Nov. 8, 1949 E. M. GREER 2,487,126

HYDRAULIC PRESS AND AUTOMATIC OPERATING SYSTEM

Filed Feb. 14, 1947 4 Sheets-Sheet 1

FIG. 1.

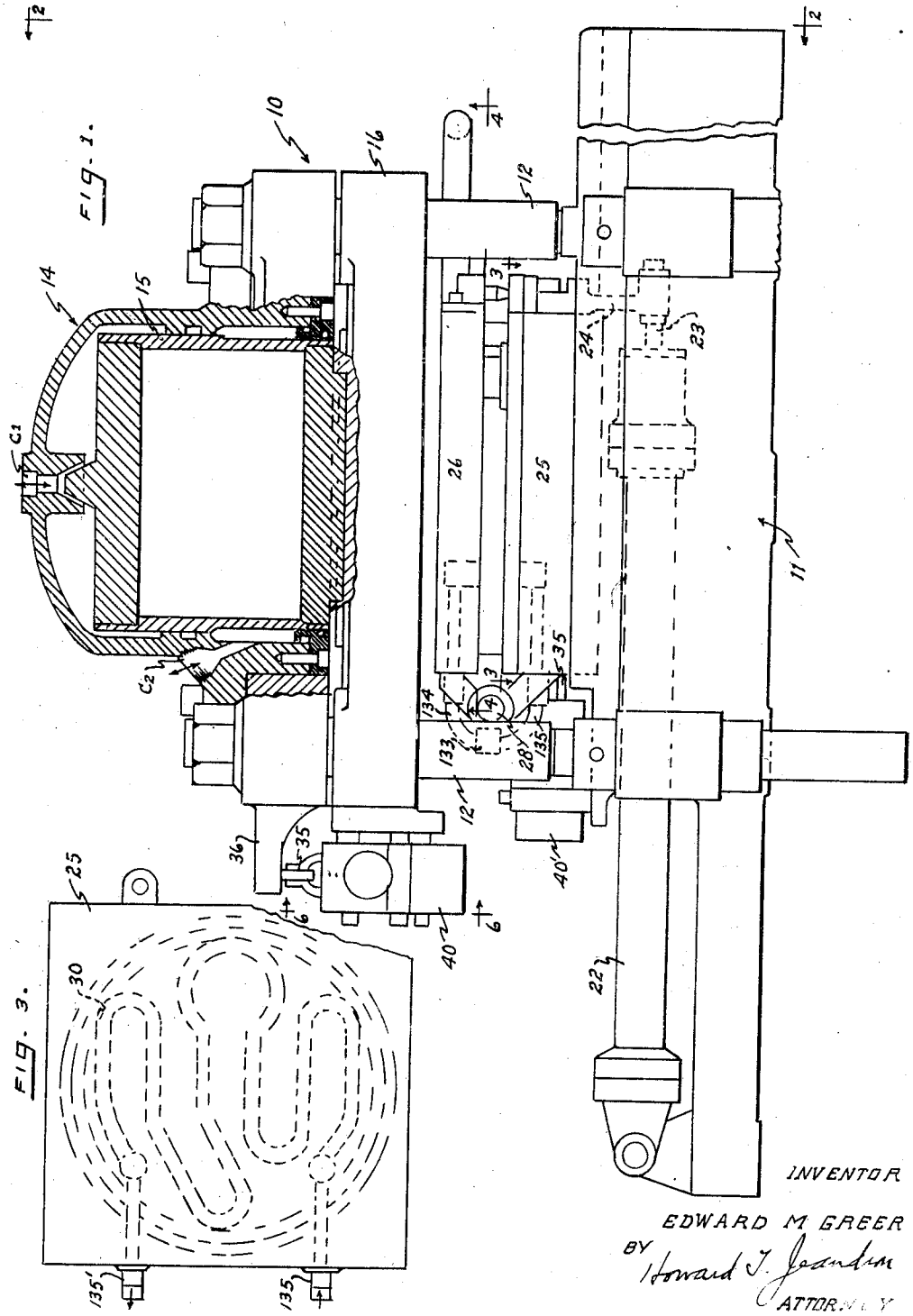


FIG. 3.

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FIG. 2.

