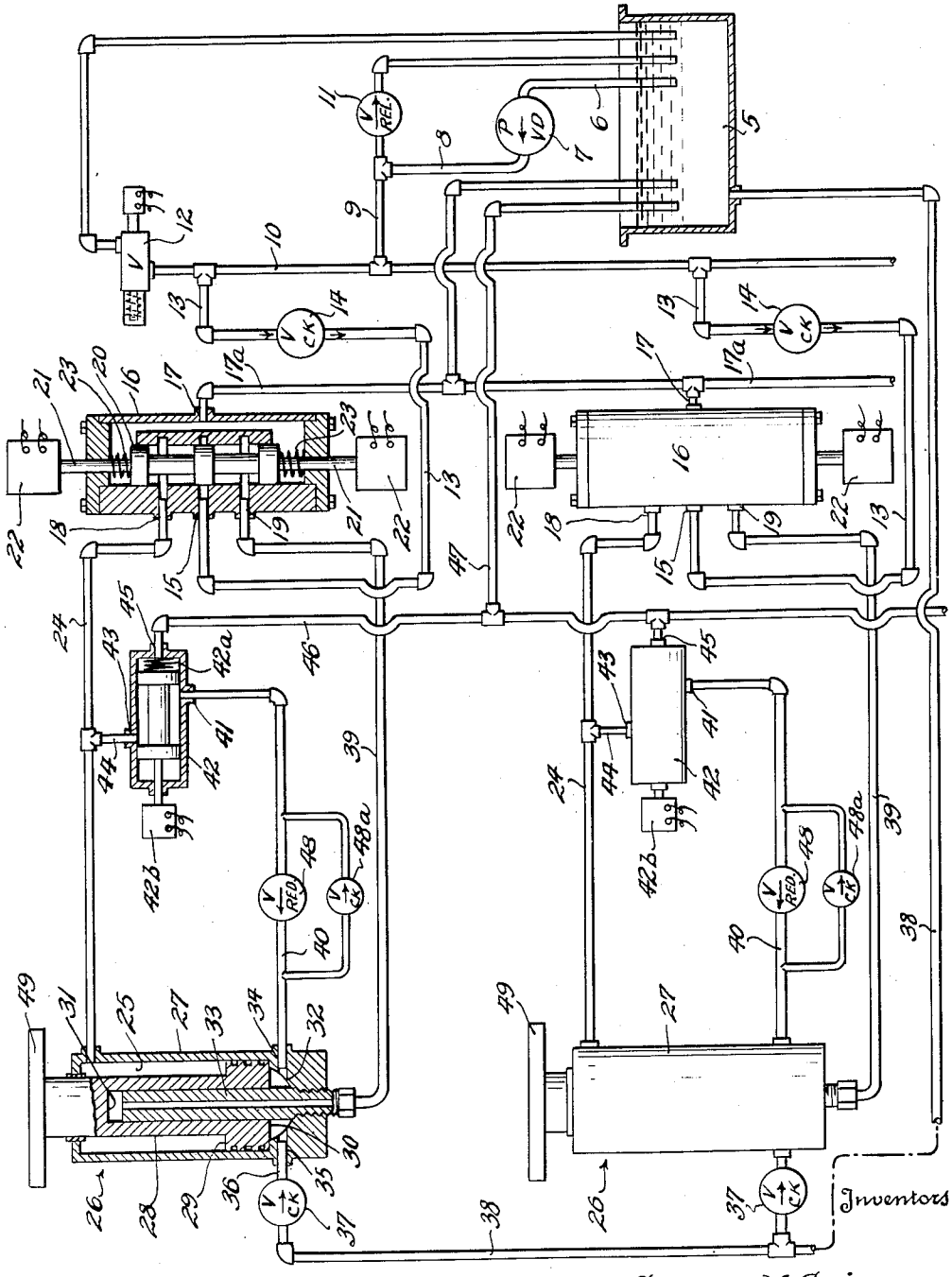
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CONTROL CIRCUIT FOR MULTIPLE
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CONTROL CIRCUIT FOR MULTIPLE HYDRAULIC PRESS SYSTEMS

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This invention deals with fluid-pressure-actuated apparatus, and in its more specific aspects, with hydraulic control circuits for hydraulic presses or similar fluid-actuated apparatus.

The present invention has as its primary object the provision of an improved control circuit for multiple hydraulic press systems, wherein a plurality of presses are operated by pressure fluid displaced by a single hydraulic pump, and wherein the individual control circuits of the presses are so arranged as to be locked-off from the remainder of the control circuits, in order that the control circuit of each individual press may operate independently of the remaining press-controlling circuits in the same manner as if each press-control circuit were supplied pressure fluid by separate pumping stations.

