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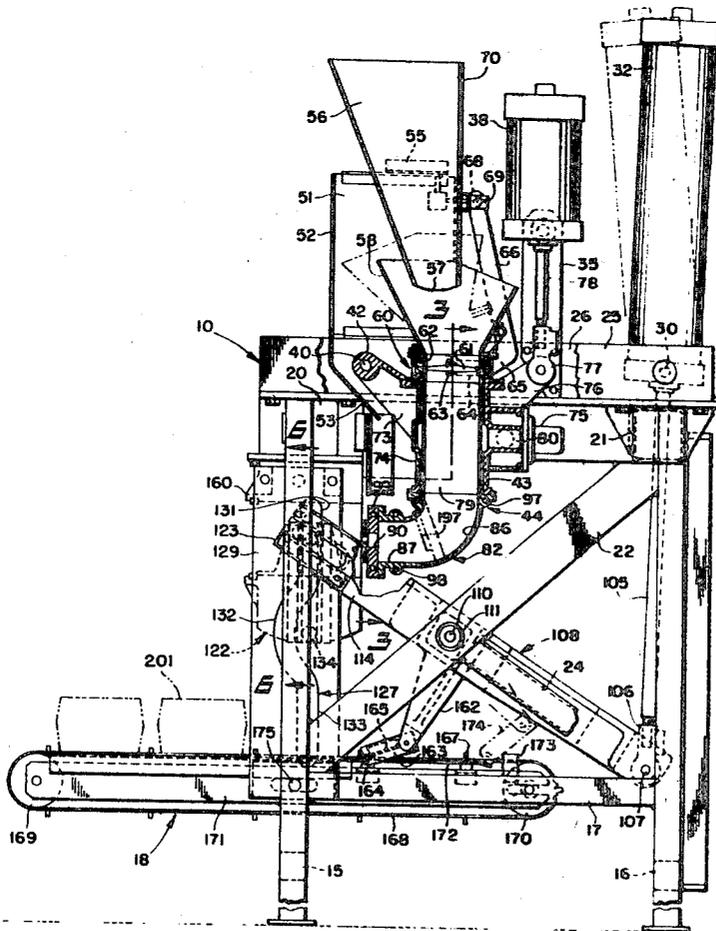
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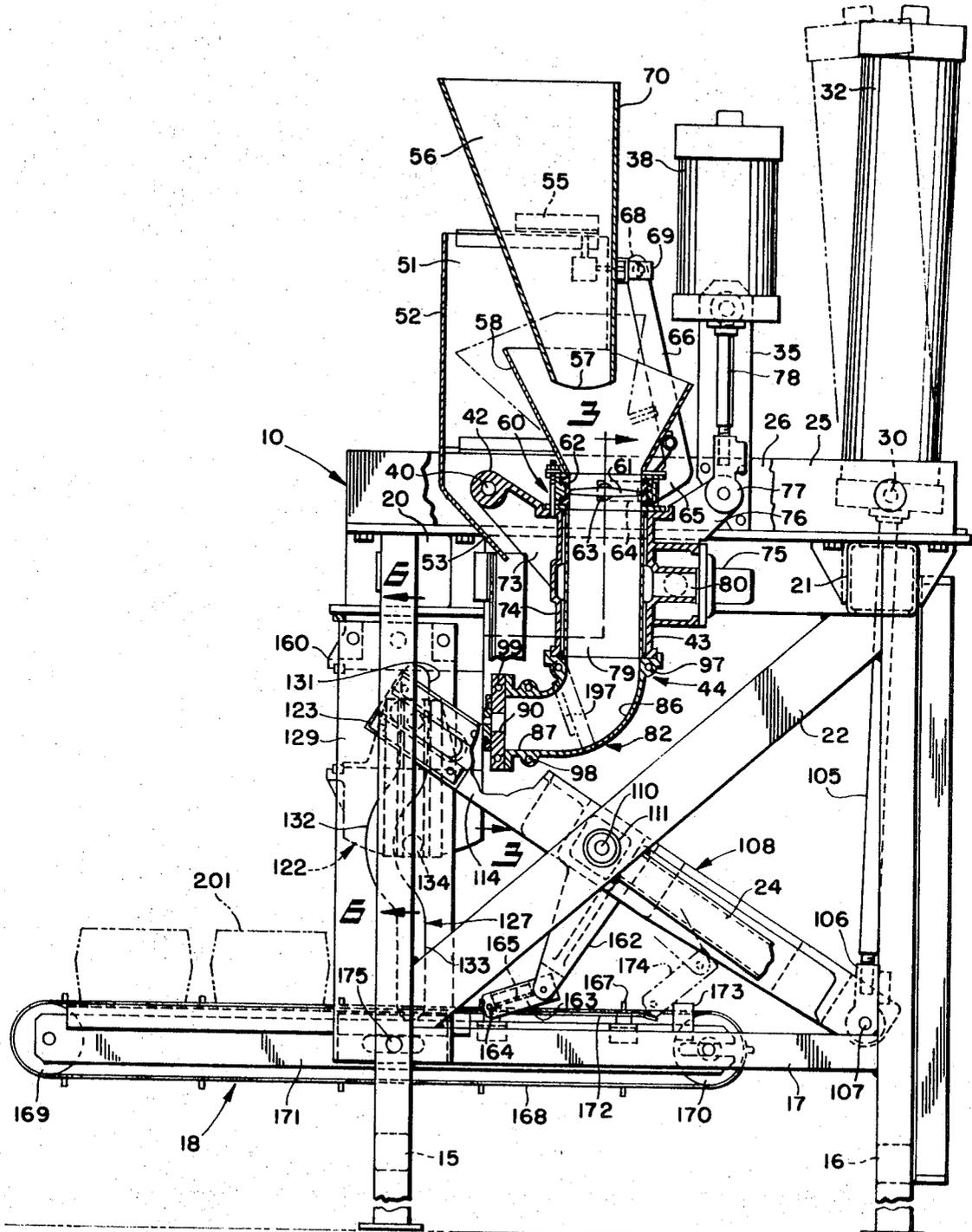
[54] **FOUNDRY SAND ARTICLE FORMING MACHINE WITH PIVOTAL BLOW RESERVOIR**  
 28 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **164/192,**  
 164/22, 164/201  
 [51] Int. Cl..... **B22c 15/24**  
 [50] Field of Search..... **164/201,**  
 200, 202, 22, 192, 183

