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R. J. LINDSEY
 APPARATUS SELECTIVELY OPERABLE AS
 A PRESS OR AS A DROP HAMMER
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2,449,401

FIG. 1

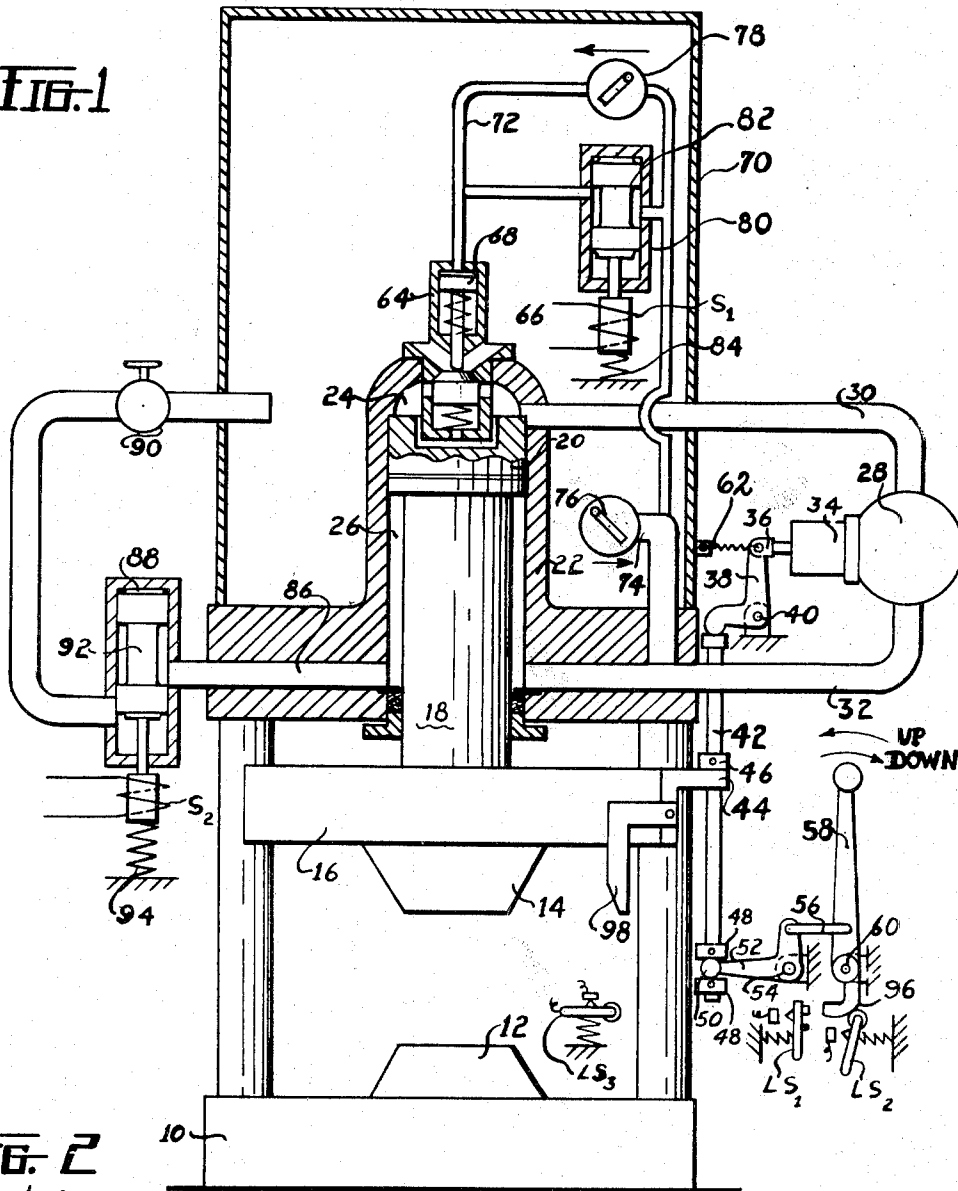
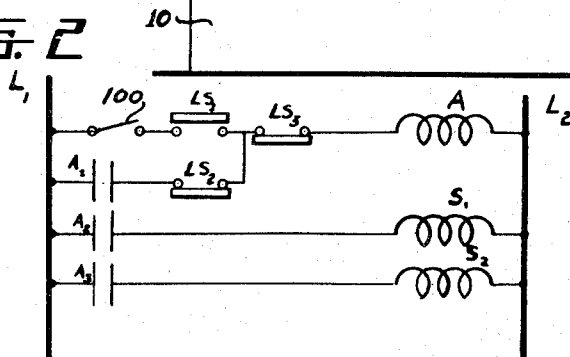