It is another object of this invention to provide a control circuit for a multiple hydraulic press system which makes possible the operation of a plurality of presses in any desired order or sequence from a single pumping station without fear of interference with the operation of any one of the plurality of presses by the operation of another press in the circuit.

It is a further object of the invention to provide a control circuit for a multiple hydraulic press system which embodies a plurality of press-actuating hydraulic motors or rams each of which is provided with advancing and retracting means to which pressure fluid may be supplied simultaneously during the pressing strokes of the presses, in order to provide positive hydraulic pressure on both sides of the pistons or plungers of the motors to prevent slippage or leakage within the motors during pressing operations.

For a further and more detailed understanding of the present invention, and the various additional objects and advantages realized therefrom, reference is made to the following description and the accompanying drawing, wherein, the single figure is a circuit diagram disclosing the multiple press control circuit of the present invention.

Referring to the drawing, the present invention makes use of a liquid reservoir 5 in which a supply of hydraulic fluid is maintained to supply the various fluid-actuated elements of the present control circuit, to be hereinafter more fully described. Extending within the reservoir 5 is the intake line 6 of a variable displacement uni-directional fluid pump 7 having an output line 8. The output line 8 of the pump is connected with a supply conduit 9 which, in turn, is connected at one end with a pressure manifold

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conduit 10, and at its opposite end with a safety pressure relief valve 11 which functions in response to a predetermined maximum pressure within the supply line 9, to return fluid displaced by the pump to the reservoir 5. Disposed at one end of the main pressure manifold 10 is a solenoid-operated two-way unloading valve 12, by which pressure fluid within the main pressure manifold 10 may be selectively exhausted to the reservoir 5.

Connected at intervals along the length of the manifold 10 are a plurality of separate branch conduits 13 in which are interposed check valves 14 which function to permit the flow of fluid in a direction from the pressure manifold 10 only. Connected to the outer ends of the branch conduits 13 are the fluid inlet ports 15 of a plurality of four-way distributing valves 16. In the usual manner, the valves 16, in addition to the fluid inlet ports 15 are provided with fluid outlets or exhaust ports 17, and first and second motor ports 18 and 19 respectively.

Internally, the four-way valves 16 are provided with longitudinally slidable spools or plungers 20 having end shafts 21 extending externally of the valve casing and connected with the armatures of solenoids 22. The plunger 20 of the valve is normally spring-pressed to a neutral position by means of coil springs 23, interposed between the ends of the plunger 20 and the end walls of the valve casing, and upon selective energization of the associated solenoids 22, the plunger is moved to positions providing for the introduction of pressure fluid to either of the motor ports 18 and 19 while connecting the opposite motor port with the exhaust outlet 17.

Communicating with each of the motor ports 18 of the valves 16 is one end of a supply conduit 24 which has its opposite end communicating with the retracting chamber 25 of a fluid-pressure-responsive motor or hydraulic ram 26. Each motor or ram 26 comprises a cylinder 27 formed with an internal cylinder bore in which is reciprocably mounted a piston plunger 28 having a ram-retracting pressure surface or area 29, a primary advancing area 30, and a booster advancing area 31. The cylinders 27 of each ram are provided internally with dome-shaped end chambers 32 through which extends an axially disposed stationary booster plunger 33 formed with an axial passage through which pressure fluid may be introducted to react upon the booster advancing area 31 of the piston plunger. The end chamber 32 of the cylinder 27 is provided with a pair of inlet ports 34 and 35 through which

fluid may be introduced to the end chamber of the cylinder to react upon the primary advancing pressure area of the piston plunger 28. Connected with the inlet port 35 of the end chamber is a conduit 36 in which is interposed a suction check valve 37 which functions to permit fluid contained within a gravity-fed manifold 38 to be drawn inwardly of the end chamber 32 as the piston plunger 28 advances under action of the booster plunger 33 to prefill the primary advancing means of the motor.

Connected with the second motor port 19 of the valve 16 is a supply conduit 39 which is connected at its opposite end with the bore of the stationary booster plunger 33. Communicating with the fluid inlet port 34 of the cylinder 27 is a supply conduit 40 which has its opposite end communicating or connected with the motor port 41 of a three-way solenoid-actuated valve 42. The valve 42 is provided with a fluid inlet port 43 which is connected, by means of a branch conduit 44, with the supply conduit 24 leading from the motor port 18 of the valve 16 to the retracting area of the individual motors 26. The three-way valves 42 are further provided with fluid outlet or exhaust ports 45 which are connected with an exhaust manifold 46 having a return conduit 47 extending within the reservoir 5. The valves 42 are operable to selectively direct pressure fluid from the supply conduits 24 to the conduits 40 associated with the main advancing area of the motors, or to connect the conduits 40 and the advancing areas of the motors to exhaust by way of the exhaust manifold 46 and are preferably spring-pressed, by means of springs 42*a* to a position establishing communication between the conduit 40 and the exhaust port 45, with the solenoid 42*b* functioning upon energization to shift the valve to its opposite position.

