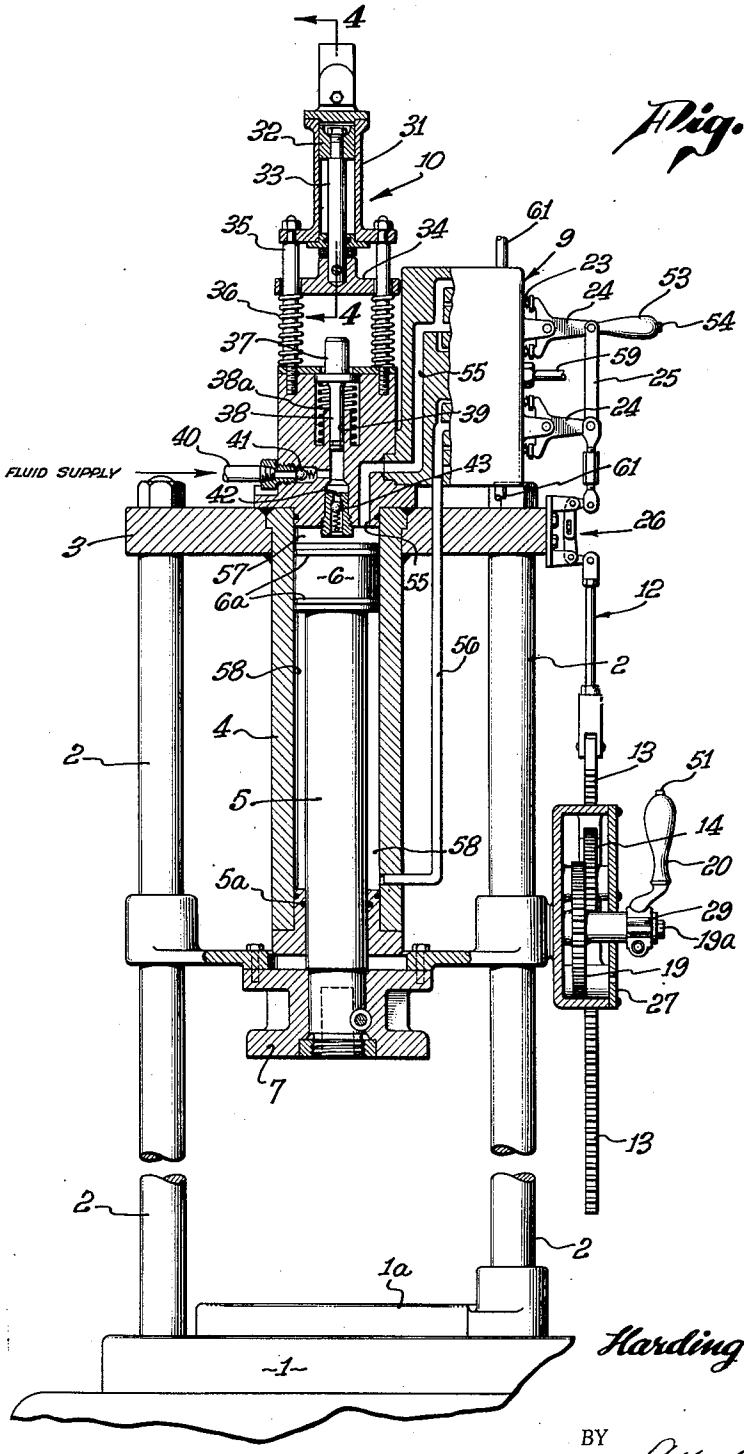
Jan. 9, 1951 H. F. BAKEWELL 2,537,391

HYDRAULIC RAM DEVICE WITH INTERMITTENT HIGH-PRESSURE FLUID SUPPLY

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Fig. 1.



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Fig. 2.

