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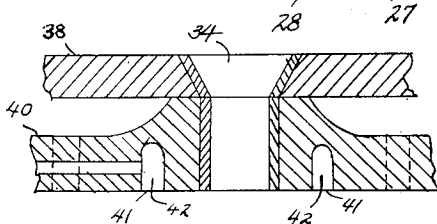
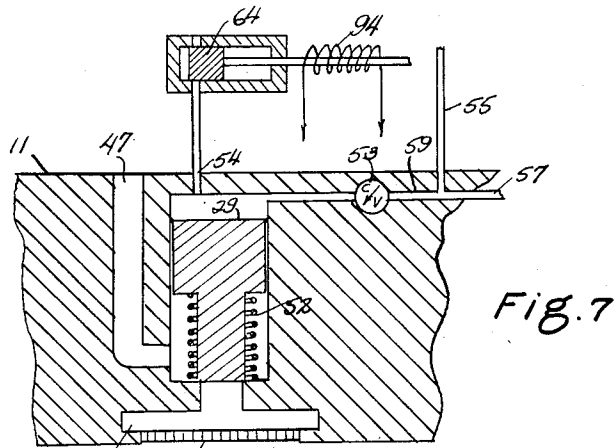
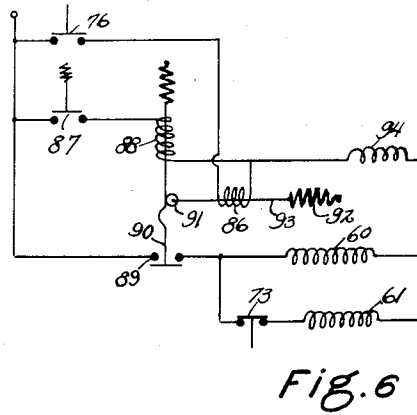
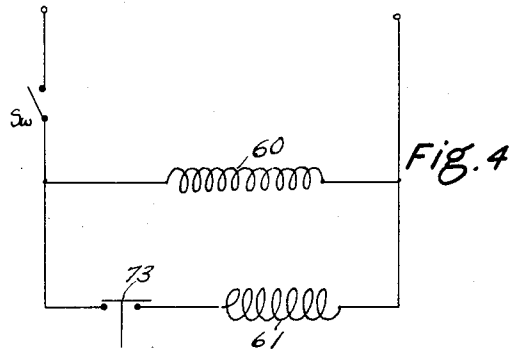
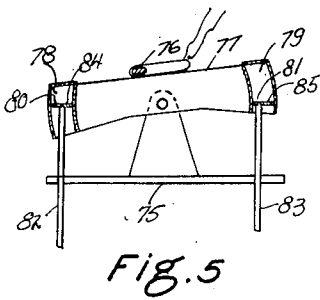
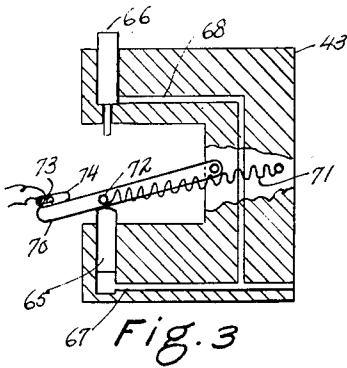
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2,779,074

METHOD OF BLOWING SAND INTO SAND MOLDS

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2 Sheets-Sheet 2



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METHOD OF BLOWING SAND INTO SAND MOLDS

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5 Claims. (Cl. 22—193)

This invention relates to a control system for a core or mold blowing apparatus and more particularly to a system and apparatus for automatically determining the blowing cycle while limiting the pressure in the mold or core box and the rate of positioning the mold or core box into blowing position. This application is a division of my application Serial No. 286,774 filed May 8, 1952, and entitled Control System for Sand Blowing Apparatus.

