July 9, 1957 H. J. B. HERBRUGGEN 2,798,266

CORE AND MOLD BLOWING METHOD AND APPARATUS

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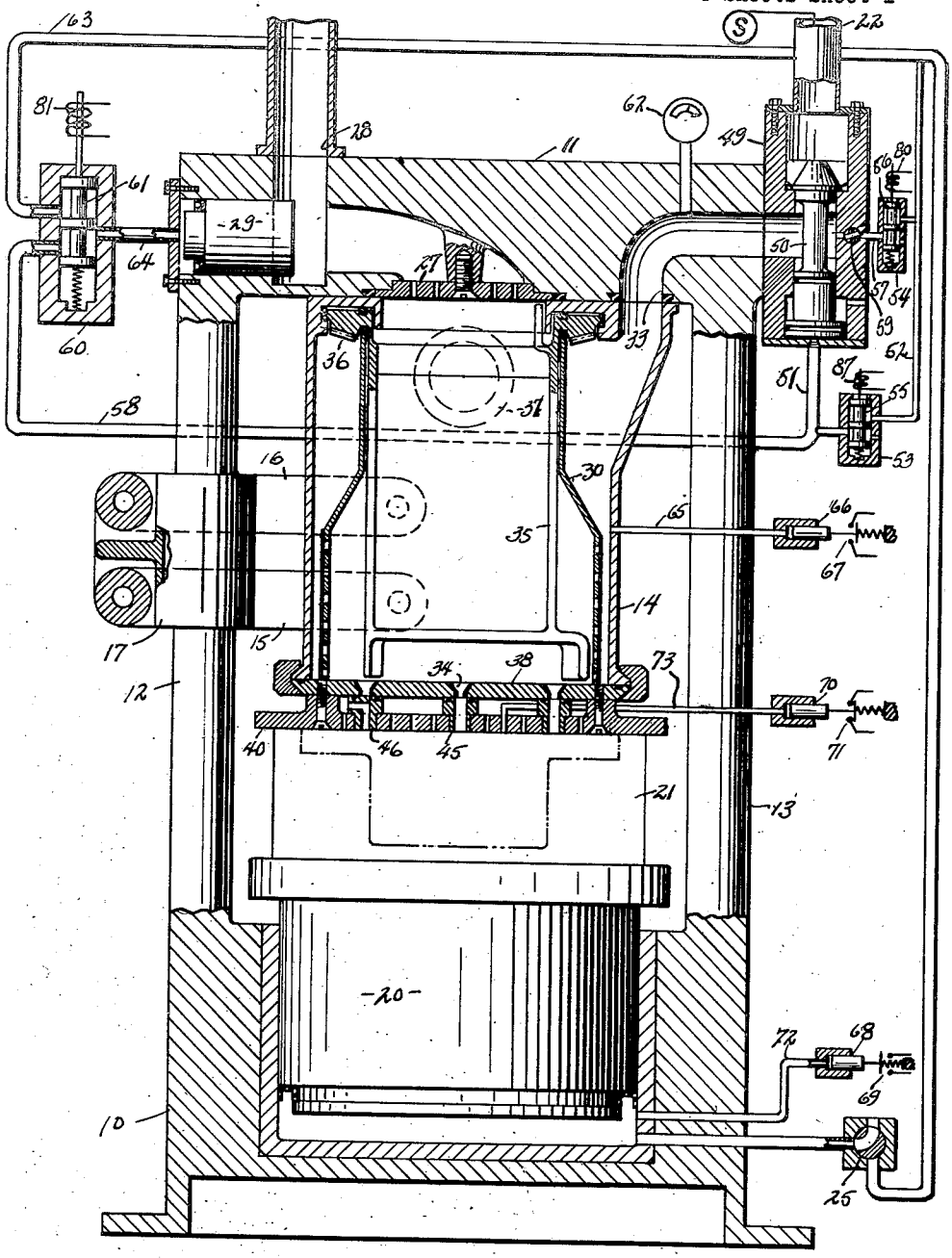