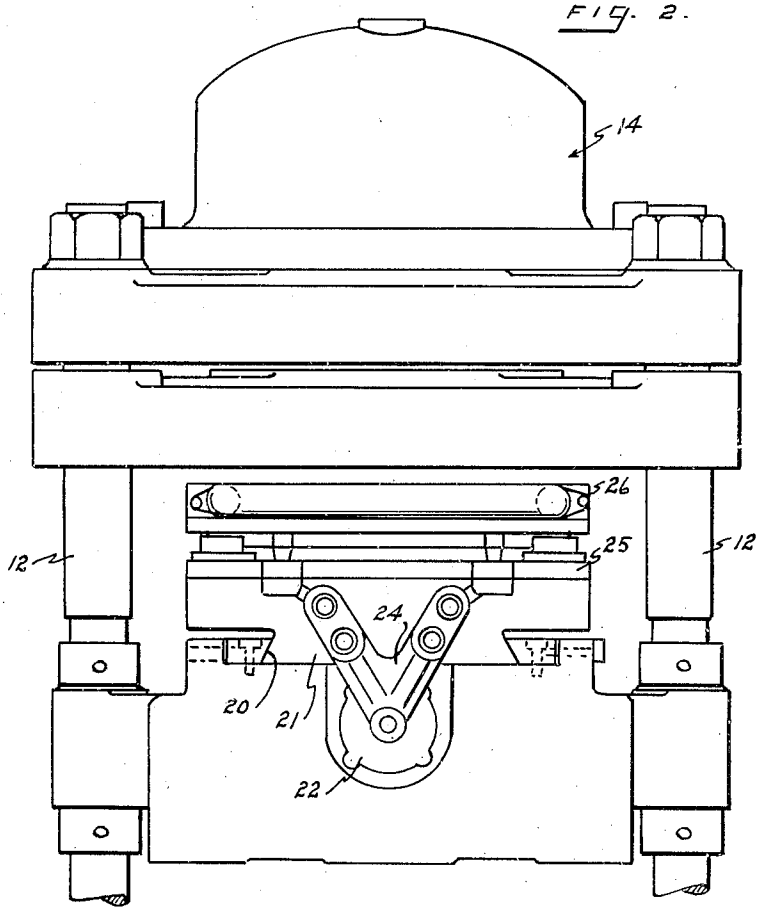
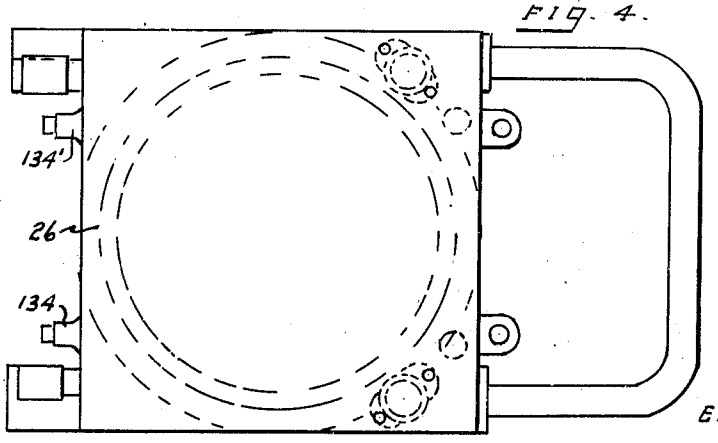


FIG. 4.



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HYDRAULIC PRESS AND AUTOMATIC OPERATING SYSTEM

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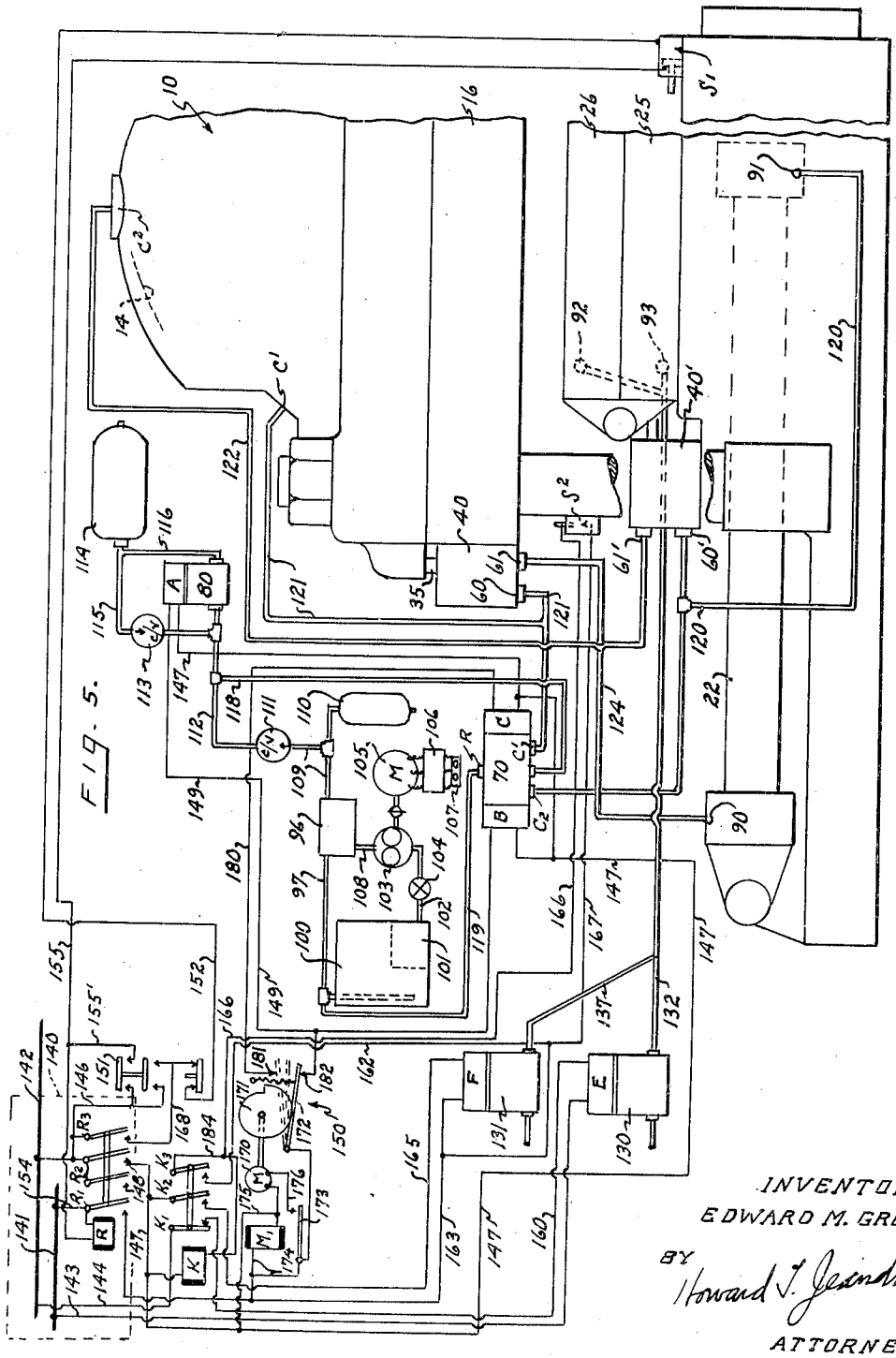


FIG. 5.

