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E. D. ABRAHAM ET AL

3,461,947

SHOCKLESS JOLT MOLDING MACHINE WITH AIR SPRING MEANS

Filed April 10, 1967

3 Sheets-Sheet 1

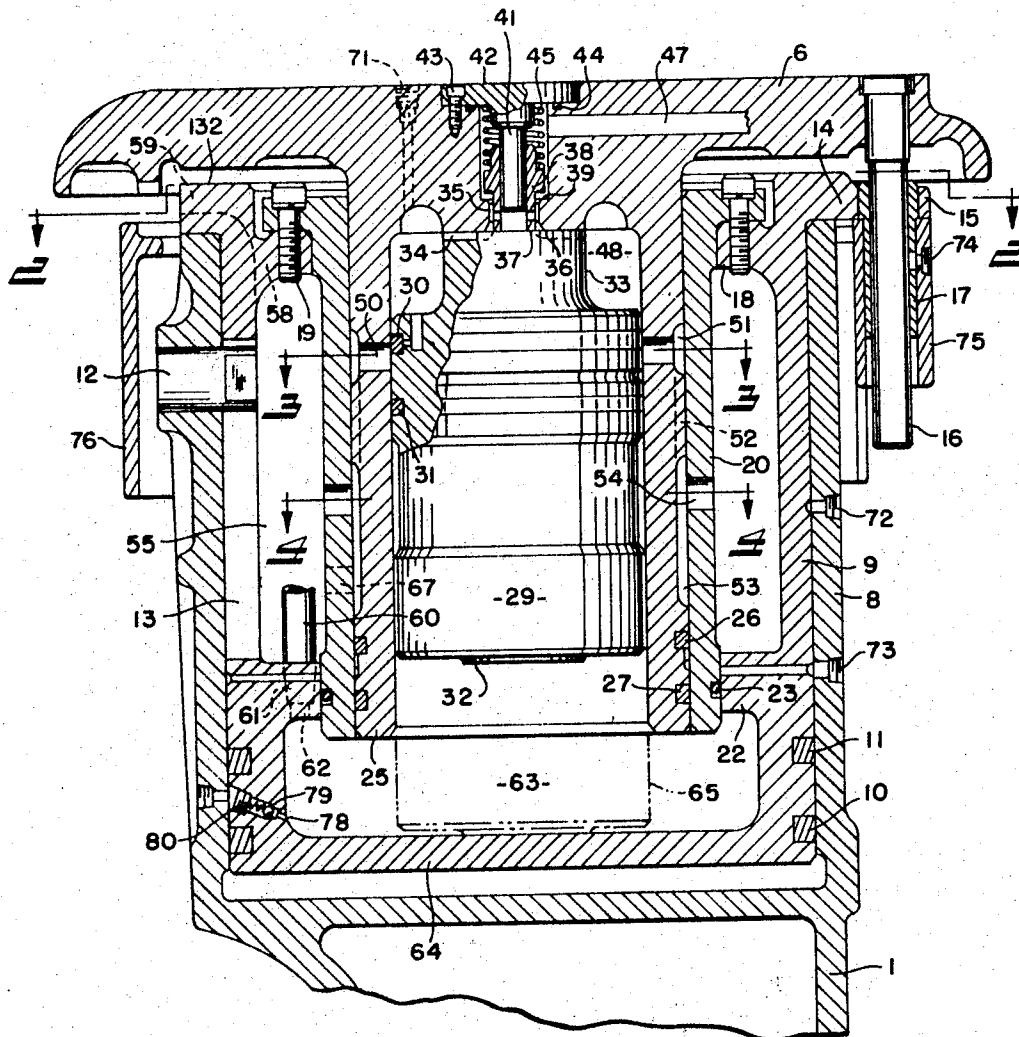


Fig. 1

INVENTORS
EDWARD D. ABRAHAM
ROBERT W. ELLMS

BY