Fig. 1

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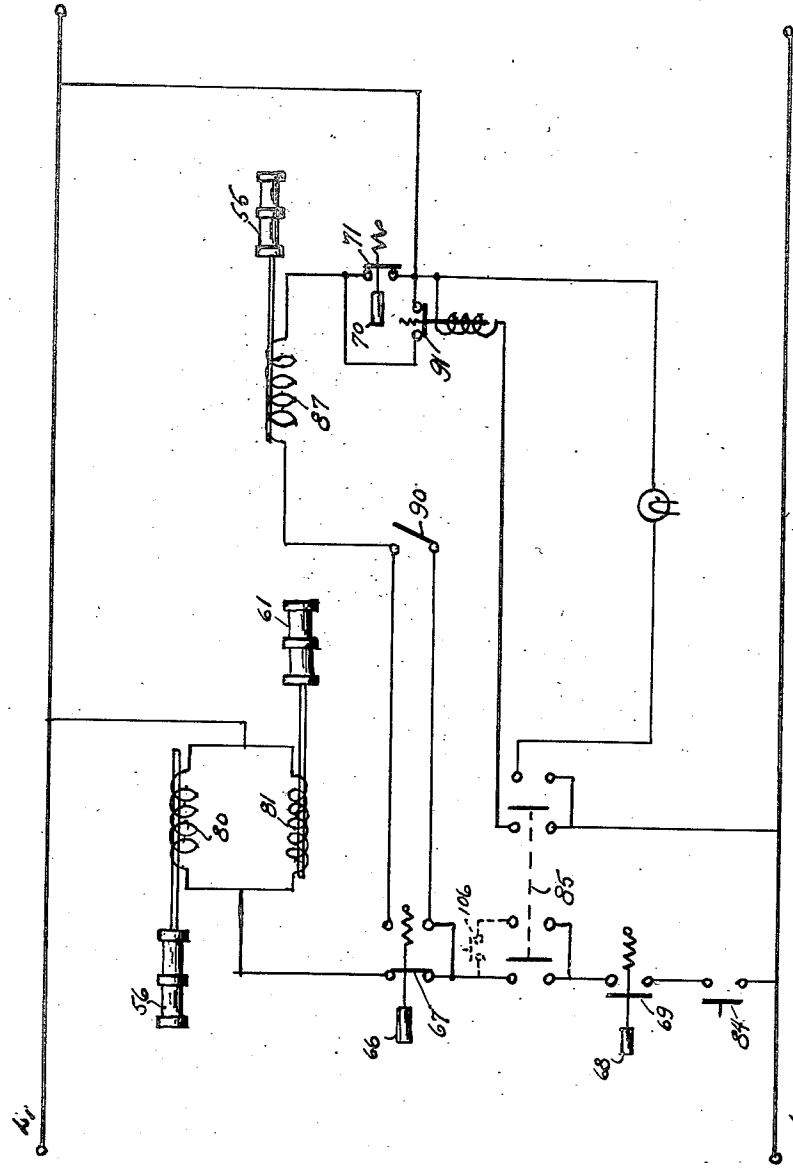


Fig. 2

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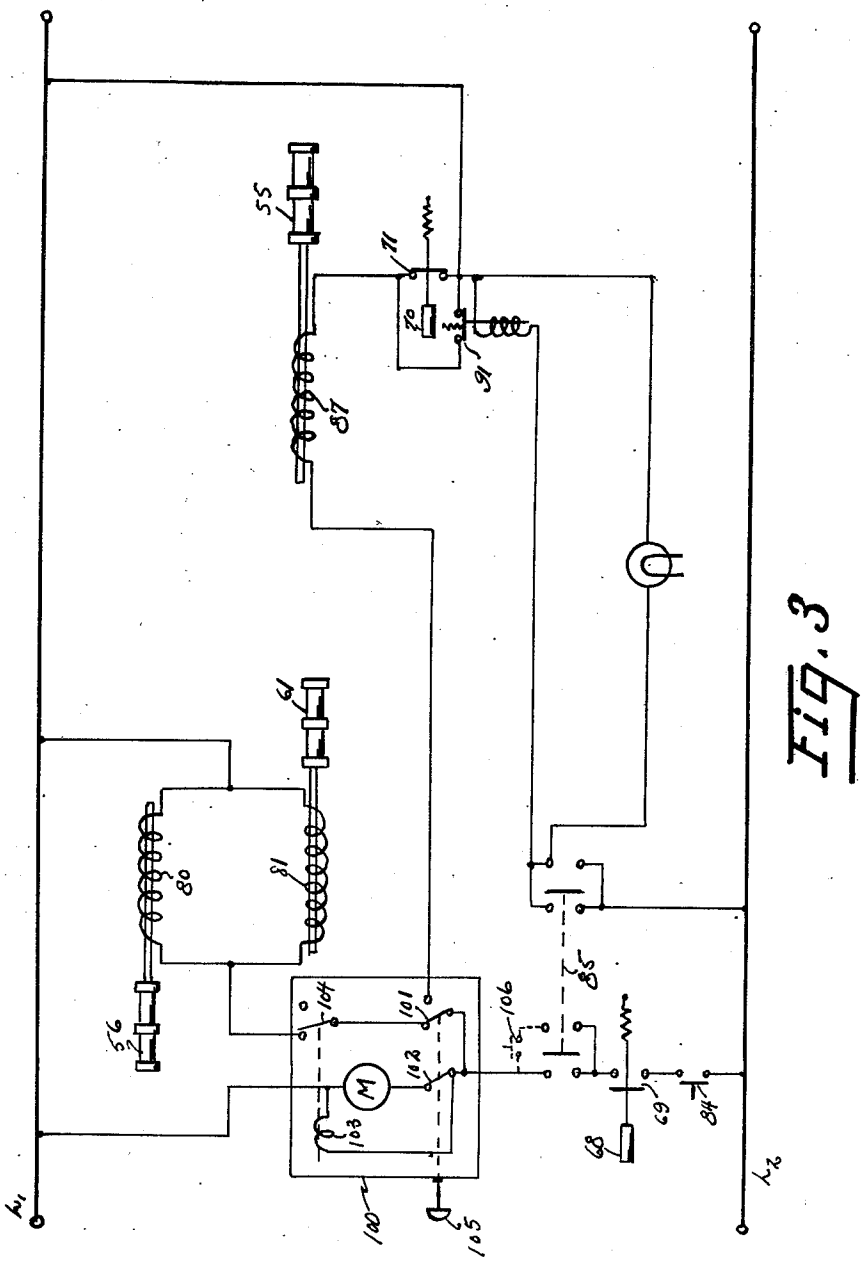


