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HYDRAULIC PRESS EQUIPPED WITH A
SYNCHRONIZED STRIPPING PLUNGER
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Fig. 1

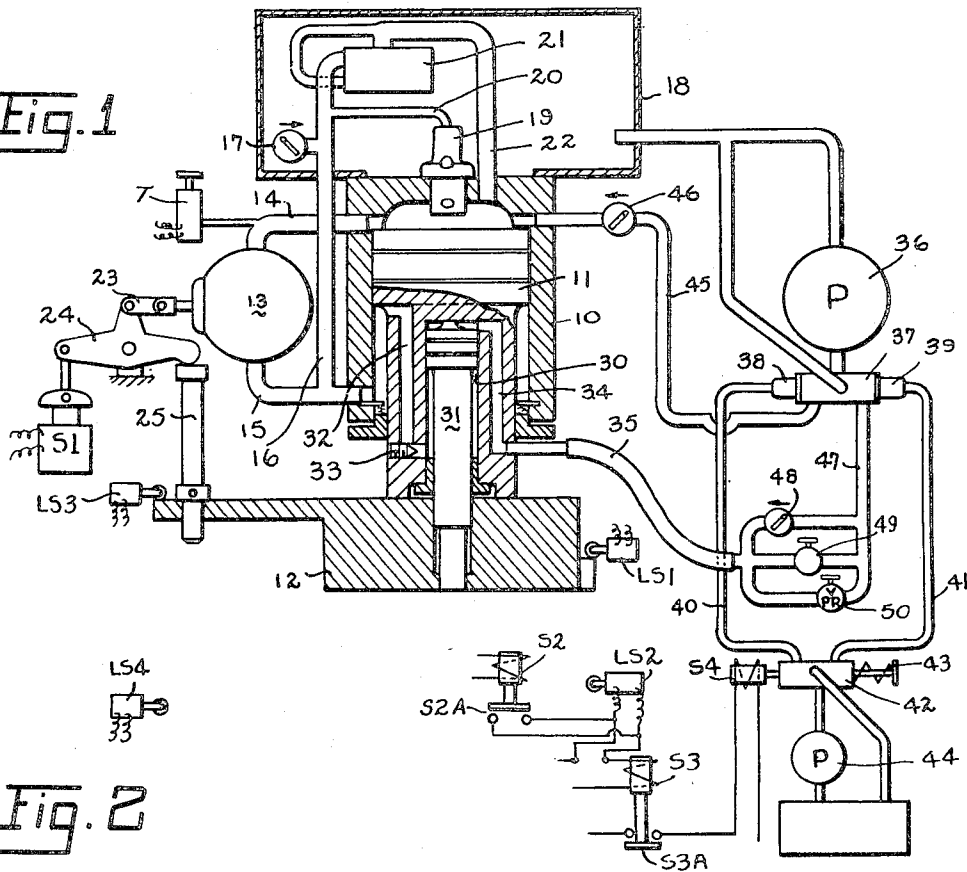
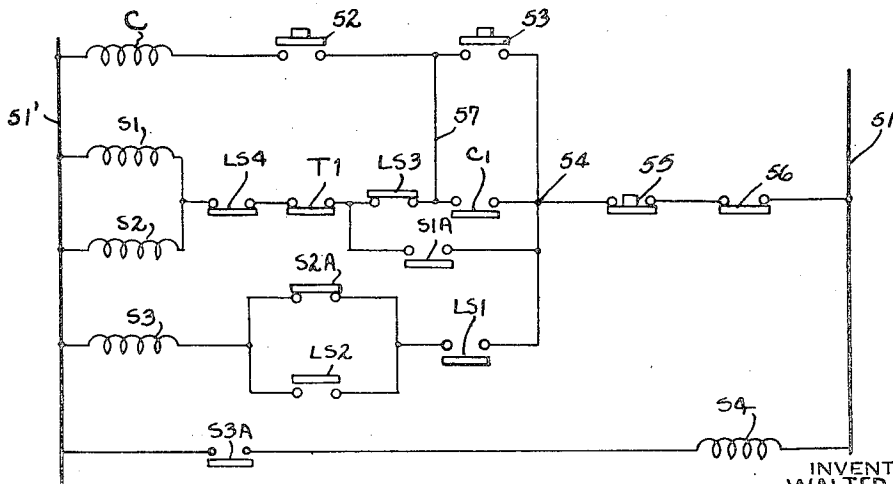


Fig. 2



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HYDRAULIC PRESS EQUIPPED WITH A
SYNCHRONIZED STRIPPING PLUNGER

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This invention relates to hydraulic apparatus and, in particular, to hydraulic drawing presses and the like.