Oberlin, Maky, Donnelly & Renner
ATTORNEYS

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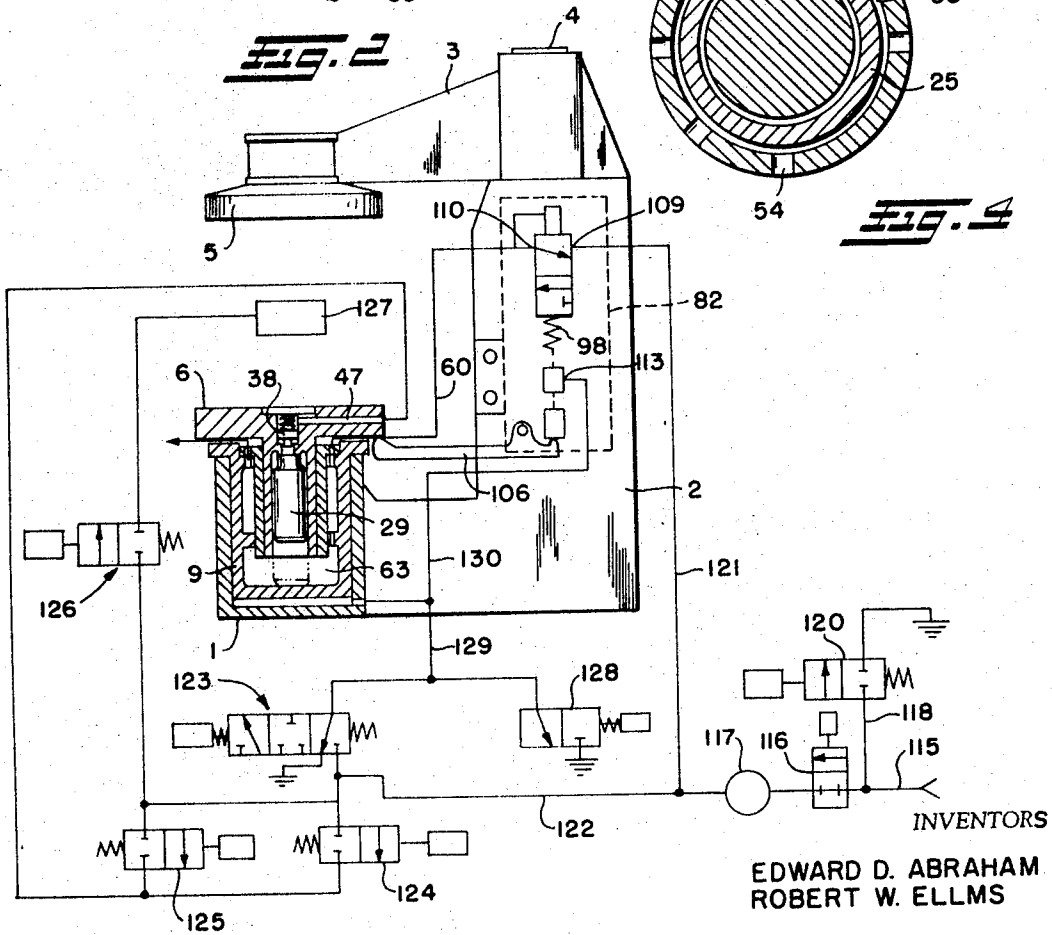
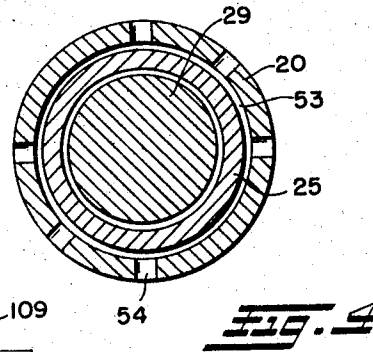
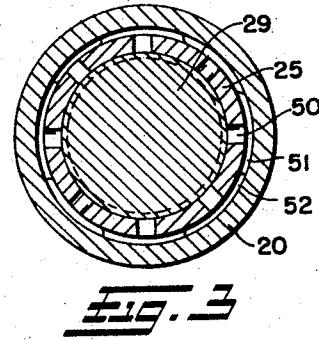
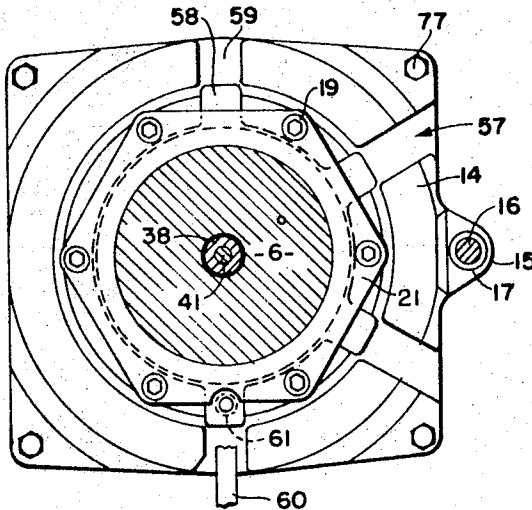
E. D. ABRAHAM ET AL

