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[54] **VARIABLE FORCE HYDRAULIC PRESS**
5 Claims, 7 Drawing Figs.

[52] U.S. Cl. 91/411;
60/97; 92/110, 92/152; 60/52
[51] Int. Cl. F15b 15/08
[50] Field of Search 91/411,
411A; 92/110, 152, 108, 109; 60/97H, 52HF

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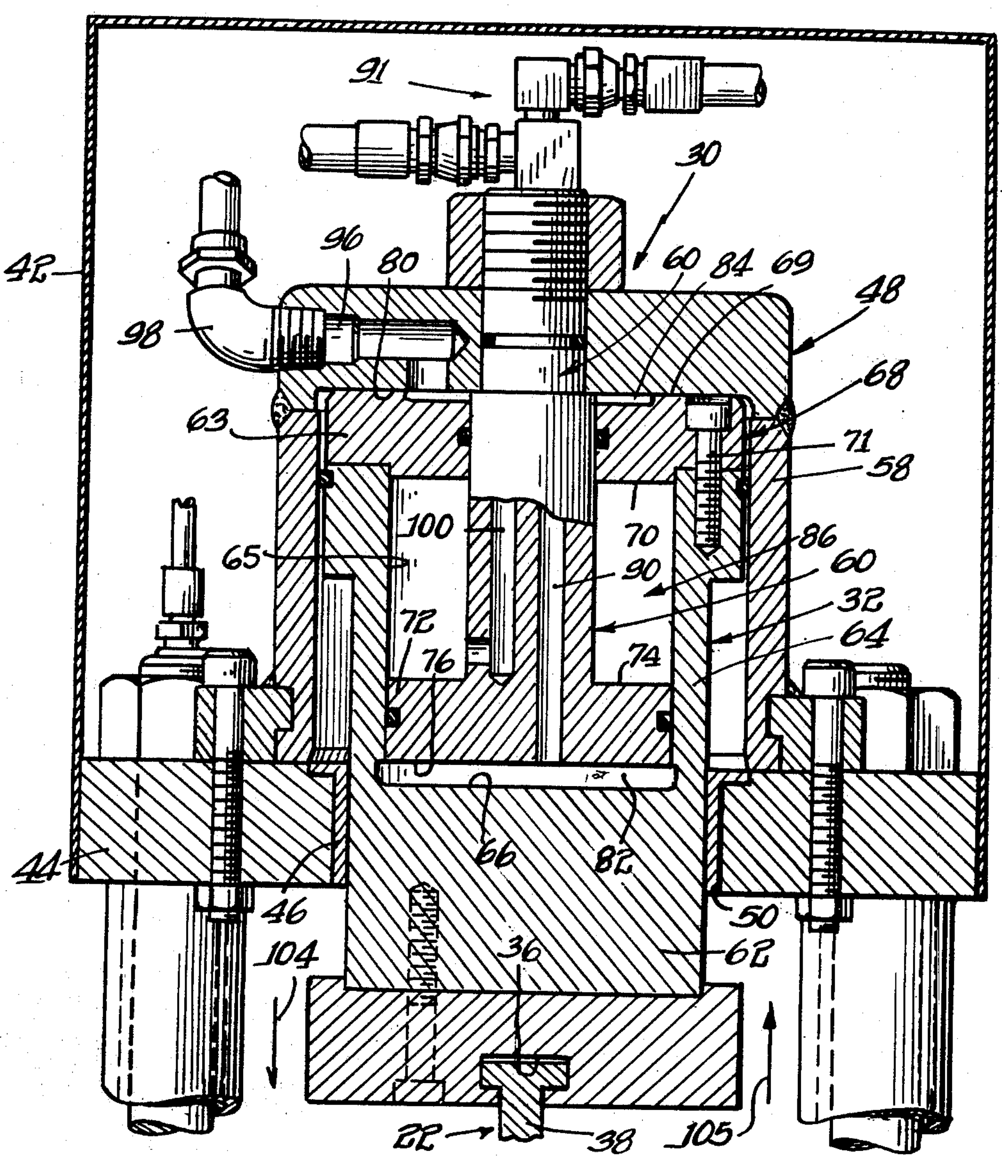
ABSTRACT: A variable force hydraulic press of the general type which includes a frame having a base portion with a support surface, and a head portion spaced above said base portion. The head portion has a ram arrangement contained therein, whereby the ram may be reciprocated toward and away from the base portion. Said ram arrangement includes a housing and a pistonlike ram element slidably positioned within said housing. The ram has first and second piston surfaces facing in the same direction and cooperating with said housing to define first and second piston chambers. Conduit means are provided in said housing to achieve a fluid path from each said chamber to the exterior thereof, said fluid paths being associated with a source of fluid under pressure and control means. Accordingly, a selective application of fluid pressure to either or both said chambers may be attained, with the force exerted by said ram varying according to the total piston surface area subject to said fluid pressure.