FIG. 2



INVENTOR.
 ROBERT J. LINDSEY

BY

Loulmin & Loulmin
 ATTORNEY

UNITED STATES PATENT OFFICE

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APPARATUS SELECTIVELY OPERABLE AS A
PRESS OR AS A DROP HAMMERRobert J. Lindsey, Mount Gilead, Ohio, assignor
to H-P-M Development Corporation, Wilmington,
Del., a corporation of Delaware

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This invention relates to fluid operable apparatus and, particularly, to fluid operable forging presses. More particularly still, this invention relates to an improved operating circuit for a fluid operable forging press.

In the forging of workpieces by forging presses said workpieces require finishing by what is known in the art as "planishing." Planishing is the act of working a piece by a number of relatively light blows of the forming die. This operation is usually carried out in the forging of round shafts, gun billets and other cylindrical objects from square or rectangular billets.

The billet is first roughly shaped in the forging press by a series of high pressure strokes of the working die. As the workpiece approaches its finished configuration the pressure required for forging decreases because the amount of metal to be moved is decreasing. Also, in the case of hot forging, it is desirable to accomplish the forging as quickly as possible in order to conserve the heat in the workpiece so that it does not have to be reheated any more than is necessary.

Accordingly, the final shaping of such workpieces is more economically accomplished by rapidly and relatively lightly striking the said workpiece with the working die. In a hydraulic press the weight of the moving parts is usually sufficient to deliver the necessary energy to the workpiece during planishing if the parts were permitted to drop freely against the said workpiece.

Accordingly, it is the primary object of this invention to provide an operating circuit for a fluid operable forging press such that the workpiece can be planished in order to complete the shaping thereof.

It is another object to provide an operating circuit for a fluid operable forging press which permits the press to be used as a drop hammer when it is so desired.

It is still another object to provide a fluid operable forging press having an operating circuit which may be selectively adjusted to permit the moving parts of the press to fall toward the work and having in association therewith means for preventing over-travel of the press platen.

These and other objects and advantages will be more apparent upon reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a fluid operable forging press having an operating circuit according to my invention; and

Figure 2 is a diagrammatic view of an electrical

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circuit used in connection with the hydraulic circuit of Figure 1.

General arrangement

A press constructed according to my invention generally comprises a stationary bed and a movable platen which mount dies adapted for forging billets. This forging may be done either hot or cold depending upon the individual requirements of the job.

The movable platen is reciprocated by a fluid operable ram which is reciprocally mounted in a cylinder in the press head, the said head being joined with the press bed by suitably rigid structural members. The fluid operable ram has advancing and retracting means associated therewith which are supplied with pressure fluid from any suitable source such as a reversible, variable delivery pump.

The control of the fluid flow to the advancing and retracting means is usually accomplished in a forging press by manual means so that the press operator has full control of the press platen at all times.

During a forging cycle the press platen advances to the work as rapidly as the pump withdraws fluid from the retracting means. After the dies have engaged with the work the platen advances as rapidly as the pump delivers pressure fluid to the advancing area.

Associated with the retracting means is a valve means selectively operable for freely exhausting the said retracting means so that the press ram and platen may be permitted freely to drop toward the workpiece and to deliver thereto the kinetic energy accumulated during its free travel.

An electric circuit is associated with the aforementioned valve means and includes switches operable by the manual means for reciprocating the press platen so that the operation of the valve means is responsive to the manipulation of the said manual means.

Structural arrangement

Referring to the drawings more in detail, 10 indicates a press bed upon which is mounted a lower die member 12. An upper die member 14 is carried by the platen 16 to which is connected the ram 18.

The ram 18 comprises the piston 20 which, with the cylinder 22, defines the advancing means 24 and the retracting means 26.