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HYDRAULIC PRESS AND AUTOMATIC OPERATING SYSTEM

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FIG. 9.

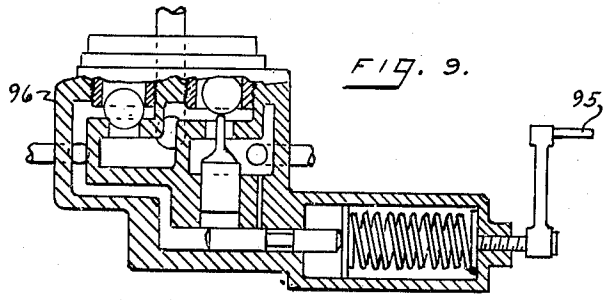


FIG. 6.

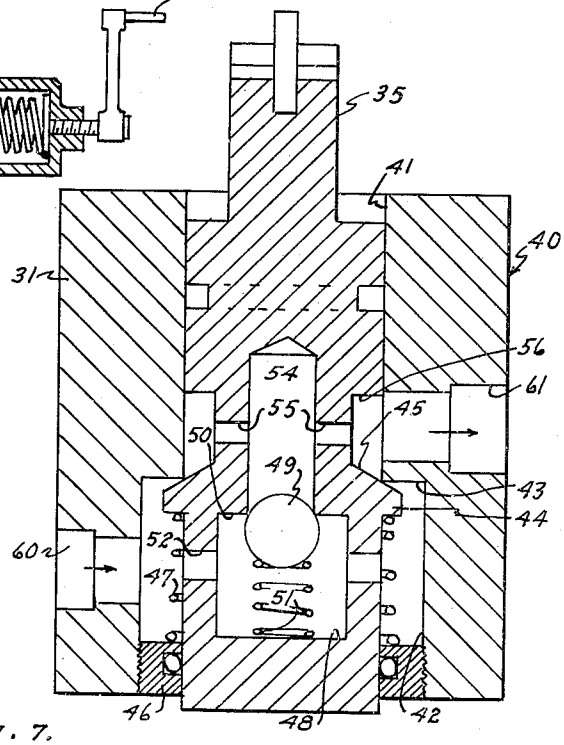


FIG. 7.

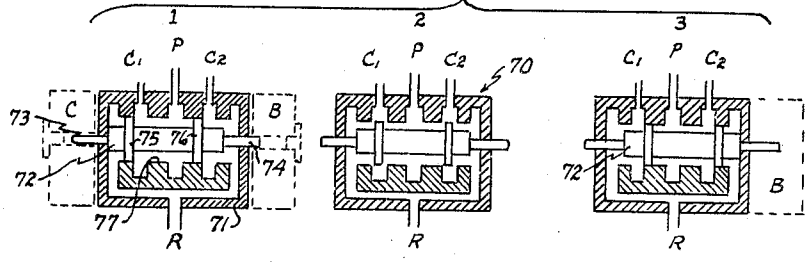
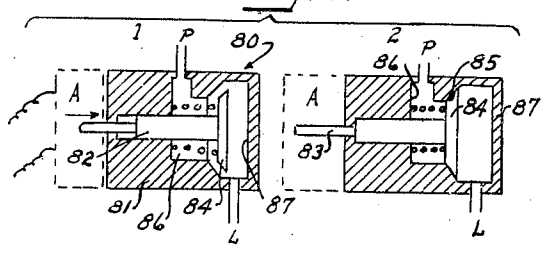


FIG. 8.



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Patented Nov. 8, 1949

2,487,126

UNITED STATES PATENT OFFICE

2,487,126

HYDRAULIC PRESS AND AUTOMATIC OPERATING SYSTEM

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Application February 14, 1947, Serial No. 728,516

7 Claims. (Cl. 18—17)

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This invention relates to hydraulically operated power presses and their operating system, and more particularly to the combination of electrical and hydraulic apparatus to control and automatically cycle the press in operation.

The normal operation of a hydraulic press is old in the art in which hydraulic fluid may be applied to one side of a piston to produce the power stroke of the press and to apply the hydraulic fluid pressure on the opposite side to return the press to an open position. However, in the prior art the presses that have been utilized to produce high pressures for a large work piston have necessarily been operated by a heavy motor and pump.

It is an object of this invention to utilize a small motor and high pressure pump with means of storing sufficient fluid for producing the necessary work positioning stroke of a press and utilizing the high pressure developed by the smaller pump to produce a work stroke on the press.

Another object of this invention is to provide a hydraulic system connected to a power press and a work positioning cylinder which includes a pair of sequence valves to provide means to control the utilization of the hydraulic pressure by the work positioning cylinder and subsequently by the power press and vice versa the opening of the power press and subsequently a return of the work positioning cylinder to its original position.

Another object of this invention is to provide means to control the flow of a heating medium to a die and, at the same time, control the positioning of said die into a hydraulic press, while storing sufficient hydraulic fluid pressure in an accumulator for positioning the hydraulic press during this cycle of operation.

A still further object of this invention is to provide means to utilize a small velocity high pressure fluid pump in combination with an accumulator and check valve to store sufficient hydraulic fluid under pressure for the work positioning stroke of a hydraulic cylinder and in addition to be utilized in the hydraulic system so that when the hydraulic cylinder has been positioned in its work positioning stroke by the fluid pressure stored in said accumulator the high pressure fluid flow from said pump will close said check valve and act upon the non-compressible fluid of the piston cylinder producing a static force maintaining a working operation on the hydraulic press.

A still further object of this invention is to utilize a time controlled switch in combination

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with solenoid operated hydraulic valves in a hydraulic system, said solenoid operated hydraulic valves controlling the flow of fluid pressure to position a pair of dies in the press and subsequently the work positioning stroke of said press, said time switch reversing said valves in a predetermined time to open said press and to return said dies to a reloading position.

