Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 1

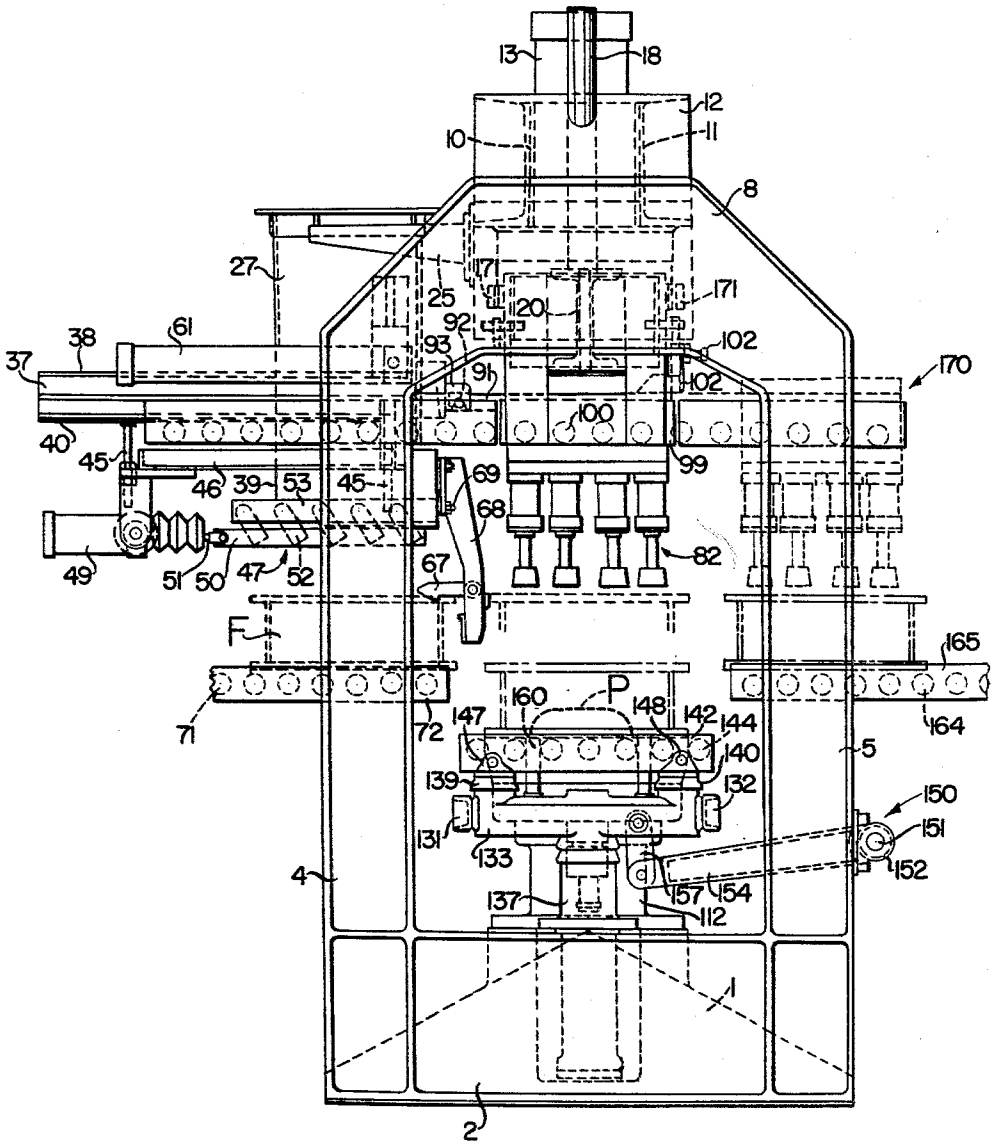


FIG 1

INVENTOR.
EDMOND K. HATCH &
LEON F. MILLER
BY
Oberlin, Maky & Donnelly
ATTORNEYS

Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 2

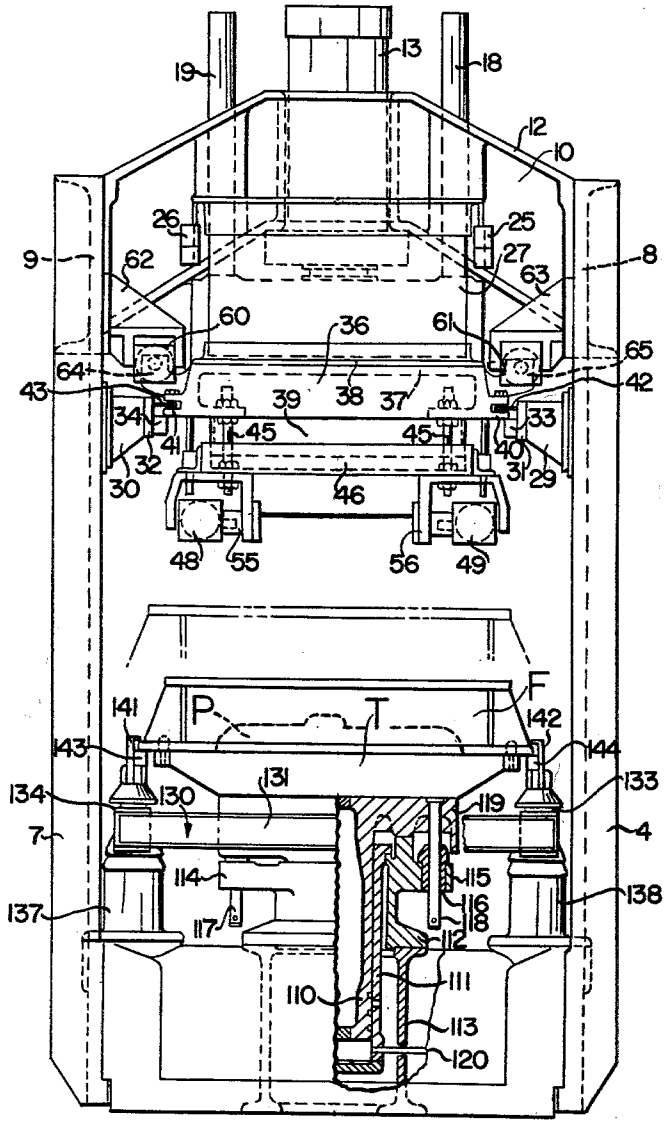


FIG 2

INVENTOR.
EDMOND K. HATCH &
BY LEON F. MILLER

Oberlin, Maky & Donnelly
ATTORNEYS

Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 3

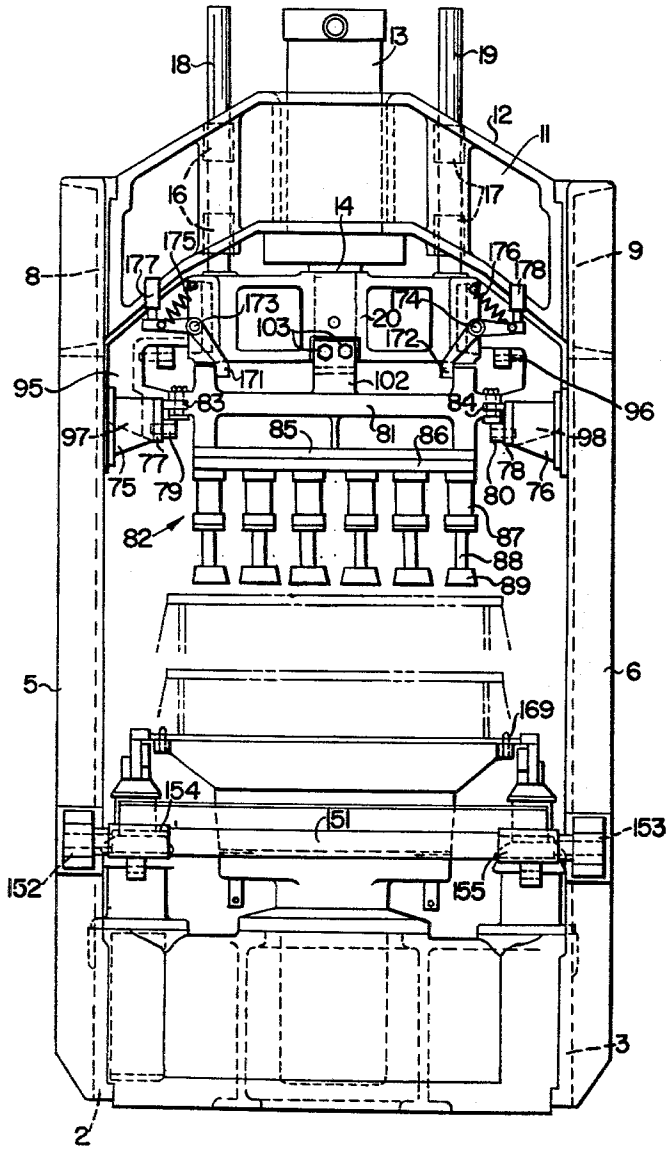


FIG 3

INVENTOR.
EDMOND K. HATCH &
LEON F. MILLER

BY

Oberlin, Maky & Donnelly

ATTORNEYS

Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 4

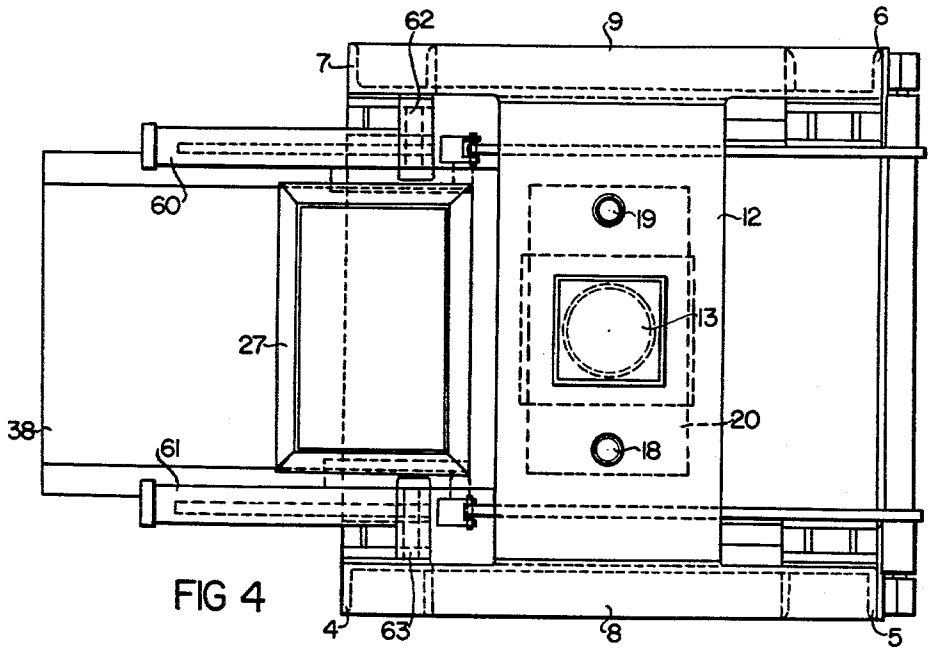


FIG 4

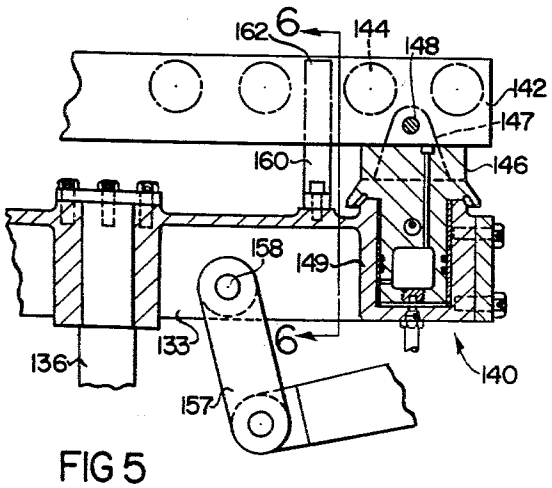


FIG 5

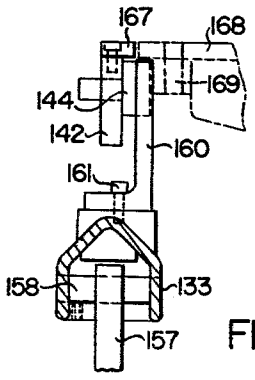


FIG 6

INVENTOR.

