June 15, 1948. W. ERNST ET AL. 2,443,311

PRESS WITH AUXILIARY EJECTOR CIRCUIT

Original Filed Aug. 28, 1939 3 Sheets-Sheet 1

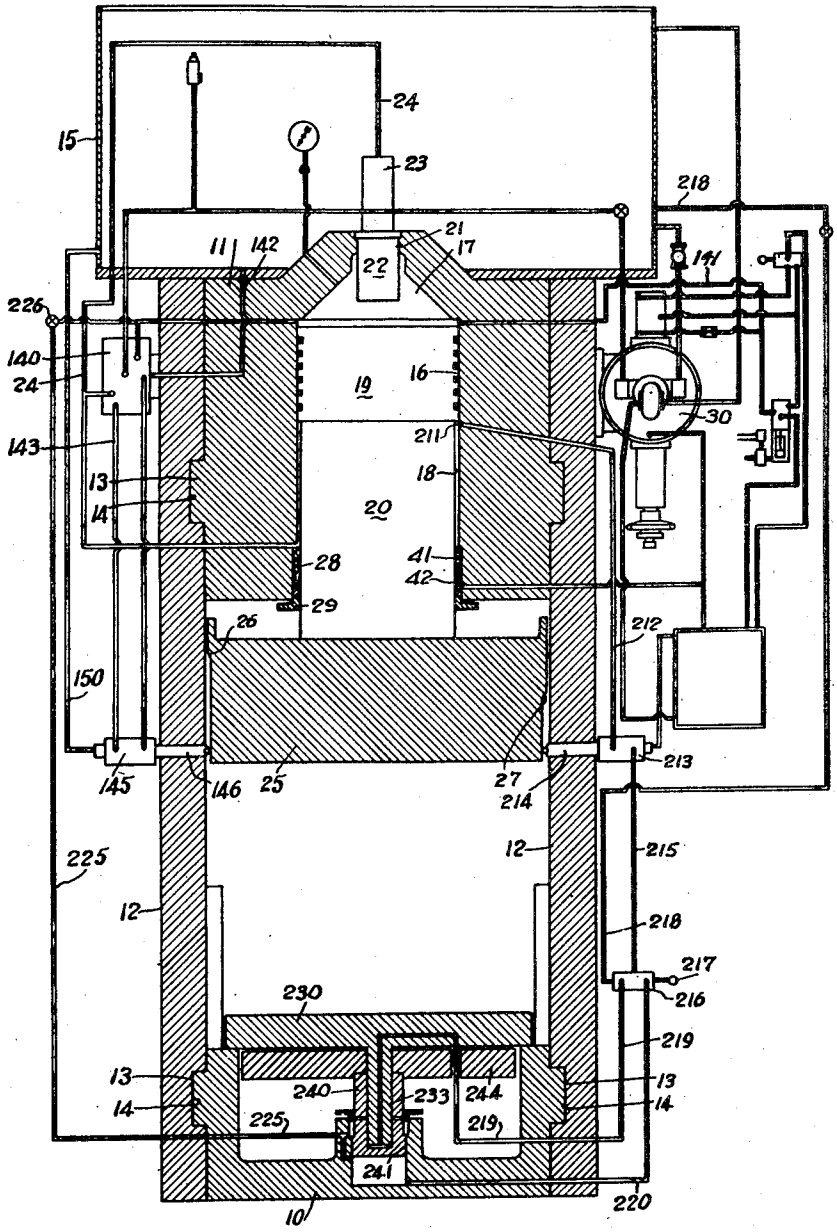


Fig. 1.

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Original Filed Aug. 28, 1939 3 Sheets-Sheet 2