Interposed within each of the conduits 40, between the valves 42 and the primary advancing area of the motors 26, is an adjustable pressure reducing valve 48 which is operable to variably reduce the pressure of fluid passing from the valve 42 to the primary advancing areas of the piston plungers 28. Disposed in by-passing relation to the pressure reducing valves 48 are check valves 48*a* providing for the passage of fluid in a direction away from the motors and toward the valves 42.

Thus, it will be seen, that as the distributing valves 16 are individually conditioned to introduce pressure fluid within the conduits 24, such fluid will normally be introduced within the retracting area of the motors, but as the valves 42 are opened, the pressure fluid is simultaneously introduced within the primary advancing areas of the motors, and advancing movement of the piston plunger 28 will ensue, due to the fact that the advancing area 30 is substantially greater than the retracting area 29 of the piston plungers. The pressure reducing valves 48 associated with the primary advancing areas of the motors function to control the pressure of fluid introduced within the primary advancing areas of the motors, in order to determine the force exerted through the piston plunger 28 to a press platen 49 carried at the outer end thereof.

In operation, assuming the piston plungers 28 to be in their innermost retracted positions, as shown in the drawing, the press cycle is begun by conditioning one of the valves 16 so as to direct pressure fluid from the pressure manifold 18 into the supply line 39 associated with the booster advancing area of the motors. At this time, the retracting area of the motor will be opened to exhaust by way of an exhaust manifold 17*a*, thereby allowing the piston plunger 28 to advance rapidly under action of the booster advancing means. In the usual manner, the booster advancing plunger is utilized to speed the extension of the piston plungers into engagement or near engagement with the work objects, and as the platen 49 carried by the piston plungers of the motor approaches the work, the valve 16 is shifted so as to direct pressure fluid through the supply line 24 and to connect the booster advancing area to exhaust. Simultaneously, the valve 42 is conditioned by energizing solenoid 42*b* so as to connect the primary advancing area of the motor with the supply line 24 whereby pressure fluid may be introduced simultaneously into both the retracting area and the primary advancing area of the motor, at which time the piston plunger 28 moves in its pressing power stroke due to the differential in pressure area between the retracting area 29 and the primary advancing area 30. The provision of positive fluid pressure on either side of the head of the piston plunger 28 insures a liquid-tight seal on either side of the head, and prevents the passage of pressure fluid around the sides of the piston plunger during its final pressing stroke.

As the piston plunger and platen reach their outermost position of extension, and the pressing stroke is finished, the valve 42 is conditioned by de-energizing solenoid 42*b* so as to open the primary advancing area of the motor to exhaust, at which time the piston plunger 28 will retract under pressure of fluid introduced to the retracting area of the motor to once again return the piston to its innermost retracted position.

In this connection, it is important to note that during any stage of the operation, of any one motor, another of the multiple circuits may be cut-in to actuate another ram or motor without fear of diminishing the operating pressure within the remaining press circuits, due to the fact that the check valves 14 will function to hold whatever pressure is within the individual motor control circuits, to prevent the release of pressure backwardly through the pressure manifold 10 upon operation of another press circuit. Hence, the present control circuit is particularly advantageous with respect to sequential press operations which require that one press after another be operated to one cycle of its overall operation and stopped whereupon another circuit is cut-in to condition another press for its particular cycle; it being understood that if a pressure stroke is completed within one press, such press may be held in its extended position without fear of slippage, due to the function of the check valves 14, and their creation of a lock within the individual circuits.

In view of the foregoing it will be seen that the present invention provides an improved and efficient control circuit for a multiple hydraulic press system which utilizes but a single fluid displacement pump to supply pressure fluid to the individual press circuits for variable sequential operation. Through the provision of the pressure manifold and check valve system, the individual press-actuating motors or rams may be controlled independently of the remaining press-actuating rams in a manner to complete any particular sequence or cycle of the ram operation, without fear of interference with such operation upon actuation of another of the ram circuits of the press system.

Control circuits formed in accordance with the present invention are further characterized by their structural simplicity, ease of operation and their economy of manufacture, maintenance and operation.

While a single preferred embodiment of the present invention has been disclosed in detail, it will be manifest that various modifications as to constructional details are possible without departing from the spirit of the invention or the scope of the following claims.