In the drawing of sheet metal and similar operations it is often necessary forcibly to remove the formed workpiece from the punch or die within which it has been shaped. Most often, it is necessary to remove the workpiece from a male die or punch portion carried by the movable platen of the drawing press. To accomplish the stripping off of the workpiece, a plunger is provided which is urged downwardly through the punch and into engagement with the workpiece thereon.

This invention has for its primary object the provision of an actuating system for such a plunger which synchronizes the action thereof with the movement of the press platen.

It is another object to provide in a hydraulic press a hydraulically actuated stripping plunger and an auxiliary hydraulic circuit therefor.

These and other objects will become more apparent upon reference to the following specification and the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a hydraulic press having an auxiliary plunger actuated by a hydraulic system according to this invention; and

Figure 2 is a diagrammatic wiring diagram showing the electrical circuit associated with the auxiliary plunger actuating system.

General arrangement

In general, a reciprocable ram is supplied with actuating fluid from any suitable hydraulic circuit such as a reversible pump.

The ram is adapted to reciprocate a die member to form a workpiece. The ram is bored to receive a plunger which is reciprocable within the said bore and is adapted to eject the workpiece from the die member carried by the said ram.

The ejecting or stripping plunger is preferably double acting and has its retraction area connected with the retraction area of the main ram. The advancing side of the stripping plunger is supplied with pressure fluid from an auxiliary hydraulic circuit. The auxiliary hydraulic circuit includes the valves and actuating means therefor which are responsive to predetermined stimuli in the main ram operating circuit. Specifically, the stripping plunger is actuated at the moment of reversal of the main ram in order to commence the ejection of the workpiece simul-

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taneously with the commencing of the retraction of the main ram and pressing member carried thereby.

Preferably, the main press ram is controlled by electrical devices which are interlocked with electrical control means for the stripping plunger so that the actuation of the former is automatically operable to actuate the latter.

Structural arrangement

Referring to Figure 1, there is shown a drawing press comprising a main cylinder 10 within which is reciprocable the differential plunger 11. The plunger 11 has attached thereto a platen 12 which is adapted to carry a pressing member (not shown).

The differential plunger 11 defines with the cylinder 10 advancing and retracting chambers which are supplied with actuating fluid from a pump 13 through the conduits 14 and 15 respectively. The conduit 15 is connected by a conduit 16 with the inwardly opening check valve 17 located within the reservoir or tank 18. Mounted in the top of the cylinder 10 is a surge valve 19 of any suitable construction, the surge valve being actuated by fluid conducted thereto by the conduit 20 which is connected with the conduit 16. Also mounted within the tank 18 is a valve 21 which is hydraulically connected with the advancing chamber of the cylinder 10 by a conduit 22 and with the retraction chamber of the cylinder 10 through the conduit 16. The valve 21 is operable at the moment of reversal of the plunger 11 at the end of a working stroke to bypass the delivery of the pump 13 while simultaneously releasing the pressure from the advancing chamber of the cylinder 10.

The pump 13 is adapted to be shifted by a linkage 23 which includes a three-armed lever 24 to which is fastened the solenoid S1. The solenoid S1 is effective, when energized, to rotate the lever 24 counter-clockwise and, through the linkage 23, to position the pump 13 to deliver into the conduit 14. When the solenoid S1 is de-energized a spring (not shown) rotates the arm 24 clockwise and places the pump in position to deliver into the conduit 15. The arm 24 is also adapted to be engaged by the rod 25 attached to the platen 12 so that the pump 13 is automatically moved to no delivery position thereby when the platen 12 and plunger 11 are in their retracted position.

The plunger 11 is bored as at 30 to receive the double acting plunger 31 the latter being reciprocable through a bore in the platen 12 so as

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to engage the workpiece or the ejector pins of the pressing member carried by the said platen. The retraction area of the plunger 31 is connected through a bore 32 with the retraction area of the plunger 11. The bore 32 includes an adjustable restrictor 33 which may comprise a needle valve or any other suitable type of choke valve. The advancing area of the plunger 31 is connected by a bore 34 in the plunger 11 with a conduit 35 which is adapted to supply actuating fluid to the said plunger.