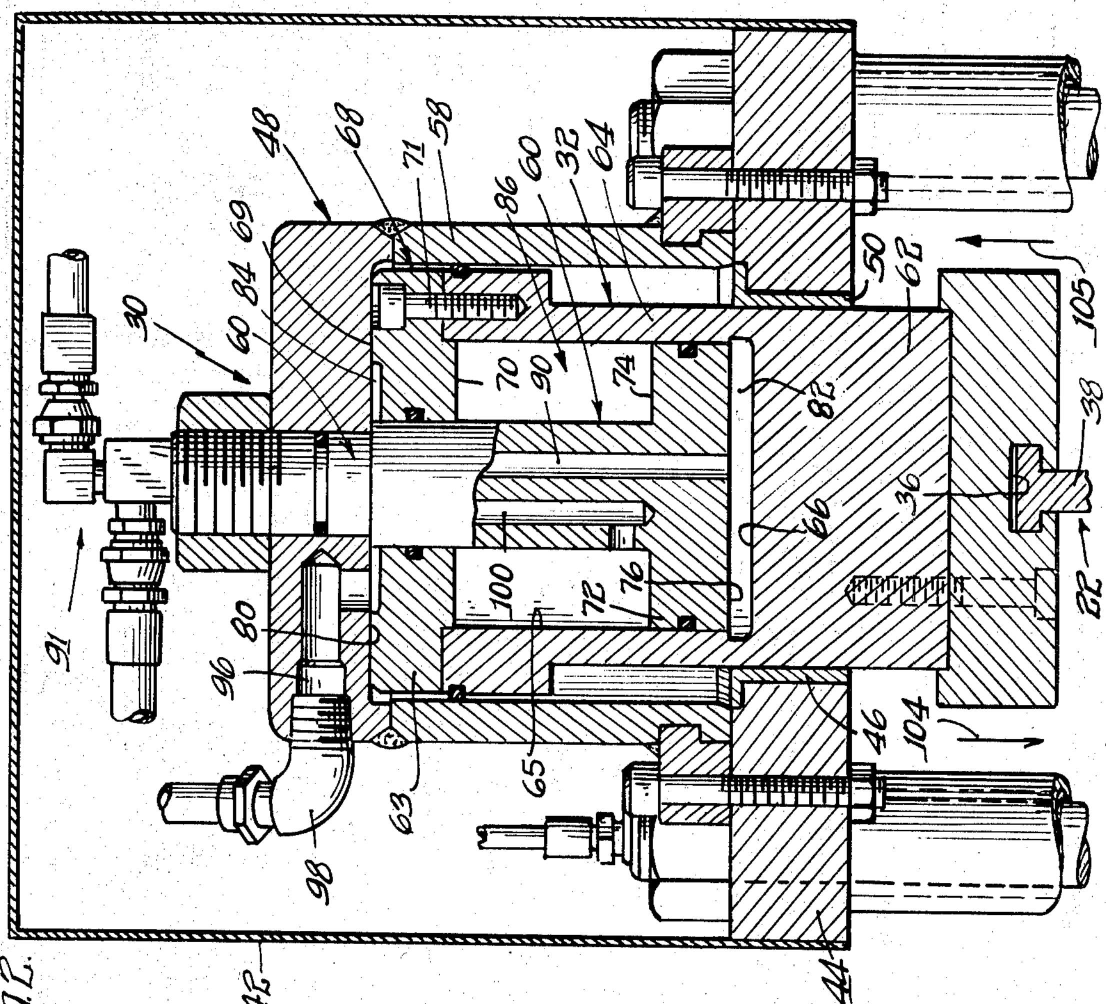


Fig. 2

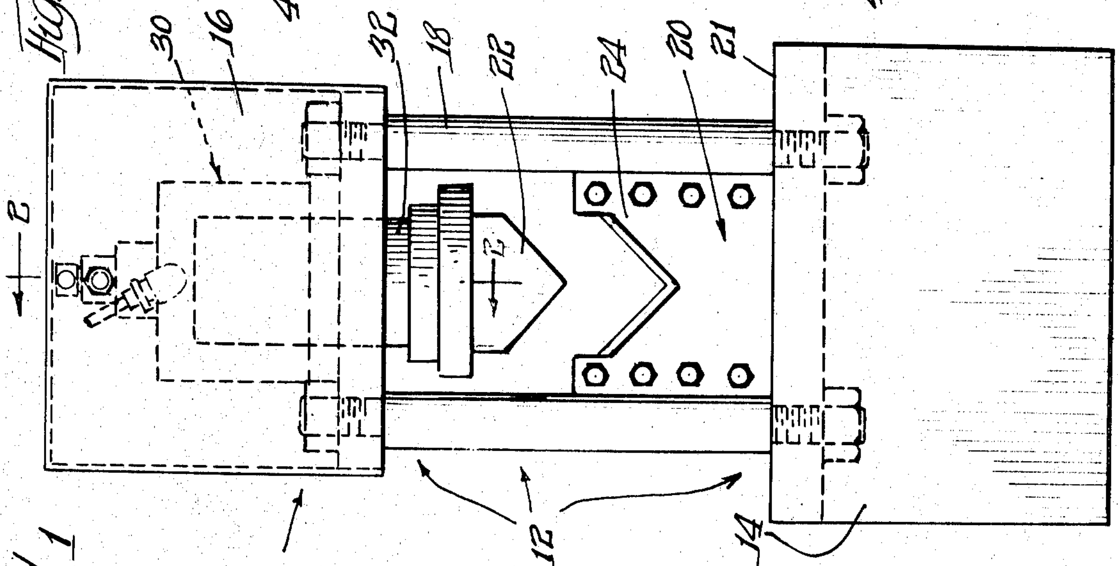


Fig. 1

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