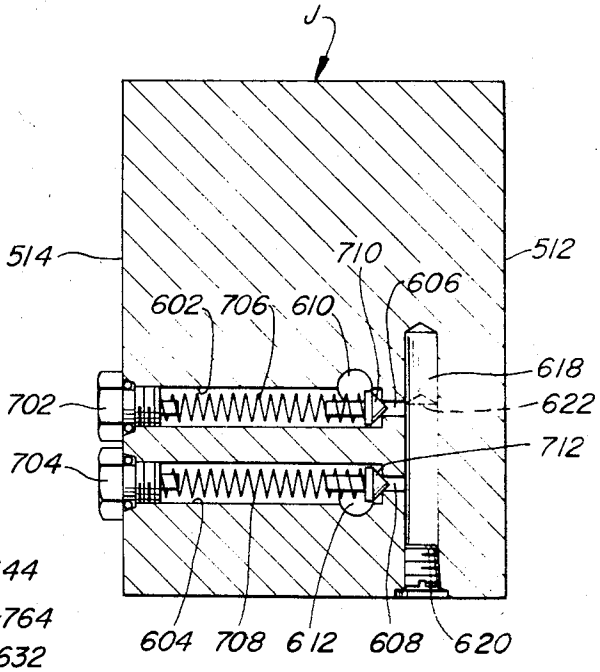


FIG. 45

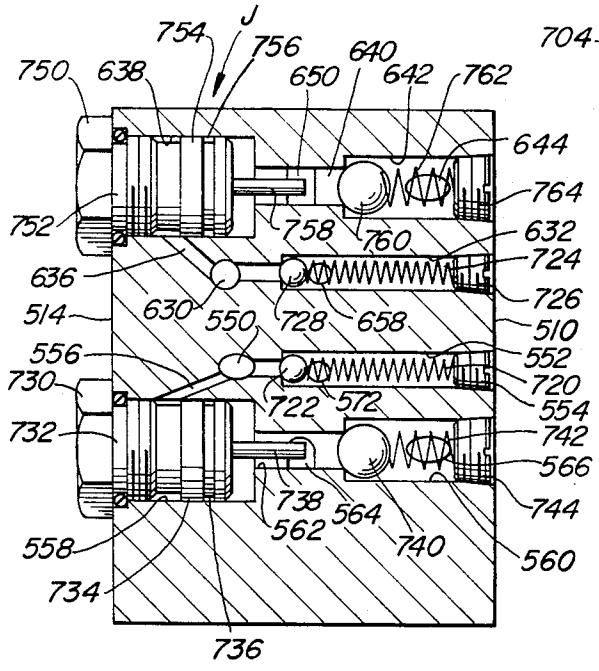


FIG. 46

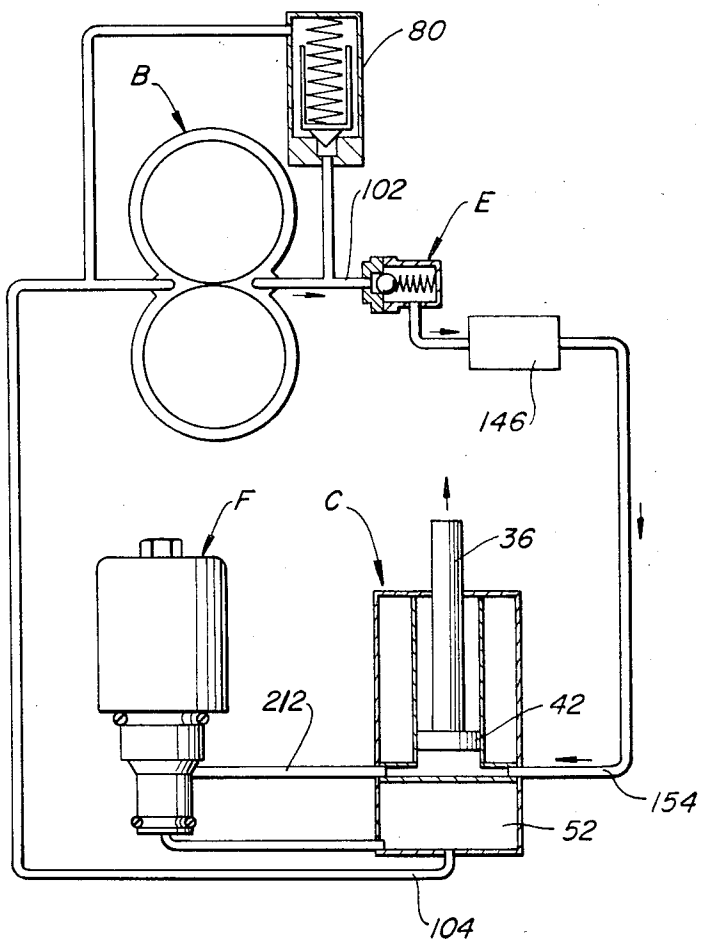
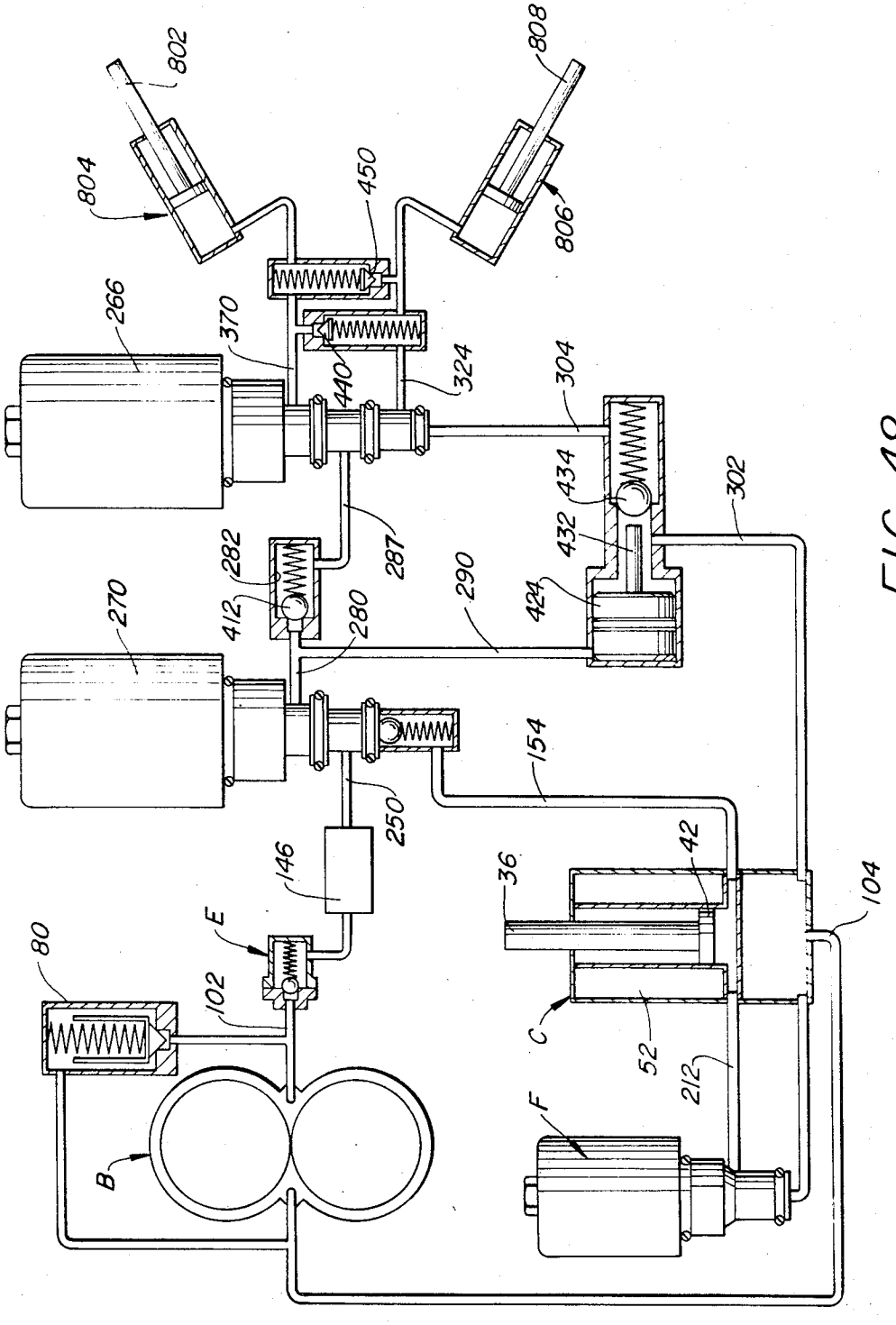


FIG. 47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282
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270
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250
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36
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104
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E
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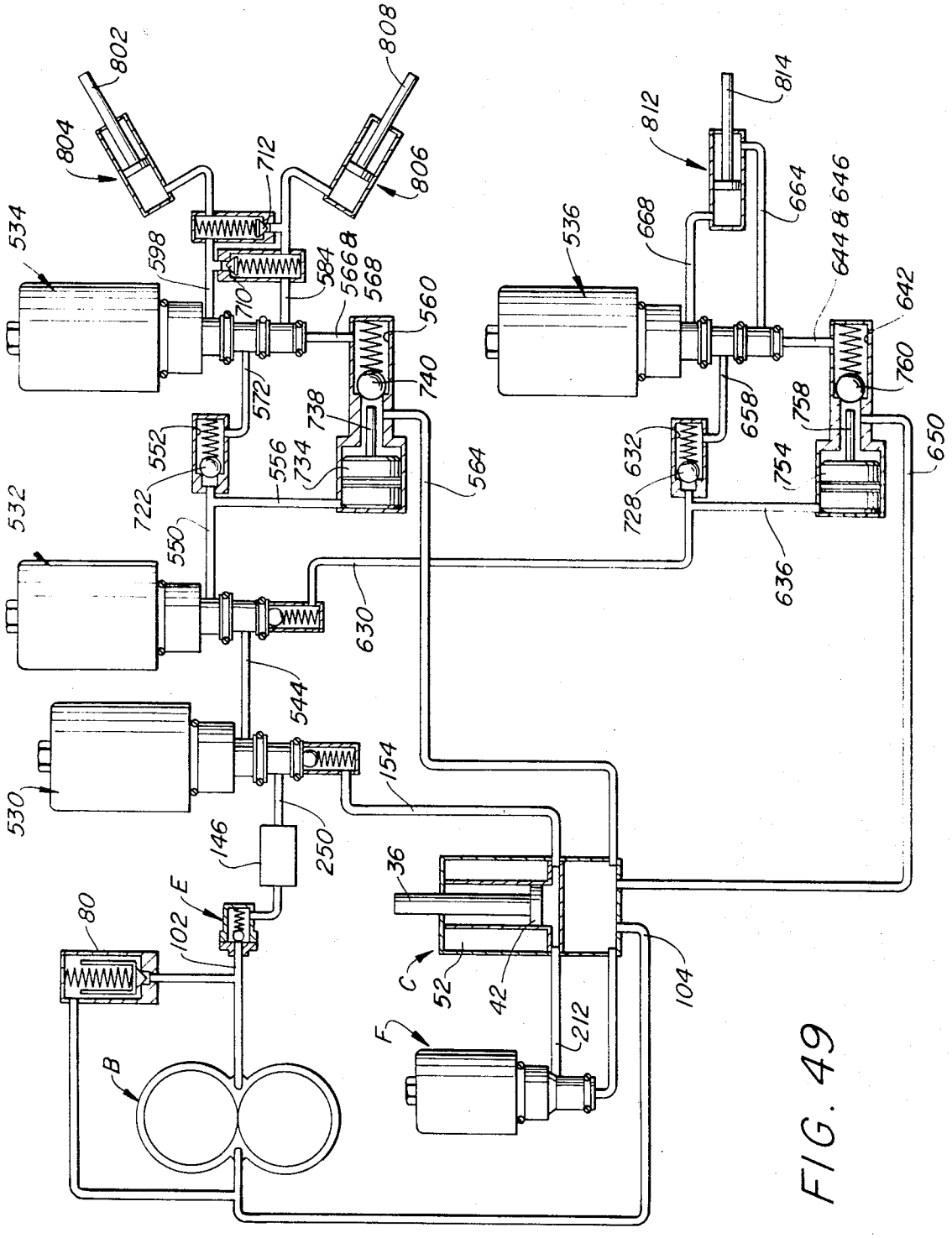
C
52
212
F
B