Fig. 3

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CORE AND MOLD BLOWING METHOD AND APPARATUS

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27 Claims. (Cl. 22—10)

This invention relates to the production of sand cores and molds and more particularly to a method and apparatus for improving the production of such cores and molds.

Sand blowing apparatus usually embodies a sand transfer chamber for delivering sand to a receptacle in the form of a mold or core box. The receptacle is usually supported on a lift or platform for positioning against the lower end of the transfer chamber, and the delivery of sand from the chamber may be aided by fluid pressure or by the combination of fluid pressure and agitation which passes the sand through a discharge opening and into the receptacle.

The fluid pressure is usually great enough so that the sand scratches or mars the mold or core box surface and may even stick to the pattern plates within the box. Likewise, the relatively high pressure applied to the box at the beginning of a blowing cycle has been known to displace the chills and wedge other loose parts into the core where they cannot be readily removed.

Accordingly it is an important object of this invention to provide a method and apparatus for blowing sand into a mold or core box without disturbing the contents or otherwise damaging the receptacle.

A further object of this invention relates to the provision of a method and apparatus for satisfactorily blowing sand into a mold or core box with considerably less fluid pressure consumption than heretofore used.

Briefly, in accordance with this invention there is provided a sand blowing apparatus having a transfer chamber with a fluid pressure inlet and an exhaust. The chamber has a blow plate with a sand discharge opening adapted for communication with a sand receptacle when positioned in sand blowing relation. The sand receptacle is preferably vented to enable the release of fluid pressure from the receptacle during the blowing operation. The sand blowing cycle may be initiated and terminated by hand operation or by automatically controlling the fluid pressure inlet and the chamber exhaust. Electromagnetically controlled valves are provided for selectively restricting the chamber inlet to permit pre-filling of the sand receptacle under a reduced fluid pressure. Other pressure operated valves are operatively coupled to the chamber and sand receptacle and arranged to selectively or otherwise remove the chamber inlet restriction and apply an increased fluid pressure to ram the sand in the receptacle at a predetermined time in the blowing cycle. The ramming of the sand in the receptacle may be applied continuously or intermittently.

In the drawings,

Fig. 1 is a vertical view in partial-section of a core blowing apparatus and fluid pressure control system;

Fig. 2 is a schematic diagram of an electro-magnetic control circuit for the apparatus and control system of Fig. 1; and

Fig. 3 is a schematic diagram of a modified form of the electromagnetic control circuit of Fig. 2

The sand blowing apparatus of Fig. 1 embodies an

enclosed vertical frame having a base 10 and vertically spaced crosshead 11 interconnected with spaced columns 12 and 13 to form a rigid load distributing supporting structure. Within the top portion of the enclosed frame is a sand transfer chamber 14 which is pivotally supported at the ends of arms 15 and 16 extending from pivotal connections at the column 12 to enable limited vertical movement of the transfer chamber within the frame. In normal use, the transfer chamber would be filled with sand from a hopper not forming part of this invention and therefore not shown. The supporting arms 15 and 16 of the transfer chamber 14 are preferably coupled to the journal 17 which in turn is rotatably mounted on the column 12 so that the transfer chamber may be swung about the column into filling position under a sand hopper and then back into the blowing position within the frame.