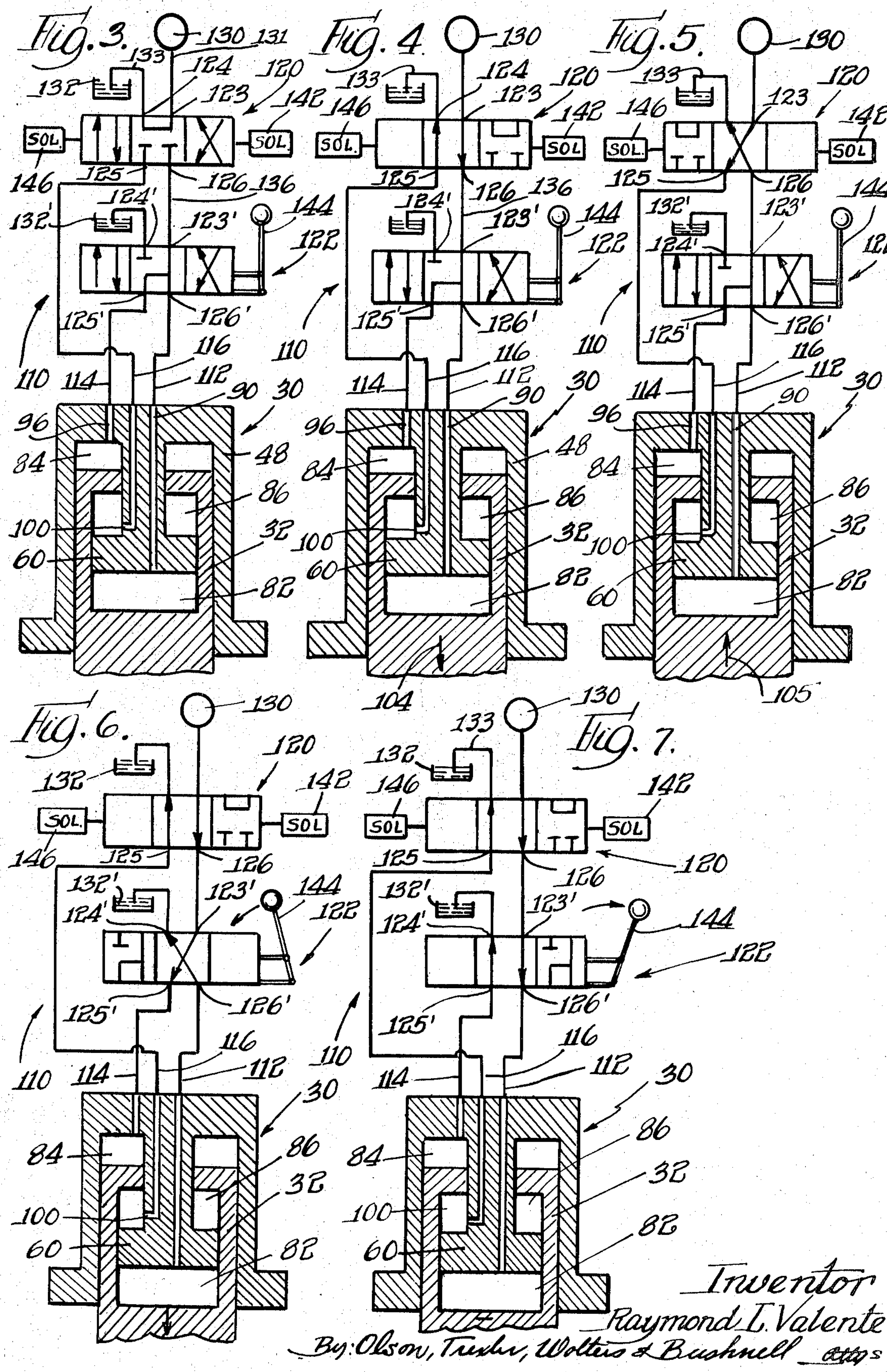
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VARIABLE FORCE HYDRAULIC PRESS