A sand blowing apparatus usually embodies some means such as a sand transfer chamber for delivering sand to a receptacle in the form of a mold or core box. The delivery of sand from the chamber may be aided by fluid pressure or by the combination of fluid pressure and an agitator. The apparatus may also be provided with means such as a lifting mechanism for positioning and clamping the sand receptacle and sand transfer chamber in sand blowing relation. A desirable feature for such an apparatus relates to the provision of an automatic blowing cycle with proper sequential control of the receptacle positioning and delivery of sand thereto.

Additional desirable features relate to safety precautions in the operation and control of the apparatus. For example, the conventional core blowing apparatus utilizes clamping and blowing pressures which many types of core boxes are too frail to withstand. Accordingly, when using sand receptacles made of wood or the like, it has been necessary in the past to make the cores by hand or to copiously vent the receptacle for use with the conventional blowing apparatus. Copious venting, however, has inherent disadvantages in the construction of the receptacle as well as providing unsatisfactory and inferior cores or molds. Furthermore, utilization of uncontrolled fluid pressure in conventional core blowing apparatus requires cumbersome and uneconomical design of the operative elements. For example, it is common practice in conventional types of apparatus to make the lift or clamping pistons slightly larger than the largest sand receptacle.

The positioning of the mold or core box into blowing relation with a sand transfer chamber presents additional problems in handling during the blowing operation, since the usual positioning or lift mechanism utilizes the full clamping force to position the mold or core box against the transfer chamber and causes damage to the apparatus and to the box.

Accordingly, it is an object of this invention to provide an apparatus and control having an improved automatic blowing cycle with proper sequential control of sand receptacle positioning and sand delivery thereto.

Another object of this invention is to control the sand delivery pressure during the blowing cycle so as to limit the pressure in the sand receptacle to a predetermined safe value.

Still another object of this invention is to limit the rate of travel of the sand receptacle positioning mechanism to a predetermined safe rate until the receptacle and sand transfer chamber are in blowing position and then to automatically supply an increased clamping pressure for the blowing operation.

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Still another object of this invention is the reduction in size of the sand receptacle lift mechanism to provide a lighter and more economical apparatus.

A further object of this invention is to automatically terminate the blowing cycle when the sand receptacle is filled with sand.

A still further object of this invention is to automatically initiate the blowing operation when the sand receptacle is properly positioned in blowing relation with the sand transfer chamber.

Briefly, in accordance with this invention there is provided a closed rigid frame having a sand transfer chamber within the top portion and surmounting a sand receptacle lift mechanism within the lower portion of the closed frame. The transfer chamber is provided with a controlled fluid pressure inlet and the apparatus includes a device to regulate the fluid pressure admitted to the chamber inlet. The apparatus also includes a fluid pressure device that operates in response to a predetermined fluid pressure in the chamber consequent upon the receptacle being filled with sand to remove the fluid pressure from the chamber and thereby automatically terminate the blowing cycle.

A sand receptacle positioning mechanism is provided which embodies a lift piston that is initially actuated by a reduced fluid pressure to limit the rate of lifting travel to a predetermined safe rate. The clamping action is controlled by fluid pressure devices which respond to a developed pressure within the lift piston cylinder when the piston has reached the limit of its travel to supply an increased fluid clamping pressure to the lift piston during the blowing cycle.

Further in accordance with this invention, the controlled fluid pressure inlet for the sand delivery mechanism may be coupled to the lifting mechanism so that it will respond to the developed pressure in the lift piston cylinder incident to the positioning of the sand receptacle in blowing relation to initiate the blowing cycle and the entire system may be coupled together to automatically initiate sand delivery and safety controls in a predetermined blowing cycle.