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SHOCKLESS JOLT MOLDING MACHINE WITH AIR SPRING MEANS

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INVENTORS
EDWARD D. ABRAHAM
ROBERT W. ELLMS

BY
Oberlin, Maky, Donnelly & Renner
ATTORNEYS

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E. D. ABRAHAM ET AL.

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SHOCKLESS JOLT MOLDING MACHINE WITH AIR SPRING MEANS

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3 Sheets-Sheet 3

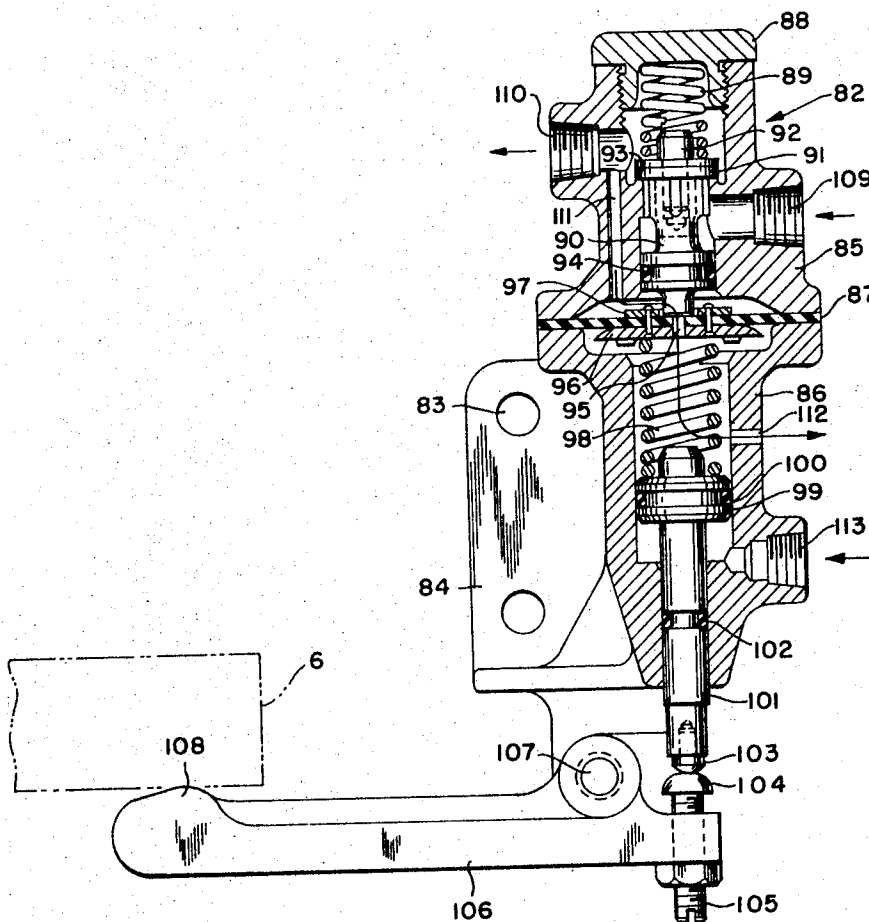


Fig. 6

INVENTORS
EDWARD D. ABRAHAM
ROBERT W. ELLMS

BY
Oberlin, Maky, Donnelly & Renner
ATTORNEYS

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3,461,947 SHOCKLESS JOLT MOLDING MACHINE WITH AIR SPRING MEANS

Edward D. Abraham, Cleveland, and Robert W. Ellms,
North Olmsted, Ohio, assignors, by mesne assignments,
to The Sherwin-Williams Company, Cleveland, Ohio,
a corporation of Ohio