BACKGROUND OF INVENTION

The present invention relates to hydraulically operated press apparatus. More particularly, this invention is concerned with a variable force hydraulic press usable in conjunction with die units to perform various metal fabricating operations.

Presses of the type to which the present invention relates normally comprise a frame having a supporting surface for a die unit and a head portion spaced therefrom by vertical standards. These die units include an anvil section which rests upon and is affixed to the supporting surface of the frame, and a blade element that is slidably engaged therewith; said anvil section normally being notched to provide a recess or channel for supporting a section of stock material. The head portion of the press houses a hydraulically operated reciprocating ram arrangement, to which is affixed the blade member of a die unit.

A shearing press of the general type to which this invention relates is described and illustrated in my copending application Ser. No. 794,582, filed on Jan. 28, 1969.

The aforementioned presses are employed in metal fabricating shops for a wide variety of purposes. For example, depending upon the particular die assemblies available, said units may be used to shear stock material of various shapes, such as angle irons, flat stock, square tubing, and square or round stock. In addition to shearing operations, these presses may be adapted for notching and coping of sheet stock, as well as bending of stock material of various shapes and sizes. Also, these press units may come equipped with a miter block so that miter cuts may be effected if desired.

In order for a fabricator to be competitive and able to provide the wide variety of finished products demanded of him, he must be able to perform all of the above-mentioned operations on stock of varying size and cross-sectional area. It should be apparent that the amount of force required to perform these numerous fabricating operations varies directly with the diameter or thickness of the stock material. Accordingly, since prior art presses are of but a single capacity, rated in tons, and further since the fabricator will normally have numerous production or fabricating runs of relatively short duration, it is necessary that his press be of such a size or rated capacity as to handle the maximum force required. Or in the alternative, the fabricator may employ a plurality of presses of different sizes.

As is believed readily appreciated, employment of a plurality of said presses is economically unfeasible for most fabricators. On the other hand, while the cost of employing a plurality of presses may be prohibitive, the use of a press having a maximum tonnage or rating far in excess of that needed for the job also proves wasteful. Such is the case, since the cycle time for the press is constant and remains the same regardless of the size or cross-sectional area of stock material being worked on. The net result is that when thin or small diameter stock is being processed, the production time is unduly increased by use of a higher capacity press than is actually required for the particular operation being performed.

For example, a shearing press capable of exerting a total force of approximately 190 tons may have a cycle time of approximately 6 to 7 seconds, while a press rated at 130 tons may have a cycle time of only 4 to 5 seconds. Still further, presses rated at 60 tons or less have a cycle time of only 3 to 3½seconds. In this regard, the term "cycle" is employed to designate the full movement of the ram, i.e., the operating and return stroke. Thus, if the larger tonnage press is employed for jobs requiring only a minimum total force, it can be seen that the cycle time and correspondingly the production time for the run will be greatly increased.

SUMMARY OF INVENTION

In conjunction with the above-discussed problems, the present invention provides a unit which affords the metal fabricator flexibility in his choices of operating force, thus in effect achieving in one unit what could only be attained heretofore with a plurality of units.

The above-noted problems are obviated and the aforementioned advantages achieved by the provision of a variable force hydraulic press comprising a housing and a pistonlike ram element slidably positioned therein, said ram having first and second piston surfaces cooperating with the internal portions of said housing to define first and second piston chambers. The housing has a plurality of passageways formed therein communicating with said chambers, such that they may be associated with a source of fluid under pressure. Accordingly, by utilization of control means, fluid under pressure may be selectively applied to either one or both said chambers so that the pistonlike ram element may be moved on the down or operating stroke with a force proportional to the total piston surface area subjected to said fluid pressure.

Various other advantages, objects and features of the present invention will be apparent to those skilled in the art as the detailed description of the illustrated embodiment is evolved hereinafter.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a shearing press of the general type to which the present invention relates.

FIG. 2 is a fragmentary sectional view of the head portion of the unit illustrated in FIG. 1, taken along the line 2–2 of FIG. 1, in the direction indicated.