EDMOND K. HATCH &
BY LEON F. MILLER

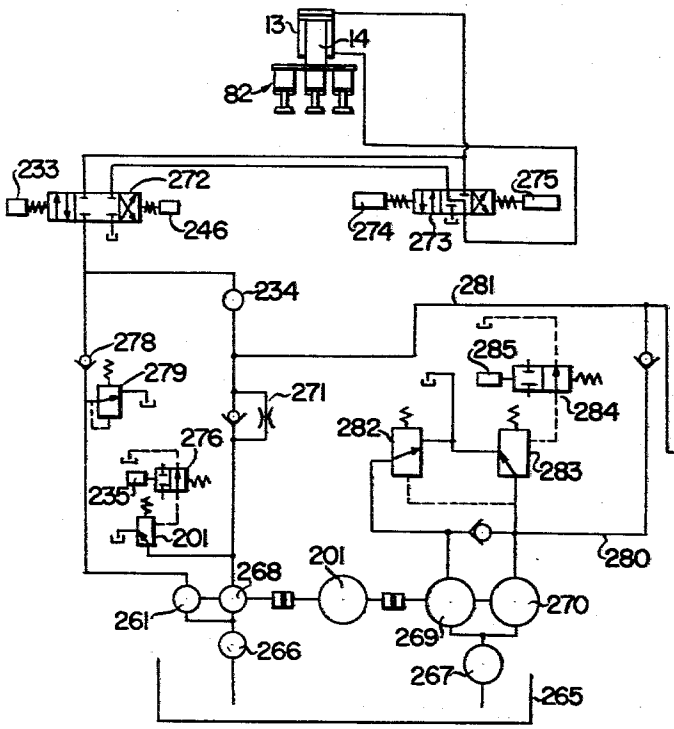
Oberlin, Maky & Donnelly

ATTORNEYS

Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 5



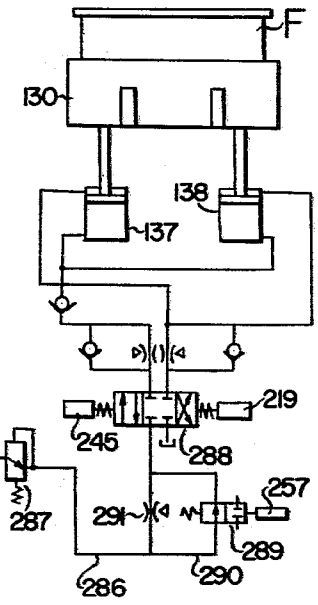


FIG 7

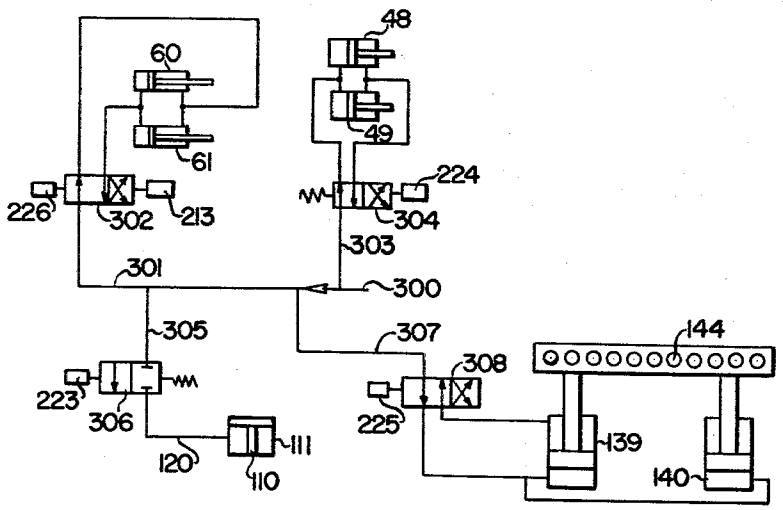


FIG 8

INVENTOR.
EDMOND K. HATCH &
LEON F. MILLER
BY
Oberlin, Maky & Donnelly
ATTORNEYS

Feb. 16, 1965 E. K. HATCH ETAL 3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Filed Aug. 24, 1961 6 Sheets-Sheet 6