FIG. 48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146
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102
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C
52
42
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FIG. 49

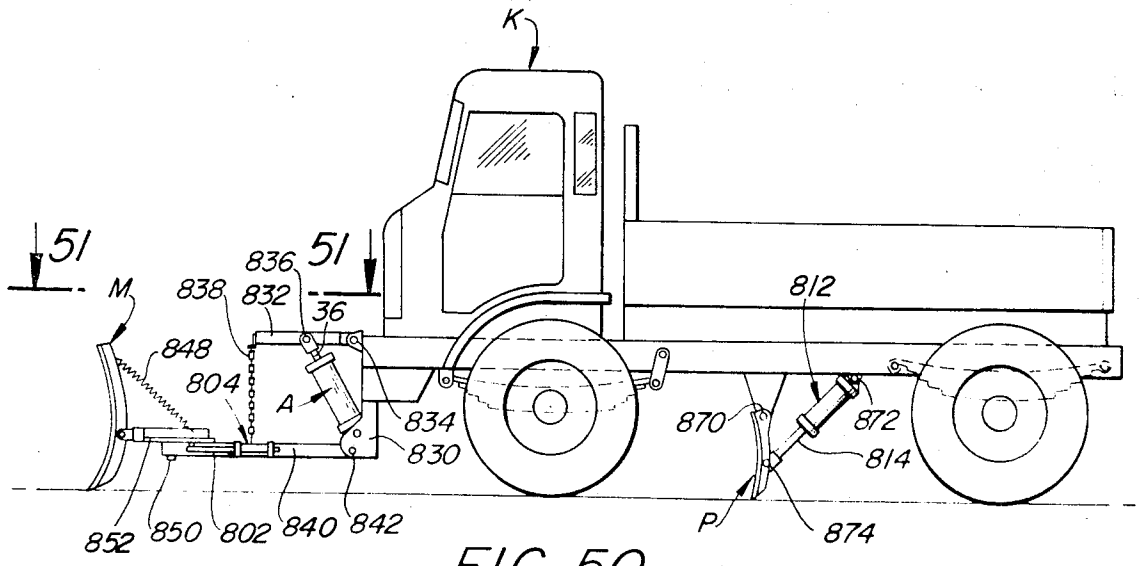
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FIG. 50

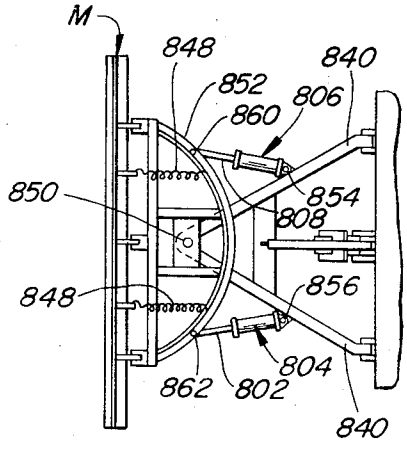
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FIG. 51

HYDRAULIC CONTROL UNIT

BACKGROUND OF THE INVENTION

This application pertains to the art of hydraulic control units and more particularly to hydraulic control units for selectively energizing hydraulic cylinders. The invention is particularly applicable for use with a power unit to control operation of plow blades on a vehicle and will be particularly described with reference thereto. However, it will be appreciated that the invention has broader applications and may be used for controlling other devices.

Power units are commonly mounted on the front end of a vehicle for controlling the position of a plow blade. Such power units commonly include a motor-pump unit and a reservoir-ram unit. Operation of the motor-pump unit extends the ram to raise the plow blade. Opening an exhaust valve returns hydraulic fluid to the reservoir for retracting the ram and lowering the plow blade when the motor-pump unit is off. It is often desirable to add additional controls to such a power unit for power angling of the plow blade or for controlling the position of a pull-plow. In previous arrangements, the addition of such additional controls has been very complicated and expensive because the power unit itself had no provision for mounting the additional controls in a convenient manner. With previous arrangements, various control blocks and solenoid-operated valves were attachable to the vehicle separate from the power unit. Installation of such additional controls was very complicated.

SUMMARY

A hydraulic control unit of the type described includes a power unit having an improved base portion for the reservoir-ram unit. The base portion is a one-piece casting and is bored to provide passages for flow of hydraulic fluid. Several different one-piece control blocks are selectively attachable to the base portion for controlling various functions of a plow blade. The base portion does not have to be modified in any manner for use with different control blocks. A single block is simply attached to the base portion for controlling as many different functions as desired.

It is a principal object of the present invention to provide an improved hydraulic control unit which is less expensive to manufacture and install.

It is also an object of the present invention to provide an improved hydraulic control unit which can be selectively varied to control a plurality of different functions simply by varying the type of control block which is attached thereto.

It is an additional object of the present invention to provide improved one-piece control block assemblies for use with a hydraulic power unit.

It is a further object of the present invention to provide a hydraulic power unit and control which is very compact.

BRIEF DESCRIPTION OF THE DRAWING

The invention may take part in certain parts and arrangements of parts, preferred embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof.

FIG. 1 is an elevational view of a power unit with which the improvements of the present invention are used, and with portions in section for clarity of illustration;

FIG. 2 is a bottom plan view of an improved base portion constructed in accordance with the present invention;

FIG. 3 is an elevational view looking generally in the direction of arrows 3—3 of FIG. 2;

FIG. 4 is an end elevational view looking generally in the direction of arrows 4—4 of FIG. 2;

FIG. 5 is an elevational view looking generally in the direction of arrows 5—5 of FIG. 2;

FIG. 6 is a side elevational view looking generally in the direction of arrows 6—6 of FIG. 2;

FIG. 7 is a cross-sectional elevational view looking generally in the direction of arrows 7—7 of FIG. 2;

FIG. 8 is a cross-sectional plan view looking generally in the direction of arrows 8—8 of FIG. 6;

FIG. 9 is a cross-sectional plan view looking generally in the direction of arrows 9—9 of FIG. 3;

FIG. 10 is a cross-sectional partial plan view looking generally in the direction of arrows 10—10 of FIG. 6;

FIG. 11 is an elevational view of a plate or control block for use with the base portion of FIGS. 2–10;

FIG. 12 is a cross-sectional elevational view looking generally in the direction of arrows 12—12 of FIG. 11;

FIG. 13 is a side elevational view of an improved control block constructed in accordance with the present invention;

FIG. 14 is a top plan view looking generally in the direction of arrows 14—14 of FIG. 13;

FIG. 15 is a side elevational view looking generally in the direction of arrows 15—15 of FIG. 14;

FIG. 16 is an end elevational view looking generally in the direction of arrows 16—16 of FIG. 15;

FIG. 17 is a cross-sectional elevational view looking generally in the direction of arrows 17—17 of FIG. 14;

FIG. 18 is a cross-sectional elevational view looking generally in the direction of arrows 18—18 of FIG. 14;

FIG. 19 is a cross-sectional elevational view looking generally in the direction of arrows 19—19 of FIG. 14;

FIG. 20 is a cross-sectional elevational view looking generally in the direction of arrows 20—20 of FIG. 14;

FIG. 21 is a cross-sectional elevational view looking generally in the direction of arrows 21—21 of FIG. 13;

FIG. 22 is a cross-sectional partial plan view looking generally in the direction of arrows 22—22 of FIG. 15;

FIG. 23 is a partial cross-sectional plan view looking generally in the direction of arrows 23–23 of FIG. 16;

23—

FIG. 24 is a partial cross-sectional plan view looking generally in the direction of arrows 24—24 of FIG. 16;

FIG. 25 is a cross-sectional elevational view looking generally in the direction of arrows 25—25 of FIG. 15;

FIG. 25A is a cross-sectional elevational view looking generally in the direction of arrows 25A—25A of FIG. 13;

FIG. 26 is a view similar to FIG. 19 and showing a pilot-operated check valve;

FIG. 27 is a view similar to FIG. 18 and showing cross-over check valves installed in block H;

FIG. 28 is an inverted side elevational view of an improved control block constructed in accordance with the present invention;

FIG. 29 is a plan view looking generally in the direction of arrows 29—29 of FIG. 28;

FIG. 30 is a cross-sectional elevational view looking generally in the direction of arrows 30—30 of FIG. 29;

FIG. 31 is a cross-sectional elevational view looking generally in the direction of arrows 31—31 of FIG. 29;

FIG. 32 is a cross-sectional elevational view looking generally in the direction of arrows 32—32 of FIG. 29;

FIG. 33 is a side elevational view looking generally in the direction of arrows 33—33 of FIG. 29;

FIG. 34 is a plan view looking generally in the direction of arrows 34—34 of FIG. 28;

FIG. 35 is an end elevational view looking generally in the direction of arrows 35—35 of FIG. 29;

FIG. 36 is a cross-sectional view taken generally in the direction of arrows 36—36 of FIG. 33;

FIG. 37 is a cross-sectional partial plan view looking generally in the direction of arrows 37—37 of FIG. 33;

FIG. 38 is an end elevational view looking generally in the direction of arrows 38—38 of FIG. 29 and with portions cut away for clarity of illustration;

FIG. 39 is a cross-sectional partial plan view looking generally in the direction of arrows 39—39 of FIG. 33;

FIG. 40 is a partial cross-sectional elevational view looking generally in the direction of arrows 40—40 of FIG. 34;

FIG. 41 is a partial cross-sectional plan view looking generally in the direction of arrows 41—41 of FIG. 28;

FIG. 42 is a partial side cross-sectional elevational view looking generally in the direction of arrows 42—42 of FIG. 35;

FIG. 43 is a partial cross-sectional elevational view looking generally in the direction of arrows 43—43 of FIG. 34;

FIG. 44 is a partial cross-sectional elevational view looking generally in the direction of arrows 44—44 of FIG. 34;

FIG. 45 is a view similar to FIG. 40 and showing check valves in position in certain bores;

FIG. 46 is a cross-sectional elevational view taken generally on line 46—46 of FIG. 34 and showing valves in certain bores;

FIG. 47 is a diagramatic illustration showing the hydraulic circuit when base portion D is used with plate G;

FIG. 48 is a diagramatic illustration showing the hydraulic circuit when base portion D is combined with control block H;

FIG. 49 is a diagramatic illustration showing the hydraulic circuit when base portion D is combined with control block J;

FIG. 50 is a general illustration showing how the improved power unit of the present invention is utilized; and

FIG. 51 is a plan view looking generally in the direction of arrows 51—51 of FIG. 50.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein the showings are for purposes of illustrating preferred embodiments of the invention only and not for purposes of limiting same, FIG. 1 shows a power unit A for moving a plow blade or the like to selective variable positions.