FIGS. 3 to 7 illustrate the ram arrangement of the press unit of FIGS. 1 and 2 in conjunction with control apparatus; the latter being illustrated schematically and in the various conditions which will achieve the aforediscussed variation in the operation of said hydraulic press apparatus.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, a shearing unit of the type to which the present invention relates is shown in FIG. 1 and designated generally **10**. Said unit **10** comprises a frame **12** which includes a base portion **14** and a head portion **16** spaced above said base portion by the vertical standards **18**. The unit **10** is designed to receive a die assemblage **20** which is supported on the upper surface **21** of the base portion **14**. Die assemblage **20** is comprised of a first die or blade member **22** and cooperating anvil portion **24**. The blade member **22** and anvil portion **24** are assembled and interconnected so that they may be handled as a unit, with the blade member **22** being slidably received between spaced sections of said anvil portion.

The upper or head portion **16** of the unit **10** includes a hydraulically operated ram arrangement, designated generally **30**. This arrangement **30** includes a ram member **32** that is adapted to be reciprocated along a path perpendicular to the base surface **21**. As can be seen in FIG. **2**, the ram **32** is provided with a T-shaped slot **36** which receives the upper correspondingly shaped portion **38** of the blade member **22**. Thus, said blade is operatively, but removably, connected with the ram **32** and upon affixing of the anvil portion **24** to the base surface **21** said blade is adapted for movement relative thereto.

The anvil **24** includes a V-shaped portion or notch **40** within which is supported the stock material, for engagement by the reciprocating blade **22**. In this regard, it should be noted that the shape of the notch will vary depending upon the particular stock material to be processed. Accordingly, when the ram is raised to the uppermost limit of its stroke the blade **22** will assume the position illustrated in FIG. **1**, thus permitting stock material to be engaged under said blade **22** and supported by the notch **40** for shearing.

As will be recalled, the amount of force required to perform a particular operation depends upon the cross-sectional area of the billet or stock material to be processed. Accordingly, where billets of relatively small cross-sectional area are employed the force required for shearing is small; on the other hand, where the cross-sectional area of the billet is large, correspondingly the force required for shearing will be greater. Prior to the present invention, in order for a fabricator to employ only the required amount of force for a fabricating operation, it was necessary to have more than one shearing unit. Or, if this was economically unfeasible, it was necessary that a fabricator determine the maximum tonnage he would need, and then purchase a unit of sufficient capacity. This latter course of action, while less expensive resulted in wasted production time, as the cycle time for a large unit will remain relatively constant irrespective of the cross section of a billet.

Turning now to the present invention, in FIG. 2 there is illustrated a variable force hydraulic press or ram arrangement **30** which provides the metal fabricator with a certain degree of flexibility in his choice of operating force, in that he may select a force commensurate with the job at hand. More specifically, FIG. **2** illustrates the upper or head portion **16** of the press **10**. As can be seen, this head portion **16** includes an outer covering or casing **42** which overlies the hydraulic ram apparatus of the press **10**. The standards **18** support or carry a base plate **44** which is apertured at **46** and which has a ram housing assembly **48** positioned thereon in overlying relationship with respect to said aperture **46**. Positioned in said aperture **46** is a bushing or insert **50** which provides a bearing surface for the pistonlike reciprocating ram member **32**. The ram member **32** is slidably received within the outer portion of said housing assembly **48** and extends therefrom toward the support surface **21**. The lowermost portion of said ram **32**, as was mentioned previously, has the T-shaped slot **36** formed therein for reception of the correspondingly shaped portion **38** of blade member **22**. In addition, as will be understood, various fluid passage means are employed to provide a path of communication from a source of fluid under pressure (not shown) to the interior of said ram housing **48** whereby the piston arrangement **32** may be reciprocated toward and away from the supporting surface **21**, as discussed.

More specifically, the hydraulically operated ram member **32** of the present invention is designed such that there are provided two pistonlike surfaces which may be individually or jointly subjected to fluid pressure in order to obtain a variation in the working or operating force. In this regard, the housing assembly **48** includes an outer housing member **58** and an inner housing core section **60** fixedly attached thereto. Said member **58** and core section **60** cooperate with the ram arrangement **32** to define a plurality of piston chambers, as will be detailed more fully hereinafter.

The ram **32** is a pistonlike member that is slidably received within the confines of said outer housing section **58**. Said ram **32** comprises a lower section **62** of substantially solid cross section; an intermediate section **64** which is hollow or tubular in nature in that same includes a socket **65** which defines a bottom wall **66**; and an upper portion **68**. The upper portion **68** is defined by an apertured plate member **63** secured to the uppermost end of the intermediate section **64** by one or more bolt members **71**. Accordingly, when assembled as shown in FIG. **2**, said apertured plate member **63** in effect provides an inwardly extending annular flange which includes an upper surface **69** and a lower surface **70**.