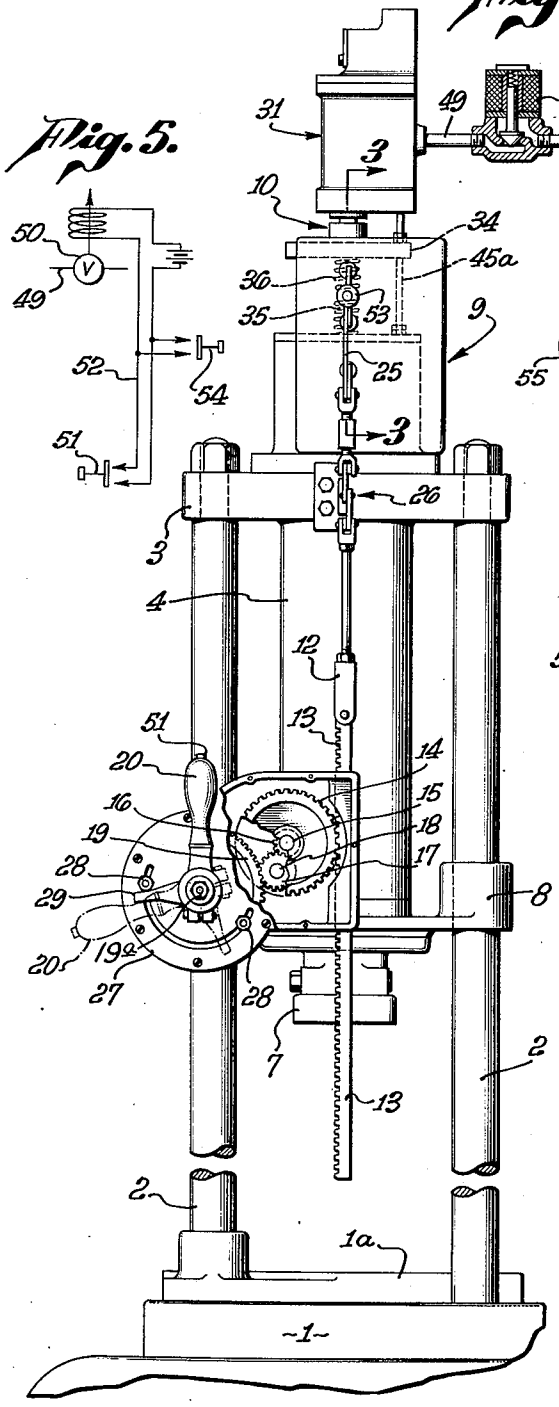


Fig. 5.

Fig. 3.

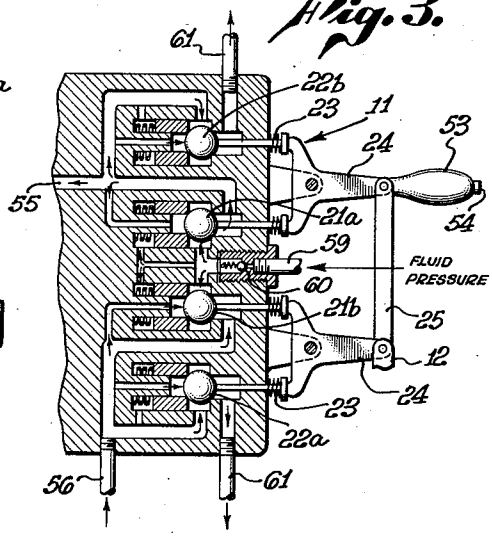
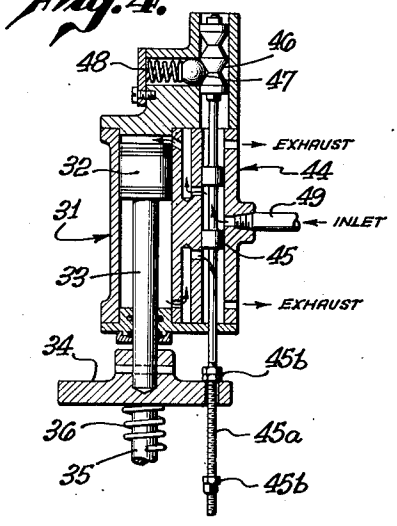


Fig. 4.



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HYDRAULIC RAM DEVICE WITH INTERMITTENT HIGH-PRESSURE FLUID SUPPLY

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8 Claims. (Cl. 60—52)

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This invention relates to hydraulic devices and pertains particularly to a hydraulic ram device adapted for pressing, stamping, broaching, and comparable operations.

One of the particular objects of the device is to provide a main hydraulic ram structure having hydraulic supply means operating at a relatively low pressure and effecting the major movements of the ram, together with an associated but separate hydraulic supply means adapted to apply relatively short duration impulses at a materially higher pressure for securing a minor ram movement at an increased force.

A further object of the invention is to provide a device of the character described having a simplified form of manual control means whereby the operator may integrate the high and low pressure hydraulic actions of the device.

A further object of the invention is to provide a hydraulic device which may be used as a press or the like which has the economy and facile maintenance advantages of a relatively low pressure system together with important advantages of a high pressure construction.