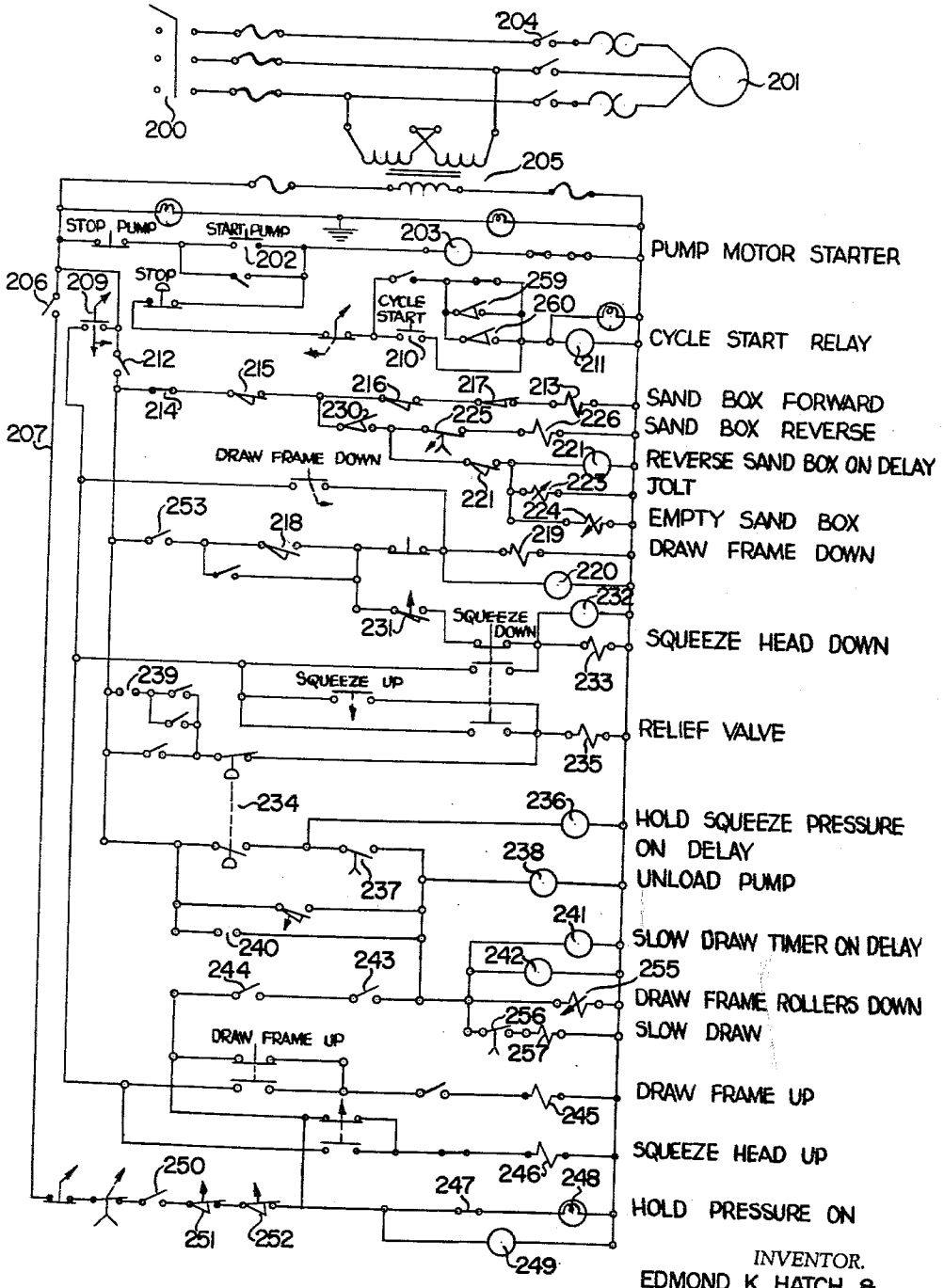


FIG 9

INVENTOR.
EDMOND K. HATCH &
LEON F. MILLER

BY Oberlin, Maky & Donnelly
ATTORNEYS

United States Patent Office 3,169,285 Patented Feb. 16, 1965

3,169,285

OVERHEAD SQUEEZE MOLDING MACHINE

Edmond K. Hatch, Warrensville Heights, and Leon F. Miller, Rocky River, Ohio, assignors to The Osborn Manufacturing Company, Cleveland, Ohio, a corporation of Ohio

Filed Aug. 24, 1961, Ser. No. 133,700
19 Claims. (Cl. 22—25)

This invention relates generally, as indicated, to an overhead squeeze molding machine and more particularly to a machine for making sand molds incorporating an overhead mechanical squeeze action and an optional jolt.

Heretofore, it has been proposed to provide an overhead squeeze molding machine wherein the ram which provides such overhead squeeze is reciprocated laterally in and out of operative squeeze position. This, of course, requires that a substantial mass be reciprocated and, moreover, extremely long and flexible feed hoses must be provided for such reciprocating ram.

With the present machine, a faster cycle is obtainable in that only the squeeze head is reciprocated and, furthermore, when it is desired to change the shape, contour or arrangement of the squeeze head, it is a much easier task. It is obviously easier to substitute reciprocating squeeze heads alone rather than heads which include a reciprocating vertically extending ram. Additionally, with such machine, it is possible to provide an optional jolt without having to combine a squeeze ram therewith. Furthermore, the operation is much cleaner because the squeeze ram is positioned above the sand and sand fill.

It is accordingly a principal object of the present invention to provide an overhead squeeze molding machine wherein only the squeeze head as opposed to the squeeze ram is reciprocated into and out of operative position.

It is another object of the present invention to provide an overhead squeeze molding machine which incorporates an optional jolt action.

It is a still further object to provide a foundry molding machine having an extremely fast cycle of operation.

It is yet another object to provide a foundry molding machine wherein the charging of the machine with the sand places the flask in proper position.

Yet another object is the provision of an overhead squeeze molding machine wherein the ram is positioned above the sand squeeze thus lengthening the life of the machine.

A still further object is the provision of apparatus for quickly and easily assembling a mold box and pattern plate in position for an optional jolt action and a subsequent overhead squeeze.

It is yet a further object to provide such apparatus which will quickly facilitate the drawing of the pattern from the mold and the discharge of the finished mold from the machine.

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 principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation of the present invention showing in phantom lines the squeeze head in its optional non-operative position;

FIG. 2 is an end elevation of such machine as seen from the left in FIG. 1 partially broken away;

FIG. 3 is an end elevation of such machine as seen from the right in FIG. 1;

FIG. 4 is a top plan view of such machine;

FIG. 5 is an enlarged detail sectional view of the draw frame;

FIG. 6 is a vertical section taken substantially on the line 6—6 of FIG. 5;

FIG. 7 is a schematic hydraulic diagram illustrating the operation of various components of the present invention;

FIG. 8 is a schematic piping diagram of the pneumatic system illustrating the operation of various components of the present invention; and

FIG. 9 is a schematic electrical diagram illustrating the operation of the present invention.

Referring now to the annexed drawings and more particularly to FIGS. 1, 2, 3 and 4, it will be seen that the machine is comprised of a base 1 of the triangular configuration shown more clearly in FIG. 1. Side frame members 2 and 3 close the ends of such triangular base 1 and four corner legs 4, 5, 6 and 7 extend upwardly from the corners of the base with the pairs of legs 4 and 5 arching over as shown to form a top frame member 8 and similarly the pairs of legs 6 and 7 arch over to form a top frame member 9. Two arched vertically extending frame members 10 and 11 extend between the top frames 8 and 9 with a top web or plate 12 further rigidifying such framework and providing a protective covering for the squeeze cylinder 13 and its ram 14 extending vertically therefrom. Such top framing 10, 11 and 12 also supports vertically spaced pairs of bearings 16 and 17 which in turn receive guide pins 18 and 19 respectively which extend through such framing and are secured to overhead squeeze frame 20. The rod 14 of the ram or cylinder 13 is also centrally secured to such frame 20.

The framing 10, 11 and 12 also supports brackets 25 and 26 which in turn support a sand hopper 27 laterally adjacent but offset from the overhead squeeze ram 13. Fixed to the pair of legs 4 and 7 are brackets 29 and 30 which support elongated frame members 31 and 32 which in turn have inwardly directed conveyor rollers as shown at 33 and 34 mounted thereon. These conveyor rollers support a sand carriage 36 for horizontal shuttling movement from a charging to a flask filling position. Such carriage includes a frame 37 having a cutoff plate 38 mounted on the top thereof which has an opening therein, which when the carriage is aligned in the FIG. 1 position, will permit a charge of sand to fall from the hopper 27 through such opening into a sand box 39 which is suspended beneath the carriage 36. The carriage frame is provided with marginal side flanges 40 and 41 which overlie the conveyor rollers 33 and 34 and such frame may also be provided with rollers 42 and 43 which are rotatable about vertically extending axes and bear against the conveyor frame members 31 and 32 to keep the carriage properly centered in the machine.

Suspended from the frame 37 on four adjusting screws 45 is a framework 46 which supports a sand box louver assembly 47 controlling the selective discharge of sand from such sand box. Such framework includes piston-

cylinder assemblies 48 and 49 which operate such louvers through operating bars 50 connected to the rods of such piston-cylinder assemblies as shown at 51. The operating rods 50 pivot the louvers 52 which are pivotally connected thereto and also to the stationary frame member 53 which is part of the frame 46. The piston-cylinder assemblies 48 and 49 are pivotally mounted on brackets 55 and 56 which are part of the frame 46, all of which are vertically adjustable with respect to the carriage frame 37.