A lift piston 20 is operatively disposed within the base of the enclosed frame for positioning a sand receptacle 21 into operative core blowing engagement with the transfer chamber. Thus, when fluid pressure is supplied from a source conduit 22 through the three-way plug valve 25, the sand receptacle 21 is lifted upwardly on the piston 20 against the transfer chamber and the entire assembly is positioned and clamped in core blowing relation against the frame crosshead 11. In this position, the filling opening of the sand transfer chamber communicates through a filter 27 with an exhaust piston 29. The crosshead 11 also has a fluid pressure inlet 33 which communicates with the transfer chamber when the chamber is properly positioned in registration therewith.

In the preferred embodiment shown in Fig. 1, the transfer chamber 14 has an inner perforated partition 30 forming a sand room surrounded by an air jacket all of which is closed at the bottom by a removable blow plate closure 38. An agitator 35 is rotatably supported within the sand room from a driving ring gear 36 which is rotatably mounted at the top of the partition 30. The ring gear is driven by a spur gear 37 which is operatively disposed outside the sand room and within the air jacket of the chamber for protection against sand and dirt. The blow plate 38 is provided with one or more discharge openings 34 and has coupled thereto a vent plate 40 which is also provided with openings adapted to vent the interior of the sand receptacle to the atmosphere. The blow plate and vent plate assembly preferably has replaceable type blow hole bushings 45 which may be interchangeably replaced by plugs shown at the left in Fig. 1 at 46. The plug 46 blocks the discharge opening through the blow plate and is provided with a right angle vent passage which nevertheless vents the interior of the receptacle to the atmosphere. Thus, the location of the various discharge openings can be changed simply by exchanging bushings by plugs or vice versa.

The operative elements of the fluid pressure control system for the apparatus are also shown mounted at the inlet side of the crosshead 11 establishing communication between the inlet 33 and the source conduit 22. The valve casing 49 communicates at its upper end through the enlarged source conduit 22 to a source of fluid pressure S. The lower end of the casing 49 also communicates with the source through restricted conduits 51 and 52 and valve casings 53 and 54. The valve casing 53 and 54 respectively carry solenoid operated valves 55 and 56 which are selectively positioned by a control circuit to be hereinafter more fully described. The valve casing 53 has an atmospheric vent which is normally in communication with the conduit 51 when the solenoid operated valve 55 is not energized. The casing 54 has a conduit 57 which is connected to the main valve casing 49 through a throttle valve 59 in direct communication with the inlet 33 in the frame cross-

head. The valve 59 will permit an adjustment of the pre-fill pressure according to the type of sand, number of blow-holes, or size of core.

The main fluid pressure system is completed through a branch 58 of the conduit 51 which communicates with another valve casing 60 carrying a solenoid operated valve 61. The casing 60 in turn has two other conduits 63, which communicates directly with the source S, and 64, which is intended to supply fluid pressure to the small area end of the exhaust valve piston 29. The branch conduit 58 communicates with the branch 64 through the valve casing 60 when the solenoid operated valve is not energized. A suitable pressure gage 62 may be coupled to the inlet 33 through the crosshead 11.

The transfer chamber 14 has a conduit 65 communicating with the operating piston 66 of a spring-biased pressure operated switch 67 which is in turn electrically coupled to a control circuit for the solenoid operated valves as best shown in Fig. 2. Similar spring-biased pressure operated switches 69 and 71 are respectively coupled to operating pistons 68 and 70 which in turn are coupled respectively to a conduit 72 to the lift piston chamber and to a conduit 73 to the interior of the sand receptacle 21.

The valve operating solenoids 80 and 81 and the pressure operated switches 67, 69 and 71 are electrically interconnected through suitable switches and contacts as schematically shown in Fig. 2 of the drawings so that several different cycles of operation may be accomplished. Thus, the solenoids 80 and 81 are connected in parallel across electrical supply lines L1 and L2 through the normally closed contacts of the pressure switch 67 and the normally open contacts of the pressure switch 69 as well as through the normally open contacts of push-button switch 84 and the contacts of the main selector switch 85. The solenoid 87 is coupled across the lines L1 and L2 through a branch circuit which extends through the normally closed contacts of pressure switch 71 from line L1 through the solenoid coil 87 and normally open contacts of pressure switch 67 to line L2. The switch 90 and the relay 91 function with the selector switch 85 in other positions to change the cycle of operation, as will be hereinafter more fully described.