According to prior practice in the art, it has been considered desirable to so design a hydraulic press construction that it is adapted to at all times exert its maximum hydraulic effort, i. e., if a 20,000 lb. press is designed to operate with a 1,000 p. s. i. hydraulic supply system, 20 sq. in. will be provided on the ram member to which the pressure is to be subjected so that when the full pressure is applied a full operation force of 20,000 lbs. is obtained. This requires that the hydraulic supply system be adapted to operate at the full rated pressure at all times even though the maximum ram force of 20,000 lbs. is needed but occasionally. In many operations encountered in pressing, stamping and other methods of material handling involving the application of pressure, it is necessary to employ the maximum ram effort only occasionally, often only as a final application of pressure to an operation which has been conducted for the most part at a reduced pressure. According to this invention, I utilize a relatively low pressure hydraulic system to effect the major portion of the ram movements in a hydraulic device, in association with a hydraulic cylinder construction which is adapted to produce a nominal ram effort under this low pressure hydraulic supply, and employ a separate relatively high pressure hydraulic supply system in association with the ram cylinder for the purpose of momentarily applying relatively high pressure hydraulic impulses to the ram when

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pressures in excess of this nominal ram effort are required. According to a preferred embodiment of the invention I provide control means of the "follower" type which are in association with both the low and high pressure hydraulic operation means whereby the operator may apply the desired low pressure to the ram for operation thereof through its low pressure range and, when the occasion demands, apply the high pressure without the interruption of the low pressure. By such an arrangement, a straightening operation could be carried out on a deformed bar or the like, for example, by applying the relatively low pressure effort on the work to build up stresses which are almost but not quite sufficient to effect the desired straightening operation, and then applying one or more short duration high pressure impulses to effect small increments of movement of the pressure ram upon the work at a materially higher pressure, after the manner of forceful hammer blows, to "set" the work.

Other features and advantages of the structure will be brought out in the ensuing description of a preferred embodiment which is illustrated in the accompanying drawings, in which:

Fig. 1 is a fragmentary vertical section of a hydraulic press construction embodying my invention;

Fig. 2 is a side elevation of the construction with portions broken away to show internal features;

Fig. 3 is a fragmentary sectional detail as taken on line 3—3 in Fig. 2;

Fig. 4 is a fragmentary vertical section of a form of hydraulic supply means as incorporated in Fig. 1, taken on line 4—4 therein, and,

Fig. 5 is a schematic representation of a suitable electrical circuit which may be utilized in this invention.

Referring to the drawings, the construction may comprise a base 1 provided with a plurality of vertically extending guide posts 2 carrying a head 3 upon which cylinder 4 is mounted. Within this cylinder 4 I provide a ram 5 carrying a piston 6 slidably engaging the cylinder 4 and having at its lower end a head 7 which is adapted to receive a die, broach, or other instrumentality adapted to engage with a particular piece of work which normally would be mounted on a bolster 1a on the base 1. Suitable packing for the ram 5 within the lower end of the cylinder 4 may be provided such as O rings or the like, as shown at 5a (Fig. 1); similarly, O rings may be used as piston rings as at 6a. Secured to the head 7 I provide a guide or cross-head 8 slid-

ably mounted on the support guide posts 2, according to more or less conventional practice.

The hydraulic supply means for the cylinder 4 may comprise a relatively low pressure valve assembly 9 and a relatively high pressure valve and pump assembly 10. As shown in Fig. 3 with more particularity, the low pressure valve assembly may be of a balanced type employing ball valves and adapted for alternative supply of hydraulic pressure to opposite sides of the piston 6, with appropriate hydraulic relief from the opposite side of the piston. A control mechanism for the ball valves is shown generally at 11, comprising a valve control linkage 12 connected to a valve control rack 13 cooperating with the follow-up control structure carried by the cross-head 8, such as a gear 14 meshed with the rack 13 and carried on stub shaft 15 fixed relative to the cross-head 8, the gear 14 being provided with a reduction pinion 16 engaging with an idler gear 17 mounted on stub shaft 18 which in turn engages a hand operated gear 19 mounted on shaft 19*a* and with a relatively constrained handle or hand-lever 20. Downward operation of the lever 20 (counter-clockwise movement as seen from Fig. 2) causes a counter-clockwise rotation of the gear 19, the pinion 16, and the gear 14, raising the rack 13, which movement is utilized to operate the low pressure valve assembly 9 in such manner as to apply pressure above the piston 6 and effect a downward movement of the ram 5.