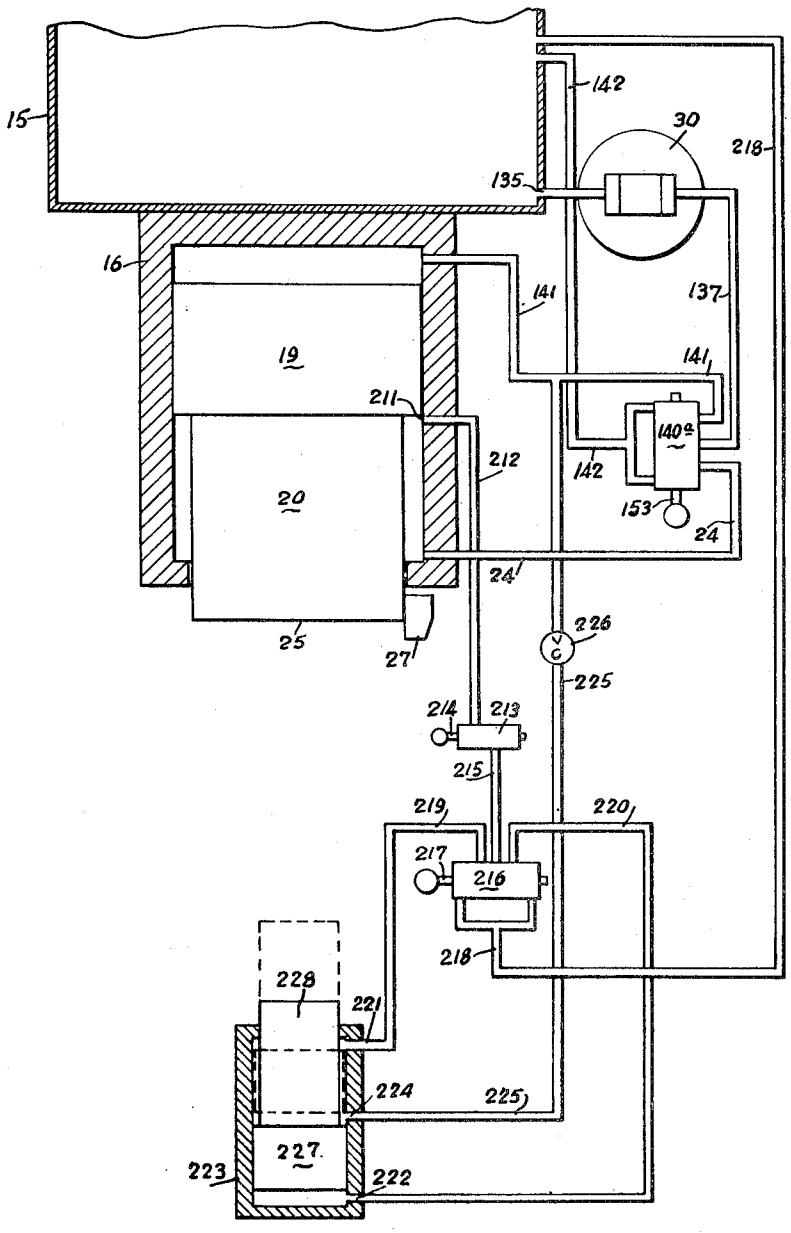


Fig. 2.

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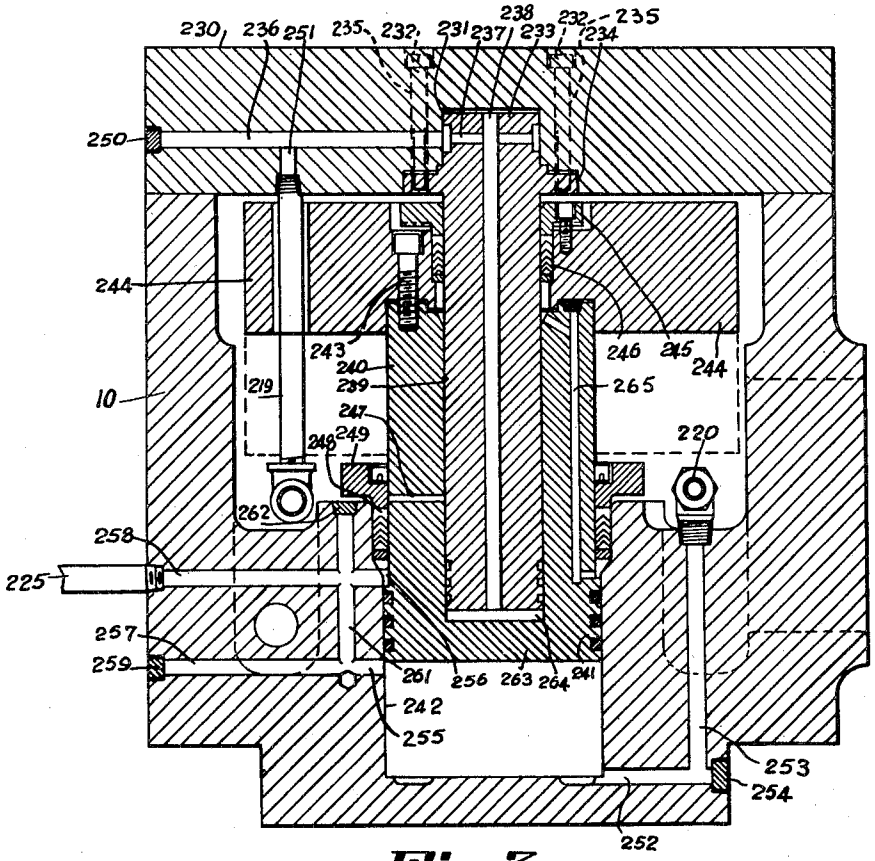