In operation, and referring now to Fig. 2 in relation to Fig. 1 of the drawings, when the main selector switch 85 is positioned to the left with the switch 90 open, the coil for the normally closed relay switch 91 is energized and the switch is open. Three-way valve 25 is opened and admits fluid pressure into the lift cylinder to lift the piston 20 and core box 21 against the transfer chamber 14 which in turn is positioned against the cross-head 11 of the frame. The pressure switch 69 closes as soon as the clamping pressure inside the lift cylinder reaches a predetermined value assuring proper clamping of the core box and transfer chamber against the cross head. Closing push-button switch 84 admits current from line L1 through pressure switch 69, selector switch 85, and pressure switch 67 to the parallel connected solenoid coils 80 and 81 which position valves 56 and 61 to establish communication between conduit 57 and the restricted intake conduit 52. Thus, fluid pressure passes from conduit 52 through valve casing 54, and conduit 57 into the air jacket of the transfer chamber 14. Fluid pressure passing through the conduit 63, valve casing 60, and conduit 64 moves exhaust piston 29 to close exhaust 28.

The restricted flow of fluid pressure entering the inlet 33 coupled with operation of the agitator 35 starts passing sand through the discharge operatings 34 into the sand receptacle 21 thereby pre-filling the receptacle with sand under a reduced pressure. During the pre-filling of the receptacle 21 the pressure within the receptacle is zero and the pressure inside the transfer chamber 14 amounts to only a few pounds. When pre-filling of the receptacle is completed, the operating piston 66 for the pressure switch 67, which may be set at approximately 10 p. s. i., shifts to open the switch contacts and circuits which energize the solenoid coils 80 and 81 and to close the energizing circuit through the solenoid coil 87. Fliud pressure now enters the main inlet valve casing 49 below valve piston 50 through valve casing 53 and conduit 51 and maintains the exhaust piston 29 closed through branch conduit 58 and valve casing 60.

Fluid pressure acting on piston 50 positions the piston to establish direct communication between the source conduit 22 and the inlet passage 33, thereby simultaneously increasing the blowing pressure to ram the sand in the receptacle. As soon as the pressure in receptacle 21 reaches a certain predetermined limit, the pressure switch 71 opens and deenergizes the solenoid 87 to exhaust the pressure at piston 50 and remove the full source pressure from the inlet 33. The pressure is also removed from exhaust piston 29 and the fluid pressure in the transfer chamber then escapes through the exhaust 23 and the pressure-ramming of sand in the receptacle 21 is interrupted until the switch 71 closes again. This occurs after the fluid pressure built up in the receptacle 21 has escaped through the vent-plate 40 and another ramming operation or cycle starts. Thus, with the selector switch 85 positioned to the left and the switch 90 open, the operation is such that the receptacle 21 is prefilled with sand at a reduced pressure and is then rammed intermittently with a high pressure until the operation is terminated by opening the operating circuit.

In the alternative, the cycle of operation may be changed to provide for pre-filling of the receptacle 21 at a reduced pressure with a subsequent continuous ramming of sand under high pressure by leaving switch 90 open and moving selector switch 85 to the right, thereby permitting the normally closed relay contacts 91 to bypass the pressure switch 71 and maintain the solenoid 87 energized after the pressure switch 67 has coupled it into the energizing circuit. In like manner, the apparatus may be continuously blown at full source pressure or intermittently rammed without pre-filling by merely closing the switch 90 and positioning the selector switch 85 to the right or left respectively.

In Fig. 3 of the drawings is shown a modified form of the control circuit wherein the pressure switch 67 is replaced by a timer mechanism designated generally at 100. This arrangement may be desirable where intricate cores are involved because for such cores the sand may pack prematurely in localized regions to build up a pressure within the receptacle sufficient to actuate the pressure switch 67. By replacing this switch with a timer controlled switch 101, the time of sand flow during prefilling can be set for a predetermined interval independently of the type of core involved.