Power unit A includes a motor-pump unit B and a reservoir-ram unit C. Motor-pump unit B includes an electric motor housing portion 12 and gear pump housing portion 14. Motor casing 12 is secured to pump housing 14 as by elongated bolts extending vertically through motor casing 12 into threaded engagement with suitable threaded bores in pump housing 14. Nuts as at 16 are attached to the opposite threaded ends of the bolts.

Pump housing portion 14 contains rotatable gears of a gear pump in a known manner. A bottom cover plate 18 is secured to housing 14 as by bolts 20. Pump housing 14 has suitable lateral holes therethrough for receiving bolts as at 22 which are threaded into suitable threaded bores in reservoir-ram unit base portion D. Nuts as at 24 are threaded onto the opposite ends of bolts 22 for securely clamping pump housing 14 to base portion D.

Reservoir-ram unit C includes an outer cylindrical member 28 positioned on base portion D and suitably sealed thereto as by seal 30. An inner cylindrical member 32 is centrally located on base portion D and suitably sealed thereto as at 34. An elongated cylindrical ram member 36 extends substantially through inner cylindrical member 32. The bottom end portion of cylindrical member 36 has a shank portion 38 receiving a piston assembly defined by cylindrical members 40 and 42 having a sealing member 44 interposed therebetween. The piston assembly is retained on shank portion 38 as by a nut 46.

Base portion D has a hollow space as at 48 beneath the piston assembly. Cylindrical members 28 and 32 are radially spaced from one another to provide a circumferential reservoir space 52 which holds hydraulic fluid.

A top cover member 54 has a centrally located opening therethrough for slidably receiving rod 36. Suitable seals are provided as at 56, 58 and 60 around rod 36. A bearing washer 62 is also provided for engaging the upper end of inner cylindrical member 32. Cover member 54 is clamped against outer cylindrical member 28 and is suitably sealed as at 64. Cover member 54 has a number of circumferentially-spaced vertical holes therethrough for receiving bolt members 66 which are threaded on their opposite ends. Bolt members 66 are threaded into suitable threaded bores as at 68 in base portion D. Nuts as at 70 are threaded onto the opposite ends of bolts 66 outside of cover member 54. This tightly clamps cover member 54 and base portion D together with cylindrical sleeve members 28 and 32 interposed therebetween.

Base portion D has a downwardly projecting lug portion thereon having a lateral hole as at 74 therethrough for mounting base portion D to a pin on the front of a vehicle. The upper end portion of rod 36 also has a lateral hole as at 76 therethrough for receiving a pin on the lifting and lowering of a plow blade.

Pump assembly 14 includes a pressure relief valve generally indicated by numeral 80 in FIG. 1 connecting the inlet and outlet ports of the pump. Pressure relief valve 80 is set to open at any desired pressure, such as around 1,500 psi, to connect the pump outlet passage with the inlet passage so that hydraulic fluid is simply circulated through the pump when rod 36 is fully extended or the pump outlet is otherwise jammed. A pressure relief valve of this type, and the general type of pump which may be used to carry out the principles of the present invention, is shown in U.S. Pat. No. 3,433,168 to Banker, the disclosure of which is hereby incorporated herein by reference. Suitable electrical terminals generally indicated by numeral 82 in FIG. 1 are provided for motor-pump unit B. Terminals 82 are connectable with a suitable voltage source, such as the battery on a vehicle.

In accordance with a preferred arrangement, base portion D of reservoir-ram unit C is specially constructed so that it can be used with units including a raising and lowering ram alone; a raising and lowering ram in combination with a control unit for power angling; or a raising and lowering ram unit in combination with an angling control unit and a pull-plow unit.

Base portion D is drilled and bored to provide a plurality of interconnected passageways through which hydraulic fluid selectively flows. Base portion D includes a stepped bore **102** and a bore **104** in sidewall **106** thereof. Sidewall **106** includes threaded bores **108** for receiving bolts **22** to connect pump housing **14** thereto. Bore **102** defines an inlet to housing portion D and is connected with an outlet port from pump housing **14**. Bore **104** defines an outlet from housing D and is connected with the inlet port on pump housing **14**.

Base portion D includes a vertical bore **112** communicating with horizontal bore **104**. Vertical bore **112** opens upwardly in communication with reservoir space **52** between radially spaced cylindrical sleeve members **28** and **32**. When motor-pump unit B is energized, hydraulic fluid is drawn from reservoir space **52** through bores **112** and **104** to the inlet of the pump. Fluid is discharged from the pump into horizontal bore **102**.

In a preferred arrangement, horizontal bore **102** from the pump outlet is normally closed by a check valve assembly E which includes a sleeve member **114** receivable within bore **102** and having a lateral opening **116** therein. Member **114** has a cylindrical bore therein receiving a coil spring **118** biasing against actuator **120** and contacting ball **122** for normally closing opening **124** in disc member **126**. Disc member **126** may have a peripheral recess therein for receiving an O-ring **128**. Valve assembly E provides a ball check valve for preventing flow of hydraulic fluid back through the outlet of the pump. O-rings **130** and **132** may be received in circular recesses **134** and **136** around bores **102** and **104** so that the inlet and outlet openings from pump housing **14** are sealed when pump housing **14** is bolted to base portion D.

Horizontal bore **102** communicating with the pump outlet has an angular bore **140** extending through base portion D and communicating therewith. Angular bore **140** intersects another bore **142** formed in sidewall **144** of base portion D. The outermost portion of bore **142** is threaded for receiving a plug and filter member **146** which is threaded therein and has a metal mesh strainer or filter **148** thereon. A suitable cylindrical mesh filter may also be located in bore **112**.

A substantially horizontal bore **150** in sidewall **152** of base portion D communicates with the inner end portion of bore **142**. Base portion D has another angular bore entering wall **152** immediately below bore **150** and extending angularly as at **154** to intersect space **48** centrally located in base portion D beneath the piston assembly on rod **36**. Another angular bore **160** communicates with space **48** and extends to intersect a bore **162** in sidewall **144**. The outermost portion of bore **162** is threaded for receiving a plug **166**. The innermost end portion of bore **162** communicates through an angular bore **168** with a bore **170** formed in sidewall **172** of housing D. Bore **170** has its open end portion threaded for receiving a cartridge of a two-way solenoid-operated cartridge valve assembly F.

Sidewall **152** includes threaded bores **176** for receiving bolts to secure suitable control members to base portion D. Base portion D includes arcuate wall portions **180** and **182** for receiving the solenoid of solenoid-operated two-way cartridge valve assembly F. Base portion D may also include a threaded bore **184** in wall **172** thereof for receiving a bolt to connect base portion D with a ground cable or the like connected with a frame of a vehicle on which power unit A is mounted.

Various control members are adapted to be bolted to sidewall **152** of base portion D. In one arrangement, a plate member G as shown in FIGS. **11** and **12** is adapted to be secured thereto. Plate member G has holes **190** formed therethrough for receiving bolts which thread into threaded bores **176** in sidewall **152** of base portion D. Plate member G has vertically spaced bores **194** and **196** which do not extend completely therethrough. Bores **194** and **196** are interconnected by a vertical bore **198**. The outer portion of bore **198** is suitably threaded for threadably receiving a plug member **202**. Plate member G is provided with a thickened section **204** simply to provide sufficient thickness for bores **194, 196** and **198**. Reinforcing rib thickened portions **208** and **210** are also provided. With plate member G assembled onto sidewall **152** of base portion D, bore **194** communicates with bore **150**, while bore **196** communicates with angular bore **176**.

A small vertical bore **212** communicates with bore **170** and with reservoir space **52** between lines inner and outer cylindrical sleeve members **28** and **32**. Small vertical bore **212** is positioned near the inner end portion of bore **170**.

With plate member G assembled to base portion D as described, the motor of motor pump unit B may be energized. Fluid is then drawn from reservoir space **52**, through vertical bore **112** in base portion D, through horizontal bore **104** in base portion D, to the inlet of the gear pump. Fluid then flows from the outlet of the gear pump past check valve E and through bore **102** to angular bore **140**. Hydraulic fluid flows from angular bore **140** through the filter in bore **142**, and through horizontal bore **150** to bore **194** on plate G. Hydraulic fluid then flows from bore **194**, through bore **198** to bore **196** in plate member G. Hydraulic fluid flows from horizontal bore **196** in plate member G through angular bore **154** to central hollow space **48** in base portion D beneath the piston assembly on rod **36**. This forces the piston assembly and rod **36** to move outwardly for locating a plow blade or the like at its proper or desirable inclination or level. Once the plow blade is in its desired position, motor pump unit B is simply de-energized. With the piston assembly raised within inner cylindrical sleeve **32**, hydraulic fluid cannot escape through the inlet passageway described back to the gear pump due to ball check valve unit E. Thus, the plow blade is held in its desirable position. If the plow blade has not been sufficiently raised or desirably angled, motor-pump unit B may again be operated for further raising rod **36**.

When it is desired to lower the plow blade, two-way solenoid-operated cartridge valve assembly F is energized. In its normally closed position, valve assembly F prevents flow of fluid from bore **168** through small vertical bore **212**. Once valve F is energized, fluid may flow from central space **48** beneath the piston assembly on rod **36**; through angular bore **160** to bore **162**; through angular bore **168**; past cartridge valve member F and through small vertical bore **212** into reservoir

space 52. The weight of the plow blade creates sufficient pressure so that fluid will gradually flow back into reservoir space 52 through small vertical bore 212 and retract rod 36. Solenoid-operated cartridge valve assembly F is de-energized when the blade is lowered to its desired position. In normal operation, motor-pump unit B is not energized when solenoid-operated cartridge valve assembly F is energized for lowering rod 36.

In accordance with another aspect of the invention, base portion D includes substantially parallel and horizontal spaced-apart bores 220 and 222 in sidewall 152 thereof adjacent bores 150 and 154. With plate G secured to base portion D, it will be recognized that bores 220 and 222 are blocked against any fluid communication therewith by thickened portion 204 of plate G. Suitable gasketing may be provided if so desired, as by O-rings received in suitable grooves around all of the ports.

In accordance with the present invention, various control units are attachable to base portion D for controlling various functions of a plow blade or the like. Improved base portion D has been described with reference to controlling raising and lowering operation of a plow blade. Vertical holes 230 and 232 provide communication of horizontal bores 220 and 222 with reservoir space 52.