In addition, with regard to the specific embodiment of the invention illustrated in FIG. **2**, the housing core section **60** is provided with an annular flangelike formation **72** on the innermost portion thereof. Said flangelike portion **72** provides an upper surface **74** and a lower surface **76**.

Turning now to the cooperation between the housing arrangement **48** and the pistonlike ram assembly **32**, it should be noted that upon assembly as shown in FIG. **1** the core section **60** is slidably received within socket **65**. Accordingly, with the elements disposed in this manner the bottom wall **66** of socket **65** provides a first piston surface that cooperates with the lowermost surface **76** on core **60** to define a first pistonlike chamber **82**. The upper surface **69** of said ram portion **68** provides a second piston surface which cooperates with the inner surface **80** of the outer housing section **58** to define a second piston chamber **84**. Also, with the core element **60** disposed within socket **65** there is defined therebetween a third piston chamber **86**, with the inner or lower surface **70** of said plate member **63** providing a third piston surface.

To provide communication between said piston chambers **82, 84** and **86** and a source of fluid under pressure, the housing arrangement **48** includes a plurality of fluid passages. More specifically, with regard to the first piston chamber **82**, the core element **60** has a first passageway **90** formed therein which is adapted to be placed in communication with said source of fluid under pressure by means of the fittings and tubing, designated generally **91**. Regarding the second chamber **84**, the outer housing section **58** is provided with a passageway **96** which communicates therewith. In order to permit said passageway **96** to be jointed or coupled to a source of fluid under pressure the entrance to said passageway **96** is threaded and there is disposed therein an elbow **98** connectable with conduit means which lead to said source of fluid under pressure. The fluid path for the third chamber **86** is provided by the passageway **100** formed in said core portion **60**, said passageway also communicating with a source of fluid under pressure via the fittings and tubing **91**, as illustrated atop of the housing arrangement **48**. In addition, in order to render said chambers fluidtight, various sealing means are provided, as illustrated in FIG. **2**.

Thus, with the provision of the piston chambers **82, 84** and **86** and their corresponding pistonlike surfaces **66, 69** and **70**, it is believed clear that the ram **32** may be reciprocated by the application of fluid under pressure to said chambers. That is to say, if fluid under pressure is introduced into either or both chambers **82** or **84**, the ram **32** will be moved downwardly in the direction indicated by the arrow **104**. The force exerted during said movement depends upon the total surface area of the pistonlike surfaces upon which said fluid acts. More specifically, if fluid is introduced into both chambers **82** and **84**, the entire area of said pistonlike surfaces **66** and **69** will be available, thus providing maximum force on the down stroke. On the other hand, if fluid under pressure is introduced into only one of said chambers **82** or **84**, only the area of the corresponding pistonlike surface will be subjected to the fluid pressure, and thus the force exerted by the ram on the down stroke will be considerably less than that when both piston surfaces are subjected to said fluid pressure.

In order to move the ram in the upward direction, viz, the return stroke as indicated by the arrow **105**, fluid under pressure is introduced into the third piston chamber **86**. In this regard, it should be noted that due to the stationary position of the housing core element **60** upon introduction of fluid under pressure into chamber **86** said fluid will operate on the piston surface **70** to move the ram in the upward direction, this movement simultaneously forcing fluid out of the chambers **82** and **84**.

A fluid control system or circuit for effecting the aforediscussed operation of the press **10** is illustrated schematically in FIGS. **3—7** in conjunction with a cross-sectional representation of the ram arrangement **33**. In this regard, said control apparatus includes various valving elements which are illustrated schematically, and in the particular disposition or condition required to provide the fluid paths needed in effecting movement of the ram **32**. Accordingly, said valving elements will be designated by like reference characters throughout FIGS. **3—7**.

Turning first to FIG. **3**, the hydraulic ram arrangement **30** discussed previously is illustrated in section, with the fluid passages **92, 96** and **100** shown in association with said fluid control system, designated generally **110**. The system **110** is essentially comprised of valving elements and fluid lines, and as illustrated includes fluid lines **112, 114** and **116** associated with the aforementioned passages **92, 96** and **100**, respectively. In addition, there are provided a pair of three position valve elements **120** and **122**, each said valve element having four separate ports or passages associated with various fluid lines of system 110. Accordingly, by operation of said valve elements various distinct fluid paths may be attained, as will be detailed more fully. For purposes of illustration, these ports or passages are designated 123, 124, 125 and 126, for valve 120, and 123', 124', 125' and 126' for valve 122.