The low pressure hydraulic valve assembly may comprise a pair of inlet valve members 21*a* and 21*b* (the valve 21*a* being adapted to function for operation of the ram 5 in the "down" direction, the valve 21*b* being adapted to function for operation of the ram in the "up" direction), and a pair of outlet valves 22*a* and 22*b* adapted respectively for establishing the necessary hydraulic relief in the "down" and "up" movements of the ram assembly. To effect operation of the valves 21*a*—22*b*, I provide valve push rods 23 and a pair of rocker arms 24 interconnected through a link 25 and coupled to the control linkage 12.

The valve arrangement shown in Fig. 3 is adapted to open the "down" direction valves 21*a* and 22*a* by a downward movement of link 25, and in order to produce this downward movement by the upward movement of the rack 13, above described, I apply a direction-reversing linkage 26, of conventional form.

The gears 14, 16, 17 and 19 are preferably carried in a housing 27 mounted on the cross-head 8 and I preferably provide adjustable limit stops 28 on this housing adapted to be engaged by a stop arm 29 integral with the lever 20, whereby the ram movement may be limited to any desired extent by suitable adjustment of the stops 28 to cause the valve assembly 9 to be returned to the neutral position in Fig. 3. The operation of the follow-up mechanism and the action of the stop means will be apparent from the drawings, it being appreciated that as long as a counter-clockwise rotative effort is maintained on the lever 20, this lever will rotate in a counter-clockwise direction as the gear 14 follows down along the rack 13, and the rotative effort applied to the lever 20 will maintain the rack 13 in its raised position, biasing the valve assembly to the "down" stroke position. As a result of steady application of this rotative effort, lever 20 moves both angularly and linearly in proportion to the travel of ram 5 and piston 6, the amount of these movements depending on the overall ratio of gear train 14—16—17—19. If this rotative effort on the lever 20 is relieved, or impeded by the engagement of the stop arm 29 with one of the stops 28, the continued downward movement of the cross-head 8 and the housing 27 will result in downward movement of the rack 13 by movement of the cross-head, pulling the valve assembly into a neutral position at which time movement of the ram assembly will stop. The pressure applied to the piston 6 may be quantitatively controlled by the amount of pressure applied to the lever 20, which governs the extent to which the ball valves are lifted from their seats, as will be apparent.

The high pressure hydraulic supply is adapted to be applied directly to the upper end of the piston 6, and for this purpose I may provide an air cylinder 31 carrying a reciprocable piston 32 mounted on a piston rod 33 extending through the lower end of cylinder 31 and provided at its lower end with a cross-head or hammer 34 carried on guide rods 35 provided with return springs 36, the hammer 34 being adapted to forcibly engage an anvil head 37 on a high pressure pump which may comprise a reciprocable pump piston 38 working in a pump cylinder 39 and provided with a return spring 38*a*. The pump assembly 38—39 is provided with a fluid inlet passage 40 (which may communicate with the supply of low pressure hydraulic fluid employed to operate the ram through the valve assembly 9) having a check valve 41, and an outlet passage 42 communicating with the space 57 above the piston 6 within the cylinder 4, said outlet 42 being provided with a check valve 43. The pump cylinder 39 is preferably formed in the head 3 for the cylinder 4, whereby a rigid structure is obtained and short fluid lines are realized.

A suitable valve mechanism for operation of the piston 32 within cylinder 31 is provided, as shown generally at 44, which may comprise a piston valve 45 having an operating rod 45*a* extending through a suitable opening in the cross-head or hammer 34 and provided with upper and lower stop members 45*b* adapted to be engaged by the hammer 34 within the limits of its operating stroke, together with valve locator detents 46 cooperating with a locator detent ball 47 provided with a ball spring 48. The detent construction 46—48 serves to locate the piston valve 45 alternatively in the full position to admit air to the upper side of the piston 32, or to the bottom side of said piston, depending upon which one of the stop members 45*b* have been engaged by operation of the cross-head hammer 34. An air inlet 49 is provided, with a valve member 50 for controlling supply of operating air pressure to cylinder 31.

The valve 50 is preferably of the solenoid control type in order to provide for electrical control of the operation of the high pressure hydraulic assembly 10, a push button 51 for closing in circuit 52 for the valve 50 being provided on the lever 20, and inasmuch as a handle 53 may be provided in direct association with rocker arms 24 to provide an alternative control member for operation of the hydraulic assembly, I may provide a parallel-connected push button 54 on the handle 53.