Movement of the sand box carriage 36 is obtained by two piston-cylinder assemblies 60 and 61 which are mounted on respective brackets 62 and 63 which are in turn secured respectively to the top frame portions 9 and 8. The brackets 62 and 63 provide a pivotal mounting for the rod end of such piston-cylinder assemblies and the pistons thereof are connected to extensions 64 and 65 on the carriage so that actuation of the piston-cylinder assemblies will move the carriage and thus the sand box from its sand charging to its sand dumping position. It is noted that the wear or cutoff plate 38 extends substantially beyond the hopper 27 in the position shown in full lines in FIG. 1 so that the plate will serve as a cutoff to prevent further flow of sand from the hopper 27 when the sand box is in the sand dumping position.

The shuttling movement of the sand carriage also serves to position an empty flask in the machine by means of a latch 67 pivotally mounted on a depending arm 68 which is secured to the sand box as shown at 69. The latch arm 67 is provided with a depending catch or dog 70 which will catch on the inside of the flask F and pull the same along conveyor rollers 71 which are mounted on frame members 72 which may be in turn mounted on the legs 4 and 7. The latch arm 67 may also be provided with a cam surface so that when the carriage is moved to the full line position shown, the arm will ride up over the top edge of the flask to drop into its latching position.

The legs 5 and 6 similarly support brackets 75 and 76 respectively which in turn support conveyor frame members 77 and 78 having inwardly directed conveyor rollers 79 and 80 thereon. These conveyor rollers are horizontally aligned and support for horizontal shuttling movement squeeze head frame 81 having the squeeze head 82 pendently mounted thereon. Rollers 83 and 84 may be mounted on such frame about vertically extending axes bearing against the conveyor frame members 77 and 78 to keep the squeeze head and squeeze head frame properly aligned in the machine. The frame 81 may be provided with a bottom plate 85 to which is secured the plate 86 of the squeeze head 82. Any suitable fastening means may be employed to secure the squeeze head in place on the frame and such can readily be removed if desired. In the illustrated embodiment, the squeeze head 82 is comprised of a plurality of downwardly projecting cylinders 87 having pistons therein with the piston rods 88 projecting therefrom and having squeeze biscuits or feet 89 mounted on the distal ends thereof adapted to engage the molding sand within the flask F positioned therebeneath in the full line position of the squeeze head shown in FIG. 1. The individual squeeze piston-cylinder assemblies may be manifolded or individually operated to obtain different pressures thereon, but in any event, reference may be had to the copending application of Edmond K. Hatch and Leon F. Miller entitled "Squeeze Molding Machine," Serial No. 127,616, filed July 28, 1961 for a more complete disclosure of squeeze heads that may be employed with this invention. Reference may also be had to the copending application of Robert W. Ellms entitled "Foundry Molding Machine with Multiple Area Squeeze Head," Serial No. 126,925, filed July 26, 1961 for a further form of squeeze head that may be employed with the present invention. In any event, it will be understood that the illustrated squeeze head is shown as an example only in that any type of squeeze head including various types of diaghragm squeeze heads may be employed with the present invention.

The squeeze head carriage frame 81 is provided with an extension 91 which has a pin 92 which engages with a downwardly opening U-shape latch member 93 extending from the sand carriage frame 37. In this manner, as long as the sand carriage frame and the squeeze head carriage frame are at the same horizontal elevation, they will be latched together for movement as a unit. However, vertical movement or lowering movement of the squeeze head carriage frame away from the sand carriage frame is not precluded by this interengagement of the two frames.

As seen more clearly in FIG. 2, the squeeze head frame 20 which is mounted on the piston or ram rod 14 includes downwardly projecting side portions 95 and 96 each of which has inwardly directed bottom edge portions 97 and 98 which support longitudinally extending conveyor frame members 99 similar to the conveyor frame members 77 and 78 and horizontally aligned therewith as well as with the conveyor frame members 31 and 32 in the FIG. 1 position. The omega-shape frame 20 then provides the conveyor frame members 99 which have inwardly directed conveyor rollers 100 thereon which are horizontally aligned with the rollers on the corresponding conveyor frame members to provide a continuous horizontal conveyor for the sand carriage and squeeze head carriage when the squeeze frame 20 is in the raised or uppermost position.

The squeeze head frame 81 is provided with an upstanding bracket 102 which includes two adjustable stop screws 103 adapted to bear against the squeeze frame 20 when the squeeze head is in the full line position shown in FIG. 1 wherein it will be aligned with the flask F positioned directly therebeneath. The movement of the sand carriage and the squeeze head and squeeze head carriage is thus obtained by means of the pair of piston-cylinder assemblies 60 and 61 and retraction of such piston-cylinder assemblies will cause the sand carriage to move to the left and the squeeze head and squeeze head carriage latched thereto through the latched mechanism 91 through 93 to move therewith until the stop screws 103 engage the side of the squeeze frame 20.

Positioned directly beneath the squeeze cylinder 13 in the center of the frame, there is provided a table T which has mounted thereon the conventional pattern P. The table is mounted on jolt piston 110 which fits within jolt cylinder 111 which in turn is mounted in annular extension 112 which is mounted on annular frame 113 within the base 1. The extension 112 is provided with opposed ears 114 and 115 which have bearings 116 therein to accommodate vertically movable aligning pins 117 and 118 which extend through the piston top 119 and are secured to the table T. The annular piston top presents a substantial mass and firmly supports the table T thereon. An air line 120 may be provided supplying air to the blind end of the jolt cylinder 111.

Surrounding the table T and the jolt piston-cylinder assembly, there is provided a cradle frame 130 comprised of two end frame members 131 and 132 and two side frame members 133 and 134. Such frame is mounted on the piston rods 136 of two piston-cylinder assemblies 137 and 138 positioned at the sides of the machine frame with such rods directly supporting the side frame members 133 and 134 (note the detail view of FIG. 5). Each of the side frame members 133 and 134 is provided at its end with vertically extending short stroke piston-cylinder assemblies 139 and 140. These short stroke piston-cylinder assemblies, which may be termed dash-pots, support horizontally extending conveyor frame members 141 and 142 which have inwardly directed rollers 143 and 144 thereon which are horizontally aligned with the rollers 71 in the conveyor frame structure 72 when the cradle is in its uppermost position as a result of extension of the piston-cylinder assemblies 137 and 138 and as a result

of the extension of the four short stroke piston-cylinder assemblies 139 and 140.

As seen more clearly in FIG. 5, the rods 146 of each of the dash-pots or small piston-cylinder assemblies is provided with a clevis or like member 147 which is pinned to the respective frame as shown at 148. The cylinder 149 for such piston-cylinder assemblies 139 and 140 may be incorporated as part of the frame 133.