Fig. 3.

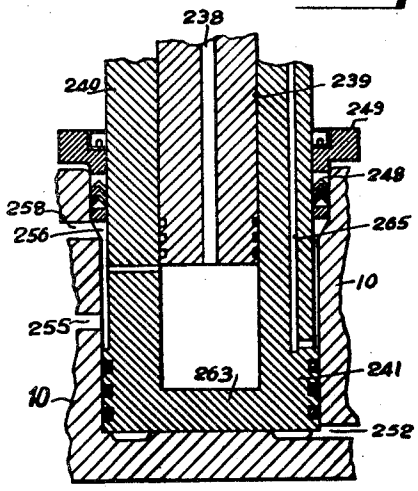


Fig. 4.

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Patented June 15, 1948 2,443,311

UNITED STATES PATENT OFFICE

2,443,311

PRESS WITH AUXILIARY EJECTOR CIRCUIT

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Substituted for abandoned application Serial No. 292,270, August 28, 1939, which is a division of application Serial No. 225,155, August 16, 1938, now Patent No. 2,229,965, dated January 28, 1941. This application November 3, 1944, Serial No. 561,716

2 Claims. (Cl. 60—97)

1

The invention relates to hydraulic press circuits and, in particular, to such circuits having means therein for ejecting workpieces.

This application is a substitute for abandoned application, Ser. No. 292,270 filed August 28, 1939, which was a division of application Ser. No. 225,155 filed August 16, 1938 (Pat. No. 2,229,965, granted Jan. 28, 1941).

One object of this invention is to provide a hydraulic press circuit having a double-acting main plunger, together with means for utilizing the fluid displaced from one side of this double-acting plunger to operate an auxiliary plunger, without the necessity of employing an additional pump.

Another object is to provide such an auxiliary plunger operating circuit, wherein the auxiliary plunger is caused to move to a predetermined position and then to automatically halt as the fluid supplied thereto reaches a discharge port uncovered by the auxiliary plunger in its motion.

Another object is to provide an auxiliary plunger operating circuit, as described above, wherein the pump for operating the main plunger performs no work while the main plunger is in its retracted position other than circulating the oil, except when the auxiliary plunger is being moved either in a forward or a reverse direction.

In the drawings:

Figure 1 is a diagrammatic view, mainly in section, showing a complete hydraulic press operating circuit including this invention.

Figure 2 is a diagrammatic view, mainly in section, showing that part of the circuit of Figure 1 employed for operating an auxiliary plunger, such as an ejector plunger, without an additional pump.

Figure 3 is a central vertical section through a commercially constructed embodiment of the auxiliary plunger or ejector plunger, shown in Figures 1 and 2.

Figure 4 is a view of the lower central portion of Figure 3, but showing the ejector plunger in its lowered or retracted position.

General arrangement

In general, the invention consists of an auxiliary plunger, such as an ejector plunger, which is operated by the fluid supplied from one side of the main plunger, while the other side is connected to exhaust. The auxiliary plunger, in itself, is constructed to serve as a sleeve valve for regulating its own action by uncovering discharge ports at predetermined points in its forward and return strokes. In this manner the auxiliary plunger is actuated without the necessity for an additional pump, and moves to a predetermined position and halts so that the pump discharge is merely a free flow, without consuming any great amount of work except at those times when the auxiliary plunger is actually being moved.