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18 Claims

ABSTRACT OF THE DISCLOSURE

A jolt-squeeze type foundry molding machine having a table with a ram supported on a chamber of air to move upwardly to strike the bottom of the table as the latter drops to provide a shockless jolt.

Conventional shockless jolt molding machines, such as seen, for example, in Ivarsson U.S. Patent No. 3,111,730 or Ellms U.S. Patent No. 3,311,954, usually require the ram which strikes the underside of the table to be supported on a large spring which is compressed as the ram is driven downwardly and the table upwardly by air pressure to impart to the ram an upward motion to strike the table as the latter descends when the air pressure is relieved. To be particularly effective, the table also may be supported on compensating springs as indicated more particularly in the above noted Ellms patent.

Such large massive springs are, needless to say, expensive and subject to fatigue, wear, and breakage. Moreover, because of the inclusion of springs, it is difficult to provide a firm support for the table during portions of the molding cycle.

It is accordingly a principal object of the present invention to provide a shockless jolt-squeeze foundry molding machine not requiring the use of springs.

A further principal object is the provision of a jolt molding machine of simplified construction having fewer parts subject to replacement.

A main object is the provision of a jolt foundry molding machine utilizing an air spring to drive a jolt ram against the table.

A further object is the provision of a shockless jolt foundry machine in which substantially constant table height can be provided for various weights of patterns, flasks and sand.

Another object is the provision of a shockless jolt-squeeze foundry molding machine wherein the operating ram cooperating with the table to provide the jolt action is supported during the jolt on a chamber of air.

Yet another object is the provision in a shockless jolt-squeeze molding machine of a valve structure which will closely maintain and regulate the pressure of the air within the noted chamber.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is a fragmentary vertical section through the table and base of the machine illustrating the jolt mechanism;

FIG. 2 is a horizontal section on a somewhat reduced scale taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is a similar horizontal section taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is a further horizontal section taken substantially on the line 4—4 of FIG. 1;

FIG. 5 is a schematic pneumatic piping diagram showing diagrammatically the position of the servo valve and the pneumatic connections to the machine; and

FIG. 6 is a fragmentary vertical section of the servo valve.

Referring now to the annexed drawings and first to FIG. 5, there is illustrated diagrammatically in side elevation a foundry molding machine incorporating the present invention. Such a machine comprises a table or base frame 1 jointed at the rear thereof to a squeeze head frame 2 supporting at the top a squeeze head arm 3 mounted for horizontal swinging movement about the axis of pin 4 projecting from the top of frame 2. The front or forwardly projecting portion of the arm 3 supports a squeeze head 5 to which a squeeze board, not shown, may be attached. The squeeze head may be pivoted aside to permit sand to be dumped from an overhead hopper, not shown, into a flask mounted on a pattern plate which is in turn supported on the table 6. The table 6 is situated directly beneath the hopper and the squeeze head in its squeeze position. In operation, the flask will be filled with sand and the sand filled flask jolted and elevated against the squeeze head to ram a foundry mold within the flask. The pattern plate and pattern will then be drawn from the mold and the cycle of operation repeated.

Referring now more particularly to FIG. 1, it will be seen that the base frame 1 includes an upstanding cylindrical portion 8 in which squeeze piston 9 is mounted for vertical reciprocation. Piston rings are provided as indicated at 10 and 11 and the extent of such reciprocation is limited by limit pin 12 projecting into vertical slot 13 in the squeeze piston wall. The pin 12 and slot 13 also keep the piston 9 from rotating within the cylinder 8.