Turning then specifically to FIG. 3, a source of fluid under constant pressure is provided and illustrated schematically at 130. The fluid pressure source 130 is joined to the fluid circuit or system 110 by means of conduit 131 which is coupled to port 123 of valve 120. Also, there is provided a first reservoir or sump 132, which is joined to port 124 of fluid system 110 by a conduit or fluid line 133. Also, there is provided a second reservoir or sump 132' coupled with the port 124' of valve 122. Quite obviously, the reservoirs 132 and 132' may be one and the same, but they are illustrated individually for purposes of clarity and to facilitate understanding of the overall operation of the system.

The respective three position valves 120 and 122 are linked together by the fluid line 136 which interconnects port 126 to the port 123' of valve 122. In addition, as is readily ascertainable from FIG. 3, the remaining valve ports 125, 125' and 126' are in communication with the previously discussed fluid lines 116, 114 and 112, respectively.

As was mentioned previously, valves 120 and 122 are three position valves having an assemblage that includes an internal, movable member that upon movement thereof will interconnect certain of the valve ports. In the illustrated arrangement, valve 120 is a solenoid operated valve, with the opposed solenoids 140 and 142 effecting movement of said internal member between two extremes or positions, said valve including a spring biasing arrangement, or its equivalent, to bias said internal member to the third or intermediate position as shown. The valve 122, as illustrated, is a manually operated valve, the lever 144 effecting the desired positioning of the internal member of said valve. Quite obviously, various alternate or equivalent valving structures may be employed, as well as equivalent actuating means from those illustrated and described.

Specifically, then with regard to the valve 120, same is adapted to effect three distinct arrangements or modes of interconnection between the fluid ports 124—126, which arrangements are illustrated in FIGS. 3, 4 and 5, respectively. In FIG. 3, with the internal member of said valve 120 in the neutral position, ports 123 and 124 are interconnected such that the fluid under pressure transmitted from the source 130 will be discharged directly into reservoir or sump 132, with the ports 125 and 126 being blocked. In FIG. 4, the internal member of said valve being indexed to the right, the ports 123 and 126 are interconnected as are ports 124 and 125. On the other hand, in the position as illustrated in FIG. 5, port 123 will now communicate with port 125 and port 124 is now interconnected with port 126.

Turning to the valve arrangement 122, the situation or arrangement achieved when said valve is in the neutral or intermediate position is illustrated in either of FIGS. 3—5. In this regard, the port 123' is in effect an inlet port, as it is coupled to and receives fluid from port 126 of valve 120. In the condition or position of valve 122 shown in FIGS. 3—5, inlet port 123' is interconnected to ports 125' and 126', port 124 being blocked. When the lever 144 is moved to the position as indicated in FIG. 6, port 123' will communicate directly with port 125', while port 126' is associated with the reservoir or sump 132' by means of the port 124'. Upon actuation of the lever 144 to the position illustrated in FIG. 7, port 123' will be coupled directly to port 126' and port 125' will be in association with the reservoir or sump 132' via port 124' and fluid line 133'. Accordingly, with the above discussion of the various valve positions in mind, there will be evolved hereinafter a detailed description of the operation of the shear press apparatus of the present invention.

Briefly, with the valve elements 120 and 122 in the position illustrated in FIG. 3, the fluid under pressure provided by the source 130 will enter valve 120 by means of the port 123 and, due to the connection of port 123 with port 124, will be discharged into the reservoir or sump 132. Upon actuation of valve 120 to the position illustrated in FIG. 4, the fluid entering valve 120 through port 123 will be transported by line 136 to valve 122, and discharged therefrom, via ports 123', 125' and 126', into lines 114 and 112, thus introducing fluid under pressure into the first and second piston chambers 82 and 84. Upon introduction of fluid into said chambers the ram 32 will move downward in the direction indicated by arrow 104. In addition, it should be noted that this movement of the ram 32 will be effective to reduce the volume in chamber 86, thus forcing any fluid therein out through lines 100, 116 and through the ports 125 and 124 of valve 120, into sump 132. Also, with regard to the valve position, as illustrated in FIG. 4, it should be kept in mind that the total surface area of both piston surfaces 66 and 69 will be subjected to fluid under pressure and accordingly the ram 32 will move downward with maximum force.

Considering then the return stroke of ram 32, attention is invited to FIG. 5. After completion of the work stroke, solenoid 142 is actuated to index valve 120 to the left, the valve 122 is maintained in the position illustrated in FIG. 5, wherein ports 124 and 126 are interconnected, as are ports 123 and 125. Valve 122 remains in the intermediate position. Thus, the fluid from source 130 will enter line 116 via the ports 123 and 125, and in turn will be introduced into the third piston chamber 86. When this occurs, the force exerted by said fluid will act upon the third piston surface 70 to move the ram arrangement 32 upwardly, as indicated by the arrow 105.