2

This invention is found to be of great value in certain applications of fluid pressure, where it is desirable to vary the intensity of the applied pressure in a predetermined manner. In the molding of certain compounds, for example, it has been found desirable to apply a moderate pressure for a time while the molding material softens and partially conforms to the shape of the mold, and thereafter to apply a higher pressure to force the softened material into the more intricate recesses of the mold so as to fill these recesses fully.

Press construction

Referring to the drawings in detail, Figure 1 shows diagrammatically in vertical section a hydraulic press having a bed 10 and head 11, inter-connected by side members or uprights 12 at interlocking dove-tail portions 13 and 14, respectively. Mounted upon the press head 11 is a surge tank 15 for containing and supplying the operating fluid utilized in the circuit. The press head 11 contains a main cylinder bore 16, one end of which serves as a press-advancing chamber 17, and the other end 18 has a press retracting chamber, these being on opposite sides of the piston head 19 of the main plunger 20. Thus, the main plunger 20 is a double-acting plunger, reciprocating in the cylinder bore 16.

Opening into the press-advancing chamber 17 is a port 21, providing communication with the interior of the surge tank 15. Mounted in the port 21 is a double-acting surge valve 22, of the type disclosed in the patent to Walter Ernst, No. 1,892,568, of Dec. 27, 1932. The details of this surge valve 22 form no part of the present invention, and its function is as a check valve, which opens when the main plunger 20 starts on its downward stroke under the influence of gravity, so as to permit the rapid traversing of the main plunger 20. The surge valve 22 is provided with a hydraulic motor within the casing portion 23 thereof, this being connected by the conduit 24 with the return chamber 18 beneath the main piston head 19, so as to forcibly open the surge valve 22 and keep it open during the retraction stroke of the main plunger 20. This action, as described in the above-mentioned patent, permits the fluid to pass directly from the chamber 17, through the port 21, back into the surge tank

16 without traversing the remainder of the hydraulic circuit. Attached to the main plunger 20 is a platen 25 which moves up and down between the press side members 12 and is guided thereby. The platen 25 is provided with two cam portions 26 and 27, for operating certain valves at predetermined positions upon the stroke of the platen 25. Surrounding the main plunger 20, for the prevention of leakage therefrom, is a packing 28 compressed by a gland 29.

Ejector sub-circuit

The ejector circuit shown at the bottom and right-hand side of Figure 1 is shown in simplified form in Figure 2. In this circuit the main cylinder bore 16 is provided with an intermediate port 211, from which a line 212 runs downwardly to a normally open two-way valve 213. The latter is provided with a valve rod 214 adapted to be engaged and shifted to close the valve 213 when the cam 27, upon the platen 25 of the main plunger 20, comes into contact with it. From the two-way valve 213, the line 215 runs downwardly to the manually operated four-way valve 216 having a valve rod 217. From the four-way valve 216 the discharge line 218 runs back to the surge tank 15. Additional lines 219 and 220 run, respectively, to top and bottom ports 221 and 222 of the ejector cylinder 223. The latter is likewise provided with an intermediate port 224, to which is connected the line 225 leading through the upwardly opening check valve 226 to the line 141. The latter runs from the main valve control valve 140a to the upper end of the main cylinder bore 16. The ejector cylinder is provided with a piston head 227 having thereabove an ejector plunger 228.

In the operation of the ejector circuit shown in Figure 2, let it be assumed that the main plunger 20 and the ejector plunger 228 are in their retracted positions (Figure 2). To operate the ejector plunger 228, the main control valve 140a, which controls the main plunger 20, is assumed to be in such a position as to cause retraction of the main plunger 20. That is, so that pressure fluid flows from the pump 30, through the line 137, the valve 140a and the line 24, into the space beneath the main piston head 19. The space above the latter is open to exhaust into the surge tank 15 by way of the line 141, the main control valve 140a and the line 142. Since the platen cam 27 is retracted, the two-way valve 213 is in its normally open position so that the flow or pressure fluid into the space beneath the main piston head 19 passes out through the port 211 and the conduit 212, through the now open valve 213, into the conduit 215.

Let it be assumed that the four-way valve 216 is positioned so that the pressure fluid from the line 215 flows through the valve 216, into the line 219, and through the upper port 221 of the ejector cylinder 223 into the space above the ejector piston head 227. By the same positioning of the four-way valve 216, the space below the piston head 227 is open to exhaust into the surge tank 15, through the port 222, the line 220, the four-way valve 216 and the line 218. If the ejector plunger 228 is in its lowered position (Figure 2) so that the piston head 227 thereof is down, then the flow of fluid through the line 219 and port 221 is by-passed and discharged through the middle port 224, the line 225, the check valve 226, the line 141, the main control valve 140a and the line 142, into the surge tank 15. Thus, a by-pass of the pump discharge 30 occurs when the main piston head 19 reaches its retracted position, and also when the ejector piston head 227 likewise reaches its retracted position.