We claim:

1. In a hydraulic control circuit for a multiple station hydraulic press system; a plurality of hydraulic motors each comprising a cylinder, a piston plunger reciprocable in said cylinder and having a primary advancing area, a retracting area and a booster advancing area, and means to introduce fluid to each of said areas; a source of fluid pressure; a pressure manifold to receive fluid pressure from said source; a plurality of first valves separately connected with said pressure manifold to selectively direct pressure fluid to either the retracting area or the booster advancing area of each of said motors while connecting the other to exhaust; a plurality of second valves connected between said first valves, the retracting areas of said motors, and the primary advancing areas of said motors to selectively direct pressure fluid to the primary advancing areas of said motors simultaneously with the introduction of pressure fluid to the retracting areas of said motors or to connect the primary advancing areas of said motors to exhaust; and check valves interposed between each of said first valves and said pressure manifold to prevent the return of fluid from said first valves to said manifold.

2. A control circuit for a multiple station hydraulic press system, comprising a plurality of fluid-pressure-actuated motors each embodying a cylinder, a piston plunger reciprocable in said cylinder and having a primary advancing area, a retracting area and a booster advancing area, and means to introduce fluid to each of said areas; a fluid displacement pump; a pressure manifold connected to receive fluid under pressure of said pump; a plurality of first valves connected respectively with said pressure manifold, the retracting areas of said motors, and the booster advancing areas of said motors and operable to selectively direct pressure fluid to either the retracting areas of said motors or the booster advancing areas thereof while connecting the other to exhaust; a plurality of second valves connected respectively with the retracting areas, of said motors and the primary advancing areas thereof to selectively direct pressure fluid introduced to the retracting areas simultaneously to the primary advancing areas or to connect said primary advancing areas to exhaust; means connected between said second valves and the primary advancing areas of said motors to vary the pressure of fluid passing therebetween; and check valves interposed between each of said first valves and said pressure manifold to prevent the passage of fluid in a direction from said first valves to said manifold.

3. In a hydraulic press control circuit; a hydraulic motor having primary advancing means, retracting means, and booster advancing means; a source of fluid pressure; a first valve means to direct fluid under pressure from said source to either said retracting means or said booster advancing means while connecting the other to exhaust; a second valve means connected between said first valve means and said retracting means to direct pressure fluid to said primary advancing means simultaneously with the introduction of fluid pressure to said retracting means; and a check valve connected between said source and said first valve means to prevent the passage of fluid in a direction from said first valve means toward said source.

4. A control circuit for a multiple station hydraulic press system, comprising a plurality of fluid-pressure-actuated motors each embodying a cylinder, a piston plunger reciprocable in said cylinder and having a primary advancing area, a smaller booster advancing area and a retracting area, and means to introduce fluid to each of said areas; a fluid displacement pump; a pressure manifold connected to receive fluid under pressure of said pump; a plurality of distributing valves each having a fluid inlet connected with said pressure manifold, a fluid outlet connected to exhaust, a first motor port connected with the retracting area of said motors, and a second motor port connected with the booster advancing area of said motors, said distributing valves being operable to selectively direct pressure fluid to either the retracting areas of said motors or the booster advancing areas thereof while connecting the other to exhaust; a plurality of second valves connected between the primary advancing areas of said motors and the first motor ports of said distributing valves to selectively direct pressure fluid discharged through the first motor ports of said distributing valves to the primary advancing areas of said motors simultaneously with the introduction of pressure fluid to the retracting areas thereof or to connect the primary advancing areas of said motors to exhaust; means connected between each of said second valves and the primary advancing areas of said motors to vary the pressure of fluid passing between said second valves and the primary advancing areas of said motors; and a check valve connected between each of said distributing valves and said pressure manifold to prevent the flow of fluid in a direction from said distributing valves toward said pressure manifold.

5. In a hydraulic control circuit; a hydraulic ram having a primary ram-advancing pressure area, a ram-retracting pressure area, and a booster ram-advancing pressure area; a fluid displacement pump; a first valve having connections with said pump, the ram-retracting pressure area of said ram and the booster ram-advancing area of said ram, and operable selectively to introduce fluid under pressure from said pump to either the ram-retracting pressure area or the booster ram-advancing area while connecting the other area to exhaust; a second valve having connections with the ram-retracting area of said ram, the primary ram-advancing pressure area thereof and exhaust, and selectively operable to hydraulically connect the ram-retracting pressure area with the primary ram-advancing pressure area or to connect the primary ram-advancing area with exhaust; and a check valve connected between said pump and said first valve to prevent passage of fluid in a direction from said first valve toward said pump.

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(References on following page)

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,552,768	Smith	Sept. 8, 1925
1,990,052	Sosa	Feb. 5, 1935
2,185,402	Dinzl	Jan. 2, 1940
2,274,603	Herman et al.	Feb. 24, 1942
2,331,026	Harrington	Oct. 5, 1943
2,437,077	Cole	Mar. 2, 1948

FOREIGN PATENTS

Number	Country	Date
124,793	Great Britain	Apr. 10, 1919