A pump 28 supplies fluid to the advancing means through a conduit 30 and, to the retracting means through a conduit 32. The pump 28

has associated therewith a servomotor mechanism 34 which is adapted for being actuated by the rod 36 which is pivotally connected with a bell crank 38. The bell crank 38 is pivoted at 40 and is adapted for being engaged by the end of the rod 42 which passes through the arm 44 connected with the platen. A collar 46 is adjustably secured to the rod 42 and abuts the arm 44 when the platen 16 is in its retracted position.

The rod 42 also has secured to the lower end thereof a pair of collars 48 which span the end 50 of a bell crank 52 pivoted at 54. The other end of the bell crank 52 is pivotally connected with a link 56 which is pinned to the operating lever 58, the latter being rotatable about the pin 60. Oscillation of the lever 58 is effective to reciprocate the rod 42 and, through the bell crank 38 to actuate the servomotor actuating rod 36. A spring 62 is adapted for continuously urging the rod 36 leftwardly thereby to place the pump 28 in position to deliver fluid through the conduit 32 to the ram retracting means.

Mounted on the top of the cylinder 22 is a surge valve 64 which comprises a valve member 66 which is continuously urged into its upper and closed position by a spring and is adapted for being moved into its downward and open position by a plunger 68. When the valve member 66 is in its closed position fluid communication between the advancing means 24 and the reservoir 70 is interrupted, while in its open position the said fluid communication is established.

The plunger 68 is connected by a conduit 72 with the conduit 74 which is in turn connected with the conduit 32. A check valve 76 opens from the reservoir 70 into the conduit 74 to supply makeup fluid to the pump during the pressing cycle. The conduit 72 includes a check valve 78 which permits fluid flow toward the plunger 68 but not away from the said plunger. The valve 78 is bypassed by a valve 80 which has a valve member 82 normally urged upwardly by a spring 84 into position to accomplish the said bypassing. A solenoid S1 is adapted, when energized, to move the valve member 82 downwardly against the thrust of the spring 84 to interrupt the aforementioned bypass.

Also connected with the retracting means 26 is a conduit 86 which includes the valves 88 and 90 and terminates in the reservoir 70. The valve 88 has a valve member 92 urged upwardly by a spring 94 to interrupt the conduit 86. A solenoid S2 is adapted, when energized, to move the valve member 92 downwardly against the thrust of the spring 94 so that fluid communication through the conduit 86 is established.

The valve 90 is a flow restricting valve of any suitable design and may comprise a manually adjustable choke valve or an automatically operable flow control valve as the particular requirements of the job may require.

Electrical circuit

The electrical circuit for actuating the solenoids S1 and S2 is illustrated in Figures 1 and 2 and comprises the normally open limit switch LS1 which is adapted for being closed by the cam portion 96 of the lever 58 when the said lever is moved clockwise about the pin 60 to bring about the advancing stroke of the platen 16. A second limit switch LS2, normally closed, is adapted for being opened by the cam 96 when the lever 58 is placed in its neutral position or in position to

bring about the upward movement of the platen 16.

A third limit switch LS3, normally closed, is positioned to be engaged by the cam 98 when the platen has advanced to its maximum desirable position. The cam 98 is carried by the arm 44 and prevents the accidental dropping of the platen 16 when there is no workpiece in the press.

Referring to Figure 2, the power lines are indicated at L1 and L2. Connected between the said power lines is a contactor A in series with the limit switches LS1 and LS3 and the selector switch 100. The limit switch LS1 is bypassed by a branch circuit including the normally open contact A1 of the contactor A and the normally closed limit switch LS2. Also connected between the lines L1 and L2 are the valve solenoids S1 and S2 which are in series, respectively, with the normally open contactor blades A2 and A3 of the contactor A.

Operation

In operation, a workpiece is placed on the die 12 and the lever 58 is moved rightwardly so that the bell crank 52 lifts the rod 42 and shifts the pump 28 to withdraw fluid from the retracting means while delivering fluid to the advancing means 18. At this time the selector switch 100 is open so that the closing of the limit switch LS1 is not effective.