A further object of this invention is to provide an electrical hydraulic automatic controlling system for the operation of a hydraulic press in which a die is provided with a heating cycle during its die positioning stroke and during the work positioning stroke of the power press and means to predetermine a time cycle for cooling the die while the press is closed for its pressing cycle, and means to re-establish the heating cycle while the power press is resuming its initial starting position, and means to reset the whole circuit for a new cycle of operation.

A still further object of this invention is to provide an electrical control circuit to control the operation of a pair of solenoid operated fluid valves in combination with a die and power press, means to control the flow of a heating fluid through a first valve when the press is operated to heat the die, means to shut off the heating fluid flow through the first valve and open a flow of cooling fluid through the second valve to the die to cool the die, and means to close the second valve and open the first valve and re-establish the heating cycle.

Other objects will be apparent by referring to the detailed description of this device and its operation, as well as the accompanying drawings in which:

Fig. 1 illustrates a front elevational view of the power press and its die positioning apparatus (illustrated partially in section),

Fig. 2 illustrates a side elevational view taken on line 2—2 of Fig. 1,

Fig. 3 is a plan view of one half of the die taken on line 3—3 of Fig. 1,

Fig. 4 is a plan view of the other half of the die taken on line 4—4 of Fig. 1,

Fig. 5 is a schematic illustration of the press in conjunction with the hydraulic and electrical systems utilized in the operation of the press,

Fig. 6 is a cross sectional view taken on line 6—6 of Fig. 1,

Fig. 7 is a cross sectional view of a double solenoid operated hydraulic valve in which the three positions of the valve are illustrated,

Fig. 8 is a cross sectional view of a single

solenoid operated hydraulic valve illustrating the two positions of the valve, and

Fig. 9 is a cross sectional view of an unloader valve as utilized in the hydraulic system.

Referring to Fig. 1, there is a power press 10 mounted on a work table or casting 11 having four supporting columns 12 with a hydraulic cylinder 14 mounted at the top of the columns 12. The hydraulic cylinder 14 is provided with a piston 15 that bears upon the pressure plate 16 of the press, the plate 16 being slidably mounted on the four columns 12. The work table 11 is provided with a track 20 (Fig. 2) in which a die holder 21 is mounted. A work positioning hydraulic cylinder 22 is also affixed to the work table 11 at one end thereof (Fig. 1), the opposite end of the work positioning cylinder having a piston rod 23 extending therefrom which is affixed to the member 21 by means of a yoke 24. The member 21, in turn, supports the lower portion of a die 25. An upper portion of the die 26 is pivotally affixed by pivot 28 to the lower half and in its closed position assumes the position illustrated in Figs. 1 and 2. The die members 25 and 26 are provided with a diffusing coil or channeled aperture 30 to permit the circulation of a heating or cooling medium. The press 10 is also provided with a pair of sequence valves 40 and 40', the valve 40 being affixed to the member 16, while valve 40' is affixed to the work table 11. The sequence valves, as illustrated in Fig. 6, are provided with an extended member 35. Valve 40 is so mounted to member 16 that its extension 35, in the position illustrated in Fig. 1, will bear against the projecting arm 36 which is affixed to the upper portion of the press. Valve 40' is so mounted on table 11 that its extension 35, in the position illustrated in Fig. 1, will bear against the lower die 25 or its support 21 which moves with the die. The sequence valves 40 and 40', as illustrated in Fig. 6, are comprised of a housing 31 having a central bore of two different diameters, the small bore 41 and the large bore 42 meeting at a shoulder 43. A valve plunger 44 is mounted through the larger bore 42 so that the valve face 45 will bear against the shoulder 43 and a retaining member 46 is threadably secured in the bore 42 to retain a spring 47, the spring 47, in turn, retaining the valve face 45 in its closed position against the shoulder 43. The plunger 44 is also provided with an internal chamber 48 in which a poppet valve 49 is mounted to bear on a shoulder 50 and the valve 49 is retained in this position by a spring 51. The chamber 48 is provided with an aperture 52 so that it may communicate with the outer bore 42. A bore 54 is provided below the poppet valve 49 and a pair of apertures 55 are provided so that the bore 54 will communicate with a recessed portion 56 of the plunger 44. An inlet port 60 is provided in the housing 31 to communicate with the bore 42, while an exhaust port 61 is provided to communicate with the recessed portion 56 of the plunger 44.

It is apparent in operation that fluid pressure entering port 60 cannot pass through this valve in the position illustrated in Fig. 6. It is also apparent that any back pressure backing up through port 61 would lift the check valve 49 and prevent excessive pressure in the system connected to port 61. It is further apparent that a mechanical pressure on the extension 35 will naturally lift the plunger 44 so that its valve face 45 becomes opened and the fluid pressure entering port 60 will be permitted to pass the valve

and out the port 61. This explains briefly the structure and operation of the sequence valve 40.

Referring to Fig. 7, we may follow the structure and operation of a double solenoid operated valve 70. The valve 70 in use will be mounted between a pair of solenoids B and C. The valve 70 is comprised of a housing 71 having four ports therein, P, R, C–1 and C–2. A plunger 72 is centrally mounted in the housing 71 and is provided with extended metal portions 73 and 74 that extend out through the housing 71 into the solenoids B and C, and, in operation, control the positioning of the plunger 72 depending upon which solenoid, in turn, may be energized and when neither solenoid is energized the plunger 72 will assume a balanced or neutral position. The plunger 72 is provided with two enlarged lands 75 and 76. The internal portion of the housing 71 provides a bore 77 through which the plunger 72 is slidably fitted. There are three positions of the valve 70 which we will refer to as 1, 2 and 3. In position 1, with solenoid B energized, the land 75 will prevent the fluid pressure port P, that is connected to the bore 77, from communicating with the return port R, which is connected to either end of the bore 77, while the land 76 prevents the pressure port P from communicating with the port C—2, which is also connected to the bore 77. However, this leaves port C—1, which is connected to the bore 77, communicating with the port P. Therefore, in this position fluid pressure will pass into the valve and out port C—1, while a return fluid pressure returning through port C—2 will pass into the valve and out port R. It is apparent that when solenoid B is de-energized the valve may be forced by a spring or otherwise to assume the position illustrated at 2, and when the solenoid C is energized the valve will assume the position illustrated at 3. When the value assumes the position 3 the plunger 72 will re-route the flow of fluid through the valve so that pressure entering the port P will pass into the valve and out port C—2, while the return pressure flowing into port C—1 and into the valve will flow out the port R.