As will be recalled, it is one of the objects of the present invention to provide a variable force press unit. Accordingly, valve 122 is constructed so that operation thereof to either of the positions illustrated in FIGS. 6 or 7 will achieve a selective application of fluid under pressure to one or the other of said first and second chambers.

Turning first to FIG. 6, when the lever 144 is moved to the position illustrated, fluid under pressure from the source 130 will enter only the line 114 through valve 122, with the first and third piston chambers 82 and 86 being connected to the sumps 132 and 132'. Thus, the force exerted by the ram arrangement 32 in the situation illustrated in FIG. 6 will be considerably less than the working force attained with regard to the arrangement of FIG. 4; the respective working forces being in the ratio of the surface area of the piston surface 69 to the total area of the piston surfaces 66 and 69.

On the other hand, when the lever 144 is moved to the position illustrated in FIG. 7 fluid under pressure from the source 130 will be transmitted only to the first piston chamber 82 by means of the line 112. Correspondingly, the second and third piston chambers 84 and 86 are coupled to the sumps 132 and 132'.

Thus, it can be seen that by the movement of the valve 122 between either one of the three positions a variation in the force exerted by the ram arrangement 32 during its downward stroke may be obtained. Quite obviously, with regard to FIGS. 6 and 7, the introduction of fluid under pressure into the third piston chamber 86 in order to effect the return stroke may be achieved by movement of the valve 120 to the position illustrated in FIG. 5.

In conjunction with the previous discussion relating to cycle time, it should be noted that in attaining maximum working or operating force, the fluid under pressure that must be supplied to fill both chamber 82 and 84 is considerably more than is needed when only one of said chambers is subjected to fluid under pressure, the volume of said chambers being directly related to the area of the respective piston surfaces. Correspondingly, since the source 130 will normally employ a pump operating at a constant rate, the time required to complete the operating stroke will be longer when employing maximum working force.

Thus, is is believed clear that the present invention provides a press unit which enables the metal fabricator to select an operating force commensurate with the job at hand. This flexibility permits more economical and efficient utilization of said press.

While a preferred embodiment of the present invention has been shown and described herein, one skilled in the art will readily envision various structural changes, modifications and substitutions which may be effected without departing from the spirit and scope of the invention defined by the appended claims.

I claim:

1. A variable force hydraulic press comprising: a housing; a pistonlike ram element slidably positioned within said housing, said ram element having first and second piston surfaces facing in the same direction and cooperating with said housing to define corresponding first and second piston chambers; conduit means providing a fluid path whereby each said chamber may be operably connected to a source of fluid under pressure, and control means associated with said conduit means for selectively applying fluid pressure to either or both said chambers, said control means comprising a pair of valve elements, the first said valve element receiving fluid under pressure from a source and adapted for transmittal of said fluid to the second valve element, said second valve element being a three position valve such that when in a first position a fluid path to both said chambers will be provided, while when in either of the two remaining positions the fluid path thus established will be but to one or the other of said chambers, such that the ram element may be moved in one direction with the force exerted thereon varying according to the surface or surfaces to which fluid under pressure is applied.

2. A variable force hydraulic press as defined in claim 1 wherein said ram element includes a third piston surface facing in a direction opposite to said first and second surfaces, said third piston surface cooperating with the housing to define a third piston chamber, and additional conduit means providing a fluid path from said third chamber to the exterior of said housing, whereby said chamber may be placed in operable association with said source of fluid pressure to move said ram element in a direction opposite to said one direction.

3. A variable force press as defined in claim 1 wherein said housing includes an inwardly extending core element; said ram element including a tubular section defining a cavity, the bottom wall of which provides said first piston surface, and said core element being relatively slidably received within said cavity, said tubular section further including an inwardly extending annular flange portion at the upper end thereof, the upper surface of which defines said second piston surface.

4. A variable force press as defined in claim 1 wherein said core element includes a flange portion on the inner end thereof having a diameter greater than the diameter of said core portion surrounded by the inner periphery of said flange portion on the ram, and the lower surface of said ram flange portion providing a third piston surface, said third piston piston surface cooperating with the upper surface of said core flange portion to define the third piston chamber, and conduit means providing a fluid path from said third chamber to the exterior of said housing whereby said chamber may be placed in operable association with said source of fluid under pressure to move the ram in a direction opposite to said one direction.

5. A variable force hydraulic press as defined in claim 1 wherein said pistonlike ram element includes a third piston surface facing in a direction opposite to said first and second surface, said third piston surface cooperating with the housing to define a third piston chamber, and said conduit means further defining a fluid path whereby said third chamber may be operably associated with said source of fluid under pressure to move said ram element in a direction opposite to said one direction.