Actuating fluid for the plunger 31 is supplied by a pump 36 which is connected to the four-way valve 37. The pump 36 is preferably a one-way delivery type pump and continuously draws fluid from the reservoir 18 and discharges the same into the valve 37. The valve 37 is provided with the pilot cylinders 38 and 39 which are connected, respectively, by the conduits 40 and 41 with the service ports of a four-way valve 42. The four-way valve 42 is adapted to be shifted into one end position by a spring 43 and, into the other end position by a solenoid S4 when the latter is energized. Pressure fluid may be supplied to the four-way valve 42 in any suitable manner such as by the pump 44.

The valve 37 comprises a pair of service ports one of which is connected by the conduit 45 through the check valve 46 with the advancing chamber of the cylinder 10. The valve 46 is effective to permit flow into the said advancing chamber but not therefrom. The other service port of the valve 37 is connected by a conduit 47 to the inlets of the valves 48, 49 and 50, the outlets of these valves being connected to the conduit 35. The valve 48 is a check valve which permits free flow of fluid from the conduit 47 to the conduit 35 but not vice-versa. The valve 49 is a choke valve adapted to create a predetermined restriction from the flow of fluid from the conduit 35 to conduit 47 and the valve 50 is a pressure relief valve adapted to relieve the pressure in the conduit 35 should the same exceed a predetermined amount.

The solenoid S4 is adapted to be energized by a contactor blade S3A which is associated with the solenoid S3. When the solenoid S3 is energized, the aforementioned contactor blades indicated at S3A closes and the solenoid S4 is energized to shift the valve 42.

Located in the press frame or in association with the platen 12 so as to be contacted thereby are a plurality of limit switches LS1, LS2, LS3 and LS4. LS2 is a normally open switch which is momentarily closed during the retraction stroke of the press platen. The limit switch LS2 is connected in parallel with a pair of contacts which have associated therewith a blade which is actuated by a solenoid S2. The solenoid S2 is adapted, when energized, to open the contacts and when deenergized to permit the said blade to close the contacts. The limit switch LS1 is a normally closed switch which is positioned so as to be opened when the plunger 11 has completed its retraction stroke. The limit switch LS3 is a normally open switch which is adapted to be closed by the platen when the latter is in its fully retracted position and the switch LS4 is a normally closed switch adapted to be opened by the platen at the end of the working stroke of the press.

A pressure responsive switch T is hydraulically connected with the conduit 14 so as to be actuated by the working pressure on the plunger 11

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when the said pressure has attained a predetermined value.

Referring to Figure 2 the arrangement of the limit switches and solenoids in the electrical circuit is shown. In Figure 2 the supply lines are indicated at 51' and 51. Connected to the line 51' is a contactor solenoid indicated at C which is connected at its other end to a switch 52 which in turn is connected with a push button 53. The push button 53 is connected to a junction point 54, the junction point being connected through a normally closed push button 55 and a normally closed temperature responsive switch 56 with the line 51. The switch 52 is a normally open push button station having means associated therewith for locking the switch in a closed position.

Also connected with the line 51' are the solenoids S1 and S2 which are connected at their other ends, with the limit switch LS4 which latter connects through the normally closed blade T1 of the switch T, the normally open limit switch LS3 and the normally open blade C1 of the contactor solenoid C with the junction point 54. A blade S1A of the solenoid S1 is arranged to bypass the limit switch LS3 and the contactor blade C1.

Also connected with the line 51' is the solenoid S3 which has connected to its other end the parallel limit switch LS2 and the blade S2A of the solenoid S2. The blade S2A and the limit switch LS2 are connected together and thence through the limit switch LS1 are connected with the junction point 54. The solenoid S3 is adapted to close the blade S3A to complete a circuit from the line 51' through the valve solenoid S4 to the line 51. A wire 57 connects from between the switches 52 and 53 to a point between the switch LS3 and the blade C1 for a purpose which will become more apparent hereinafter.

Operation

Assume that the press occupies the position shown in Figure 1, that is, with the plunger 11 fully retracted. A working stroke of the press is instituted by energizing the solenoid S1 by depressing the start button 53. Closure of the button 53 completes a circuit through the solenoid S1 through the limit switch LS4, the pressure switch T1, the limit switch LS3, the push button 53, the reverse button 55 and the temperature switch 56 to the line 51. When the solenoid S1 is energized the blades S1A close and thus establish a holding circuit permitting the push button 53 to be released.