Referring to Fig. 8, which illustrates the single solenoid operated valve 80, this valve is normally in an open position, as illustrated in position 1, and when the solenoid A is energized it will be in a closed position, as illustrated at 2. Valve 80 is comprised of a housing 81 having a valve plunger 82 mounted centrally therein. The plunger 82 has an extension 83, which extends outside the housing 81 into the solenoid A. The plunger 82 at its opposite end is provided with a valve face 84. The valve face 84 co-acts with a valve seat 85 in its closed position. A pair of chambers 86 and 87 in the housing 81 are separated by the valve 84 in its closed position. A pressure port P is connected to chamber 86, while a line port L is connected to chamber 87. It is apparent that fluid pressure entering port P will normally flow through chamber 86 past the valve 84, through chamber 87 and out the line L, but when the solenoid A is energized the valve 84 will close and prevent the flow of fluid as described.

Referring to Fig. 9, a pressure control valve is illustrated and is similar to the valve illustrated in the Patent Number 2,264,375, issued December 2, 1941, but in the particular use of the valve as illustrated there has been added to this valve a regulating handle 95 which permits a resetting of the pressure, so that the unloading pressure of this valve may be varied according to the required pressure desired in this system. Any other pres-

sure control valve may be similarly controlled and used. More specifically, referring to Fig. 9, the pressure applied to this valve will continue to build up until the piston is forced to move, moving against the resistance of the spring controlled by the handle 95, permitting the fluid pressure to build up to a maximum and thus unloading this valve. Therefore, by the adjustment of handle 95, the maximum or minimum operating pressure in the hydraulic system illustrated in Fig. 5 may be set as predetermined.

Referring to Fig. 5, the power press 10 is illustrated and the electrical and hydraulic systems are schematically illustrated in their association with the power press 10. Since two sequence valves 40 are utilized we will refer to them on Fig. 5 as 40 and 40'. The power press 10 is provided with two cylinder ports C—1 and C—2 and, as already described, the sequence valve 40 is provided with a pair of ports 60 and 61, while sequence valve 40' will be provided with a pair of ports 60' and 61'. The work positioning cylinder 22 is also provided with a pair of cylinder ports 90 and 91. Likewise, the dies 25 and 26 are provided with a pair of fluid ports 92 and 93. A hydraulic system comprised of a reservoir 100 with a filter 101 mounted therein is connected by means of pipe 102 to a pump 103. A shut-off valve 104 is provided between the pump and reservoir to permit closing or opening this line; a motor 105 is provided and connected to the pump 103 to drive the same; the motor 105 is controlled by a magnetic switch 106 and an on-off control button 107, the magnetic switch 106 being connected to a source of potential not shown. The fluid pump 103 is, in turn, connected by a line 108 to an unloader valve 96, the unloader valve, in turn, having a return line 97 connected to the reservoir 100 and the unloader valve being connected to a pressure line 109, the line 109 being connected to a fluid storage accumulator 110 and to a check valve 111, the check valve, in turn, being connected by a fluid line 112 to a solenoid operated valve 80, the line 112 also being connected to a check valve 113 and the valve 113 being, in turn, connected to an accumulator 114 by means of a line 115. The line 115 is also connected by means of a line 116 to the opposite side of the valve 80. A pressure line 118 is connected to the line 112 at one end thereof and to the pressure port of a valve 70 at the other end thereof. The valve 70 is, in turn, connected by means of its return port R to the reservoir 100 by means of a line 119. The valve 70 is also connected from its port C—2 by means of a line 120 to the port 60' of the sequence valve 40', the line 120 is also connected to the port 91 of the hydraulic cylinder 22. The valve 70 by means of its port C—1 is connected through a line 121 to the port 60 of the sequence valve 40 and the line 121 also is connected to the port C—1 of the hydraulic cylinder 14 of the power press 10. The opposite port C—2 of the cylinder 14 is connected by means of a line 122 to the port 61' of the valve 40'. The valve 40 is also connected through its port 61 by means of a line 124 to the port 90 of the hydraulic cylinder 22. Thus, the complete hydraulic system is so constructed and connected. A pair of solenoid operated valves 130 and 131 are connected to the dies 25 and 26 so that valve 130 may control the flow of steam to these dies and valve 131 may control the flow of cold water to these dies. Valve 130, is therefore, connected to a source of steam, not shown, while valve 131 is connected to a source of cold water supply, not