In accordance with another aspect of the invention, an improved control block H is provided for attachment to sidewall 152 of base portion D for controlling power angling of a plow blade or the like.

Control block H comprises a one-piece casting having holes 240 therethrough for receiving bolts which are threaded into threaded bores 176 in sidewall 152 of base portion D. Sidewall 244 of control block H is oppositely positioned to sidewall 152 of base portion D, while sidewall 246 is in contact therewith. Sidewall 246 of control block H includes horizontal bore 250 and lower bore 254. Bore 250 in control block H is alignable with bore 150 in base portion D, while bore 254 is alignable with bore 154 in base portion D.

One-piece control block H includes spaced-apart bores 260 and 262 extending inwardly from top wall 264 thereof. Bore 260 is adapted to receive a four-way solenoid-operated cartridge valve assembly 266. Bore 262 is adapted to receive a three-way solenoid-operated cartridge valve assembly 270.

Horizontal bore 250 includes a pair of bores 251 and 252 intersecting valve bore 262 simply to provide sufficient flow of hydraulic fluid. An angular bore 280 connects valve bore 262 with horizontal bore 282. Bore 282 is suitably threaded so that its open end can be closed by a threaded plug 283. Another horizontal bore 286 extends through valve bore 260 to provide a bore 287 connecting valve bore 260 with bore 282.

A bore 288 is connected through angular bore 290 with angular bore 280. A bore 294 opposite bore 288 is connected therewith through bore 296. An angular bore 302 in sidewall 246 intersects bore 296. An angular bore 304 in sidewall 246 connects the lower portion of valve bore 260 with bore 294. Bore 286 is suitably tapped for closing its outer end as by threaded plug 308. Bore 304 is also tapped for closure by a threaded plug 310.

A horizontal bore 312 in end wall 314 is connected with bore 316 in sidewall 244. Bore 316 is divided into two parts 318 and 319 which communicate with valve bore 260. The outer end portion of bore 312 is suitably tapped for threadably receiving a plug 320. Bore 316 has its outer end portion suitably tapped for threadably receiving a plug 322. Bore 312 intersects a vertical bore 324 extending inwardly from upper face 264 of block H. Bore 324 is suitably tapped for threadably receiving a fitting 326 having a flexible hose 328 connected therewith for connecting bore 324 in fluid flow communication with a hydraulic cylinder for power angling a plow blade.

A bore 330 in sidewall 244 intersects bore 324. The outer portion of bore 330 is suitably tapped for threadably receiving a plug 332. Bore 330 extends past bore 324 and communicates with bore 334 through a reduced bore 336. Bore 334 is formed in bottom wall 340 of block H. Bore 324 also communicates through an angular bore 350 with a bore 352. Bore 352 communicates with a horizontal bore 354 formed in sidewall 246 through a reduced bore 356. The outer end portions of bores 334 and 352 are tapped for receiving threaded plugs 358 and 360.

Bore 354 intersects bores 362 and 364 which communicate with the upper portion of valve bore 260. Bores 362 and 364 also intersect a vertical bore 370 extending vertically into block H from upper surface 264. A bore 372 extends inward from end wall 314 to provide access for boring holes 362 and 364. Bore 372 is suitably tapped for receiving a threaded plug 374. An angular bore 376 establishes communication between bore 370 and bore 334. Bore 354 is suitably tapped to be closed by a threaded plug 382. A suitable fitting 402 is threadably receivable in bore 370. Fitting 402 is connected with a flexible hose 404 leading to another cylinder for power angling a plow blade.

FIG. 25A shows bore 282 intersecting bore 287. A ball check valve is provided by having a ball 42 received in bore 282 and bearing against a shoulder at the reduced diameter portion thereof. Ball 412 is biased into closed position by a coil spring 416 bearing thereagainst and against plug 283. Bore 287 from valve bore 260 is on one side of ball 412, while bore 280 from valve bore 262 is on the other side of ball 412. Thus, hydraulic fluid can flow only from bore 262, through bore 280, past ball 412, into bore 282, then into bore 287 and into valve bore 260. Hydraulic fluid cannot flow in the reverse direction from valve bore 260 because that fluid is stopped by ball 412 upon entering bore 282 from bore 287.

FIG. 26 shows a pilot-operated check valve 420 received in bore 288. Pilot-operated check valve 420 includes a portion 422 threadable into the outer end portion of bore 288. Valve 420 includes an elongated shank portion 424 on which a piston member 426 is slidably received. Piston 426 includes a circumferential recess 428 for receiving a seal. Piston 426 is slidable relative to shank portion 424 within cylindrical bore 288. Piston 426 also includes a circumferential recess portion 430 aligned with angular bore 290. Piston 426 further includes an elongated projection 432 extending into bore 296. Bore 294 receives a ball 434 biased against the shoulder at the intersection of bores 294 and 296 by a coil spring 436 having its other end bearing against plug 438 which is threaded into the outer end portion of bore 294.

When hydraulic fluid is flowing under pressure through bore 282, hydraulic fluid also flows through bore 280 into circumferential recess 430 on piston 426.

This causes piston 426 and its projection 432 to move toward ball 434 and disengage ball 434 from sealing engagement against the shoulder connecting bores 294 and 296. Hydraulic fluid can then flow from bore 294 past ball 434 into bore 296 and out bore 302.

When there is no pressure in conduit 280 forcing piston 426 in a direction to open ball 434, spring 436 simply returns ball 434 to its closed position and forces piston 426 back to its original position.

FIG. 27 shows bore 352 having a spring-biased check valve member 440 normally closing communication between bore 352 and bore 356. A coil spring 442 bears against check valve member 440 and against a plug 444 threadably received in the open end portion of bore 352. Bore 334 likewise has a check valve member 450 normally closing communication between bore 334 and bore 336. A coil spring 452 bears against a check valve member 450 and against a plug 454 threadably received in the open outer end portion of bore 334. If hydraulic pressure in bore 324 becomes too high, or the cylinder is fully extended, the pressure will move valve 450 away from its seat so that fluid can flow into bore 334. Fluid can then flow through angular bore 376 into bore 370 where it will flow back to the reservoir 52. Likewise, if pressure within bore 370 becomes too great, the pressure acting through bore 354 and bore 356 will force valve member 440 off its seat so that fluid can flow into bore 352. This hydraulic fluid can then flow through angled bore 350 into bore 324 where it will be exhausted back in reservoir 52.

Control block H is bolted to base portion D with bores 250 and 254 respectively communicating with bores 150 and 154. Bore 302 communicates with bore 220. Bore 222 on base portion D is simply closed by the flat outer face 246 of block H.

With valve 270 in its de-energized position, motor-pump unit B may be energized. Fluid will then simply flow as previously described through base portion D and out bore 150 into bore 250 in control block H. Valve member 270 will block flow of this fluid upward to inclined bore 280. Valve 270 will permit flow of hydraulic fluid downward out of bore 254 in control block H back into bore 154 in base portion D. Thus, with valve 270 de-energized, energization of motor-pump unit B will simply permit operation of the raising and lowering ram as previously described with respect to FIG. 1.

When the solenoid of valve 270 is energized, the valve moves to another position wherein flow of hydraulic fluid through bore 262 from bore 250 to outlet bore 254 is blocked. However, flow is permitted upward from bore 250 through bore 262 to inclined bore 280. Hydraulic fluid flows through bore 280 and bore 290 to open the pilot-operated check valve as previously described with respect to FIG. 26. Piston member 426 moves toward ball 434 to displace the ball from its seat. Hydraulic fluid continues to flow from bore 280 through bores 282 and 287 into bore 260. Hydraulic fluid will selectively flow out of bore 260 depending upon whether valve 266 is energized or de-energized.

With valve 266 in its de-energized condition, hydraulic fluid will flow from bore 287 upwardly through bore 260, and through bores 362 and 364 to bore 370. Hydraulic flow will then flow through line 404 to a hydraulic cylinder for angling a plow in one angling direction. In this condition of valve 266, bores 312 and 304 are blocked by the valve against flow of fluid from bore 287. Hydraulic fluid from the other cylinder connected with hydraulic line 328 flows into bore 324. This hydraulic fluid flows through bore 312 to the bottom portion of bore 260. Hydraulic fluid then flows through bore 304 over to bore 294 and past ball 434 which is open. Fluid then flows into bore 296, through bore 302 and over into bore 220 in base portion D. This hydraulic fluid is simply exhausted to reservoir 52.

In the event the hydraulic cylinder becomes fully extended or other blockage occurs, the pressure within bore 354 will act through bore 356 and force check valve 440 off its seat. High pressure hydraulic fluid will then flow into bore 352 and through bore 350 in bore 324. This hydraulic fluid will also be exhausted by the same path described back into reservoir 52.

In order to angle the plow in the opposite direction, valve 266 is energized while valve 270 remains energized. Hydraulic fluid enters bore 260 in the same manner as previously described. However, with valve 266 in its energized condition, hydraulic fluid cannot flow upward through bore 260 to bore 364 because this passage is blocked by the valve. Instead, the valve permits flow downward through bore 260 to bore 312. Hydraulic fluid then flows through bore 312 into bore 324 and through hydraulic line 328 to the opposite hydraulic cylinder for angling the plow in an opposite direction. Hydraulic fluid from the other cylinder then bleeds back through hydraulic line 404 into bore 370. This fluid flows through bores 362 and 364 into bore 260 where it passes down through valve 266 to bore 304. Naturally, bore 304 is blocked against flow of fluid from bore 287 in the energized condition thereof. This hydraulic fluid is exhausted back to reservoir 52 in the same manner as previously described. When the cylinder is fully extended, or if other blockage occurs, the high pressure within bore 330 will force check valve 450 off its seat so that hydraulic fluid will enter bore 334. This hydraulic fluid will then flow through angled bore 376 into bore 370 where it will also be exhausted through bores 362 and 364 back to bore 260, and flow through valve 266 down to bore 304 for discharge back into reservoir 52.

When the pump is de-energized, there is no hydraulic fluid flowing through conduit 280 and the pilot-operated check valve is closed. Therefore, when the pump is de-energized no fluid can bleed from either of the angling cylinders back through bore 304 because ball 434 is blocking the passage to exhaust bore 296. Even if the pump is de-energized while valve 266 is in its energized or de-energized condition, hydraulic fluid cannot escape from the angling cylinders back through bore 260 and bore 287 because check valve 412 in FIG. 25A prevents such back flow. The angling cylinders will then remain in the position to which they have been adjusted. Valves 266 and 270 are normally de-energized once they have served their purpose for angling the blade to its desired position.

From the above description, it will be seen that motor-pump B may be selectively energized and de-energized for raising and lowering rod 36 to selectively raise and lower a plow when valves 266 and 270 are de-energized. With valve 270 energized, selective energization or de-energization of valve 266 will power angle the plow in either of opposite directions when motor-pump unit B is energized.

In accordance with another aspect of the invention, an improved control block J is shown in FIG. 28. Con-

trol block J is adapted for use with units including a lifting and lowering cylinder; power angling cylinders; and a pull-plow cylinder. Control block J includes opposite sidewalls **504** and **506**; opposite end walls **508** and **510**; and upper and lower walls **512** and **514**.