In the drawings,

Fig. 1 is a partial vertical section of the blowing apparatus schematically coupled together with the mechanical controls of the system;

Fig. 2 is a schematic circuit diagram for electro-magnetically controlling the blowing cycle while maintaining safety precautions during the blowing operation;

Fig. 3 is an enlarged partial sectional view of the device which regulates the pressure in the sand receptacle;

Fig. 4 is a schematic circuit diagram of an electro-magnetic control system for regulating the pressure in the sand receptacle;

Fig. 5 is an enlarged view, partially in section, of the fluid pressure device which automatically determines the blowing cycle;

Fig. 6 is a schematic circuit diagram for electro-magnetically controlling the pressure in the sand receptacle and terminating the blowing cycle;

Fig. 7 is a partial sectional view of the sand transfer chamber exhaust in a modified form; and

Fig. 8 is a partial view, in section, of the blow and vent-plate assembly at the discharge opening.

Referring to Fig. 1 of the drawings, there is shown a sand blowing apparatus embodying a closed frame having a base 10 with a vertically spaced cross head 11 rigidly interconnected together through spaced vertical columns 12 and 13 to form a support for the operative members of the apparatus which will uniformly distribute the operating loads. A sand transfer chamber 14 is operatively supported within the upper portion of the frame by arms 15 and 16 which are pivotally connected to a journal 17

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rotatably mounted on the column 12. A sand hopper 18 is supported externally of the closed frame on the column 12 and above the plane of the sand transfer chamber 14. The hopper is provided with a discharge opening 19 which is normally closed by a pivot gate 20 and surrounded by a loose scraper ring 21. The arrangement is such that the sand transfer chamber 14 can be rotated on its journal 17 about the column 12, into filling position under the hopper 18 and then can be swung back within the closed frame into core blowing position.

Within the lower portion of the closed frame, there is provided a cylinder 22 which supports a movable lift piston 23 for vertical movement towards and away from the sand transfer chamber. The lift piston 23 supports a clamping table 24 on which a sand receptacle such as a mold or core box 25 is placed for positioning and clamping in blowing relation against the sand transfer chamber. The term core box will hereinafter be used to describe either a core box or mold for convenience of description.

The sand transfer chamber 14 forms a blow-head which is pivotally supported at the ends of the arms 15 and 16 for vertical movement parallel to the columns 12 and 13 within the closed frame. Thus, when a core box 25 is placed on the clamping table 24 and the lift piston 23 is actuated to lift the core box into engagement with the underside of the sand transfer chamber, the entire assembly of core box and transfer chamber is positioned against the cross head 11. The filling opening 26 of the transfer chamber communicates through a filter 27 with an exhaust space 28 in the cross head having an exhaust valve 29 which may be opened or closed as will be hereinafter more fully described.

The sand transfer chamber 14 has an inner perforated partition 30 forming an inner sand room surrounded by an air jacket in communication with a fluid pressure inlet 33 at the top of the transfer chamber. Fluid pressure is admitted through the inlet 33 into the air jacket and passes through the perforations in the partition 30 into the sand room to force sand through a discharge opening 34 at the base of the chamber. The sand room in the transfer chamber contains an agitator 35 which is rotated by a gear ring 36 supported at the top of the transfer chamber. The gear ring 36 is driven by a spur gear 37 which is located in the air jacket for protection against sand and dirt. The spur gear 37 may be driven by any suitable means such as an electric motor. The bottom of the sand transfer chamber 14 is closed by a removable blow-plate 38 which is coupled to the chamber through a spider by bayonet type lugs 39 for ready maintenance and interchange.

The blow plate 38 preferably has a single sand discharge opening 34 in the center and carries a vent plate 40 which is adapted to engage the top of the core box 25 for venting the box to the atmosphere. Other vents 41 around the discharge opening 34 of the blow-plate do not communicate with the free air but are connected through a venting chamber 42 with a fluid pressure operated device 43 as best shown in Fig. 8 of the drawings. The vents are suitably spaced from the discharge opening 34 to avoid the escape of sand from the core box.