The press platen now advances toward the work as rapidly as fluid is withdrawn from the retracting means 26. During this time the suction in the advancing means 24 pulls the valve member 66 downwardly so that fluid enters the said advancing means from the reservoir 70. When the dies engage the work, the valve member 66 closes and the fluid delivered to the advancing means through the conduit 30 urges the platen downwardly at forging pressure. During this time, fluid is withdrawn from the retracting means 26 through the conduit 32 and also from the reservoir 70 through the check valve 76 and conduit 74 to the pump 28.

When the forging stroke has been completed, the operator moves the lever 58 leftwardly thereby reversing the delivery of the pump 28 to bring about the upward movement of the platen 16. At this time the pressure developed in the retracting means 26 is conducted by the conduits 74 and 72 to the plunger 68 thereby to move the valve member 66 downwardly and to exhaust fluid from the advancing means 24 to the reservoir 70.

After the required number of forging strokes have been performed on the workpiece to bring it roughly to shape, it is desired to finish the forging operation by planishing the workpiece with a series of light blows by the die 14. To this end, the operator closes the switch 100. Then, when the lever 58 is moved rightwardly to place the pump on forward stroke, the limit switch LS1 is also closed thereby energizing the contactor A and closing the blades A1, A2 and A3. The blades A1 comprise a holding circuit for the contactor A while the blades A2 and A3 are effective, respectively, to energize the solenoids S1 and S2.

The energization of the solenoid S1 is effective to move the valve member 82 downwardly to interrupt the bypass of the check valve 78 and to retain the plunger 68 and valve member 66 in their downward position. This provides for free fluid communication between the advancing means 24 and the reservoir 70. Simultaneously, the energization of the solenoid S2 establishes

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fluid communication between the retracting means 26 and the reservoir 70 through the restriction 90.

Under these conditions the retracting means 26 is freely exhausted so that the press ram 18 and platen 16 fall rapidly into working engagement with the workpiece. The energy delivered to the workpiece is sufficient to perform a certain amount of forming without any pressure being built up in the advancing means 24. After the die has struck the workpiece the operator shifts the lever 58 to the left opening the limit switches LS1 and LS2. This drops out the contactor A and deenergizes the valve solenoids S1 and S2 so that the valve members again move into their upper position. Movement of the lever to the left also reverses the pump 28 so that it delivers fluid to the retracting means 26 and lifts the platen 16 and die 14 from the work. When the platen is retracted far enough, the operator again shifts the handle 58 to the right and another planishing stroke is made. This is continued until the workpiece is fully formed.

It will be apparent that the planishing takes place very rapidly and that the press ram need be retracted from the work only so far as it is necessary for it to develop sufficient kinetic energy sufficiently to form the workpiece. It will be noted that when the press is being operated as a drop hammer or for planishing, the pump 28 discharges freely through the surge valve 64 to the reservoir during the advancing stroke. The speed of descent of the moving parts of the press may be regulated by the restricting means at 90 should the speed be too great for some work operations. If the electrical circuit is set for planishing and the lever 58 is accidentally moved to the right when there is no workpiece in the press, the cam 98 and limit switch LS3 cooperate to deenergize the contactor A before the dies 12 and 14 come together. This prevents the dies from being damaged by being closed together too rapidly.

It will be understood that I desire to comprehend within my invention such modifications as may come within the scope of the appended claims.

I claim:

1. In a fluid operable press, a bed, a platen over said bed, a ram connected with said platen for reciprocating the same, fluid operable advancing and retracting means associated with said ram, a surge valve between said advancing means and a reservoir, fluid operable means connected with said retracting means and responsive to a predetermined pressure therein to open said surge valve, a reversible delivery fluid source connected with said advancing and retracting means, means selectively operable for controlling the direction of delivery of said source for reciprocating said ram and platen, valve means in the connection between said fluid operable means and said retracting means selectively operable for entrapping fluid in said fluid operable means and other valve means operable for exhausting said retracting means, said valve means being operable in unison with each other for obtaining gravitational descent of said platen.