In the operation of the device, assuming a desired piece of work is located on the bolster 1*a* and the desired type of tool is provided in the ram head 7, the operator starts the ram in its desired downward movement by operating the lever 20 in a counter-clockwise direction which opens the valves 21*a* and 22*a* applying high pressure from the inlet 59 past check valve 60 to a pas-

sage 55 communicating to the space 57 above the piston 6 and connecting the space 58 below the piston 6 through line 59 to the lower return passage 61 from the valve assembly 9. The resulting application of pressure at the space 57 will cause downward movement of the piston 6 and ram 5 at a rate governed by the operating capacity of the pressure supply system associated with the assembly 9. This may comprise a conventional high pressure pump mechanism (not shown) adapted to supply a pressure on the order of 500–1000 p. s. i. which may constitute the "relatively low pressure" required. If the area of the piston 6 is 20 sq. in., for example, with a 1000 p. s. i. pressure supply, a resultant pressure effort of 20,000 lbs. may be applied to the work. The operator may apply a greater pressure when the occasion demands, by energizing the solenoid circuit 52 for the solenoid 50 by depressing the push button 51, which admits air to the cylinder 31 above the piston 32 forcing it downwardly and driving the associated hammer 34 against the anvil 37 of the pump 38—39, forcing hydraulic fluid through the outlet 42 past the check valve 43 into the space 57. Pressures as high as 10,000 p. s. i. may be produced by the compact high pressure pump assembly 38—39 (depending upon the air pressure supplied to the cylinder 3, and the areas of the pistons 32 and 33), thus raising the pressure in space 57 commensurately and applying a resultant effort on the ram many times that supplied by the low pressure system. A check valve 60 is provided, as at the inlet 53, to prevent dissipation of this high pressure back through the low pressure supply system. The high pressure produced in the space 57 will cause a short sharp movement of the ram 5, this movement rapidly dissipating the pressure resulting from a single impulse provided by the pump piston 38, although if the button 51 is kept closed, a rapid succession of increments of high pressure application will be maintained.

The stroke of the piston 38 can be considered as a constant, for all practical purposes, and the relation of the areas of the pistons 6 and 38 may be relied upon to establish a given desired downward movement of the ram 5 for each operational stroke of the piston 38. For example, if the area of the piston 6 is a net 20 sq. in., and the displacement of the piston 38 is a net 0.2 cubic inch, each full stroke of the piston 38 may be utilized to cause a downward movement of 0.010" on the part of the ram 5.

It will be appreciated that the specific valving arrangement herein disclosed for the relatively low pressure assembly may be modified without affecting the scope of this invention, that the proposed form of relatively high pressure assembly is not required, and that other forms of "follow-up" control mechanisms are useful. Those skilled in the art will appreciate various modifications applicable to these elements of the invention, and I therefore do not choose to be limited to the specific details herein delineated and described, but rather to the scope of the subjoined claims. In these claims the expressions "low" and "high" pressure will be interpreted in the relative sense, rather than as defining pressures within specific ranges.

I claim:

1. In a hydraulic device, the combination which comprises: a hydraulic ram provided with hydraulic fluid supply means adapted for operation of said ram at a given maximum fluid pressure; a separate hydraulic fluid supply system of the reciprocating type adapted for imposing an intermittent operating pressure in excess of said given maximum upon said ram; control means for said supply means; control means for said supply system; manually controllable operating means associated with both said control means and mounted for movement with said ram for separate and concurrent control of said supply means and said supply system whereby said intermittent operating pressure may be caused to be imposed upon said ram during application of said given maximum pressure.

2. In a hydraulic ram device, the combination which comprises: a hydraulic cylinder provided with a reciprocable piston member carrying a ram extending through one end of said cylinder; low pressure hydraulic fluid supply means in fluid communication with said cylinder at both sides of said piston member for alternative movement of said ram in each longitudinal direction; a high pressure hydraulic fluid supply means in fluid communication with said cylinder at one side of said piston member; valve control means for said low pressure hydraulic fluid supply means; and valve control means for said high pressure hydraulic fluid supply means; both said valve control means including a manual control member mounted for movement with said ram, said manual control member being operatively associated with both of said valve control means for separate and concurrent control of the respective hydraulic supply means.

3. In a hydraulic ram device, the combination which comprises: a hydraulic ram provided with hydraulic fluid supply means adapted for operation of said ram at a given maximum fluid pressure; a separate hydraulic fluid supply system including pump means of the reciprocating type adapted for intermittently imposing operating pressures upon said ram in excess of said given maximum; a fluid operated piston member operatively associated with said pump means and adapted to effect reciprocation thereof upon supply of operating fluid-pressure to said piston member; manual control means for supply of operating fluid-pressure to said piston member; and a manually operable control member for said hydraulic fluid supply means mounted for movement with said ram.