The transfer chamber exhaust valve 29 is spring biased in a normally open position and the fluid pressure inlet 33 in the cross head 11 contains a spring-biased valve 44 which normally isolates the chamber inlet 33 from a source of fluid pressures connected to the cross head 11 by the main supply line 45. Fluid pressure is also led from the supply line 45 to the casings 48 and 49 of normally closed valves 50 and 51 which in turn have control conduits 55 and 56 leading to the cross head and to the lift piston cylinder respectively. The control conduit 55 leading from the valve casing 49 has a branch conduit 57 communicating with the underside 58 of the inlet valve 44 to oppose the spring load and another branch conduit 59 communicating with the exhaust valve 29 to oppose the spring load on that valve.

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In the preferred embodiment shown in Fig. 1, each of the valves 50 and 51 are electro-magnetically positioned by means of solenoids 60 and 61 acting on the respective piston rods 62 and 63. When the solenoid 60 is energized it positions the valve 50 to establish communication between the conduit 56 leading to the lift piston cylinder 22 and the main supply line 45 to position the core box 25 in core blowing relation against the sand transfer chamber 14. In like manner, when the solenoid 61 is energized it positions the valve 51 to establish communication between the main supply line 45 and the branch conduits 57 and 59. The arrangement is such that fluid pressure acting on the under side 58 of the inlet valve 44 opens the inlet conduit 46 to pressure from the supply line 45 while fluid pressure acting on the exhaust valve 29 counteracts the spring load and isolates the transfer chamber 14 from the exhaust opening 47 in the cross head 11. The energization of each of these solenoids 60 and 61 may be hand-controlled by means of a circuit switch to initiate and stop the core blowing cycle or may be automatically controlled by a circuit as shown in Fig. 2 to remain energized for a predetermined core blowing cycle, as will be hereinafter more fully described.

Referring now to Fig. 3 of the drawings, there is shown an enlarged view of the fluid pressure device 43 that communicates with the venting chamber 42 which surrounds the discharge opening 34 in the blowplate 38. This device has a U-shaped body with pistons 65 and 66 freely supported in each leg for movement along a common axis parallel to the base of the body. Each piston 65 and 66 surmounts a fluid pressure path 67 and 68 communicating with the venting chamber 42. When fluid pressure is supplied from the core box 25 through the venting chamber 42 to the fluid pressure device, each of the pistons 65 and 66 are lifted in the same direction. A lever arm 70 is pivotally connected to the base of the U-shaped body and extends between the legs of the body to intersect the common aligned axis of the freely supported pistons 65 and 66. The lever arm 70 is biased by a spring 71 which is connected to an off-center position 72 on the arm 70 so as to retain the arm in either one of two positions overlying one or the other of the pistons 65 or 66. The spring load on the spring 71 is selected so that it will be overcome by the force of piston 65 acting under a predetermined safe value of fluid pressure in the core box 25 to snap the lever arm 70 from its lower position to its upper position between the legs of the U-shaped body.

At the free extremity of the lever arm 70 is a mercury switch 73 which, in the preferred embodiment shown, is normally closed in the lower position of the lever arm so that when the lever arm is tilted upwardly the mercury travels by gravity to the lower end of the switch capsule 74 and opens the circuit between the wires connected thereto. These wires may be connected in a simple hand-controlled start and stop circuit as shown in Fig. 4 of the drawings, so that when the lever arm 70 is tripped to open the mercury switch 73 it also deenergizes the solenoid 61 to close the valve 51 and allow the spring biased inlet valve 44 to isolate the sand transfer chamber 14 from the main fluid pressure supply line 45. The pressure is also removed from the spring-loaded exhaust valve 29 which opens and allows the transfer chamber 14 to exhaust to the atmosphere, thereby causing a reduction of fluid pressure in the chamber and in the core box until such time as the freely supported pistons 65 and 66 in the fluid pressure device 43 drop back to their initial positions by virtue of gravity and swing the lever arm 70 back to its initial position to again close the mercury switch 73 and energize the solenoid 61. This operation may take place a number of times during a core blowing cycle and functions to regulate fluid pressure in the core box 25 by pulsing the admission of fluid pressure to the sand transfer chamber 14 so that it never reaches a value greater than the core box will withstand.