Simultaneously with the energization of the solenoid S1, the solenoid S2 is energized and opens the blades S2A. However, since the limit switch LS1 serially connected with the blades S2A was previously opened by the platen, the energization of the solenoid S2 is not immediately effective.

After the press platen has advanced into and accomplished the work to be done thereby, the solenoid S1 is deenergized either through actuation of the pressure switch T, the actuation of the limit switch LS4 or the actuation of the push button switch 55, and the pump 13 shifts to direct fluid to the retraction chamber of the cylinder 10. Simultaneously with the deenergization of the solenoid S1, the solenoid S2 is deenergized thereby permitting the blade S2A to close. Closure of the blade S2A establishes a circuit through the solenoid S3, and the limit switch LS1 to the junction point 54 and thence through the switches 55 and 56 to the line 51.

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Energization of the solenoid S3 closes the blade S3A and energizes the valve solenoid S4 so as to shift the valve 42. The shifting of the valve 42 directs pilot fluid from the pump 44 through the conduit 40 to the pilot cylinder 38 thus shifting the valve 37 to direct pressure fluid from the pump 36 to the conduit 47. The pressure fluid delivered to the conduit 47 passes through the check valve 48 and the conduit 35 into the passage 34 and thence to the advancing area of the plunger 31. Thus, substantially simultaneously with the de-energization of the solenoid S1, actuating fluid is conducted to the advancing side of the stripping plunger 31.

Referring to the operating circuit for the main pressing plunger 11, at the moment of reversal of the plunger 11, that is, when the solenoid S1 is deenergized and the pump 13 commences to deliver into the retraction chamber, the valve 21 functions momentarily to delay the retraction stroke. This delay is accomplished by bypassing the pump delivery through the conduit 16 and the valve 21 while simultaneously relieving the pressure in the advancing chamber through the conduit 22 and the valve 21. After a predetermined reduction of the pressure in the advancing chamber, the aforementioned bypass is closed off and the retraction stroke of the plunger 11 commenced.

It will be apparent that during this period of delay, the stripping plunger 31 has been actuated so as to bear against the workpiece to be removed from the press and that, therefore, the stripping of the workpiece from the punch or die will commence as soon as the retraction stroke of the plunger 11 and platen 12 commences. The stripping is thus accomplished without any delay.

The limit switch LS2, which is connected in parallel with the blade S2A, is adapted to energize the solenoid S3 during the retraction stroke of the platen 12 should it be desired to accomplish the stripping of the workpiece in this manner. It will be apparent, however, that the delay in the actuation of the plunger when the same is controlled by the limit switch LS2, is sufficient to permit the platen 12 to be retracted from the stationary die member so that the workpiece, when ejected, is likely to fall through a distance which may be sufficient to produce harmful effects. Accordingly, it is preferable to actuate the stripping plunger by means of the solenoid S2 and the contact blade S2A.

During the retraction stroke of the plunger 11, the stripping plunger 31 is in its lower position. When the platen reaches its uppermost position a cam carried by the platen engages and opens the limit switch LS1 thus deenergizing the solenoid S3. Deenergization of the solenoid S3 permits the blade S3A to open thus deenergizing the solenoid S4. With the solenoid S4 deenergized the spring 43 shifts the valve 42 to direct pilot fluid through the conduit 41 to the pilot cylinder 39 of the valve 37, shifting the latter to direct the discharge from pump 36 through the conduit 45 and into the advancing chamber of the cylinder 10. The fluid thus directed to the said advancing chamber is discharged, when the press stands idle, through the surge valve 19 and into the tank 18. Shifting of the valve 37 also connects the conduit 47 with the inlet side of the pump 36 whereupon fluid within the chamber 30 above the stripping plunger 31 is withdrawn slowly through the conduit 35 and the choke valve 49 to retract the stripping plunger within the main

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plunger. The space below the stripping plunger receives liquid upon retraction of the plunger by way of the choke 33, passage 32 and the retracting area of the main plunger.

During the advancing stroke of the plunger 11 the discharge from the pump 36 is effective to augment the speed of advance of the plunger 11.

Full automatic cycling of the press may be had by locking the button 52 closed. This energizes contactor solenoid C and closes the blades C1. The, when the press platen reaches its Figure 1 position and closes the limit switch LS3, the solenoids S1 and S2 are automatically re-energized to commence another advancing stroke of the platen.

It will be apparent that various modifications may be made in the structural arrangement of this invention without in any way departing from the spirit of the invention, and, accordingly, it is desired to comprehend such modifications as may be considered to come within the scope of the appended claims and the invention.