To operate the ejector mechanism, the operator shifts the valve rod 217 so that the flow of pressure fluid from the line 215 passes through the four-way valve 216, into the line 220 and through the port 222, into the lower end of the ejector cylinder 223. Under this influence the ejector piston head 227 rises until it reaches the dotted position shown in Figure 2, and uncovers the middle port 224. The fluid entering the lower port 222 is thereupon by-passed through the port 224, the line 225, the check valve 226, the line 141, the main control valve 140a and the line 142, into the surge tank 15. Therefore, after the ejector plunger has accomplished its ejecting action, the flow of the pump 30 again is by-passed through the middle port 224. The vertical width of the ejector piston head 227 and the separation of the ports 222, 224 and 221 are proportioned so that this result occurs. In this manner the ejector piston head 227 serves not only as a piston head but also as a valve head for uncovering the port 224 after its work has been finished, either upon the ejection stroke or upon the retraction stroke. When the main piston head 19 is in its retracted position (Figure 2), therefore, the pump 30 is performing no work except to circulate the working fluid through the circuit previously described, into the surge tank 15. This circulation occurs except when the ejector plunger 228 is being moved either upwardly or downwardly.

The presence of the platen-operated two-way valve 213 is not essential to the successful operation of this circuit. It is optionally inserted in the circuit so as to protect the ejector cylinder 223 against high pressure fluid. It will be observed that if the travel of the main piston head 19 is sufficient to uncover the port 211 leading into the line 212 when the main plunger 20 advances sufficiently far upon its working stroke, then high pressure fluid will not be detrimental since without the valve 213 it will merely flow through the line 215, the four-way valve 216, the line 219, the port 221, the ejector cylinder 223, the port 224 and the line 225, back to the line 141, which during the working stroke of the press is the pressure line.

By providing the normally open two-way valve 213, however, it becomes unnecessary to design the four-way valve 216 and the ejector cylinder 223 to withstand this high pressure. In order to prevent the flow of high pressure fluid through the ejector cylinder 223 at the end of the working stroke of the main plunger 228, the cam 27 at this point engages and shifts the valve rod 214 of the normally open valve 213 into its closed position. Thus, when the platen 25 is moved downwardly to the proper point, the pressure will be shut off from the four-way valve 216 and the ejector cylinder 223 by means of the closing of the normally open valve 213. The provision of the upwardly opening check valve 226 in the line 225 prevents the backing up of pressure fluid in the line 225 from the line 141 during the pressing stroke. Moreover, the automatic closing of the two-way valve 213 when the platen 25 is down, effectively prevents the ejector plunger 228 from being operated by error. This prevents possible damage to the apparatus by the accidental operation of the four-way valve 216.

The ejector cylinder 223 shown in Figure 2 is a simplified form. Figure 3 shows a commercial

form of the same device. The construction shown in Figure 3 was so designed that all pressure connections and piping are concealed as much as possible within the press, and also to utilize a limited space because the height of the pressing table was limited. The ejector shown in Figure 3 also has the feature of serving as a valve member for by-passing the flow of the pump when the ejector plunger is in its raised or lowered positions.

Mounted upon the press bed 10 is a bolster plate 230, in which is provided a socket 231. Secured within the socket 231, as by the screws 232, is a tube 233 having a flanged portion 234 for receiving the lower ends of the screws 232. The latter pass downwardly through holes 235 in the bolster plate 230. The bolster plate 230 is provided with a horizontal bore 236, communicating with a transverse bore 237 and longitudinal bore 238 in the tube 233. The latter extends downwardly into a corresponding bore 239 within the ejector plunger 240, the latter having an enlarged piston head 241 operating in an enlarged bore 242. Secured to the upper end of the ejector plunger 240, as by the screws 243 (one only being shown), is the ejector platen 244. A gland 245 and packing 246 serve to prevent leakage from the internal bore 239 past the upper portion of the tube 233. The ejector plunger 240 is provided with a transverse passageway 247 a short distance above the upper edge of the piston head 241. A packing 248, compressed by the gland 249, similarly prevents leakage around the outside of the ejector plunger 240.