In the preferred arrangement shown in Fig. 3, the timer drive motor M is coupled to line L, through switch 102 independent of the solenoid circuit and an electromagnetic clutch coil 103 is provided to drivingly engage the motor M with a conventional timer cam not shown in the drawings. The clutch coil 103 also acts as a solenoid to close switch 104 to the parallel circuit of solenoids 80 and 81, thus insuring energization of those solenoids at the same time as the timer motor M starts its timing cycle.

The switches 101 and 102 are mechanically coupled together to a hand reset device 105 by means of which they can be manually positioned to the right or left. When positioned to the right, the parallel circuit of solenoids 80 and 81 are isolated and the solenoid 87 is coupled for energization to permit continuous blowing or intermittent ramming at high pressure respectively depending upon whether switch 85 is positioned to the right or left. When the switches 101 and 102 are positioned to the left, the timer is active and solenoids 80 and 81 are energized to pre-fill the receptacle with sand

at low pressure. When the timer times out, switches **101** and **102** are positioned to the right to de-energize the solenoids **80** and **81** and the timer motor M and energize solenoid **87** to start the high pressure ramming which will be intermittent or continuous depending upon whether the switch **85** is positioned to the left or right. A safety switch **106** actuated when the core box is positioned against the chamber may be coupled into the circuit as shown by the dotted lines in Figs. 2 and 3.

Thus, there has been provided a method and apparatus whereby a sand receptacle such as a mold or core box may be prefilled with sand at a restricted or reduced blowing pressure and thereafter rammed intermittently or continuously at a relatively high fluid pressure, thereby accomplishing satisfactory results in the production of sand cores with less consumption of fluid pressure. The pre-filling at reduced pressure also aids in protecting the surfaces of molds or core boxes and to offset the possibility of breakage or damage and eliminates the danger or imperfect cores due to the disturbance of chills and other loose parts within the receptacle.

I have shown and described what I consider to be the preferred embodiment of my invention along with similar modified forms and suggestions and, it will be obvious to those skilled in the art that, similar changes and modifications may be made without departing from the scope of my invention as described by the appended claims.

I claim:

1. In a sand blowing apparatus the method of blowing sand into a receptacle consisting of, pre-filling the receptacle with sand at one blowing pressure and thereafter ramming additional sand into the receptacle at a higher blowing pressure.

2. In a sand blowing apparatus the method of filling a receptacle consisting of, pre-filling the receptacle with sand at one blowing pressure and thereafter intermittently ramming additional sand therein at a higher blowing pressure.

3. The method of blowing sand from a transfer chamber to a receptacle consisting of pre-filling the receptacle with sand under the influence of one blowing pressure, and thereafter alternately ramming the sand in the receptacle at a higher blowing pressure and exhausting the transfer chamber.

4. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, means for initially supplying fluid pressure to the transfer chamber to pre-fill the receptacle with sand, and other means for subsequently supplying an increased fluid pressure to the transfer chamber for ramming and packing the pre-filled and additional sand in the receptacle.

5. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, a sand transfer chamber having a blowing pressure inlet and exhaust and including a sand discharge opening adapted to be operatively positioned to communicate with a sand receptacle, means for restricting the fluid pressure inlet to reduce the blowing pressure during pre-filling of the receptacle with sand, and other means for removing the inlet restriction to increase the blowing pressure supplied to the transfer chamber for ramming and packing the sand in the receptacle.

6. In a sand blowing apparatus having a transfer chamber with a discharge opening adapted for communication with a sand receptacle, said chamber having a fluid pressure inlet, a solenoid controlled means for restricting the flow of fluid pressure to the inlet, other solenoid operated means for removing the restriction to increase the flow of fluid pressure to the chamber inlet, an electrical circuit including a switch adapted to be positioned to energize said first solenoid operated means, and a second electrical circuit including a pressure operated switch operatively coupled to the transfer chamber for energizing said other solenoid operated means in response to the attainment of a predetermined pressure within the transfer chamber.

7. The apparatus of claim 6, wherein the second circuit includes another pressure operated switch coupled to the sand receptacle and operative in response to the attainment of a predetermined pressure in the receptacle to deenergize said second circuit and thereby to isolate the transfer chamber from the increased pressure.

8. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, a sand transfer chamber having a blowing pressure inlet and exhaust and including a sand discharge opening adapted to be operatively positioned for communication with a sand receptacle, means including a solenoid actuated valve for controlling the blowing pressure inlet to restrict the blowing pressure supplied to the chamber inlet during pre-filling of the receptacle with sand, other means including a second solenoid actuated valve for controlling the blowing pressure inlet to remove the restriction of the first solenoid actuated valve to supply an increased blowing pressure to the chamber inlet after pre-filling the receptacle with sand, an electrical circuit including a switch adapted to be positioned to energize said first solenoid actuated valve, and a second electrical circuit including a pressure operated switch operatively coupled to the transfer chamber for energizing said other solenoid actuated valve in response to the attainment of a predetermined pressure within the transfer chamber.