shown. Valve 130 is, in turn, connected by means of a line 132 to an inlet connection 133 (Fig. 1) which is, in turn, connected by means of pipes 134 and 135 to the dies 26 and 25 respectively. Pipes 135' and 134' are connected to a waste drain. Likewise, valve 131 is connected by means of a pipe 137 to the inlet connection 133 which is connected to the dies, as already described, thus the cooling and heating systems and their controls are apparent. In order to describe the functioning of the hydraulic system and the cooling and heating system it is necessary to disclose the electrical system which controls the operation of both fluid systems. The electrical system is comprised of an inlet box 140 connected to a source of potential (not shown) by a pair of leads 141—142. A main relay R is provided to control a plurality of switches R—1, R—2, and R—3. The relay coil is connected by a lead 154 to the main line 141. Contact R—1 is also connected to lead 154. The opposite side of the relay coil is connected by a line 155 to a limit switch S—1 that is opened by the return of the dies 25, 26 to their loading position. Lead 141, by means of a lead 143, is connected to the solenoid E. The opposite side of solenoid E is connected by a lead 160 to a contact K—1 of a normally closed switch 1 of a relay K, the opposite side of switch 1 being connected by a lead 144 to the line 142, the relay K is connected to the lead 147 on one side and to the contact K—3 on the other side. The opposite side of K—3 is connected by a lead 162 to a common lead 163 which is, in turn, connected to the open side of switch R—1 of the main relay R. The solenoid operated valve F is also connected by means of lead 163 to the open side of switch R—1 of relay R, while the opposite side of solenoid F is connected by a lead 165 to the switch K—2 of the relay K. The opposite side of switch K—2 is, in turn, connected to the lead 147 which, as already described, connects to the switch R—2 of the main relay. A trip switch S—2 is connected by means of leads 166 and 167 to the opposite sides of the switch K—3. The switch S—2 is operated by the press member 16 in its downward movement when it bears upon an extension member extending out of switch S—2. A start-stop button 151 is connected to the main relay switches R—2 and R—3 by a lead 146, while the opposite side of the start button 151 is connected by a lead 168 to the switch R—3. Lead 168 is also connected to one side of the stop button, while the opposite side of the stop button is connected by means of a lead 152 to the normally closed limit switch S—1. The opposite side of switch S—1 is connected by means of a lead 155 to the main relay R and to lead 155' which is connected to the start button 151. A time switch 150 is also included which is comprised of a relay M—1, a motor 170 and a cam 171 driven by the motor 170, the cam 171 controlling the position of a switch 172. The relay M—1 controls the operation of a switch 173. The relay M—1 is connected by means of a lead 174 to the common lead 163 connected to switch R—1 of relay R. The lead 174 is also connected to one side of switch 173 and to one side of switch 172. The relay M—1 on its opposite side is connected by a lead 175 to the common lead 147 which is connected to the switch R—2 of the main relay R. Lead 175 is also connected to one side of the motor 170, the opposite side of the motor being connected by a lead 176 to the opposite side of the switch 173. The solenoids A, B and C are connected to the switch 172, that is, solenoid C is connected by a

lead 180 to contact 181 and solenoids A and B are connected by means of a lead 149 to a contact 182 of switch 172. The opposite side of solenoids A, B and C are conected by a common lead 147 to the switch R—2 of the main relay R.

In operation, it is necessary to start the hydraulic circuit motor 105 by closing switch 107. This conditions the hydraulic circuit for operation. That is, it produces a fluid pressure with the pump 103 charging through the unloader valve 96 to charge a predetermined pressure in the accumulator 110 and through the normally open valve 80 to charge the accumulator 114. With this system ready for operation the operator may close the switch 151. That is, when the dies 25—26 have been properly filled with the material to be pressed and the dies 25—26 will be positioned on the outermost position of the work table 11 with the hydraulic cylinder 22 having its piston 23 fully extended. Thus the closing of switch 151 will energize solenoids A and B, and relay R, of course, will be energized due to the closing of switch 151 and held energized by the normally closed switch S—1, the potential passing from lead 142 to switch R—2, through lead 146 to switch 151, through the closed switch, through the lead 155' and 155 back to relay R through the relay and lead 154 to the opposite side of the line. The potential from lead 142 and switch R—2 and lead 146 also passes through switch 151, through lead 152, through switch S—1, through lead 155, through the relay R, through the opposite lead 154 to the main line 141, thus the relay R closes and switch 3 will be closed to form a holding circuit when the button 151 is released. The relay R wil stay energized until switch S—1 is opened at the return of the die positioning cylinder to its outermost position, which trips the switch S—1. In the initial operation of ths device a circuit may be followed from lead 141, through lead 143 to the solenoid E, back through lead 160 to the normally closed switch K—1, through lead 144 to the opposite side of the line 142. Thus, the valve 130 will be retained open so that steam pressure may flow through line 132 to the dies 25 and 26, through their ports 93 and 92 respectively and out the waste connection. This steam heat medium flows through the dies during the interval of time when the dies are moved into the position illustrated in Fig. 1 and continues while the press cylinder moves downward until it contacts the die 26, at which time the switch S—2 will be tripped by the member 16. The closing of switch S—2 will energize relay K, the potential flowing from lead 142, through switch R—2 of main relay R which is closed, through contact 148 and lead 147 to relay K, through K, through a lead 184, through lead 166, through the closed switch S—2 back through lead 167 to the common lead 163, through the closed switch R—1 of main relay R, through the lead 154 to the oposite side of the line 141. Thus, the energizing of relay K will open switch K—1 and close switches K—2 and K—3, opening switch K—1 thus de-energizes solenoid E closing the steam line. Whereas, closing switch K—2 will energize solenoid F. This may be followed from the main line 142, through switch R—2 of main relay R, through line 147 to switch K—2, through the closed switch, through line 165 to solenoid F and back through the common line 163 to the closed switch R—1 of main relay R, through lead 154 to the opposite side of the line 141. When relay K is energized switch K—3 will also be closed. This provides a holding circuit to retain relay K energized until switch S—2 again opens. Thus, with solenoid F energized valve 131 will be opened and a cooling medium, such as water, will flow through line 137 to the dies 25 and 26 to cool them and out the waste line. At the time the main relay R was energized and switch R—1 was closed a circuit was also completed from switch R—1 through line 163, through line 174, through the relay M—1, through lead 175 to the common lead 147 back through switch R—2 to the opposite side of the source of potential. This closed switch 173 and potential also flowed from line 174, through switch 173, through lead 176 to the motor 170, through the motor 170 back through lead 175 to the common lead 147 and, as described, back to the opposite side of the source of potential thus causing motor 170 to be operated. The motor 170, in turn, driving cam 171. Since cam 171 positions the switch 172 it will in its initial position, as illustrated in Fig. 5, close switch 172 against contact 182 and the potential from line 174 will flow through switch 172, through the contact 182, through the line 149 to both solenoids A and B and the opposite sides of solenoids A and B are connected by lead 147 back to the switch R—2 and the opposite side of the source of potential thus solenoids A and B are energized and the valve 80 will be closed, as already described, while the valve 70 will be positioned, as illustrated in position 3 of Fig. 7.