A squaring shaft assembly 150 is provided ensuring conjoint operation of the piston-cylinder assemblies 137 and 138, such assembly including a pivot shaft 151 mounted in bearings 152 and 153 or pillow blocks secured to the outside faces of the legs 5 and 6. Arms 154 and 155 keyed to rotate with the shaft are pivotally connected to links 157 which are in turn pivoted to the side frame members 133 and 134 as shown at 158. The squaring shaft and arms connected to the side frames by the links ensures then that the piston-cylinder assemblies 137 and 138 will operate at the same speed.

On each of the side frame members 134 and 135, there is provided a pair of draw pins 160, each of which as seen in FIGS. 5 and 6, is provided with an L-shape bottom held to the respective side frame members by suitable fasteners such as screws 161. Each of the draw pins 160 extend up between the rollers 144 on the roller frames mounted on the rods of the piston-cylinder assemblies 139 and 140 and such draw pins extend to a position slightly below the tops of the rollers in the maximum elevation of such rollers as provided by the pistons 146. Thus elevation of the pistons of the piston-cylinder assemblies 139 and 140 will cause the lower flange of the flask F to rest upon the rollers 144 and when the pistons of such assemblies are retracted through a short stroke, e.g. ⅜ of an inch, the lower flange of the flask will rest on the tops of the draw pins as shown at 162.

When the piston-cylinder assemblies 137 and 138 are fully extended as well as the dash-pots 139, 140, the rollers 144 will be aligned both with the flask entry rollers 71 and the flask exit rollers 164 mounted on conveyor frames 165 in the same manner that the rollers 71 are mounted on the frame 72. It will, of course, be understood that both the entry and exit flask conveyors need not be attached directly to the machine, but may be part of a separate flask conveying system.

The conveyor frames 142 and 143 may be provided with top guide rails as shown at 167 in FIG. 6 closely to confine the flask flange 168 whereby it will be centered in the machine and aligning pins 169 may be provided properly to center the flask with respect to the table and pattern thereon.

Operation

Briefly, referring to FIG. 1, with the cradle frame 130 in its up position and with the four dash-pots 139, 140 also in their up position, the rollers 144 will be aligned with the entry and exit rollers 71 and 164 respectively. A flask will enter the machine from the left and be hooked by the latch 67 attached to the sand carriage. With the sand box of the sand carriage filled with a sand charge from the hopper 27, the piston-cylinder assemblies 60 and 61 will move the slide cutoff plate and the sand box from the left to the right thus bringing the sand charge and the flask directly over the pattern P positioned on the table T. It will, of course, be realized that this operation will push a finished mold from the machine on the exit rollers 164. In this position, the flask will now be on the rollers 143 and 144 and the sand carriage with the squeeze head latched thereto will now be directly over the pattern P and the squeeze head will be pushed to the dotted line position shown at 170 in FIG. 1. While in this position, the center roller conveyor section lowers placing the flask directly over the pattern P on the table T and the mold box is thus assembled. The piston-cylinder assemblies 48 and 49 are now energized opening the louvers 52 and the sand charge drops on the pattern and into the flask. At this time, the pattern, flask and sand therein can now be jolted if desired and while this is taking place, the sand carriage moves back to the left when the louvers 52 are closed and the box will be recharged with sand from the sand hooper which will fall into the sand box when the opening in the cutoff plate 38 is aligned therewith. It will, of course, be understood that the vertical lowering of the flask away from the sand box releases the latching engagement between the edge of the flask and the latch member 67. This latch member will, of course, latch on to a new flask when the sand box is moved back to its full line position as shown in FIG. 1. This return of the sand carriage also brings the squeeze head 82 back into the center of the machine until the stop screws 103 contact the frame 20. Energization now of the stationary overhead squeeze piston-cylinder 13, 14 will move the frame 20 downwardly moving the squeeze head 82 down therewith.

As seen in FIG. 3, pivotally mounted latching members 171 and 172 pivoted at 173 and 174 respectively to the frame 20 automatically shift into position to hold the squeeze head within the squeeze frame 20 as the frame 20 moves downwardly away from the top machine frame 11. Such latches are loaded by springs 175 and 176 respectively and the ends of such latching dogs contact adjustable stops 177 and 178 which, when the frame 20 is lowered, permit the latches to swing about their pivots to block movement of the frame 81 on the rollers 79 and 80. Continued lowering of the squeeze head by actuation of the piston-cylinder assembly 13, 14 causes the shoes 89 to engage the sand and such shoes can readily conform to the sand surface to squeeze the sand in the flask to the desired uniform hardness. A pressure switch as hereinafter described in the hydraulic circuit to the cylinder 13 may be employed to squeeze each sand mold to the same degree of hardness. When the overhead squeeze has been completed, the squeeze frame 20 will be retracted or lifted carrying with it the squeeze head and continued upward movement will cause the stops 177 and 178 to engage the latches 171 and 172 pivoting them to the position shown in FIG. 3 against the pressure of springs 175 and 176 so that the squeeze head will now be free to move laterally on the conveyor rollers 79 and 80. It is noted that the raising of the squeeze head will cause the pin 92 to engage in the latch member 93 again to couple the sand carriage and the squeeze head carriage together for movement as a unit. With the dash-pots 139 and 140 lowered, the draw frame 130 will now be elevated supporting the mold comprised of the flask and sand therein on the four draw pins 160 and elevation of the dash-pots 139, 140 will elevate the rollers 143 and 144 lifting the mold from the draw pins and aligning the conveyor on which the flask rests with the entry and exit conveyors. The pattern will be blown and sprayed in the conventional manner and energization of piston-cylinder assemblies 60 and 61 will push the finished mold from the machine on the exit conveyor rollers 164 while bringing a new flask F in position for the cycle to be repeated.

For a more detailed description of the operation, reference may be had to FIGS. 7, 8 and 9. In setting up the machine, the main selector switch 200 is turned on and the pump motor 201, which may be a 30 H.P. 1800 r.p.m. motor, is energized by pressing push button switch 202 which energizes relay 203 closing switches 204 to energize the pump 201. Such switches 204 may be in a 3 line, 440 60 cycle circuit with the remainder of the controls being in a 110 volt circuit derived therefrom through transformer 205. The relay 203 also closes switch 206 in the main 207.