9. An apparatus for blowing sand from a transfer chamber having a discharge opening into a receptacle, said chamber having a main valve controlled inlet adapted to be connected to a source of blowing pressure, said chamber also having a restricted valve controlled inlet adapted to be connected to the source independently of said main inlet, means for opening the restricted valve controlled inlet to pre-fill the receptacle under a reduced blowing pressure, other means coacting in response to the attainment of a predetermined pressure in the chamber to open the main valve controlled inlet and thereby cause the pre-filled sand to be rammed in the receptacle under the influence of the full blowing pressure.

10. The apparatus of claim 9, wherein said first-mentioned means is a solenoid actuated valve member and wherein said other means is a pressure actuated switch coupled to the transfer chamber, and an electrical circuit adapted to operatively connect said solenoid actuated valves and switch to a source of electrical energy.

11. An apparatus for blowing sand from a transfer chamber having a discharge opening into a receptacle, said chamber having a main valve controlled inlet adapted to be connected to a source of blowing pressure, said chamber also having a restricted valve controlled inlet adapted to be connected to the source independently of said main inlet, means for opening the restricted valve controlled inlet to pre-fill the receptacle under a reduced blowing pressure, and timer actuated means for opening the main valve controlled inlet after a predetermined time interval, thereby causing the pre-filled sand to be rammed in the receptacle under the influence of the full blowing pressure.

12. In an apparatus for blowing sand from a transfer chamber having a discharge opening into a receptacle, a main valve controlled inlet adapted to connect the chamber to a source of blowing pressure, a restricted valve controlled inlet adapted to connect the chamber to the source independently of the main inlet, a valve controlled exhaust for the chamber, means for opening the restricted valve controlled inlet to pre-fill the receptacle under a reduced blowing pressure, other means coacting in response to the attainment of a predetermined pressure in the chamber to open the main valve controlled inlet while maintaining the valve controlled exhaust closed, thereby causing the pre-filled sand to be rammed in the receptacle under the influence of the full blowing pressure.

13. The apparatus of claim 12, wherein said first-mentioned means includes a solenoid actuated valve for the main inlet and wherein said other means includes a

solenoid actuated device and a pressure responsive switch coupled to the transfer chamber and coacting in response to the attainment of a predetermined pressure in the chamber to open the main valve controlled inlet, and an electrical circuit adapted to operatively connect the solenoid actuated valves and the pressure responsive switch to a source of electrical energy.

14. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination of, solenoid actuated means for supplying the blowing pressure to the chamber to pre-fill the receptacle with sand, other solenoid actuated means for supplying an increased blowing pressure to ram sand in the receptacle, an electrical circuit including a switch adapted to be positioned to energize said first solenoid actuated means, and a second electrical circuit including a pressure operated switch operatively coupled to the transfer chamber for energizing said other solenoid actuated means in response to the attainment of a predetermined pressure in the transfer chamber.

15. An apparatus for blowing sand from a transfer chamber having a discharge opening adapted for communication with a receptacle comprising in combination, pressure actuated means for positioning the receptacle in sand blowing relation adjacent the discharge opening of the transfer chamber, solenoid actuated means for supplying blowing pressure to the chamber to pre-fill the receptacle with sand, other solenoid actuated means for supplying an increased blowing pressure to ram the sand in the receptacle, an electrical circuit including a pressure responsive switch operatively coupled to the pressure actuated receptacle positioning means and coacting in response to the attainment of a predetermined pressure therein to energize said first solenoid actuated means, and a second electrical circuit including a pressure switch operatively coupled to the transfer chamber for energizing said other solenoid actuated means in response to the attainment of a predetermined pressure in the transfer chamber.

16. In a sand blowing apparatus having a sand transfer chamber with a discharge opening in communication with a sand receptacle, an electrical control circuit therefor comprising, a first solenoid actuated valve adapted to be positioned when energized to supply a blowing pressure to the chamber, a second solenoid actuated valve adapted to be positioned when energized to supply an increased blowing pressure to the chamber, a main switch, a pressure switch having a normally closed and a normally open contact and coupled to the chamber for operation between the contacts in response to the attainment of a predetermined pressure in the chamber, means for connecting said first solenoid actuated valve to a source of electrical energy through the normally closed contact of said pressure switch and said main switch, and other means connecting said second solenoid actuated valve to the source of energy through the normally open contact of said pressure switch.