The top of the piston 9 is provided with a flange 14 which overlies the top edge of the cylindrical portion 8 of the base 1 which includes a projection 15 enclosing jolt guide pin 16 and its surrounding bushing 17. The top of the pin 16 is connected to the table 6.

The squeeze piston 9 also includes at its upper end a somewhat lower inwardly directed shelf 18 to which is fastened by the cap screws indicated at 19 a cylindrical liner 20. The fasteners extend through a top flange 21 of the liner and into the shelf 18. The lower end of the liner 20 fits snugly within annular inner projection 22 on the squeeze piston 9 and an O-ring seal is provided as indicated at 23.

Within the liner 20, there is slidably mounted the pendant cylindrical projection 25 from the table 6 which itself acts as a piston within the cylinder of the liner and accordingly piston rings 26 and 27 are provided in the lower end of the cylindrical projection 25. Within the downwardly projecting cylinder 25 of the table 6 there is mounted for reciprocation a ram 29 also provided with piston rings as indicated at 30 and 31. The bottom of the ram is provided with a slight projection indicated at 32 and the top with a substantial projection 33. The projection 33 is provided with diametrically opposed grooves or passages 34 which communicate with air passage 35 in the table 6. The top of the ram engages the underside of the table as indicated at 36 to provide the jolt strike.

When the ram is in engagement with the underside of the table as indicated at 36, it will also engage sleeve extension 37 of poppet valve member 38 moving the same off the seat 39 provided in the passage 35. A pop-

pet guide 41 depends from annular plate 42 secured by fasteners 43 to the table. The annular plate 42 with the help of O-ring seal 44 seals the upper end of the enlarged portion of the passage 35 in which the annular poppet 38 reciprocates. A compression spring 45 extends between the plate 42 and the illustrated shoulder of the poppet 38 urging the poppet downwardly or to its seated position against the seat 39. Air is supplied to the poppet through lateral passage 47 in the table 6. Thus when the ram is in its uppermost or strike position against the bottom of the table 6, the poppet 38 will be forced open to permit air to enter the chamber 48 between the table and the ram from the passage 47.

When the ram 29 moves downwardly, the pressure in chamber 48 will be exhausted through ports 50, eight in number as seen in FIG. 3, into annular chamber 51 connected by vertical passages 52, four in number as seen in FIG. 3, to elongated annular chamber 53. From the annular chamber 53, the air exhausts through ports 54, six in number as seen in FIG. 4, into annular chamber 55 in the squeeze piston 9. From there, the air pressure is exhausted to atmosphere through grooves 57 in the top of the squeeze piston, which grooves include vertical portions 58 in the inwardly extending ledge 18 and horizontal portions 59 in the top annular flange 14. One of the four such grooves as seen in FIG. 2 is provided with a pipe 60 which extends down through the chamber 55 and is threadedly connected at 61 to the tapped passage 62 through the annular inwardly extending projection 22 of the squeeze piston 9. The passage 62 thus connects the pipe 60 to the plenum chamber 63 within the squeeze piston 9 beneath the cylindrical projection 25 of the table 6 and the ram 29. With insufficient pressure in the chamber 63 to overcome the weight of the ram 29, the ram will rest firmly on the bottom 64 of the squeeze piston as indicated by the phantom line position 65. Thus by controlling fairly precisely the pressure in the chamber 63, a shockless jolt mechanism can be provided without requiring a massive operating spring.

In addition to the exhaust ports 54 for the jolt air, an emergency port 67 may be provided in the wall of the liner 20 for the purpose of preventing the table from flying out of the liner 20 should the servo valve, hereinafter described, stick. The pressure in chamber 63 would then be exhausted through the port 67 if the cylindrical projection 25 of the table uncovers such a port and if it moved any higher the air in chamber 63 would additionally exhaust through the ports 54.