Four spaced-apart stepped valve bores are formed in control block J extending downwardly thereinto from upper surface **512** as at **520, 522, 524** and **526**. Bores **520** and **522** each receive a solenoid-operated three-way cartridge valve assembly **530** and **532**. Each bore **524** and **526** receives a solenoid-operated four-way cartridge valve assembly **534** and **536**. A horizontal bore extends inward from sidewall **506** to intersect bore **520**. As shown in FIG. **37**, bore **538** is in two passages **540** and **541** to provide sufficient area for flow of hydraulic fluid. Another horizontal bore **542** below bore **538** intersects a lower portion of bore **520**.

An inclined bore **544** communicates with the upper portion of bore **520** above horizontal bore **538**. Inclined bore **544** communicates with horizontal bore **546** which extends through bore **522** from sidewall **504**. The outer end portion of bore **546** is suitably tapped for threadably receiving a plug **548**. Another inclined bore **550** communicates with the upper portion of bore **522** and intersects the lower portion of vertical bore **552** extending inward from upper surface **512**. The outer portion of bore **552** is suitably tapped for threadably receiving a plug **554**.

As shown in FIG. **44**, inclined bore **550** communicates with another inclined bore **556** which intersects bore **558** extending into block J from bottom surface **514**. An opposite bore **560** extends into block J from upper surface **512** and is aligned with bore **558**. Bores **558** and **560** are connected by a smaller bore **562**. Bore **564** extending into block J from sidewall **506** intersects bore **562** as shown in FIG. **36**. An inclined bore **566** communicates with bore **560** and intersects horizontal bore **568** extending into block J from sidewall **506**. The outer portion of bore **568** is suitably tapped for threadably receiving a plug **570**. Bore **568** also extends through the lower end portion of valve bore **524**. An inclined bore **572** extends into block J from sidewall **506**. Bore **572** intersects bores **524** and **552** substantially intermediate upper and lower surfaces **512** and **514** of block J. The outer portion of bore **572** is suitably threaded for threadably receiving a plug **576**.

A horizontal bore **580** extends inward from end wall **508** and intersects bore **524** above bore **568**. The outer portion of bore **580** is suitably tapped for threadably receiving a plug **582**. A vertical bore **584** extends inward from upper wall **512** and intersects bore **580**. Bore **584** is suitably tapped for threadably receiving a fitting **586** connected with a hydraulic line **588** leading to a hydraulic cylinder.

Another bore **590** extending into block J from end wall **508** is divided into two bores **592** and **594**, which intersect the upper portion of bore **524** above bore **572**. Bore **590** has its outer end portion suitably tapped for threadably receiving a plug **596**. Bore **590** intersects a vertical bore **598** extending into block J from upper surface **512**. Bore **598** is not drilled as deep as bore **584**, as clearly shown in FIG. **35**.

A pair of spaced-apart bores **602** and **604** extend into block J from bottom surface **514** thereof. Each bore **604** and **602** has a terminal reduced diameter portion **606** and **608**. Horizontal bores **610** and **612** formed in end wall **508** intersect bores **598** and **602**, and **584** and **604**. Bores **610** and **612** have their outer portions threaded for threadably receiving plugs **614** and **616**. A horizontal bore **618** extending inward from sidewall **506** intersects bore **584** and bore **606**. Bore **618** has its outer portion suitably tapped for threadably receiving a plug **620**. Another horizontal bore **622** in sidewall **506** intersects bore **608**, and bores **592** and **594**. The outer portion of bore **622** is suitably tapped for threadably receiving a plug **624**.

A horizontal bore **630** extends inward from end wall **510** to intersect bore **522**. Bore **630** extends through bore **522** and intersects vertical bore **632** formed in upper surface **512**. Bore **630** intersects the lower end portion of bore **632** as shown in FIG. **43**. Bore **630** has its outer end portion suitably tapped for threadably receiving a plug **634**. An inclined bore **636** intersects bore **630** and a bore **638** formed in bottom surface **514**. Bore **638** communicates through bore **640** with bore **642** formed in upper surface **512**. An inclined bore **644** intersects horizontal bore **646** in sidewall **504** which also intersects the bottom end portion of bore **526**. The outer portion of bore **646** is suitably tapped for threadably receiving a plug **648**. An angled bore **650** in sidewall **504** communicates with bore **562** and intersects horizontal bore **652** formed in sidewall **506**. The outer portion of bore **650** is suitably tapped for threadably receiving a plug **656**.

A horizontal bore **658** extending inward from end wall **508** intersects an intermediate portion of bore **526** and also intersects bore **632** as shown in FIG. **43**. The outer portion of bore **658** is suitably tapped for threadably receiving a plug **660**. A horizontal bore **664** in end wall **508** intersects the lower portion of valve bore **526** above bore **646**. The outer portion of bore **664** is suitably tapped for threadably receiving a fitting **665** having a hydraulic hose **666** connected therewith and to a hydraulic cylinder. Another horizontal bore **668** in end wall **508** intersects the upper portion of valve bore **526** above bore **658**. The outer portion of bore **668** is suitably tapped for threadably receiving a fitting **670** attached to a hose **672** leading to a hydraulic cylinder. Bore **668** is divided into a pair of smaller bores **674** and **676** which intersect the upper portion of valve bore **526**.

Block J has a plurality of holes **680** therethrough extending across sidewalls **504** and **506** for receiving bolts which are threaded into threaded holes **176** on base portion D for securing control block J thereto.

FIG. **45** shows check or cross-over pressure relief valves received in bores **602** and **604**. The open end portions of bores **602** and **604** are suitably tapped for threadably receiving plugs **702** and **704**. Coil springs **706** and **708** positioned in bores **602** and **604** bear against plugs **702** and **704**, and against check valve members **710** and **712**. Check valves **710** and **712** normally prevent flow of hydraulic fluid between bores **602** and **606**, and **604** and **608**.

FIG. **46** shows check valves in bores **552** and **632**, and pilot-operated check valves in certain other bores. Coil spring **720** received in bore **552** bears against plug **554** and against ball **722**. Bores **550** and **572** are located on opposite sides of ball **722** so that fluid cannot flow past ball **722** from bore **572** to bore **550**. Coil spring **724** is positioned within bore **632** to bear against plug **726** threadably received in the outer end portion of bore **632** and against a ball **728**. Ball **728** is located between bores **630** and **658** so that hydraulic fluid can-

not flow past ball 728 from bore 658 to bore 630. Flow in the opposite direction is permitted because balls 722 and 728 will move away from their seats.

Bore 558 threadably receives a valve member 730 having a shank portion 732 on which a piston member 734 is slidably positioned within bore 558. Piston member 734 may have a suitable circumferential groove as at 736 for receiving a sliding seal. Piston member 734 includes a projection 738 extending into bore 562. Bore 560 receives a ball 740. A coil spring 742 is positioned between ball 740 and a plug 744 threaded into the open outer portion of bore 560. When pressurized fluid flows through angled bore 556 to bore 558, piston member 734 is forced to the right as viewed in FIG. 46 so that projection 738 moves ball 740 away from its seat. Hydraulic fluid can then flow past ball 740 from bore 556, through bore 560 and into bore 562 so that it may flow out through bore 564.

Another valve member 750 is threaded into bore 638 and includes a shank portion 752 on which a piston member 754 is slidably positioned. Piston member 754 may have a circumferential groove 756 for receiving a sliding seal. Piston member 754 includes a projection 758 extending into bore 640. A ball member 760 is received in bore 642. A coil spring 762 bears against ball 760 and a plug 764 threaded into the outer end portion of bore 642. When hydraulic fluid is flowing under pressure through bore 630, the fluid flows through angle bore 636 into bore 638. This shifts piston member 754 to the right as viewed in FIG. 46 so that projection 758 strikes against ball 760 to move ball 760 away from its seat. Hydraulic fluid may then flow from bore 644, through bore 642, past ball member 760, into bore 640 and out through bore 650. When there is no hydraulic pressure moving pistons 734 and 754 to the right, projections 738 and 758 will not move balls 740 and 760 away from their seats against the force of springs 742 and 762. Springs 742 and 762 will then force balls 740 and 760 against their seats.

When control block J is secured to base portion D, bore 538 on control block J communicates with bore 150 on base portion D. Bore 542 on control block J communicates with bore 154 on base portion D. Bore 652 on control block J communicates with bore 220 on base portion D. Bore 564 on control block J communicates with bore 222 on base portion D.

When cartridge valve 530 is de-energized, hydraulic fluid may flow therethrough from bore 538 to bore 542, while flow of hydraulic fluid from bore 538 to bore 544 is blocked. Therefore, in the de-energized condition of valve 530, energization of motor-pump unit B will simply operate to extend rod 36 on reservoir-ram unit C. De-energization of motor-pump unit B will simply leave rod 36 in its extended position. Energization of valve F will allow draining of hydraulic fluid from beneath the rod piston back into the reservoir. Thus, when valve member 530 is not energized, power unit A operates in the same manner as previously described with plate G attached to base portion D.

When it is desired to angle the plow blade, valve member 530 is energized. In the energized condition of valve 530, flow of hydraulic fluid therethrough from bore 538 to bore 542 is blocked, while flow of hydraulic fluid is permitted through the valve from bore 538 to bore 544. Therefore, hydraulic fluid flows into the intermediate portion of valve bore 522 through bore 546. In the de-energized condition of valve member 532, flow of hydraulic fluid from bore 546 to bore 630 is blocked, while flow of hydraulic fluid from bore 546 to bore 550 may take place. Therefore, hydraulic fluid flows through bore 550 to bore 552. This opens the ball check valve in bore 552 and hydraulic fluid flows into bore 524 through bore 572. When hydraulic fluid is flowing under pressure in bore 550, the pilot-operated check valve is opened because hydraulic fluid flows from bore 550 through angle bore 556 to bore 558 for operating piston member 734 to move ball 740 away from its seat.

In the de-energized position of valve 534, flow of hydraulic fluid from bore 572 down to bore 580 is blocked, while flow of hydraulic fluid from bore 572 up to bores 592 and 594 is permitted. Hydraulic fluid then flows through bores 592 and 594 to bore 598. Hydraulic fluid will then flow to one of the angling cylinders from bore 598. Also in the de-energized position of valve 534, flow of hydraulic fluid is permitted downward from bore 580 to bore 568. Therefore, fluid from the other power angling cylinder may flow through bore 584, down to bore 580, into bore 524, into bore 568, into bore 566 to bore 560, past ball 740, through bores 562 and 564, then out bore 564 over to bore 220 in base portion D where the fluid is exhausted to reservoir 52.

When the angling cylinder is fully extended or a blockage occurs, the pressure of hydraulic fluid in bore 622 will act against valve member 712 to open the valve. Therefore, fluid may flow from lines 592 and 594 through bore 622, through bore 608, past check valve 712 into bore 604, out bore 612 into bore 584 where the fluid will be exhausted back into reservoir 52.