The outer end of the horizontal bore 236 is closed by a threaded plug 250, and an intermediate port 251 is connected to the pipe 219, previously described. The lower end of the cylinder bore 242 is provided with a port 252, similar to the port 222 in Figure 2 and connected by the passageway 253 leading to a connection with the pipe 220, previously described. One portion of the port 252 is closed by the threaded plug 254. The ejector cylinder bore 242 is provided with middle and upper ports 255 and 256, communicating respectively with the parallel bores 257 and 258. The bore 257 is closed at its outer end by the threaded plug 259, whereas the bore 258 is connected to the conduit 225, previously described. The bores 257 and 258 are inter-connected by the bore 261, closed at its upper end by the threaded plug 262.

The operation of the ejector mechanism of Figure 3 is similar to that of Figure 2, previously described. Let it be assumed that the ejector platen 244 is in its raised position, as shown in Figures 1 and 3, so that the ejector has performed its ejecting action. To retract the ejector platen 244 the operator shifts the four-way valve 216 so that pressure fluid passes into the line 219, in the manner previously described (Figure 2). The pressure fluid from the line 219 passes through the port 251 and the passageways 236, 237 and 238, downwardly through the tube 233 into the lower end of the plunger bore 239. This forces the ejector plunger 240 and its piston head 241 downwardly until they occupy the position shown in Figure 4. When this occurs the transverse plunger passageway 247 passes the lower end of the tube 233 and opens up the plunger bore 239 for communication with the upper horizontal passageway 258. The discharge of the pump 30 thenceforth is by-passed from the plunger bore 239, through the passageway 247 and the upper bore 258, which connects with the pipe 225 (Figure 2) leading through the check valve 226 to the pipe 141, thence through the main control valve 140a to the discharge line 142 and the surge tank 15.

When it is desired to operate the ejector plunger 240 in the opposite direction so as to raise the ejector platen 244 from the position shown in Figure 4 to that shown in Figure 3, the operator shifts the four-way valve 216 (Figure 2) so that pressure fluid is admitted through the line 220 and port 252 to the space beneath the ejector piston head 241 (Figure 4). The pressure beneath the piston head 241 raises the plunger 240 until the piston head 241 uncovers the port 255, whereupon the discharge of pressure fluid is subsequently by-passed through the bores 257, 261 and 258 into the conduit 225, as previously described. The ejector plunger advancing area is thus the lower end 263 of the piston head 241, whereas the return area thereof consists of the lower end 264 of the plunger bore 239. The passageway 265 within the ejector plunger 240 is solely for the purpose of taking care of leakage and also to prevent pressure from building up under the packing 246.

The remaining portions of the circuit shown in Figure 1 are described and claimed in our Patents No. 2,229,965 (issued Jan. 28, 1941) and No. 2,239,147 (issued April 22, 1941).

It will be understood that we desire to comprehend within our invention such modifications as come within the scope of the claims.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a hydraulic press system, a main hydraulic motor having advancing and retracting areas, a pump, a circuit connecting said main motor with said pump, an auxiliary hydraulic motor having an auxiliary cylinder and an auxiliary piston, connecting means for hydraulically connecting said auxiliary motor with said main motor, means associated with said auxiliary motor for by-passing the flow of pressure fluid thereto in response to the motion of said auxiliary piston to a predetermined position, a valve in said hydraulic connecting means for regulating the supply of pressure fluid to said auxiliary motor to control the actuation of the latter, and controlling means in said circuit for controlling the operation of said main hydraulic motor independently of the actuation of said auxiliary motor and the position of said valve.

2. In a hydraulic press system, a main cylinder having a ram advancing portion and a ram retracting portion, a double acting main ram therein, means for supplying pressure fluid to said main cylinder, an auxiliary cylinder, an auxiliary piston therein, a hydraulic connection between said auxiliary cylinder and said main cylinder, controlling means in said hydraulic connection adapted to allow operation of said auxiliary piston in either direction while said ram is held stationary, means for controlling movement of said ram independently of said auxiliary piston and said controlling means, and means responsive to the travel of said auxiliary piston to a predetermined position for exhausting fluid from said auxiliary cylinder.

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