For automatic operation, the selector switch 209 is turned to automatic and the pressing of push button switch 210 energizes holding relay 211 which holds in

for the complete ccyle. Such relay, inter alia, closes switch 212 which energizes the sand box forward solenoid 213 through normally closed switch 214 and closed limit switches 215, 216 and 217. When the box reaches its forward position centered over the flask and pattern, it opens limit switch 217 deenergizing solenoid 213. The limit switch 217 has another set of contacts 218 which close when the contacts 217 open energizing draw frame down solenoid 219 and relay 220. It will, of course, be understood that as the sand box comes forward, it brings the empty flask with it and places the flask on the frame rollers over the pattern and as the frame rollers are lowered by energization of solenoid 219, the flask will come to rest on the pattern plate and trip limit switch 221 which energizes timer 222, jolt solenoid 223 and empty sand box solenoid 224. When the timer 221 times out, it closes switch 225 in series with sand box reverse solenoid 226. Energization of solenoid 224 opens the louvers of the sand box to dump the charge of sand in the assembled flask and pattern plate and at the same time the jolt action begins through the energization of solenoid 223, if a jolt action is desired.

When the sand box returns through energization of solenoid 226, it trips limit switch contact 230 open and closes contact 231 energizing relay 232 and squeeze head down solenoid 233. As the squeeze head starts down and contacts the molding sand, the pressure in the hydraulic system increases until the full predetermined pressure is obtained actuating pressure responsive switch 234. The upper contacts of such switch deenergize relief valve solenoid 235 and the closing of the lower contacts of the pressure switch 234 energizes hold squeeze pressure timer 236 which on delay closes contacts 237. Closing of contacts 237 energizes relay 238 which opens contacts 239 and closes holding contacts 240. The closing of switch 237 by the timer 236 also energizes slow draw timer 241 and relay 242. The energization of relay 242 closes switch 243 which is in series with contacts 244 closed by the cycle relay 211 to energize the draw frame up solenoid 245 and the squeeze head up solenoid 246. The relay 242 also opens contacts 247 in series with the hold pressure on signal light 248 which was energized by the closing of contacts 244 and 243. Relay 249 in parallel with the signal light 248 is also energized to close contact 250 which is in series with limit switch contacts 251 and 252 operated by the draw frame and squeeze head being up. The opening of the contacts 247, of course, deenergizes the hold pressure on signal light 248 and the subsequent raising of the squeeze head or draw frame will close contacts 251 or 252 to provide a holding circuit for relay 249. Relay 242 also opens contacts 253 to deenergize the draw frame down solenoid as well as the squeeze head down solenoid 233. At the same time as the energization of the relay 242, the solenoid 255 is energized ensuring that the dash-pots are in the lower position and that the flask contacts the stripping pins 160. The energization of the solenoids 245 and 246 starts the draw frame and squeeze head up and when the timer 241 opens contacts 256 to deenergize solenoid 257, the slow draw solenoid 257 will thus be deenergized and the draw frame will continue up at a higher velocity. When the draw frame and squeeze head have reached their maximum position, they will open respectively limit switch contacts 259 and 260 to deenergize the cycle relay 211 which, of course, opens contacts 212 deenergizing the components in series therewith, one of which is the draw frame roller down solenoid 255. With this solenoid deenergized, the draw frame rollers 144 will be raised through the stroke of the dash-pots to align such rollers with the entry rollers 71 and exit rollers 164 lifting the flask from the draw pins 160 whereby the flask with the mold therein may be shuttled from the machine on the exit conveyor. It is noted that relay 249 will maintain solenoids 245 and 246 energized between cycles through the main 207 and the pressure for maintaining the draw frame and squeeze head up is developed by a small 8 gallon pump 261 which supplies a constant pressure at about 300 p.s.i. This completes the cycle except for the blow off and spray of the pattern which will occur when the cycle relay is deenergized by contacts 259 and 260 being actuated. It will, of course, be noted that various manual switches are employed throughout to control the function of, for example, the squeeze head down solenoid and the draw frame up and squeeze head up solenoids whereby the machine may be operated manually by such override switches. Moreover, various emergency stop switches are also provided.

Referring now more particularly to FIG. 7, it will be seen that the hydraulic system is comprised of a reservoir 265 which may be, for example, a 350 gallon tank which supplies through filters 266 and 267 the 8 gallon per minute pump 261, a 25 gallon per minute pump 268, a 75 gallon per minute pump 269 and a 25 gallon per minute pump 270. All of such pumps are driven from the pump motor 201. The outlet of the pump 268 leads through a flow control valve 271 through pressure switch 234 through an open center four-way solenoid operated valve 272 which may be operated by solenoids 233 and 245 to cause the squeeze head to go down and up respectively. To obtain a faster movement action, a second valve 273 may be employed which may be energized simultaneously with the valve 272 by solenoids 274 and 275. When the valve 273 is energized, for example, to move the squeeze head down, the fluid from the rod end of the cylinder 13 will be fed back into the blind end so that the difference in areas between the rod and blind ends will cause the squeeze head to move down rapidly.

Relief valve 276 is provided in the outlet of pump 268 which is operated by solenoid 235, such valve being in series with an unloading valve 277 which may be set, for example, to unload at 1500 p.s.i. A check valve 278 in the outlet line of the 8 gallon capacity pump 261 will keep the higher pressures in the outlet of the pump 268 from moving into the outlet of the pump 261. An unloading valve 279 set to unload, for example, at 300 p.s.i. may be provided in the outlet of pump 261. The 8 gallon capacity pump 261 will maintain the entire system at approximately 300 p.s.i. In addition to the two valves 272 and 273, the high volume pump 269 supplying fluid at approximately 75 gallons per minute will serve initially to supply fluid through lines 280 and 281 of the squeeze head to bring it down rapidly and when the squeeze biscuits 89 contact the sand, the pressure in the system will increase and at approximately 500 p.s.i., the unloading valve 282 will unload transferring the operation of the system to the low volume higher pressure pumps 268 and 270. The unloading valve 283 may be set to unload at approximately 1000 p.s.i. and a relief valve 284 may also be employed operated by a solenoid 285 which may be operated simultaneously with the relief valve solenoid 235. Fluid may also be supplied through line 286 having a 300 p.s.i. unloading valve 287 therein through a double solenoid operated four-way open center valve 288 which operates the cradle or draw frame lift cylinders 137 and 138. The valve 288 may be operated by solenoids 245 and 219 selectively to raise and lower the draw frame 130 having the flask F thereon. The solenoid operated spring return shut-off valve 289 operated by solenoid 257 is provided in a line 290 in parallel with a restriction 291. It can readily be seen that the initial energization in the draw of solenoid 257 will block the line 290 forcing all of the fluid through the restriction 291 to obtain the initial slow draw. When the timer 241 times out opening switch contacts 256 deenergizing solenoid 257, the fluid will pass through bypass line 290 completing the draw at the higher speed.