In the energized position of valve 534, the flow of hydraulic fluid from bore 572 up to bore 592 and 594 is prevented, while flow from bore 572 downward to bore 580 is permitted. Therefore, pressurized hydraulic fluid will flow through bore 580 to bore 584 and out to the opposite power angling cylinder for angling the plow in an opposite direction. In the energized condition of valve 534, hydraulic fluid may flow therethrough from bores 592 and 594 down to bore 568. Therefore, hydraulic fluid from the other power angling cylinder is exhausted through bore 598, through bores 592 and 594 to valve bore 524, down through the valve member to bore 568, through bore 566 to bore 560, past ball 740 into bore 562, out bore 564 over to bore 152 in base portion D where the fluid is exhausted to reservoir 52.

In the event of an over-pressure condition, hydraulic fluid in bore 584 acts through bore 618 on check valve member 710 through bore 606. When an over-pressure condition exists, hydraulic fluid will then flow past check valve 710 into bore 602 where the fluid may then flow out bore 610 into bore 598 for being exhausted back to reservoir 52 as previously described. The cross-over pressure relief valves also permit flow of fluid from one power angling cylinder to the other when the motor-pump unit is not energized. This allows the plow blade to "give" when an immovable object is struck by one side of the plow.

When valve member 530 is de-energized, there will be no flow of hydraulic fluid under pressure through bore 550 so that the pilot-operated check valve will not be opened. No fluid can then flow past the check valve in bore 552 or past the pilot-operated check valve so

that the power angling cylinders remain in their desired position.

In the energized position of valve member 532, and while valve member 530 is still energized, flow of hydraulic fluid from bore 546 upward to bore 550 is blocked, while flow of hydraulic fluid from bore 546 may occur through valve member 532 down to bore 630. Hydraulic fluid then flows from bore 630 over to bore 632. Hydraulic fluid flows past the ball check valve in bore 632 and out through bore 658 over to valve bore 526. In the de-energized condition of valve member 536, hydraulic fluid is blocked against flowing downwardly out through bore 664, while flow may occur through valve 536 upwardly to bore 668. Hydraulic fluid then flows out through bore 668 to a cylinder on a pull-plow. There may be two cylinders on the pull-plow or there may be a double-acting cylinder. This will move the pull-plow cylinder to a desired position. Whether the cylinder is a double-acting one or two different cylinders, hydraulic fluid may be exhausted through bore 664 back into valve bore 526. In the de-energized condition of valve 536, hydraulic fluid may then flow downwardly from bore 664 to bore 646. This hydraulic fluid then flows through bore 644 over to bore 642. When hydraulic fluid is flowing through bore 630, hydraulic fluid pressure acting through inclined bore 636 operates on piston member 754 to move ball 760 away from its seat. Therefore, hydraulic fluid is exhausted from bore 764 into bore 642, past ball 760 into bore 640, then out bore 650 over to bore 652 and to bore 220 on base portion D through which hydraulic fluid may flow into reservoir 52.

In the energized condition of valve 536, hydraulic fluid is blocked against flowing upward from bore 658 to bore 668, while flow is permitted downwardly to bore 664. Hydraulic fluid will then flow to move the pull plow cylinder or cylinders in an opposite direction. Hydraulic fluid from the pull-plow cylinder or cylinders is then exhausted back through bore 668, and bores 674 and 676 into the upper portion of valve bore 526. This hydraulic fluid may flow in the energized condition of valve member 536, downwardly therethrough to bore 646. This hydraulic fluid is then exhausted back to reservoir 52 through the same passages previously described.

With valve member 530 energized and valve 532 de-energized, it will be recognized that valve member 534 is operated in substantially the same manner as described with respect to control block H for selectively power angling a plow blade or the like. With valve member 532 energized, hydraulic fluid does not flow over to valve bore 524 so that power angling does not take place. Instead, hydraulic fluid flows to valve bore 526 so that a pull-plow or other accessory may be operated.

As shown in FIG. 47, energization of motor-pump unit B draws hydraulic fluid from reservoir 52 of reservoir-ram unit C through outlet 104. Hydraulic fluid is discharged from motor-pump unit B through outlet 102. The hydraulic fluid flows through check valve E and filter 146 beneath piston 42 on rod 36. Rod 36 will then be extended any desirable distance. When rod 36 has been extended to its desired position, motor-pump unit B is simply de-energized. When it is desired to lower rod 36, solenoid-operated cartridge valve F is energized. Hydraulic fluid then bleeds from beneath piston 42 through line 212 and valve F back to reservoir 52. If rod 36 is fully extended, or a stoppage occurs while motor-pump unit B is still operating, hydraulic fluid is simply bypassed through relief valve 80 and circulates between the inlet and outlet of the pump.

FIG. 48 shows the arrangement when control block H is used with base portion D. When solenoid-operated cartridge valve 270 is not energized, alternate operation of motor-pump unit B and valve F extends or retracts rod 36 in the same manner as described with respect to FIG. 47. When valve 270 is energized, flow of hydraulic fluid through valve 270 to outlet 154 is blocked. Hydraulic fluid may then flow through valve 270 from line 250 to line 280. Hydraulic pressure in line 290 moves piston 424 of the pilot-operated check valve to move ball 434 away from its seat. Hydraulic fluid also flows past ball 412 in bore 282 through line 287 to solenoid-operated cartridge valve 266. When valve 266 is not energized, flow of fluid from line 287 to line 304 is blocked, while flow from line 287 to line 370 is allowed. Therefore, rod 802 of hydraulic cylinder 804 is extended. In this de-energized condition of valve 266, flow may occur from line 324 to line 304. Therefore, hydraulic fluid in hydraulic cylinder 806 may be exhausted to retract rod 808. Hydraulic fluid is exhausted back through line 304 and past ball 434 to line 302 back to reservoir 52. If an over-pressure condition exists, cross-over check valve 440 is moved away from its seat so that hydraulic fluid may flow from line 370 over into line 324 which is open for exhausting to reservoir 52. Flow may also take place between cylinders 804 and 806 when the pump is not operating. When valve 266 is energized, flow of hydraulic fluid from line 287 to line 370 is blocked, while flow may take place from line 287 to line 324. Line 370 is also open for flow to line 304. In this energized condition of valve 266, rod 808 of hydraulic cylinder 806 will be extended. Hydraulic fluid will drain from cylinder 804 back through line 370, valve 266 and line 304 in the same manner as previously described.

FIG. 49 generally shows the arrangement when control block J is attached to base portion D. When valve 530 is not energized, rod 36 may be extended and retracted in the same manner as described with respect to FIG. 47. When valve 530 is energized, flow of hydraulic fluid from line 250 to line 154 is blocked, and flow occurs from line 250 to line 544 over to valve 532. When valve 532 is not energized, flow of hydraulic fluid is blocked from line 544 to line 630, while flow may occur from line 544 to line 550. Hydraulic fluid then flows over to valve 534. Selective energization or de-energization of valve 534 will operate to selectively energize either of the angling cylinders 804 or 806 in the same manner as described for energization or de-energization of valve 266 in FIG. 48. Operation of this portion of the circuit is the same as described with respect to FIG. 48. When valve 532 is energized, flow is blocked from line 544 to line 550, while flow may occur from line 544 to line 630 over to valve 536. Hydraulic fluid flows past ball 728 and line 658 to valve 536. Pressure in line 636 moves piston 754 to open ball 760 by way of projection 758. When valve 536 is not energized, flow is blocked from line 658 to line 664, while flow may occur from line 658 to 668. Line 664 is also open to exhaust line 644 and 646. Hydraulic fluid flowing to cylinder 812 will then extend rod 814. Hydraulic fluid on the other side of the piston will exhaust through line 664 past ball 760 into line 650 back

to reservoir **52.** Energization of valve **536** opens line **658** to flow with line **664,** while flow from **658** to line **668** is blocked. Line **668** is also open to line **644** and **646.** Hydraulic fluid flowing through line **664** will then retract rod **814** and hydraulic fluid on the other side of the piston will be exhausted through line **668,** through valve **536** to lines **644** and **646** back to reservoir **52.**

It will be recognized that the solenoid-operated cartridge valves described are conventional and commercially available items. For example, the solenoid-operated two-way cartridge valves may be of the type identified by part number 2015356 as available from Meyer Products, Inc. of Cleveland, Ohio. The solenoid-operated three-way cartridge valve assemblies may be of the type identified by part number 2015357 as available from Meyer Products, Inc. of Cleveland, Ohio. The solenoid-operated four-way cartridge valve assemblies may be of the type identified by part number 2015358 as available from Meyer Products, Inc. of Cleveland, Ohio.

As shown in FIG. **50,** power unit A is mountable upon the front bumper or frame **830** of a vehicle K. A frame member **832** pivoted as at **834** is also pivotally connected as at **836** with rod **36.** Frame member **832** is connected by a chain or the like **838** with lower frame members **840** which are also pivoted on horizontal axes as at **842.** Frame members **840** are connected with a plow blade M. Coil springs **848** connect the upper rear portion of blade M with frame members **840.** Selective energization and de-energization of motor-pump unit B and valve F selectively extends or retracts rod **836.** This selectively pivots frame member **832** upward or downward to pivot frame members **840** upward or downward about pivot axes **842** to raise or lower plow blade M.

Plow blade M is pivoted as at **850** to frame members **840** for movement on a vertical pivot axis. Blade M may also have an arcuate frame member **852** thereon. Hydraulic cylinders **804** and **806** are mounted on frame member **840** as by pivots **854** and **856.** Rods **802** and **808** of cylinders **804** and **806** are also pivotally connected to arcuate member **852** as at **860** and **862.** Selective energization of the control unit as previously described will alternately energize cylinders **804** or **806** to angle blade M about pivot **850** to any desired angular position.

Vehicle K may also have a pull-plow attached to the underside or rear thereof. A pull-plow P is shown pivoted to the frame of vehicle K as at **870.** Cylinder **812** is also pivoted to the vehicle as at **872.** Rod **814** of cylinder **812** is pivoted to blade P as at **874.** Selective energization of cylinder **812** as previously described will raise or lower blade P about pivot **870.** It will be recognized that the showing of the plow blades is very diagramatic and is intended only for purposes of illustration to show the general environment in which the improved control unit of the present invention is used.

The improved control unit of the present invention employs a common base portion D with different multi-function control blocks. When power unit A is to be used only for raising or lowering a plow blade, plate G is simply secured to base portion D. When power unit A is to be used for raising and lowering a plow and for power angling, control block H is simply secured to base portion D. When power unit A is to be used for raising and lowering a blade; power angling a blade; and controlling a pull-plow or the like; control block J is simply attached to base portion D. The described arrangement is very convenient because it is necessary to manufacture and supply only a single base portion D. Customers may order any desired control block depending upon how many functions they wish to use power unit A for. All of the control valves and the like are compactly arranged on power unit A and it is simply necessary to extend hydraulic lines directly from the control blocks on power unit A to the hydraulic cylinders. Energization of the solenoid valves is carried out in a known manner by having switches located within the cab of vehicle K for operation by a person driving vehicle K. Selectively closing the switches energizes the valves to control all operations from within the cab of the vehicle.