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The fluid pressure regulation may also be controlled by a timer or by a fluid pressure responsive or timed throttle valve in the inlet. The relief of this pressure is accomplished in pulsations at sufficient frequency so that the chamber is not completely exhausted between pulsations.

The core blowing cycle described in connection with the circuit of Fig. 4 of the drawings is a simple hand-controlled stop and go operation which required the intervention of the operator to determine the duration of the blowing cycle. Referring again to Fig. 1, the preferred embodiment shown there may be operated to automatically determine the duration of the core blowing cycle by virtue of the pressure operated device 75. An enlarged view of this device is shown in Fig. 5 of the drawings in the form of a differential fluid pressure operated device carrying a mercury switch 76. The differential device 75 is in the form of a scale arm 77 pivotally supported intermediate its ends which are in the form of valve chambers 78 and 79 open at the base to receive fluid pressure orifices 80 and 81 which in turn are connected through suitable conduits 82 and 83 to the air jacket of the sand transfer chamber 14. Each of the orifices 80 and 81 is provided with a washer 84 and 85 to allow expansion of the fluid pressure within the closed end of the corresponding valve chamber formed in each end of the scale arm 77. Thus, an unbalance of pressure between the orifices 80 and 81, or a difference in the length of the scale lever arms or in the washer sizes will cause the scale arm 77 to tilt or rotate about its pivotal support.

In the preferred embodiment shown in Fig. 1 of the drawings, one of the orifices 81 is coupled to the air jacket adjacent the inlet end of the transfer chamber 14 while the other orifice 80 is coupled to the air jacket in spaced relation adjacent the discharge end of the transfer chamber, so that while the core box 25 is being filled with sand and the fluid pressure is flowing from the inlet 33 of the transfer chamber through the discharge opening 34 there is a differential of pressure between each of the orifices 80 and 81. The scale lever arms are such that the differential of pressure through the transfer chamber 14 will maintain the scale arm 77 in a position to render the mercury switch 76 normally open. As soon as the core box 25 is filled with sand however, fluid pressure within the transfer chamber equalizes and the scale arm 77 is tilted to close the mercury switch 76 and energize a solenoid 86 in an electro-magnetic control circuit to de-energize the solenoids 60 and 61 and thereby automatically terminate the core-blowing cycle as shown in schematic circuit diagram of Fig. 6 of the drawings.

In the circuit diagram of Fig. 6, the core blowing cycle is initiated by means of a momentary push button 87 which energizes the solenoid 88 to close the normally open contacts 89. The closing of the contacts 89 energizes the solenoid 60 and the solenoid 61 through the normally closed mercury switch 73. Since the push button 87 is a momentary push button, means are provided for holding the solenoid circuits energized after the push button 87 is released. As shown in Fig. 6, this is accomplished by latching the contact arm 90 with the spring biased roll 91 to maintain the energizing circuit through the solenoids 60 and 61. This latch will maintain the energizing circuit until the mercury switch 76 is closed to energize the latch solenoid 86 which provides an unlatching force greater than the bias of the spring 92 on the latch arm 93 to remove the latch and open the contacts 89, thereby deenergizing the solenoid circuits 60 and 61 until such time as the push button 87 is again operated.

The control and regulation of the pressure within the core box 25, which was described in connection with Figs. 2 and 3 of the drawings as a pulsating operation which periodically closed the fluid pressure inlet to the transfer chamber 14 and opened the chamber exhaust 47, may be modified so that the chamber exhaust 47 remains closed and only the fluid pressure inlet 33 is pulsed so that the

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fluid pressure within the transfer chamber 14 is reduced a lesser extent each time that the safe limit of fluid pressure in the core box 25 is attained. This modified form, wherein the exhaust remains closed during the pulsing of the fluid pressure inlet, saves the time of rebuilding the fluid pressure to the blow pressure and may be advantageous in some circumstances.