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

1. In combination in a drawing press, a fluid operable drawing plunger, a fluid operable ejector plunger, a source of pressure fluid for supplying actuating fluid to said drawing plunger, a first control means effective when actuated to bring about the advancing stroke of said drawing plunger, a source of pressure fluid for supplying actuating fluid to said ejector means, a second control means effective when actuated to bring about the advancing stroke of said ejector plunger, means interlocking said control means to prevent the actuation of the second thereof when the first thereof is actuated, and means responsive to a predetermined advancing movement of said drawing plunger for simultaneously rendering ineffective said first control means and for actuating said second control means.

2. In combination in a hydraulic press, a drawing plunger having fluid operable advancing and retracting means associated therewith, an auxiliary ejector plunger carried by said drawing plunger and having fluid operable advancing and retracting means associated therewith, means hydraulically connecting the retracting means of said drawing plunger with the retracting means of said ejector plunger, a reversible pump connected with said drawing plunger for supplying actuating fluid thereto, means continuously urging said pump into position to deliver to said retracting means of said plunger, electrical means effective when energized to position said pump to deliver to said advancing means of said drawing plunger, an auxiliary fluid source connected with the advancing means of said ejector plunger, electrical control means effective when energized to permit the supply of fluid from said fluid source to said ejector plunger, an electrical circuit connected with said first mentioned electrical means and adapted selectively to be energized to bring about the advancing stroke of said drawing plunger, a second electrical circuit connected with said second mentioned electrical means adapted when energized to bring about the advancing stroke of said ejector plunger, and means including a contactor connected in parallel with said first mentioned electrical means for permitting the energization of said

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second mentioned electrical means simultaneously with the deenergization of said first mentioned electrical means.

3. In combination in a drawing press, a drawing plunger having fluid operable advancing and retracting areas associated therewith, a reversible pump connected with said areas and selectively operable to supply actuating fluid to one or the other, means normally positioning said pump to deliver to said retracting area and a solenoid adapted when energized to position said pump to deliver to said advancing area, a bore in said plunger, a reciprocable ejector plunger mounted in said bore and having fluid operable advancing and retracting areas associated therewith, an adjustable choke valve having its inlet connected with the retracting area of said drawing plunger and its outlet connected with the retracting area of said ejector plunger, a fluid source connected with the advancing area of said ejector plunger for supplying actuating fluid thereto, valve means connected with said fluid source and said ejector plunger and normally positioned to exhaust said ejector plunger, electrical actuating means for actuating said valve to bring about the supply of fluid from said fluid source to said ejector plunger advancing means, means for energizing said solenoid to bring about the advancing movement of said drawing plunger, means parallelly connected with said solenoid and operable when energized to prevent the energization of said electrical actuating means, means for deenergizing said solenoid at the conclusion of the working stroke of said drawing plunger, means operable simultaneously therewith for energizing said electrical actuating means, and means operable at the conclusion of the retraction stroke of said drawing plunger for deenergizing said electrical actuating means.

4. In combination in a drawing press, a fluid operable drawing plunger, a fluid operable ejector plunger carried by said drawing plunger, a first source of pressure fluid for supplying actuating fluid to said drawing plunger, a first electrical control means effective when energized to bring about the advancing stroke of said drawing plunger, a second source of pressure fluid for supplying actuating fluid to said ejector plunger, a second electrical control means effective when energized to bring about the advancing stroke of said ejector plunger, means selectively operable for energizing said first control means, a contactor having a normally closed blade serially connected with said second control means connected with said first control means so as to be energized simultaneously therewith, means operable at the conclusion of the working stroke of said drawing plunger for deenergizing said first control means and also said contactor, the deenergization of said contactor being adapted to bring about the energization of said second control means, and means including a normally closed limit switch serially connected with said second control means for bringing about the deenergization thereof when said drawing plunger has completed its retraction stroke.

5. In combination in a drawing press, a double acting drawing plunger, a double acting ejector plunger carried thereby, a first source of pressure fluid connected with said drawing plunger for supplying actuating fluid thereto, a first electrical control means adapted when energized to bring about the supply of fluid from said first fluid source to the advancing side of said drawing

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plunger, means including an adjustable choke valve hydraulically connecting the retracting side of said drawing plunger with the retracting side of said ejector plunger, a second source of pressure fluid for supplying actuating fluid to the advancing side of said ejector plunger, a second electrical control means effective when energized to permit the supply of pressure fluid from said second source to the advancing side of said ejector plunger, an adjustable choke valve serially arranged between said second source and said ejector plunger, means for energizing said first control means to bring about the working stroke of said drawing plunger, means operable at the conclusion of said working stroke for deenergizing said first control means to bring about the retracting stroke of said drawing plunger, and electrical means associated with said second control means for preventing the energization thereof during the advancing stroke of said drawing plunger or when said drawing plunger is in its retracted position.