Lubricating ports are provided in the machine for the various moving parts such as the port 71 in the top of the table 6 for the ram 29, port 72 for the squeeze piston 9, and port 73 for the cylindrical projection 25 of the table 6. An oil fitting 74 is provided in hub 75 which is part of the shield 76 secured to the squeeze cylinder flange 14 by the fasteners 77 indicated in FIG. 2. Near the bottom of the chamber 63, there is provided a blow-out port 78 which removes excess oil from the chamber through check valve 79 and a restricted orifice device 80.

Referring now to FIGS. 5 and 6, air pressure to the plenum chamber 63 is provided by a position servo valve 82 which can be mounted on the squeeze head frame 2 by suitable fasteners through the apertures 83 in the plate 84. As seen in FIG. 6, the valve includes an upper valve body 85 and a lower valve body 86 separated by diaphragm 87. The upper end of the valve is closed by a nut 88 providing a seat for compression spring 89 which bears against the upper end of balanced spool 90. The top of the balanced spool includes a resilient washer 91 held in place by fastener 92, the latter also serving to retain the compression spring 89. The washer 91 seats against valve seat 93 in the closed position of the valve. Below the inlet 109 the spool 90 is provided with an O-ring seal 94 in the enlarged land sliding in the spool passageway. The bottom of the balanced spool bears against the center of the diaphragm 87 which is

provided with a central vent port aligned with a central vent port 95 in diaphragm plate 96. A special washer 97 surrounding the projecting lower end of the balanced spool 90 is secured through the diaphragm to the diaphragm plate 96. A medium pressure compression spring 98 extends between the diaphragm plate and the top of piston 99 which is provided with a seal ring indicated at 100. The piston includes a stem 101 projecting through the lower end of the lower valve body which is also provided with an O-ring 102. The removable stem tip 103 bears against the head 104 of an adjusting screw 105 mounted in one end of actuating arm 106 which is pivoted at 107 to the lower end of the valve. The opposite end of the arm includes an upper projection 108 adapted to bear against the underside of the table 6 during certain portions of the operating cycle of the machine.

The port 110 at the top of the valve is connected to the plenum chamber 63 beneath the ram and table and a feed back or vent passage 111 connects the port 110 with the top of the diaphragm 87. Increased pressure on the top of the diaphragm 87 will tend to push the diaphragm away from the lower end of the balanced spool 90 against the pressure of spring 98 opening the center ports in the diaphragm and the diaphragm plate to permit the pressure from the port 110 to exhaust through vent opening 112. A port 113 is provided beneath the piston 99 to permit the jolt action to continue as the table is elevated by the squeeze piston to ram the sand against the squeeze head or board.

Referring now to FIG. 5, it will be seen that air may be supplied from plant line 115 through shut-off valve 116 to line lubricator 117. A branch line 118 is connected to pattern blow-off valve 120 which may be manually operated. From the lubricator, line 121 is connected to the port 109 of the servo position valve 82. Line 122 is connected to squeeze valve 123 and two jolt valves 124 and 125 as well as vibrator valve 126. The latter leads to a vibrator 127 which may be used to facilitate the drawing of the pattern from the mold. The valves 124 and 125 in parallel may be hand and knee operated, respectively. The squeeze valve is provided with three positions, the center being a blocking position, and as indicated at 128 a manually operable relief valve is provided in line 129 which includes a branch 130 leading to the port 113 of the servo valve 82.

In operation, in the at rest position of the machine, the jolt table 6 would be bottomed on the upper surface of the flange 14 as indicated at 132 in FIG. 1 and the ram 29 would be in its phantom line position 65 resting against the bottom 64 of the squeeze piston 9. In this lowermost position of the table 6, the sensing arm 106 will cause the piston 99 of the servo valve to move to its maximum up position forcing the valve washer 91 away from the seat 93. When air is turned on to the machine by the shifting of valve 116, air pressure is supplied through line 121 to the port 109 of the servo valve. Since the valve is open air will then pass through the outlet port 110 to the pipe 60 supplying pressure to the plenum chamber 63. Increasing pressure in the plenum chamber now causes the ram 29 to rise to its full line position as seen in FIG. 1 opening the poppet 38 and this will in turn slightly elevate the table 6 due to the pressure in the chamber 63 acting on the bottom of the projection 25 and the bottom of the ram 29. As the table elevates, the sensing arm 106 will also elevate being pivoted in a clockwise direction about the pivot 107 by the pressure of spring 98. This then permits the valve element 91 substantially to close and with the arm sensing the position of the table 6, the pressure within the chamber 63 will be maintained through the servo valve at from about 6 to about 25 p.s.i. and preferably from about 8 to about 16 p.s.i. The sand filled flask with the pattern therein on the table 6 is now ready to be jolted and this can be accomplished by actuation of either of the valves 124 or 125 supplying pressure to the