A preferred way of modifying the apparatus to enable it to operate in this modified manner is shown in the partial sectional view of the crosshead in Fig. 7 of the drawings. In this modified construction, the fluid pressure conduit 59 in the crosshead 11, which counteracts the loading spring 52 to close the exhaust valve 29, is provided with a one way check valve 53 which prevents the removal of fluid pressure from the exhaust valve 29 when the solenoid 61 is deenergized by the pulsing mercury switch 73. The exhaust valve chamber is provided with an atmospheric release vent 54 from the crosshead which is normally closed by means of an electromagnetically operated valve 64. In this modified form of operation, the exhaust valve 29 need not open until the termination of the core blowing cycle. Accordingly, the solenoid 94 for positioning the valve 64 to open the atmospheric vent 54 to the exhaust valve chamber may be connected in series with the solenoid 86 and the mercury switch 76 so that when the core blowing cycle is automatically terminated by the operation of the switch 76 the solenoid 94 is also energized and opens the atmospheric vent 54 to the exhaust valve chamber, thereby enabling the exhaust valve 29 to open and exhaust the sand transfer chamber.

As previously noted, energization of the solenoid 60 also establishes communication between the main fluid pressure supply line 45 and the cylinder 22 of the lift piston to position the core box in core blowing relation against the sand transfer chamber. In the preferred embodiment shown in Fig. 1, the conduit 56 supplies such fluid pressures through a one way check valve 95 directly to the underside of the lift piston 23 in the piston cylinder. The conduit 56, or the inlet from valve casing 50, is of lesser cross sectional area than the main fluid pressure supply line 45 so as to restrict the flow of fluid pressure to the lift piston cylinder. This results in a restricted flow of pressure being supplied to the lift piston cylinder 22 which nevertheless is sufficient to lift the piston 23 and position the core box 25 and transfer chamber 14 against the crosshead 11. The restricted flow of fluid pressure is such that it will allow a predetermined safe rate of lifting travel of the lift piston 23 and prevent the core box 25 from being slammed or banged against the blow plate 38 of the sand transfer chamber. The main fluid pressure supply line 45 also communicates with the lift piston cylinder through a normally closed fluid pressure operated valve 96 which is biased in the closed position by a spring 97 in the valve casing 98. The end of the valve casing 98 opposite the spring 97 is in communication through another conduit 99 and fluid operated valve 100 with the conduit 56. The valve 100 is also normally biased in the closed position by means of a spring 101 at one end of the casing 102 while the other end of the casing 102 communicates with the branch conduit 103 which is connected to the supply conduit 56.

When the lift piston 23 reaches the limit of its travel, after having positioned the core box and transfer chamber against the crosshead 11, the pressure builds up in the piston cylinder 22 and develops a unit pressure greater than the restricted pressure supplied by the conduit 56 which is sufficient to overcome the spring bias on the valve 100 and position the valve to establish communication between the conduit 56 and the valve casing 98. The valve 96 is positioned under fluid pressure from conduit 99 to establish communication between the main fluid pressure supply line 45 and the lift piston cylinder 22, thereby supplying full fluid line pressure to the lift piston cylinder 22 to maintain the core box and transfer

chamber in secure clamped core blowing relation against the crosshead 11.

The casing 106 of a fluid pressure operated differential exhaust valve 107 is also connected at one end with the lift piston cylinder 22 and at the other end with the supply conduit 56. The differential valve 107 normally maintains the exhaust vent 108 of the casing 106 closed until the solenoid 60 is deenergized to isolate the supply conduit 56 from the main fluid pressure supply line 45 and remove the fluid pressure from the conduit 56 to allow the line pressure in the lift piston cylinder 22 to exhaust and lower the core box 25 from core blowing position for ready removal and replacement.