It will be recognized that improved base portion D has a reservoir area defined between outer peripheral wall **902** and inner peripheral wall **904** in FIG. **2.** This is a circumferential reservoir defining area which communicates with reservoir **52** when cylindrical sleeve members **28** and **32** are assembled on base portion D. Base portion D has a ram area inwardly of peripheral wall **904** which includes space **48.** This area and space communicate with the bottom of a piston on rod **36** when inner cylindrical sleeve member **32** is assembled to base portion D.

For purposes of definition, it will be recognized that one-piece base member D is cooperable with any of one-piece control blocks G, H or J. The one-piece base member and the cooperating one-piece control block have a plurality of interconnected passages therein for selectively controlling raising and lowering movement of a plow blade; power angling of a plow blade; or movement of a pull plow blade or the like. One-piece control block D may be considered as having a plane control surface defined by surface **152** for connection to the control block. The remainder of the exterior surface of one-piece base member D may be considered a remaining exterior surface. In addition, plane surface **106** on one-piece base member D may be considered a pump connecting surface and the remaining exterior surface a remaining exterior surface. Bores **104** and **112** in base member D cooperate to define a pump inlet passage. Bores **102, 140, 142** and **150** cooperate to define a pump outlet passage through base member D. This defined pump outlet passage has an outlet opening on control surface **152.** Bore **154** may be considered a ram energizing passage which extends from control surface **152** to the ram energizing surface area of base member D. Bores **160, 162, 168, 170** and **212** cooperate to define a relief passage extending from the ram defining surface area of base member D to the reservoir defining surface area thereof. Bores **220** and **230** cooperate to define a first return passage in base member D leading to the reservoir defining area thereof from control surface **152.** Bores **222** and **232** define a second return passage leading to the reservoir defining surface area of base member D from control surface **152** thereof.

Bores **194, 196** and **198** in control member or plate G cooperate to define a circulating passage for connecting the defined pump outlet passage with the defined ram energizing passage.

Control block H may be considered as having a first or connecting control block surface **246** which connects to surface **152** of base member D. Connecting surface **246** has first and second control block passages

250 and 254 leading to first selector valve 270 or valve bore 262. First and second passages 250 and 254 in control block H are alignable with the defined pump outlet passage and ram energizing passage respectively in base member D. Bores 280 and 287 define a connecting passage for connecting selector valves 270 and 266, and valve bores 262 and 260. Bores 304, 294, 296 and 302 define a control block return passage for connecting valve bore 260 with the defined first return passage in base member D. Bores 362, 364 and 370 cooperate to define a first operating passage extending from valve bore 260 to the exterior surface of control block H. Bores 312 and 324 cooperate to define a second operating passage connecting the valve bore 260 with the exterior surface of control block J. With respect to control J, a pilot-operated check valve is in the defined control block return passage and is operated by a pilot passage 290 communicating with the defined connecting passage between selector valves 266 and 270. Bores 334 and 352 along with their connecting bores define cross-over passages for cross-connecting the defined first and second operating passages.

Control block J includes first and second vertically spaced-apart passages 538 and 542 leading to first valve bore 520 or first selector valve 530. First and second passages 538 and 542 are aligned with the defined pump outlet passage and ram energizing passage in control surface 152 of base member D. Surface 506 of control block J defines a connecting surface which mates with surface 152 on base member D. Bores 544 and 546 define a first connecting passage for connecting first selector valve 520 and its bore with second selector valve 522 and its bores. Bores 550, 552 and 572 define a second connecting passage for connecting second selector valve 522 and its bore with third selector valve 524 and its bore. Bores 630, 632 and 658 define a third connecting passage for connecting second selector valve 522 and its bore with fourth selector valve 526 and its bore. Bores 592 and 594 connect bore 598 with selector valve 524 and its bore to define a first operating passage from third selector valve 524 to the exterior surface of control block J. Bores 580 and 584 define a second operating passage connecting third selector valve 524 and its bore with the exterior surface of control block J. Bores 568, 556, 562, 560 and 564 cooperate to define a return passage in control block J for connection with the defined second return passage in base member D. Bores 674 and 676 cooperate with bore 668 for connecting fourth valve bore 526 with the exterior surface of control block J. Bore 664 defines another operating passage connecting valve bore 526 with the exterior surface of control block J. Bores 644, 646, 650 and 652 define a return passage connecting valve bore 526 with connecting surface 506 of control block J for communication with the defined first return passage in base member D. It will be recognized that the defined two return passages in control block J each have pilot-operated check valves therein which are respectively connected through a pilot passage with the defined connecting passage connecting second valve bore 522 with either third valve bore 524 or fourth valve bore 526. One-way check valves are also provided in the defined connecting passages which connect valve bores. The operating passages defined leading from third valve bore 524 includes cross-over check valve means for interconnecting the two operating passages when an excessive pressure condition exists.

Although the invention has been described with respect to certain preferred embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification. The present invention includes all such equivalent alterations and modifications and is limited only by the scope of the claims.

Having thus described my invention, I claim:

1. A one-piece base member for a hydraulic power unit, said base member having an inner reservoir defining surface area and an inner ram defining surface area, said base member having an exterior surface, a pump inlet passage in said base member extending from said reservoir defining surface area to said exterior surface, a pump outlet passage in said base member extending therethrough from a first portion of said exterior surface to a second portion of said exterior surface, said pump outlet passage having a first pump outlet opening in said first portion of said exterior surface and a second pump outlet opening in said second portion of said exterior surface, a ram energizing passage in said base member extending from said exterior surface to said ram defining surface area, said ram energizing passage having a ram energizing passage opening in said exterior surface, a ram relief valve receiving bore in said base member, and a ram relief passage in said base member extending from said ram defining surface area to said reservoir defining surface area through said ram relief valve receiving bore.

2. The base member of claim 1 wherein said ram energizing passage opening is in said second portion of said exterior surface, and further including plate means for attachment to said base member over said second portion of said exterior surface, said plate member having a plate surface facing said second portion of said exterior surface, a communicating passage in said plate member having first and second spaced-apart communicating passage openings in said plate surface, said first communicating passage opening being aligned with said second pump outlet opening, and said second communicating passage opening being aligned with said ram energizing passage opening.

3. The base member of claim 1 and further including a first return passage therein extending from said reservoir defining surface area to said exterior surface and having a first return passage opening in said exterior surface.

4. The base member of claim 3 wherein said ram energizing passage opening and said first return passage opening are in said second portion of said exterior surface, and further including plate means for attachment to said base member over said second portion of said exterior surface, said plate member having a plate surface facing said second portion of said exterior surface, a communicating passage in said plate member having first and second spaced-apart communicating passage openings in said plate surface, said first communicating passage opening being aligned with said second pump outlet opening, and said second communicating passage opening being aligned with said ram energizing passage opening, said first return passage opening being blocked by a plate surface portion of said plate surface.

5. The base member of claim 3 wherein said ram energizing passage opening and said first return passage opening are in said second portion of said exterior surface, and further including a one-piece first control

block for attachment to said base member over said second portion of said exterior surface, said first control block having first and second spaced-apart valve receiving bores therein, said first control block having a first control block surface facing said second portion of said exterior surface of said base member, said first control block having first and second spaced-apart control block passages extending from said first control block surface to said first valve receiving bore, said first and second control block passages having first and second spaced-apart control block passage openings in said first control block surface, said first control block passage opening being aligned with said second pump outlet opening, said second control block passage opening being aligned with said ram energizing passage opening, a bore connecting passage connecting said first and second valve receiving bores, a return passage extending from said second bore to said first control block surface and having a return passage opening on said control block surface aligned with said return passage opening in said exterior surface of said base member, first and second spaced-apart bore outlet passages extending from said second valve receiving bore to the exterior surface of said first control block.

6. The device of claim **5** and further including a check valve bore in said bore connecting passage between said first and second valve receiving bores.

7. The device of claim **6** and further including a pilot operated check valve bore in said return passage from said second valve receiving bore to said first control block surface, and a pilot passage connecting said pilot operated check valve bore with said bore connecting passage.

8. The device of claim **7** and further including cross-over check valve bores and passages connecting said bore outlet passages from said second valve receiving bore.

9. The device of claim **5** and further including cross-over check valve bores and passages connecting said bore outlet passages from said second valve receiving bore.

10. The base member of claim **3** and further including a second return passage extending from said reservoir defining surface area to said exterior surface and having a second return passage opening in said exterior surface.

11. The base member of claim **10** wherein said ram energizing passage opening and said first and second return passage openings are in said second surface portion of said exterior surface, and further including plate means for attachment to said base member over said second portion of said exterior surface, said plate member having a plate surface facing said second portion of said exterior surface, a communicating passage in said plate member having first and second spaced-apart communicating passage openings in said plate surface, said first communicating passage opening being aligned with said second pump outlet opening, and said second communicating passage opening being aligned with said ram energizing passage opening, said first and second return passage openings being blocked by a portion of said plate surface.

12. The base member of claim **10** wherein said ram energizing passage opening and said first and second return passage openings are in said second portion of said exterior surface, and further including a one-piece control block attachable to said base member over said second portion of said exterior surface, said control block having a facing exterior surface portion facing said second portion of said exterior surface of said base member and a remaining control block exterior surface, said control block having first, second, third and fourth valve receiving bores therein, first and second spaced-apart control block passages extending from said facing exterior surface portion to said first valve receiving bore and having first and second spaced-apart control block passage openings in said facing exterior surface portion, said first control block passage opening being aligned with said second pump outlet opening on said second surface portion of said base member, said second control block passage opening being aligned with said ram energizing passage opening on said second surface portion of said base member, a first bore connecting passage connecting said first and second valve receiving bores, a second bore connecting passage connecting said second and third valve receiving bores, a third bore connecting passage connecting said second and fourth valve receiving bores, first and second spaced-apart third valve receiving bore outlet passages extending from said third valve receiving bore to said remaining control block exterior surface, first and second spaced-apart fourth valve receiving bore outlet passages extending from said fourth valve receiving bore to said remaining control block exterior surface, a first return passage extending from said third valve receiving bore to said facing exterior surface portion and having a first return passage opening therein, a second return passage extending from said fourth valve receiving bore to said facing exterior surface portion and having a second return passage opening therein, said first and second return passage openings on said facing exterior surface of said control block being aligned with said first and second return passage openings in said second surface portion on said base member.

13. The device of claim **12** and further including first and second check valve bores in said second and third bore connecting passages.

14. The device of claim **13** and further including first and second pilot operated check valve bores in said first and second return passages in said control block, and first and second pilot passages extending respectively from said second bore connecting passage to said first pilot operated check valve bore and from said third bore connecting passage to said second pilot operated check valve bore.

15. The device of claim **14** and further including cross-over pressure relief bores and passages connecting said first and second outlet passages from said third valve receiving bore in said control block.

16. A one-piece control block for use with a hydraulic power unit, said block having a substantially plane connecting exterior surface and a remaining exterior surface, first and second spaced-apart valve receiving bores in said remaining exterior surface, first and second spaced-apart passages extending from said connecting exterior surface to said first valve receiving bore, a bore connecting passage connecting said first and second valve receiving bores, first and second spaced-apart outlet passages extending from said second valve receiving bore to said remaining exterior surface, and a return passage extending from said second valve receiving bore to said connecting exterior surface.