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passage 47 in the table 6. With the poppet 38 open because of the contact between the top of the ram 29 and the sleeve extension 37, the jolt cycle will then commence. At this point it should be appreciated that, for example, if the ram weighs approximately 80 pounds and is of a 6" diameter, only about 3 p.s.i. in the chamber 63 is required to elevate it to the full line position shown. The weight of the table 6, of course, will be substantially more and the pressure employed in the plenum chamber 63 controlled by the servo valve 82 will be enough to provide the jolt action now to be described.

When air is supplied to the chamber 48 above the ram through the line 47 and the open poppet, pressure in such chamber acts to force the ram 29 downwardly and, of course, also acts to push the table 6 upwardly by acting on the underside thereof within the chamber 48 above the ram. The downward movement of the ram 29 compresses the air within chamber 63 and further assists in the elevation of the table 6 by increasing the pressure acting on the underside of the cylindrical projection 25 within such chamber 63. As soon as the ram 29 moves away from the poppet 38, the spring 45 will close the poppet precluding further air pressure in the chamber 48. The ram, however, continues downwardly until the exhaust ports 51 are opened to exhaust the jolt air through the annular passage 51, the vertical passages 52 and the exhaust ports 54 into the chamber 55 to be exhausted to atmosphere through the grooves 59 beneath the top of the table 6. This jolt exhaust blows air outwardly from beneath the table to prevent sand and other dirt from coming into contact with the sliding surfaces of the machine.

As the table 6 moves upwardly, the arm 106 pivots to relieve pressure of spring 98 to permit the servo valve to close in effect trapping the air in chamber 63, except for restricted vents 111, 95 and 112, and the pressure in the chambers 63 and 48 is then of a reverse ratio when the exhaust ports are opened so that the ram will then be pushed upwardly and the table 6 will fall to obtain a jolt strike at 36 as the upwardly moving ram strikes the downwardly moving table. This jolt action may continue as long as the operator holds either the valve 124 or the valve 125 open.

Now to start the squeeze portion of the cycle, the operator will shift the valve 123 supplying squeeze pressure to the line 129 elevating the squeeze piston 9 and also supplying pressure through line 130 to the port 113 of the servo valve 82. Pressure through the port 113 overrides the action of the arm 106 by supplying squeeze air pressure to the underside of the piston 99 so that the spool 90 is balanced between the pressure acting on the top of the valve element and the pressure acting on the bottom of the piston 99 which acts on the spool through the spring 98 and the diaphragm 87. The jolt action can then be continued as the table 6 is elevated to squeeze the sand within the flask. At the completion of the squeeze cycle, the operator reverses the valve 123 or alternatively holds the valve in blocked position for a predetermined time and then may shift the valve to cause the table to descend and draw the pattern from the flask. If desired, the table top of the flange 14 as indicated at 132 by the closing of valve 116 for the loading and unloading of the flask, pattern or mold.

By carefully controlling the pressure in the chamber 63 through the servo valve 82, the ram 29 can, in effect, be bounced off a cushion or pillow of air to strike the underside of the table 6 to provide a shockless jolt mechanism. Since the elevating ram strikes the descending table 6, the jolt impact will not be transmitted through the frame of the machine to the surrounding sub-structures. The setting of the servo valve can be controlled through the adjusting screw 105 to compensate for various weights of tables, patterns, sand and flask. The only spring within the machine itself that may require replacement is the poppet spring 45 which can easily be removed by means of the fasteners 43.