This lift piston arrangement may be readily coupled together with the other operative elements of the apparatus into an overall automatically operated system as shown in the preferred embodiment of Fig. 1 and in the circuit control diagram of Fig. 2. This is accomplished by inserting an additional contact switch 110 in series with the solenoid 61 and controlling the switch so that the solenoid 61 is not energized until after the core box 25 is positioned and clamped in core blowing relation with the sand transfer chamber. In the preferred embodiment of Fig. 1, the switch contacts 110 are closed by another differential fluid pressure operated valve 112, having the large area side 113 of its casing 114 coupled to the conduit 105 and the small area side 115 coupled directly to the main fluid pressure supply line 45. The valve 112 carries an operating lever 111 which is positioned with the valve 112 to close contacts 110 mounted on the valve casing after the lift piston 23 has reached its limit of travel and the pressure from the lift cylinder 22 is sufficient to overcome the balance of the line pressure at the other end of the casing 114.

When the lift mechanism hereinbefore described is coupled together with the control system and other operative elements of the apparatus, it enables a reduction in size of the lift piston due to the reduced or limited opposing fluid pressure load attainable in the core box. Heretofore, it has been common practice to make the lift piston area slightly larger than the supported surface of the largest core box. This led to cumbersome and uneconomical designs which can be overcome by utilizing the lift mechanism and apparatus described and which enables safe operation with a lift piston of a size slightly greater than the sand filling opening of the transfer chamber.

The circuit of Fig. 2 also illustrates additional refinements; one of which is a normally open safety switch 116, also in series with the solenoid 61, which has contacts 117 that may be closed by the core box 25 or lift piston mechanism in core blowing position.

Another refinement relates to the automatic starting and stopping of the agitator 35 within the sand transfer chamber 14. As previously noted, the agitator 35 may be driven by an electrical motor M. The energizing windings 120 of the motor may be connected in parallel with the solenoids 60 and 61 and in series with a switch 121 as shown in Fig. 2. The switch arm 121 is carried by a spring-biased movable valve 122 which is positioned in its casing 123 by the increased pressure in the line 103 when the core box and transfer chamber are positioned against the cross head 11 to close the contacts 124 and energize the motor windings 120.

Thus, applicant has provided a sand blowing apparatus with a control system which automatically determines the duration of the blowing cycle while maintaining certain safety precautions such as limiting the maximum

developed fluid pressure in the sand receptacle to a predetermined safe value as well as limiting the rate of lifting travel of the receptacle and transfer chamber to prevent damage during positioning. The system also includes other ancillary safety controls all of which are automatically operated in proper sequence throughout the blowing cycle.

This apparatus and control system enables the automatic blowing of sand into wooden or other frail sand receptacles without damage and enables a reduction in the size of the lift clamping pistons, thereby eliminating cumbersome construction and providing a lighter weight and more efficient blowing apparatus which operates automatically in an optimum manner.

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

I claim:

1. A method of making sand molds comprising, blowing sand into a mold-forming receptacle until the unit pressure therein reaches a predetermined amount which is less than the unit pressure of the source of pressure utilized for blowing the sand, then stopping the blowing of sand until the unit pressure in the receptacle is lowered, and then repeating the operation until the receptacle is filled with sand.

2. A method of blowing sand from a transfer chamber into a mold-forming receptacle comprising, throttling the blowing pressure to limit the resultant unit pressure in the receptacle to an amount less than unit pressure of the blowing pressure source.

3. A method of blowing sand from a transfer chamber into a mold-forming receptacle comprising, alternately admitting and releasing blowing pressure to and from the chamber until the receptacle is filled with sand, and controlling the alternate admission and release of blowing pressure to limit the unit pressure in the receptacle to an amount less than the unit pressure of the blowing pressure source.

4. A method of blowing sand from a transfer chamber into a mold-forming receptacle comprising, admitting blowing pressure to the chamber until a predetermined safe amount of unit pressure is attained in the receptacle, then stopping and releasing the blowing pressure from the receptacle, and then repeating the operation until the receptacle is filled with sand.

5. A method of making sand molds comprising, blowing the sand into a mold-forming receptacle in pulsations until the receptacle is filled with sand and controlling the pulsations to limit the pressure in the receptacle to a predetermined amount in the range between above atmospheric and below the blowing pressure of the sand.

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