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**ABSTRACT:** A machine for the production of foundry sand articles including a first piston-cylinder assembly for forming a box, a second such assembly for filling a reservoir with molding sand and clamping such reservoir laterally against such box for the sand to be blown therein, the first assembly disassembling such box and stripping the sand article therein onto a discharge conveyor after the second assembly has withdrawn the reservoir for filling, the first assembly also indexing the conveyor.





**Fig. 1**

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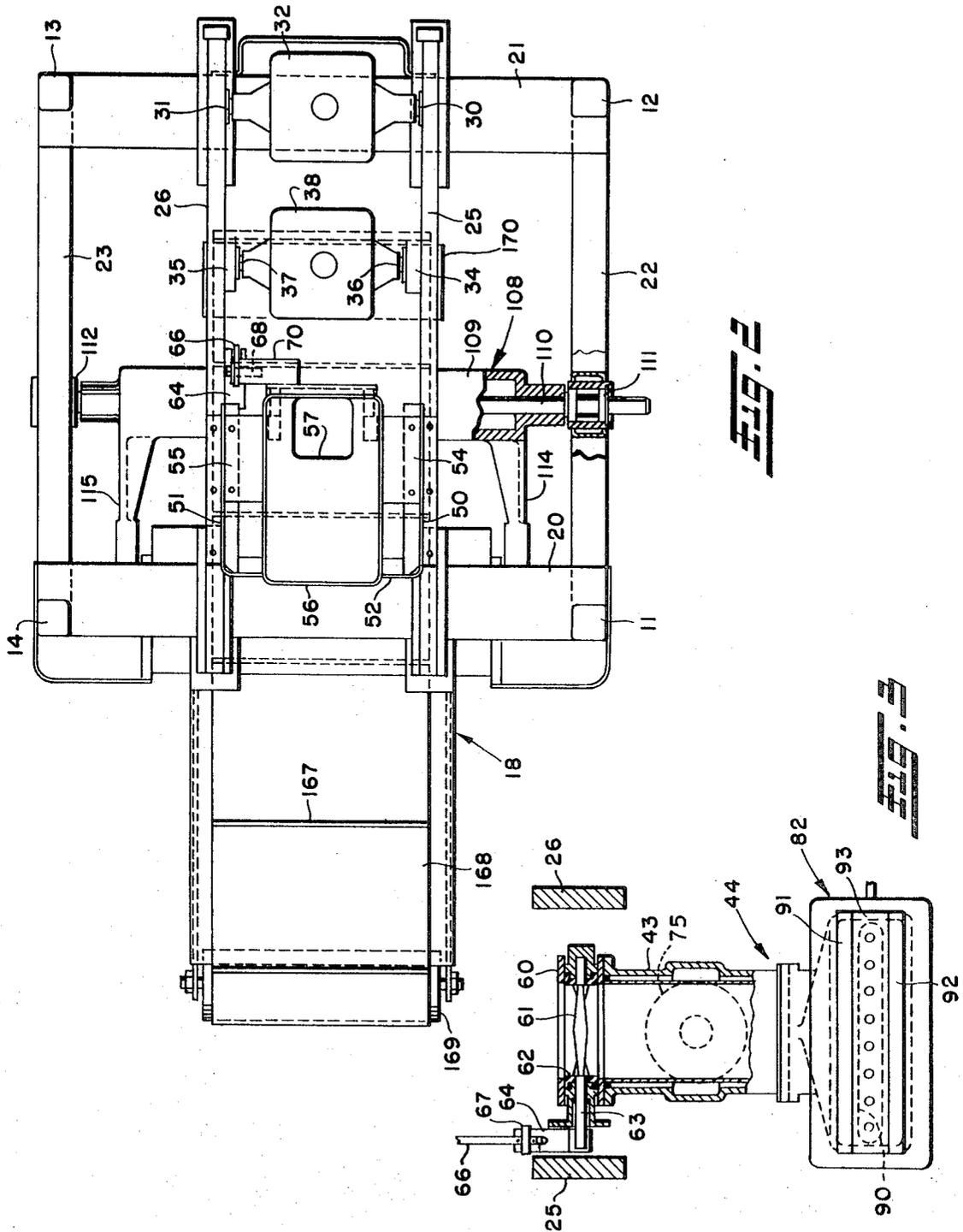
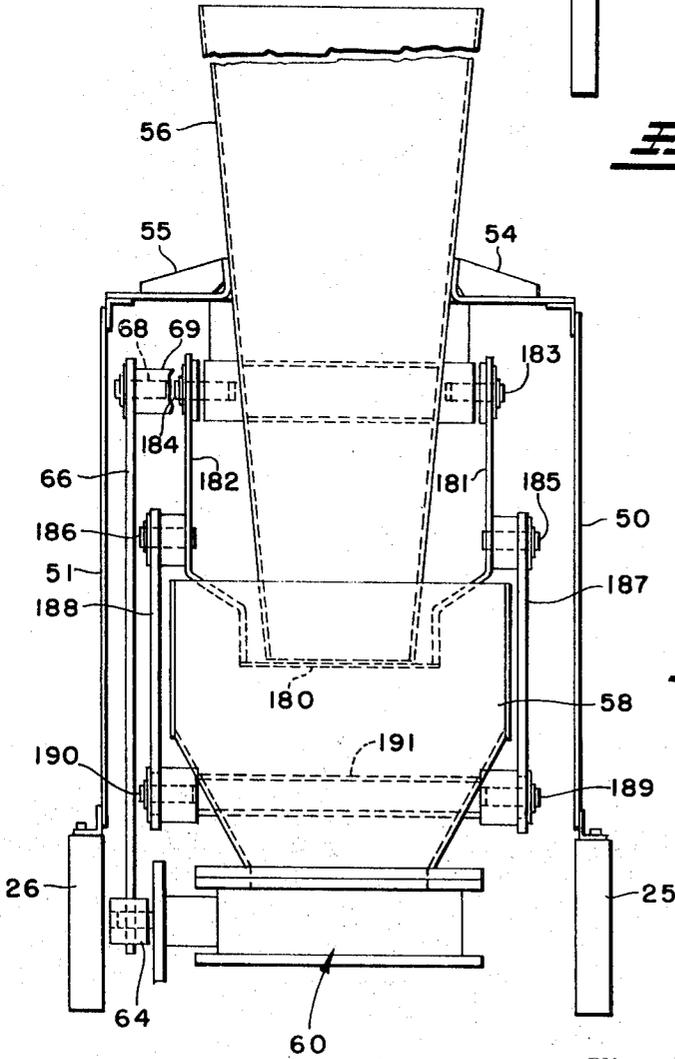
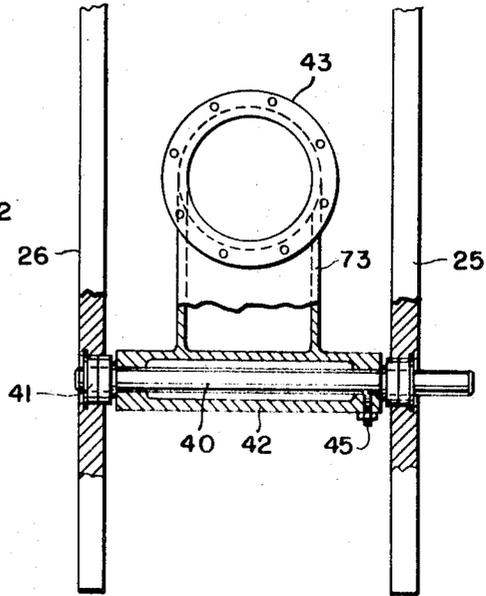
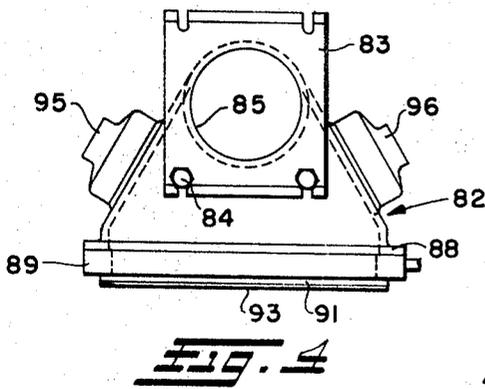