Other modes of applying the principles of the invention

may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

We, therefore, particularly point out and distinctly claim as our invention:

1. A jolt foundry molding machine comprising a table, a ram, and air spring means operative to drive said ram against said table to provide a jolt strike, said air spring means comprising a plenum chamber supporting both said table and said ram.
2. A foundry molding machine as set forth in claim 1 wherein said table includes a depending cylindrical projection, said ram being mounted for reciprocation within said projection.
3. A foundry molding machine as set forth in claim 1 including means responsive to the strike of said ram against said table to supply air pressure to the top of said ram to drive the latter against said air spring means during the jolt cycle of the machine.
4. A foundry molding machine as set forth in claim 1 including a servo valve operative to control the air pressure within said air spring means.
5. A foundry molding machine as set forth in claim 1 wherein said air spring means acts partially upon said table to lift and then drop the same as said ram is driven thereagainst.
6. A foundry molding machine as set forth in claim 1 including squeeze means operative to elevate said table, ram, and air spring means whereby a foundry mold may simultaneously be squeezed while the table is struck by said ram.
7. A foundry molding machine as set forth in claim 1 including poppet valve means opened by the strike of the ram against said table operative to drive the ram against said air spring means to rebound against said table.
8. A foundry molding machine comprising a table, a cylinder, a jolt ram mounted within said cylinder for reciprocation against said table, and means operative to admit air pressure to the chamber above said ram to drive the latter downwardly whereby said ram will rebound on the air chamber therebelow to strike said table; a servo valve operative to control the air pressure in the chamber below said ram, said servo valve including sensing means operative to control the operation of said servo valve in response to the position of said table.
9. A foundry molding machine as set forth in claim 8 including squeeze means operative to elevate said table to ram a foundry mold thereon against a squeeze head, and override means operative to bypass said sensing means to permit continued jolting of said table during the squeeze.
10. A foundry molding machine as set forth in claim 9 wherein said override means comprises a piston-cylinder assembly operated in conjunction with said squeeze means.
11. A foundry molding machine as set forth in claim 9 wherein said servo valve comprises a balanced spool having a diaphragm at one end thereof, said sensing and override means acting on said diaphragm through a compression spring.
12. A foundry molding machine as set forth in claim 8 wherein said servo valve comprises a balanced spool, a vented diaphragm acting on one end of said spool, and feedback means from said chamber beneath said ram acting on said diaphragm means.
13. A foundry molding machine as set forth in claim 8 wherein said means operative to admit air pressure to the chamber above said ram comprises a poppet valve opened by the engagement of said ram and table.
14. A foundry molding machine as set forth in claim 13 including means operative to exhaust the chamber above said ram after a predetermined downward movement thereof.
15. A foundry molding machine as set forth in claim 13 wherein the downward movement of said ram elevates said table at least until the chamber above said ram is ex-

hausted whereby the table will drop as the ram rebounds to strike the same providing a shockless jolt.

16. A foundry molding machine comprising a table including a vertical cylindrical extension therebeneath, a jolt ram mounted within said extension, air chambers above and below said ram, means operative to admit air pressure to the chamber above said ram to drive the latter downwardly, and means operative to control the pressure in said chamber below said ram whereby when the chamber above said ram is exhausted, the pressure in the chamber below said ram will cause the ram to rebound upwardly and strike the table, said means operative to control the pressure in the chamber below said ram comprising a table position responsive servo valve.

17. A foundry molding machine as set forth in claim 16 wherein the means operative to admit air pressure to the chamber above said ram comprises a poppet valve opened in response to engagement of the table and ram.

18. A foundry molding machine as set forth in claim 16 including means operative to maintain the pressure in

the chamber below said ram at from about 6 p.s.i. to about 25 p.s.i.

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15 J. SPENCER OVERHOLSER, Primary Examiner

ROBERT D. BALDWIN, Assistant Examiner

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