17. The control block of claim 16 and further including a check valve bore in said bore connecting passage.

18. The control block of claim 17 and further including a pilot operated check valve bore in said return passage, and a pilot passage extending from said bore connecting passage to said pilot operated check valve bore.

19. The control block of claim 18 and further including cross-over check valve relief bores and passages connecting said first and second outlet passages.

20. A one-piece control block for a hydraulic power unit, said block having a substantially plane connecting exterior surface and a remaining exterior surface, said block having first, second, third and fourth valve receiving bores in said remaining exterior surface, first and second spaced-apart passages extending from said connecting exterior surface to said first valve receiving bore, a first bore connecting passage extending from said first valve receiving bore to said second valve receiving bore, a second bore connecting passage extending from said second valve receiving bore to said third valve receiving bore, a third bore connecting passage extending from said second valve receiving bore to said fourth valve receiving bore, first and second spaced-apart passages extending from said third valve receiving bore to said remaining exterior surface, first and second spaced-apart passages extending from said fourth valve receiving bore to said remaining exterior surface, a first return passage extending from said third valve receiving bore to said connecting exterior surface, and a second return passage extending from said fourth valve receiving bore to said connecting exterior surface.

21. The control block of claim 20 and further including first and second check valve bores communicating respectively with said second and third bore connecting passages.

22. The control block of claim 20 and further including first and second pilot operated check valve bores communicating respectively with said first and second return passages.

23. The control block of claim 22 and further including first and second check valve bores communicating respectively with said second and third bore connecting passages.

24. The control block of claim 23 and further including cross-over relief check valve bores and passages interconnecting said passages extending from said third valve receiving bore.

25. The control block of claim 20 and further including cross-over relief check valve bores and passages interconnecting said passages extending from said third valve receiving bore.

26. A hydraulic power unit including a reservoir-ram unit including a reservoir and a ram and having a one-piece base member, pump means attached to said base member and having a pump inlet and a pump outlet, a pump inlet passage in said base member extending from said reservoir to said pump inlet, said base member having a control exterior surface and a pump connecting exterior surface, a pump outlet passage extending therethrough from said pump connecting surface to said control exterior surface and having a pump outlet opening in said control exterior surface, pump check valve means for checking reverse flow of hydraulic fluid through said pump outlet, a ram energizing passage extending from said control exterior surface to said ram and having a ram energizing passage opening in said control exterior surface, a ram relief valve attached to said base member and having first and second positions, a ram relief passage extending from said ram to said reservoir through said ram relief valve, said ram relief valve blocking flow of fluid through said ram relief passage in said first position thereof and opening said ram relief passage to flow of fluid from said ram to said reservoir in said second position thereof, and a one-piece control block attached to said base member over said control exterior surface, said control block having connecting passage means for interconnecting said pump outlet opening in said control exterior surface and said ram energizing passage opening in said control exterior surface, whereby energization of said pump means with said ram relief valve in said first position supplies fluid to said ram for extending said ram and movement of said ram relief valve to said second position with said pump means de-energized retracts said ram by exhausting fluid from said ram to said reservoir.

27. The device of claim 26 wherein said control block comprises a one-piece plate member having said connecting passage means therein.

28. The device of claim 26 wherein said base member includes a first return passage extending between said control exterior surface and said reservoir and having a first return passage opening in said control exterior surface.

29. The device of claim 28 wherein said control block includes a plate member having a blocking surface for blocking said first return passage opening.

30. The device of claim 28 and further including a second return passage in said base member extending from said control exterior surface to said reservoir and having a second return passage opening in said control exterior surface.

31. The device of claim 30 wherein said control block includes a blocking surface for blocking said first and second return passage openings in said control exterior surface.

32. The device of claim 26 and further including a first return passage in said base member extending from said control exterior surface to said reservoir and having a first return passage opening in said control exterior surface, said control block having first and second selector valves thereon movable between first and second positions, said control block having a connecting exterior surface facing said control exterior surface on said base member and a remaining exterior control block surface, first and second spaced-apart control block passages extending from said control block connecting surface to said first selector valve, said first and second control block passages defining said connecting passage means, said first control block passage communicating with said pump outlet passage opening in said control exterior surface and said base member and said second control block passage communicating with said ram energizing passage opening in said control exterior surface of said base member, a valve connecting passage connecting said first and second selector valves, said first selector valve being operative in said first position thereof to establish fluid flow therethrough from said first control block passage to said second control block passage and to block fluid flow therethrough from said first control block passage to said valve connecting passage, said first selector valve being operative in said second position thereof to block fluid flow

therethrough from said first control block passage to said second control block passage and to establish fluid flow therethrough from said first control block passage to said valve connecting passage, first and second spaced-apart operating passages extending from said second selector valve to said remaining control block exterior surface, a control block return passage extending from said second selector valve to said control block connecting surface and communicating with said first return passage in said base member, said second selector valve being operative in said first position thereof to establish fluid communication therethrough from said valve connecting passage to said first operating passage and from said second operating passage to said control block return passage and to block fluid flow therethrough from said valve connecting passage to said second operating passage and said control block return passage, said control block being operative in said second position thereof to establish fluid flow therethrough from said valve connecting passage to said second operating passage and from said first operating passage to said control block return passage, and to block fluid flow therethrough from said valve connecting passage to said first operating passage and said control block return passage.

33. The device of claim **32** and further including check valve means in said valve connecting passage for allowing fluid flow from said first selector valve to said second selector valve and blocking fluid flow from said second selector valve to said first selector valve.

34. The device of claim **33** and further including a pilot operated check valve in said control block return passage, a pilot passage extending from said valve connecting passage to said pilot operated control valve, said pilot operated check being movable between a closed position blocking fluid flow therethrough from said second selector valve and an open position allowing fluid flow therethrough from said second selector valve, said pilot operated check valve being in said closed position when said first selector valve is in said first position so that no fluid is flowing under pressure through said valve connecting passage, said pilot operated check valve being in said open position when said first selector valve is in said second position so that fluid is flowing under pressure through said valve connecting passage and into said pilot passage to move said pilot operated check valve to said open position.

35. The device of claim **34** and further including a pair of cross-over relief check valves interconnecting said first and second operating passages, said cross-over relief check valves being normally closed to block communication between said first and second operating passages and being openable under predetermined pressure in either of said first or second operating passages to establish fluid flow therebetween.

36. The device of claim **32** and further including a second return passage in said base member extending from said control exterior surface to said reservoir and having a second return passage opening in said control exterior surface, said control block having a blocking surface for blocking said second return passage opening.

37. The device of claim **26** and further including first and second spaced-apart return passages in said base member extending from said control exterior surface to said reservoir, said control block having spaced-apart first, second, third and fourth selector valves movable between first and second positions, said control block having a connecting exterior surface facing said control exterior surface on said base member and a remaining exterior control block exterior surface, first and second spaced-apart control block passages extending from said connecting exterior surface to said first selector valve, said first and second passages defining said connecting passage means, said first control block passage communicating with said pump outlet passage opening in said control surface of said base member and said second control block passage communcating with said ram energizing passage opening in said control exterior surface of said base member, a first valve connecting passage connecting said first and second selector valves, said first selector valve being operative in said first position thereof to establish fluid flow therethrough from said first control block passage to said second control block passage and to block fluid flow therethrough from said first control block passage to said first valve connecting passage, said first selector valve being operative in said second position thereof to block fluid flow therethrough from said first control block passage to said second control block passage and to establish fluid flow therethrough from said first control block passage to said first valve connecting passage, a second valve connecting passage extending from said second selector valve to said third selector valve, a third valve connecting passage extending from said second selector valve to said fourth selector valve, said second selector valve being operative in said first position thereof to establish fluid flow therethrough from said first valve connecting passage to said second valve connecting passage and to block fluid flow therethrough from said first valve connecting passage to said third valve connecting passage, said second selector valve being operative in said second position thereof to establish fluid flow therethrough from said first valve connecting passage to said third valve connecting passage and to block fluid flow therethrough from said first valve connecting passage to said second valve connecting passage, first and second spaced-apart operating passages extending from said third selector valve to said remaining exterior surface of said control block, a first control block return passage extending from said third selector valve to said control block connecting exterior surface, and communicating with said first return passage on said base member, said third selector valve being opeartive in said first position thereof to establish fluid flow therethrough from said second valve connecting passage to said first operating passage and from said second operating passage to said first return passage and to block fluid flow from said second valve connecting passage to said second operating passage and said first return passage, said third selector valve being operative in said second position thereof to establish fluid flow from said second valve connecting passage to said second operating passage and from said first operating passage to said first return passage and to block fluid flow therethrough from said second valve connecting passage to said first operating passage and said first return passage, spaced-apart third and fourth operating passages extending from said fourth selector valve to said remaining control block exterior surface, a second control block return passage extending from said fourth selector valve to said connecting exterior surface and communicating with said second return passage in said base member, said fourth selector valve

being operative in said first position thereof to establish fluid flow therethrough from said third valve connecting passage to said third operating passage and from said fourth operating passage to said second return passage and to block fluid flow therethrough from said third valve connecting passage to said fourth operating passage and said second return passage, and said fourth selector valve being operative in said second position thereof to establish fluid flow therethrough from said third valve connecting passage to said fourth operating passage and from said third operating passage to said second return passage and to block fluid flow therethrough from said third valve connecting passage to said third operating passage and said second return passage.

38. The device of claim **37** and further including first and second check valves respectively in said second and third valve connecting passages for allowing fluid flow from said second selector valve to said third and fourth selector valves and blocking fluid flow from said third and fourth selector valves to said second selector valve.

39. The device of claim **38** and further including first and second pilot operated check valves respectively in said first and second control block return passages, a first pilot passage extending from said second valve connecting passage to said first pilot operated check valve, a second pilot passage extending from said third valve connecting passage to said second pilot operated check valve, said first and second pilot operated check valves being normally closed to block fluid flow through said first and second control block return passages from said third and fourth selector valves, said pilot operated check valves being movable to open position to allow fluid flow through said first and second control block return passages by fluid flowing under pressure through said second and third valve connecting passages and into said first and second pilot passages.

40. The device of claim **39** and further including cross-over pressure relief check valve means interconnecting said first and second operating passages, said relief check valve means being normally closed to block fluid flow between said first and second operating passages and being movable to open position under predetermined pressure in either of said first and second operating passages to establish fluid flow therebetween.

41. A power unit and control device for controlling the position of a plow blade including an extendable and retractable ram for raising and lowering said blade and power angling cylinder means for angling said blade in either of opposite directions, said device including a reservoir-ram unit having a one-piece base member and a one-piece control block directly connected to said base member, said base member and control block having a plurality of interconnected passageways bored therein and connected through selector valve means for selectively extending and retracting said ram to raise and lower said blade and for selectively energizing said power angling cylinder means to angle said blade to a desirable position.

42. The device of claim **41** wherein said base member and one-piece control block further include interconnected passageways bored therein and connected through selector valve means for selectively controlling energization of an additional plow blade.

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