Thus when the main relay R is closed solenoid E is energized and solenoids A and B are energized through the timer 150. In this condition the dies are heated and the hydraulic fluid pressure passing through valve 70 will transfer the dies by means of cylinder 22 to the position illustrated in Figs. 1 and 5. Having arrived at the position illustrated the die 25 will trip valve 40' and the hydraulic fluid pressure will pass out port 61, through the line 122 into port C—2 forcing the press cylinder downward until the member 16 trips the switch S—2. It should be noted that during the downward movement of the hydraulic cylinder 10, valve 80 is retained in a closed position, therefore, the stored fluid pressure in the accumulator 114 must pass through the check valve 113 to be utilized to supply a sufficient volume of fluid to fully position the cylinder through its full stroke until member 16 rests upon the die 26 and it has tripped switch S—2 to its closed position. Since we have already described how relay K is energized by the closing of switch S—2 the control of operation now remains under the action of cam 171. Thus, as cam 171 rotates it will first break the contact 182 which will de-energize solenoids A and B and as the cam rotates further it will allow switch 172 to close against contact 181. This completes a circuit to solenoid C energizing the solenoid. The circuit may be followed from one side of the source of potential through lead 174, through the switch 172, contact 181, lead 180, through the solenoid C, through the common lead 147 back to the other side of the source of potential.

It is to be noted that the timer 150 will control the time cycle between the time of closing the circuit to solenoids A and B, and the de-energization of the solenoids and the energization of solenoid C, thus a predetermined cycle may be set by the cam 171 and this is governed by the necessary time to position the die, the necessary time to position the press upon the die and the time for the actual pressing operation which completes the first half cycle. From this point on the return cycle of the press

and die positioning elements are not necessarily timed, but are controlled by a limit switch.

With solenoids A and B de-energized valve 80 will again be open while valve 70 is released by the B solenoid, but since solenoid C becomes energized it will shift to the position illustrated at position 1 in Fig. 7. Thus, fluid pressure entering valve 70 from line 118 passes out of the valve through port C—1 and line 121. Since valve 40 will be in a closed position the fluid passes on to the port C—1 of the hydraulic cylinder 10. Thus, the main press cylinder will be retracted until the member 16, which supports valve 40, reaches a predetermined position when the extension 35 of valve 40 is tripped opening the valve. At this time the fluid pressure from line 121 will pass through valve 40 out port 61 and through line 124 to port 90 of the cylinder 22. Thus, the hydraulic cylinder 22 will be extended and the dies 25—26 will be moved to the right, Fig. 1, because of their connecting yoke 24 until die trips switch S—1. This will break the circuit through the main relay R, thus interrupting the potential supplied through switches R—1, R—2 and R—3 to the control apparatus and this will, in turn, de-energize solenoid C and the apparatus is prepared for a new cycle of operation.

It is to be noted that the heating cycle will remain on, the heating cycle continuing while the press closes upon these dies and the member 16 closes switch S—2 which energizes relay K to thus open switch K—1 and de-energize solenoid E, thus ending the heating cycle and at the same time switch K—2 is closed which controls the energizing of solenoid F starting the cooling cycle. The solenoid F is retained energized until switch S—2 opens (which is the return cycle of the press) and when switch S—2 is opened the control switches K—1 and K—2 become reversed due to relay K being de-energized, thus solenoid E is again energized and the heating cycle resumes. This permits retaining the dies in a hot condition so that time is not lost to again heat the dies to a sufficient degree for operation. The cooling cycle has been so timed and prearranged with this apparatus that a short interval of cooling is sufficient to permit the plastic within the dies to attain a set so that it may be removed at the end of the return stroke of the positioning apparatus even though the dies are again heating and preparing themselves for a new charge.

Having described the apparatus and a complete sequence of operation, according to Fig. 5, it is apparent that the press and its die positioning apparatus may be modified without departing from the spirit of this invention, and it is also true that the hydraulic system utilized may be modified in any way as long as a sufficient volume of fluid at a given pressure is supplied to position the press and a second high pressure is supplied to be utilized for a pressing operation without departing from the spirit of this invention, and it is also to be noted that any timing device might be utilized to control electrically, or otherwise, the actual opening and closing of the fluid heating valve, the fluid cooling valve and the hydraulic system control valves without departing from the spirit of this invention, and this invention shall be limited only by the appended claims.