2. In a fluid operable press, a cylinder, a ram reciprocable in said cylinder having advancing and retracting means, a surge valve in said cylinder adapted for connecting said advancing means with a reservoir, fluid operable means responsive to a predetermined pressure for opening said surge valve and hydraulically connected with said retracting means, a reversible pump

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connected with said advancing and retracting means for selectively supplying fluid thereto, a normally closed valve connected with said retracting means and actuatable to connect said retracting means with exhaust, manual means for bringing about the supply of fluid from said pump to said advancing means or to said retracting means, control means actuated by said manual means when the latter is positioned to bring about the supply of fluid to said advancing means for actuating said valve and for entrapping fluid in said fluid operable means, and means selectively adjustable to make said control means either effective or ineffective.

3. In a fluid operable apparatus which is adapted for use as a press or as a drop hammer, a movable part comprising a platen and ram, advancing and retracting means associated with said ram, a surge valve to supply fluid to said advancing means, fluid operable means responsive to a predetermined pressure to open said surge valve and hydraulically connected with said retracting means, a reversible pump connected with said advancing and retracting means, manual means comprising a pivoted lever for controlling the delivery of said pump, valve means actuatable to connect said retracting means with exhaust and to disconnect it from said fluid operable means, electrical means for actuating said valve means, first switch means adapted to be closed by said pivoted lever when the latter is positioned to bring about the delivery of fluid to said advancing means, second switch means selectively adjustable to open or closed position, said switch means and said electrical means being serially connected for permitting or preventing the actuating of said valve.

4. In a fluid operable apparatus adapted for use as a press or as a drop hammer, a reciprocable platen having advancing and retracting means, a surge valve adapted for connecting said advancing means with a reservoir, fluid pressure responsive means associated with said surge valve for moving it into open position, a normally open valve connecting said fluid pressure responsive means with said retracting means, a reversible pump connected with said advancing and retracting means, a pivoted lever for controlling the delivery of said pump movable into a first position for bringing about the supply of fluid to said advancing means and into a second position to bring about the supply of fluid to said retracting means, and into a third position to halt the delivery of said pump, a normally closed valve connected between said retracting means and exhaust, electrical means for moving said normally open valve into closed position and said normally closed valve into open position, first switch means adapted to be closed by said pivoted lever when the latter is in its first position, second switch means selectively adjustable to open or closed position, and third switch means adapted to be opened by said pivoted lever when the latter is in its second or third position, said switch means and said electrical means being serially connected for selectively bringing about the actuation of said valves.

5. In a fluid operable press, a cylinder, a ram reciprocable therein, advancing and retracting means for said ram, a surge valve in said cylinder for connecting said advancing means with a reservoir, fluid pressure responsive means for actuating said surge valve connected with said retracting means by a check valve opening away from the latter, normally open valve means by-

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passing said check valve, a reversible pump connected with said advancing and retracting means, a normally closed valve connecting said retracting means with exhaust, a pivoted lever and linkage associated with said pump and movable into a first position to bring about the supply of fluid to said advancing means and into a second position to bring about the supply of fluid to said retracting means, and into a third position to halt the delivery of said pump, first electrical means associated with said normally open valve operable when energized to close said valve, second electrical means associated with said normally closed valve operable when energized to open said valve, first switch means adapted to be closed by said pivoted lever when moved into said first position, second switch means adapted to be opened when said pivoted lever is moved into said second or said third position, a selector switch, said switches being serially arranged whereby the simultaneous closing of all three thereof is operable to actuate said electrical means, and other switch means adapted in response to a predetermined advancing movement of said platen to deenergize said electrical means.

6. In a fluid operable apparatus adapted for being used as a press or as a drop hammer, a movable platen, fluid operable advancing and retracting means associated with said platen, a surge valve between said advancing means and a reservoir, fluid operable means for opening said surge valve normally connected with said retracting means to receive actuating fluid therefrom, means for alternately supplying actuating fluid to said advancing and retracting means for reciprocating said platen in both directions under pressure for operation of the apparatus as a press, means for supplying actuating fluid to said retracting means to lift said platen under pressure and for exhausting said retracting means to permit said platen to drop by gravity for operation of the apparatus as a drop hammer, means operable during drop hammer operation of the apparatus for conveying pressure fluid from said retracting means to said fluid operable means but preventing fluid flow from said fluid operable means whereby said surge valve is maintained open, and means operable in response to a predetermined movement of said platen in its advancing direction for interrupting said exhaust connection for retarding the speed of descent of said platen.