4. In a hydraulic ram device, the combination which comprises: a hydraulic cylinder provided with a reciprocable piston member carrying a ram extending through one end of said cylinder; low pressure hydraulic fluid supply means in fluid communication with said cylinder at both sides of said piston member for alternative movement of said ram in each longitudinal direction; a high pressure hydraulic fluid supply means in fluid communication with said cylinder at one side of said piston member; valve means for said low pressure hydraulic fluid supply means; valve means for said high pressure hydraulic fluid supply means; and valve control means including a member mounted on the ram for movement therewith and manually movable between operating and non-operating positions to control supply of low pressure fluid to the ram, and a fixed stop engageable with the manually movable member to cause the movable member to occupy a non-operating position to limit travel of the ram.

5. In a hydraulic ram device, the combination which comprises: a hydraulic cylinder provided with a reciprocable piston member carrying a ram extending through one end of said cylinder;

low pressure hydraulic fluid supply means in fluid communication with said cylinder at both sides of said piston member for alternative movement of said ram in each longitudinal direction; a high pressure hydraulic fluid supply means in fluid communication with said cylinder at one side of said piston member; valves regulating supply of fluid under pressure in each of said high pressure and low pressure fluid supply means; and valve control means comprising a control member rotatably mounted on the ram to move longitudinally therewith and capable of rotational movement relative to the ram during longitudinal movement of the ram, and linkage operatively connecting the control member to said valves regulating supply of fluid under pressure.

6. A hydraulic ram device as in claim 5, in which the linkage operatively connecting the control member to the valves comprises: a rack extending parallel to the direction of ram movement and itself capable of limited longitudinal movement parallel to the direction of ram movement; a gear train operatively connecting the control member to the rack, whereby revolution of the control member moves the rack relative to the ram when the ram is stationary; and means operatively connecting the rack to the valves regulating low pressure fluid supply in order to operate the valves as a result of movement of the rack.

7. In a hydraulic ram device, the combination which comprises: a hydraulic ram provided with hydraulic fluid means including supply means for operation of said ram at a given maximum fluid pressure; a second hydraulic fluid means for imposing progressively increasing operating pressures upon said ram in excess of said given maximum pressure, said second supply means comprising a cylinder, a reciprocating hydraulic pump member in said cylinder provided with a projecting piston member, a conduit providing a continuously available supply of liquid to said cylinder, and an air cylinder associated with said pump member and provided with a piston and piston rod assembly adapted to strike said projecting piston member upon supply of operating air pressure to said air cylinder to effect an operating stroke of said projecting piston member;

and control means for separately controlling the supply of hydraulic fluid to the first mentioned hydraulic fluid means and the supply of operating air to the cylinder.

8. In a hydraulic ram device, the combination which comprises: a hydraulic ram provided with hydraulic fluid means including supply means for operation of said ram at a given maximum fluid pressure; a second hydraulic fluid means for imposing progressively increasing operating pressures upon said ram in excess of said given maximum pressure, said second supply means comprising a cylinder, a reciprocating hydraulic pump member in said cylinder provided with a projecting piston member, a conduit providing a continuously available supply of liquid to said cylinder, and power actuated hammer means at one end of the pump member including a hammer member adapted to strike said projecting piston member a percussive blow to effect an operating stroke of said projecting piston member; and control means for separately controlling the supply of hydraulic fluid to the first mentioned hydraulic fluid means and the operation of the hammer means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
415,750	Vaile	Nov. 26, 1889
552,274	Cole	Dec. 31, 1895
726,425	Harmet	Apr. 28, 1903
1,429,665	Wood	Sept. 19, 1922
1,855,434	Vickers	Apr. 26, 1932
1,883,166	Vickers	Oct. 18, 1932
1,903,887	Widener	Apr. 18, 1933
2,165,095	Frechette	July 4, 1939
2,211,692	Ferris	Aug. 13, 1940
2,267,064	Wikelund	Dec. 23, 1941
2,366,417	MacMillin	Jan. 2, 1945
2,373,167	Cherry	Apr. 10, 1945
2,398,558	Reimuller	Apr. 16, 1946
2,403,912	Doll	July 16, 1946
2,404,545	Stevens	July 23, 1946