FIG. 2

FIG. 3

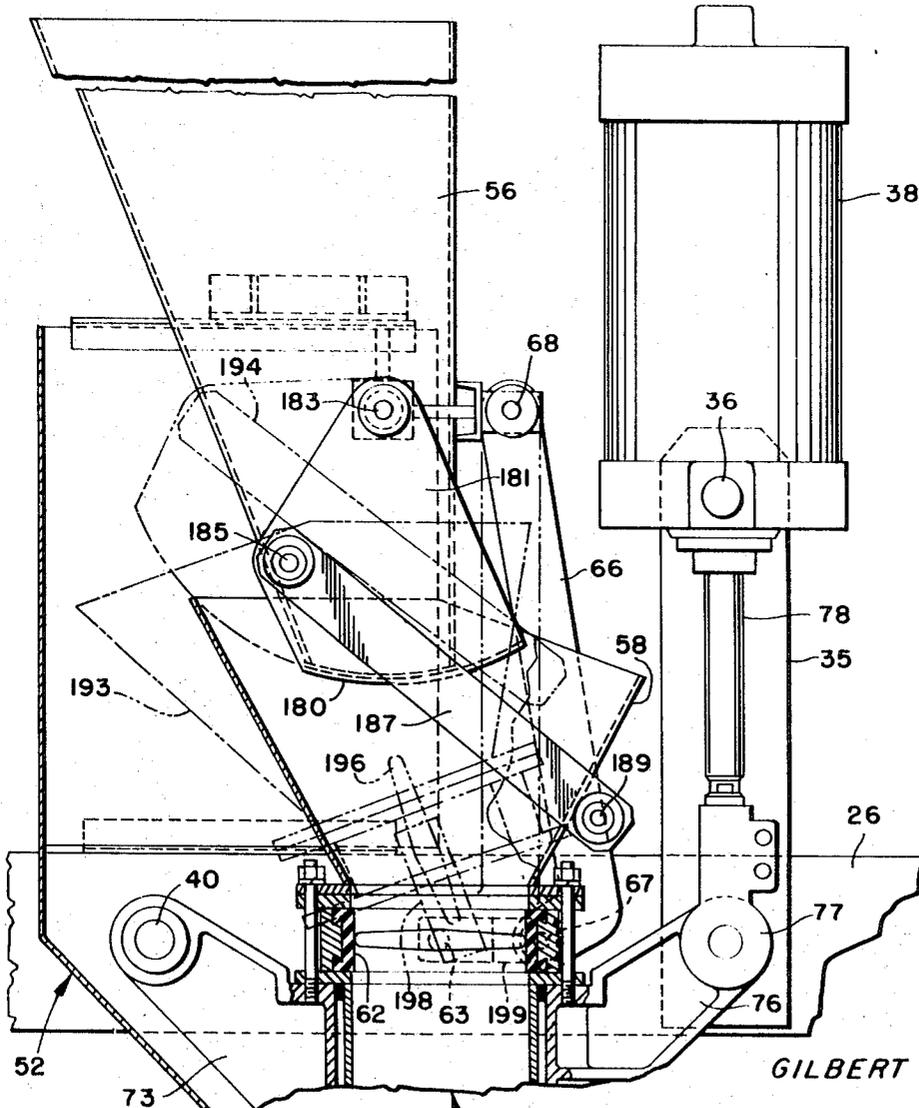
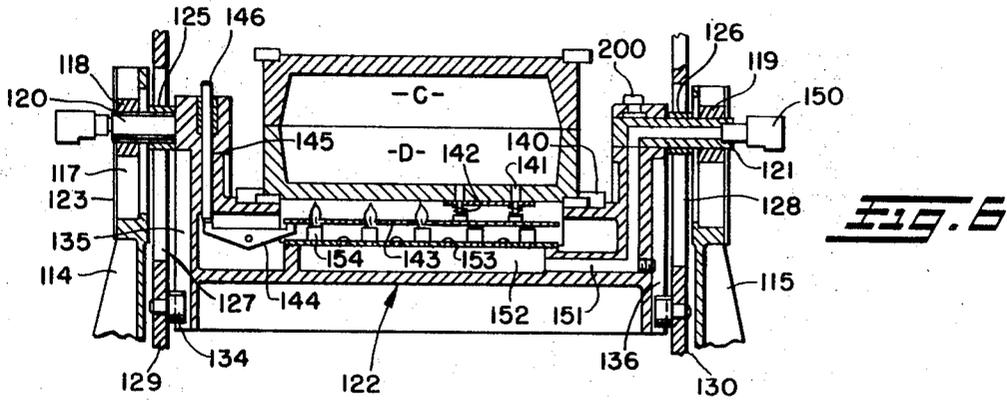
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FIG. 7