17. The apparatus of claim 16, wherein said last-mentioned means includes normally closed pressure switch coupled to the sand receptacle for operation in response to the attainment of a predetermined safe pressure in the receptacle and wherein said normally closed switch is connected in series with said second solenoid actuated valve.

18. The apparatus of claim 16 including pressure actuated means for positioning the sand receptacle into and out of sand blowing relation with the transfer chamber and including another pressure switch having a normally open contact coupled to said pressure actuated positioning means for operation in response to the attainment of a predetermined pressure therein, and wherein said first solenoid actuated valve connecting means extends through the normally open contact of said other pressure switch.

19. In a sand blowing apparatus having a sand transfer chamber with a discharge opening in communication with a sand receptacle, an electrical control circuit therefor comprising, a first solenoid actuated valve adapted to be positioned when energized to supply a blowing pressure to the chamber, a second solenoid actuated valve adapted to be positioned when energized to supply an increased blowing pressure to the chamber, a main switch, a pressure switch having a normally closed and a normally opened contact and having a switch arm coupled to the chamber for operation between the contacts in response to the attainment of a predetermined pressure in the chamber, means for connecting said first solenoid actuated valve to a source of electrical energy through the normally closed contact of said pressure switch and said main switch, a second pressure switch having normally closed contact and coupled to the sand receptacle for operation in response to the attainment of a predetermined safe pressure in the receptacle, means for connecting said second solenoid actuated valve to the source of energy through the normally open contact of said first pressure switch and the normally closed contact of said second pressure switch, said last mentioned means including a selector switch adapted to be positioned to electrically by-pass the contacts of said first pressure switch.

20. The apparatus of claim 19 wherein said last-mentioned means also includes a relay switch adapted to be energized through the main switch to electrically by-pass the normally closed contact of said second pressure switch.

21. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, a vertically disposed sand transfer chamber having a blowing pressure inlet and exhaust and including a sand discharge opening in the bottom thereof adapted to be operatively positioned to communicate with a sand receptacle, said blowing pressure inlet to the chamber being located in the side wall thereof adjacent the chamber bottom and having a passageway adapted for connection to a supply of fluid under pressure, means for restricting the passageway to reduce the blowing pressure during prefilling of the receptacle with sand, and other means for removing the passageway restriction to increase the blowing pressure supplied to the transfer chamber for ramming and packing sand in the receptacle.

22. The apparatus of claim 20, wherein the transfer chamber includes a separate internal chamber wall leaving a plurality of openings adjacent the bottom establishing communication with the transfer chamber and the blowing pressure inlet.

23. The apparatus of claim 22 wherein the internal chamber has means for agitating the sand to aid its passage through the discharge opening in the transfer chamber.

24. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, a sand transfer chamber having a blowing pressure inlet and exhaust and including a sand discharge opening adapted to be operatively positioned to communicate with a sand receptacle, a source of fluid under full blowing pressure, another source of fluid under reduced blowing pressure, means for coupling the fluid pressure inlet to the source of reduced blowing pressure until the receptacle is prefilled with sand, and other means for subsequently coupling the inlet to the source of full blowing pressure to ram and pack the sand in the receptacle.

25. In an apparatus for blowing sand from a transfer chamber into a receptacle the combination comprising, means for initially supplying fluid under pressure to the transfer chamber to prefill the receptacle with sand, other means for subsequently supplying fluid under increased pressure to the transfer chamber to ram and pack sand into the receptacle, and means coacting with the fluid pressure to agitate the sand and aid its transfer from the chamber into the receptacle.

26. In an apparatus for blowing sand from a transfer chamber into a receptacle which has a pattern plate positioned at the bottom thereof the method consisting of, initially introducing sand into the receptacle and against

the pattern plate at a pressure which is sufficient to fill the receptacle but below the pressure necessary to ram and pack the sand therein, and thereafter introducing additional sand into the receptacle at a pressure sufficiently high to effect a ramming and packing of the sand therein.

27. In an apparatus for blowing sand from a transfer chamber into a receptacle the method consisting of, forming a mold within the receptacle by initially causing sand to be carried by a relatively low pressure fluid stream from the transfer chamber into the receptacle to prefill the receptacle with sand, and thereafter ramming the charge of sand by further introducing sand under a higher blowing pressure until the mold becomes sufficiently hard and dense for casting purposes.

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