6. An electrical control system for controlling the movements of a drawing plunger and an ejector plunger in a drawing press which comprises a first electrical means adapted when energized to bring about the working stroke of said drawing plunger, a second electrical control means adapted when energized to bring about the ejecting stroke of said ejector plunger, a contactor adapted when deenergized to permit the energization of said second control means and when energized to prevent the energization of said second control means, said contactor being adapted to be energized and deenergized simultaneously with said first control means, whereby the deenergization of said first control means at the end of a working stroke of said drawing plunger is effective substantially instantaneously to permit the energization of said second control means.

7. In combination, first and second double acting plungers, fluid pressure supply means for said plungers, first control means for said first plunger movable into a first and a second position for bringing about a supply of fluid to said first plunger in its advancing and retracting movements, respectively, second control means for said second plunger movable into a first and a second position for bringing about the supply of fluid to the advancing area of said second plunger or for exhausting said advancing area, respectively, yielding means continuously urging said control means toward their second positions, first and second electrical means energizable for moving said first and second control means, respectively, into their first positions, other electrical means energizable simultaneously with said first electrical means for interrupting the circuit to said second electrical means and de-energizable simultaneously with said first electrical means to reestablish the circuit to said second electrical means, and switch means responsive to the movement of said first plunger into its fully retracted position for interrupting the circuit to said second electrical means.

8. In a drawing press having a drawing plunger and an ejector plunger, a first electrical means energizable to bring about the working stroke of said drawing plunger and de-energizable to bring about the retracting stroke of said drawing plunger, a second electrical means energizable to bring about the ejecting stroke of said ejector plunger and de-energizable to bring about the retracting stroke of said ejector plunger, normally closed switch means in circuit with said second electrical

means, means connected in parallel with said first electrical means and operable when energized to open said switch means, and other switch means in circuit with said second electrical means and positioned to be opened by said drawing plunger in its fully retracted position.

9. In combination in a drawing press, a drawing plunger and an ejector plunger each having advancing and retracting means, first electrical means energizable to bring about a supply of fluid to the advancing means of said drawing plunger and de-energizable to bring about a supply of fluid to the retracting means of said drawing plunger, second electrical means energizable to bring about a supply of fluid to the advancing means of said ejector plunger and de-energizable to bring about the exhaust of the advancing means thereof, a circuit interlocking said electrical means whereby the de-energization of the first thereof substantially instantaneously energizes the second thereof, switch means actuated by said drawing plunger in its fully retracted position for de-energizing said second electrical means, and channel means connecting the retracting means of said plungers.

10. In combination in a drawing press, a drawing plunger and an ejector plunger each having advancing and retracting means, first electrical means energizable to bring about a supply of fluid to the advancing means of said drawing plunger and de-energizable to bring about a supply of fluid to the retracting means of said drawing plunger, second electrical means energizable to bring about a supply of fluid to the advancing means of said ejector plunger and de-energizable to bring about the exhaust of the advancing means thereof, a circuit interlocking said electrical means whereby the de-energization of the first thereof substantially instantaneously energizes the second thereof, switch means actuated by said drawing plunger in its fully retracted position for de-energizing said second electrical means, channel means connecting the retracting means of said plungers, and restricting means in said channel means adjustable to throttle the passage of fluid between the retracting means of said plungers.

11. In combination in a drawing press, a drawing plunger and an ejector plunger each having advancing and retracting means, first electrical means energizable to bring about a supply of fluid to the advancing means of said drawing plunger and de-energizable to bring about a supply of fluid to the retracting means of said drawing plunger, second electrical means energizable to bring about a supply of fluid to the advancing means of said ejector plunger and de-energizable to bring about the exhaust of the advancing means thereof, a circuit interlocking said electrical means whereby the de-energization of the first thereof substantially instantaneously energizes the second thereof, switch means actuated by said drawing plunger in its fully retracted position for de-energizing said second electrical means, restricted channel means connecting the retracting means of said plungers, and means restricting the exhaust of fluid from the advancing side of said ejector plunger.

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