What is claimed is:

1. The combination of a press apparatus and a pair of dies, a heating and cooling system for said dies, and an automatic operating electric-hydraulic system for said press, including a press operable by hydraulic pressure, a die positioning apparatus operable by hydraulic pressure, a hydraulic pressure source including a pair of solenoid operated valves and a hydraulic fluid storage accumulator connected to said press, a pair of hydraulic sequence valves, one operable by closing said press and the other operable by positioning a die in said press, a pair of solenoid operated valves to control the flow of a cooling medium and a heating medium to said die, an electrical operating system including a timer to control the operation of said first mentioned pair of valves and the pair of sequence valves as well as controlling said heating and cooling system valves in a sequence of operations, means to open said heating system valve and at the same time operate said positioning apparatus to position said die within said press, means to operate said first sequence valve when said die is positioned in said press to, in turn, position said press for operation with the stored hydraulic fluid, means to close said heating valve and open said cooling valve and at the same time hold said press in operation with a predetermined pressure from said fluid pressure source, means to start said timer operating at the end of said press positioning stroke, means controlled by said timer to close said cooling system valve and re-open said heating system valve and at the same time to retract said press to an open position, means to open said second sequence valve when said press reaches its open position and operate said die positioning apparatus to position said die at a re-charging position, and means to recharge said accumulator for another sequence of operation.

2. The combination of a press apparatus and a die, a heating and cooling system for said die and an automatic operating electric-hydraulic system for said press, including a press operable by hydraulic pressure, a die positioning apparatus operable by hydraulic pressure, a hydraulic pressure source including a pair of solenoid operated valves and a hydraulic fluid storage accumulator connected to said press, a pair of hydraulic sequence valve, one operable by closing said press and the other operable by positioning a die in said press, a pair of solenoid operated valves to control the flow of a cooling medium and a heating medium to said die, an electrical operating system including a timer and a pair of limit switches to control the operation of said first mentioned pair of valves and the pair of sequence valves as well as controlling said heating and cooling system valves in a sequence of operations, means to open said heating system valve and at the same time operate said positioning apparatus to position said die within said press, means to operate said first sequence valve when said die is positioned in said press to, in turn, position said press for operation with the stored hydraulic fluid, means to close said heating valve and open said cooling valve and at the same time hold said press in operation with a predetermined pressure from said fluid pressure source, means to start said timer operating at the end of said press positioning stroke with said first mentioned limit switch, means controlled by said timer to close said cooling system valve and re-open said heating system valve and retract said press to an open position, means to open said second sequence valve when said press reaches its open position and, in turn, operate said die posi-

tioning apparatus to position said die at a re-charging position and trip said second limit switch and de-energize said solenoid operated valves, and means to recharge said accumulator for another sequence of operation.

3. The combination of a press apparatus and a die, a heating and cooling system for said die and an automatic operating electric-hydraulic system for said press, including a press operable by hydraulic pressure, a die positioning apparatus operable by hydraulic pressure, a hydraulic pressure source including a pair of solenoid operated valves and a hydraulic fluid storage accumulator connected to said press, a pair of hydraulic sequence valves, one operable by closing said press and the other operable by positioning a die in said press, a pair of solenoid operated valves to control the flow of a cooling medium and a heating medium to said die, an electrical operating system including a timer, a pair of limit switches and a start-stop button with a holding circuit to control the operation of said first mentioned pair of valves and the pair of sequence valves as well as controlling said heating and cooling system valves in a sequence of operations, means to open said heating system valve and at the same time operate said position apparatus to position said die within said press, means to operate said first sequence valve when said die is positioned in said press to, in turn, position said press for operation with the stored hydraulic fluid, means to close said heating valve and open said cooling valve and at the same time hold said press in operation with a predetermined pressure from said fluid pressure source, means to start said timer operating at the end of said press positioning stroke with said first mentioned limit switch, means controlled by said timer to close said cooling system valve and re-open said heating system valve and retract said press to an open position, means to open said second sequence valve when said press reaches its open position and operate said die positioning apparatus to position said die at a re-charging position and trip said second limit switch and de-energize said electrical system breaking said holding circuit, and means to re-charge said accumulator for another sequence of operation.

4. A press apparatus according to claim 2 in which the hydraulic fluid storage accumulator is connected to a hydraulic system, which includes a small velocity fluid flow pump which develops a high fluid pressure, and means to pump hydraulic fluid pressure from said system through one of said solenoid operated hydraulic valves to store fluid in said accumulator and through the other solenoid operated hydraulic valve to operate said positioning apparatus, and means to utilize the fluid pressure stored in said accumulator to position said press for its pressing operation, and means to subsequently utilize said maximum pressure developed by said pump on said incompressible fluid in said hydraulic press when it reaches its working position.

5. A press apparatus according to claim 4 including a hydraulic system connected to a pair of solenoid operated valves, said hydraulic system including a small velocity high pressure pump and an unloader valve to supply a predetermined high pressure flow, said first valve of said pair of hydraulic valves being a single solenoid operated valve and said second valve being a double solenoid operated valve, means to store fluid pressure passing through said first valve with said accumulator, means to supply fluid pressure from said system through said second valve when a first solenoid is energized to position said die and, in turn, utilize said stored fluid pressure of said accumulator in positioning said press, and means to de-energize said first solenoid and energize said second solenoid of said second valve to utilize said hydraulic system pressure to return said fluid press to its open position and to return said positioning apparatus to its re-charging position, and means to re-charge said accumulator through said first valve at the same time.

6. A press apparatus according to claim 4 which includes in said electrical system a pair of relays which, in turn, control the operation of a plurality of switches, said first relay being energized by said start-stop button and being retained energized by said second mentioned limit switch and, in turn, de-energized when said second mentioned limit switch is opened, and said timer being started when said first mentioned relay is energized, said second mentioned relay being energized with the closing of said first mentioned limit switch and, in turn, de-energized with the opening of said first mentioned limit switch.

7. A press apparatus according to claim 4 including in said electrical operating system a pair of relays which, in turn, control the operation of a plurality of switches, said relays being energized or de-energized by the opening and closing of the said pair of limit switches, said solenoid operated heating valve being energized to an open position when said first mentioned relay is energized, said solenoid operated heating valve being de-energized when said second relay is energized and, at the same time, said solenoid operated cooling valve being energized to an open position, and said cooling valve being closed when said second relay is de-energized, while said heating valve is again energized.

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