As seen in FIG. 8, air under pressure may be supplied from a source 300 at approximately 80 pounds per square inch and such air will pass through line 301 into a four-way solenoid operated valve 302 controlled by solenoids 213 and 226 which supply air selectively to the blind and

rod ends of the piston-cylinder assemblies 60 and 61 to obtain movement of the sand carriage and the squeeze head. A line 303 connects the source 300 with a four-way spring return solenoid operated valve 304 which is operated by solenoid 224 to control the operation of the piston-cylinder assemblies 48 and 49 to open and close the sand box louvers. Line 305 connects the source 300 with a two-way or shutoff spring return solenoid operated valve 306 which is operated by solenoid 223 to control the operation of the jolt piston 110. A line 307 connects the source 300 with a four-way solenoid operated valve 308 operated by solenoid 255 to control the operation of the four dash-pots 139, 140 to raise and lower the draw frame rollers from the drawing pins 160.

It can now be seen that there is provided a foundry molding machine capable of an extremely fast cycle with such machine cycle including an optional jolt in addition to a mechanical overhead squeeze. Such overhead squeeze is provided by a stationary overhead squeeze piston. The shuttling of the sand charge into the flask charge position from the fill position temporarily removes the squeeze head from the squeeze ram and replaces it when the sand box moves back to the fill position whereby the squeeze head will be in position properly to squeeze the thus sand charged machine. Moreover, with the present invention, it is possible to employ a multiplicity of various squeeze heads to obtain the desired squeeze action. With the mechanical squeeze, a uniform predetermined squeezing pressure may be applied mechanically to the top surface of the sand mold. Once the predetermined squeeze pressure is obtained, it can be held through the use of a timer before the squeeze head is removed and the mold drawn. This holding action may be employed to permit squeeze heads having relatively movable sand engaging portions (e.g. multiple pistons, diaphragms) properly to adjust to apply such predetermined pressure uniformly over the surface of the sand mold. With other type squeeze heads, such brief holding of the pressure will also produce better quality molds. Also, it will be seen that the shuttling movement of the sand charge is additionally employed to charge the machine with empty flasks and remove the completed molds.

It will, of course, be understood that the machine may be employed with the jolt action only, or vice versa, it may be employed with the mechanical squeeze action only depending upon the requirements of the particular foundry.

Other modes of applying the principle 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 foundry molding machine comprising a frame, a squeeze piston cylinder assembly secured to an upper portion of said frame, a squeeze head support, and a squeeze frame secured to the piston of said squeeze piston cylinder assembly for vertical movement therewith, said squeeze frame comprising a horizontally extending conveyor section, a squeeze head, means to shuttle said squeeze head from said support onto said conveyor section for vertical movement with said piston and squeeze frame, and means to prevent horizontal displacement of said squeeze head during such vertical movement.

2. A foundry molding machine as set forth in claim 1 wherein said squeeze frame comprises an omega-shape frame having inwardly directed flask supporting rollers on the legs thereof.

3. A foundry molding machine as set forth in claim 1 including a sand box operatively connected to said squeeze head for shuttling movement therewith into and out of a position vertically beneath said piston on said conveyor section, and means releasably connecting said squeeze head and sand box whereby said squeeze head may thus move vertically with said conveyor section.

4. A foundry molding machine as set forth in claim 3 including means to move a flask with said sand box to position the same vertically beneath said piston when said sand box is thus positioned.

5. A foundry molding machine as set forth in claim 4 including support means for such flask thus positioned, and means to lower said support means to assemble such flask with a pattern plate to form a mold box.

6. A foundry molding machine as set forth in claim 5 including jolt means supporting such assembled flask and pattern plate, and means responsive to the assemblage of such flask and pattern plate to empty such sand box and then jolt the thus filled mold box.

7. A foundry molding machine as set forth in claim 6 including means responsive to a predetermined time delay after the emptying of said sand box to remove said sand box and replace it with said squeeze head on said conveyor section.

8. A foundry molding machine as set forth in claim 7 including means responsive to the position of said squeeze head vertically beneath said piston operative to energize said squeeze piston cylinder assembly to move said conveyor section and thus said squeeze head downwardly.

9. A foundry molding machine as set forth in claim 8 including means responsive to a predetermined increase in pressure in the fluid system of said squeeze piston cylinder assembly further to increase the pressure therein until a predetermined squeeze pressure is obtained on the sand within such mold box.

10. A foundry molding machine as set forth in claim 9 including means responsive to a predetermined interval of application of such squeeze pressure to reverse the operation of said squeeze piston cylinder assembly to raise said conveyor section and thus said squeeze head.

11. A foundry molding machine comprising an upstanding frame, a squeeze ram assembly fixedly mounted on the upper portion of such frame, a horizontally movable squeeze head, means to shuttle said squeeze head to a position vertically beneath said ram for vertical movement therewith whereby said squeeze head will be operative to squeeze sand within a mold box vertically positioned therebeneath, and means to maintain said head beneath said ram during such vertical movement.

12. A foundry molding machine comprising a machine frame, a vertically reciprocable ram permanently located in the upper portion of said machine frame, horizontally extending conveyor means mounted on said machine frame, a sand box and squeeze head releasably interconnected and mounted on said conveyor means for horizontal movement as a unit, means to shuttle said sand box and squeeze head back and forth along said conveyor means alternately to position said sand box or squeeze head vertically beneath said ram, and a squeeze frame movable with said ram, said squeeze frame including a conveyor section horizontally aligned with said conveyor means in the up position of said ram adapted to receive said sand box or squeeze head.

13. A foundry molding machine as set forth in claim 12 including means to move a flask horizontally with said sand box to position such flask vertically beneath said ram on said conveyor section.

14. A foundry molding machine as set forth in claim 12 including means responsive to the vertical movement of said squeeze frame to latch said squeeze head in said squeeze frame to preclude relative horizontal movement of said squeeze frame and squeeze head.

15. A foundry molding machine as set forth in claim 12 wherein said squeeze head comprises a plurality of sand engaging surfaces, each vertically movable with respect to the other.

16. A foundry molding machine as set forth in claim 12 including means laterally adjacent said ram to fill said sand box with sand.

17. A foundry molding machine as set forth in claim

16 wherein said means to fill said sand box with sand comprises a sand chute, said sand box including a cutoff plate which moves with said sand box and closes said chute when said sand box is poitioned beneath said ram.

18. A foundry molding machine as set forth in claim 17 including means to dump the sand from said sand box automatically in response to the assemblage of a flask and pattern therebeneath.

19. A foundry molding machine as set forth in claim 12 wherein said squeeze frame comprises an omega-shape member with said ram secured centrally thereto.

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