7. In a fluid operable apparatus adapted for use as a press or as a drop hammer, a vertically reciprocable ram having advancing and retracting means, a surge valve connected between said advancing means and a reservoir, fluid operable means for opening said surge valve, means for supplying actuating fluid to said fluid operable means simultaneously with the supply of fluid to said retracting means, a fluid source connected with said advancing and retracting means, control means associated with said source and movable into a first position to bring about the supply of actuating fluid to said advancing means and into a second position to bring about the supply of actuating fluid to said retracting means, normally closed valve means connected between said retracting means and exhaust, means operated by said control means when in said first position to open said valve and to interrupt communication between said fluid operable means and the means supplying fluid thereto, and means adjustable for selectively making said last mentioned means either effective or ineffective.

8. In a fluid operable apparatus, adapted for

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use as a press or as a drop hammer, a vertically reciprocable ram having advancing and retracting means, a surge valve connected between said advancing means and a reservoir, fluid operable means for opening said surge valve, a normally open valve connecting said fluid operable means with said retracting means to receive actuating fluid therefrom, a fluid source connected with said advancing and retracting means, control means associated with said source and movable into a first position to bring about the supply of actuating fluid to said advancing means and into a second position to bring about the supply of actuating fluid to said retracting means, a normally closed valve connected between said retracting means and exhaust, valve actuating means operated by the movement of said control means into said first position for actuating said normally open valve into closed position and said normally closed valve into open position, selector means selectively positionable to make said valve actuating means effective or ineffective, and other means operated by the movement of said control means out of said first position to return said valves to their respective open and closed positions.

9. In a fluid operable apparatus adapted for use as a press or as a drop hammer, a vertically reciprocable ram having advancing and retracting means, a surge valve connected between said advancing means and a reservoir, fluid pressure responsive means connected with said retracting means and responsive to pressure thereon for opening said surge valve, a fluid source connected with said advancing and retracting means, control means associated with said source and movable into a first position to bring about the supply of actuating fluid to said advancing means and into a second position to bring about the supply of actuating fluid to said retracting means, normally closed valve means connected between said retracting means and exhaust, electrical means energizable to urge said valve into its open position and to entrap fluid in said fluid pressure responsive means, switch means positioned to be closed by the movement of said control means into said first position for energizing said electrical means, a holding circuit for said electrical means, and other switch means positioned to be actuated by said control member as it moves from said first position toward said second position for interrupting said holding circuit thereby to de-energize said electrical means and to return said valve to its closed position.

10. In a fluid operable apparatus which is adapted for use as a press or as a drop hammer, a reciprocable platen having advancing and retracting means, a fluid source connected with said means; control means movable into a first position to bring about the supply of fluid from said source to said advancing means and into a second position to bring about the supply of fluid from said source to said retracting means, a surge valve connected between said advancing means and a reservoir, fluid operable means connected with said retracting means and responsive to a predetermined pressure therein for actuating said surge valve into open position, and means of maintaining said surge valve open to permit operation of said ram as a drop hammer comprising normally open valve means between said fluid operable means and said retracting means, and means selectively operable for closing said valve when said surge valve is open.

11. In a fluid operable apparatus adapted for being used as a press or as a drop hammer, a movable platen, fluid operable advancing and retracting means associated with said platen, a surge valve between said advancing means and a reservoir, fluid operable means for opening said surge valve normally connected with said retracting means to receive actuating fluid therefrom, means for alternately supplying actuating fluid to said advancing and retracting means for reciprocating said platen in both directions under pressure for operation of the apparatus as a press, means for supplying actuating fluid to said retracting means to lift said platen under pressure and for exhausting said retracting means to permit said platen to drop by gravity for operation of the apparatus as a drop hammer, means operable during drop hammer operation of the apparatus for conveying pressure fluid from said retracting means to said fluid operable means but preventing fluid flow from said fluid operable means whereby said surge valve is main-

tained open, and means operable in response to a predetermined movement of said platen in its advancing direction for restricting said exhaust connection for retarding the speed of descent of said platen.

ROBERT J. LINDSEY.

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