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## FOUNDRY SAND ARTICLE FORMING MACHINE WITH PIVOTAL BLOW RESERVOIR

This invention relates generally as indicated to a foundry sand article forming machine and more particularly to a simplified automatic mold or core blowing machine.

The present invention represents certain improvements in mold and core blowing machines of the type seen in Ellms U.S. Pat. No. 3,089,205. Machines similar to that disclosed in such patent have been widely used in the hot box production of cores.

In such machines simplification is highly desirable and yet without sacrifice of versatility in the jobs the machine can do as well as its production rate.

It is accordingly a principal object of the present invention to provide a machine for the production of foundry sand articles of a highly simplified nature which still has high versatility and productive capacity.

Another principal object is the provision of such machine utilizing a blow reservoir which is shifted to and from operative position, such shifting automatically opening a butterfly fill valve at the top of the reservoir.

Still another main object is the provision of such machine utilizing two main operating cylinders, one assembling, disassembling and stripping the blown article from box halves, the other indexing the reservoir to and from operative communication with such box halves.

A further object is the provision of such machine utilizing a single piston-cylinder assembly in conjunction with an operating lever for assembling the box halves, such lever also indexing the take-away conveyor for the completed sand articles.

A yet further object is the provision of such machine having two main operating piston-cylinders, each performing a multiplicity of functions.

Another object is the provision of a side blow sand article forming machine utilizing a unique pivotally mounted reservoir which when tilted away from the mold box automatically opens a butterfly valve therein for filling of the reservoir.

Yet an additional object is the provision of a mold or core blowing machine utilizing a cradle automatically placing the blown mold or core on a take-away conveyor, the position of the cradle with respect to the conveyor automatically stripping the mold or core from the box supported by the cradle.

It is also an object to provide a foundry mold or core blowing machine utilizing a unique reservoir having cast in place cooling tubes.

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, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation partially broken away and in section of a machine in accordance with the present invention;

FIG. 2 is a top plan view again partially broken away and in section of the machine seen in FIG. 1;

FIG. 3 is an enlarged fragmentary vertical section through the reservoir taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is a detail top plan view of the lower portion of the reservoir as seen for example from the line 4—4 of FIG. 3;

FIG. 5 is a fragmentary horizontal section taken through the reservoir pivot shaft;

FIG. 6 is a fragmentary vertical section through the cradle assembly and guides as seen from the line 6—6 of FIG. 1;

FIG. 7 is an enlarged fragmentary side elevation of a sand chute chop gate assembly which may be employed with the present invention; and

FIG. 8 is a fragmentary end elevation of such assembly more clearly illustrating the various linkages involved.

Referring now to FIGS. 1 and 2, it will be seen that the machine comprises an upstanding frame 10 which includes corner columns 11, 12, 13 and 14. The columns 11 and 14 are interconnected near the bottom by a transverse frame member 15 and similarly the columns 12 and 13 are connected by the member 16. The paired columns at each side of the machine are interconnected by horizontal frame members 17 which support therebetween conveyor 18 extending horizontally near the lower portion of the machine.

Extending between the tops of the columns 11 and 14 is a frame member 20 and between the tops of columns 12 and 13, frame member 21. At each side of the machine there is a diagonal strut interconnecting the columns on that side as indicated at 22 and 23. Such struts may be braced by diagonal frame members 24. The frame member thus far described may be of a rectangular tubular construction welded or otherwise suitably secured together.

At the top of the frame 10 there is provided two upstanding relatively heavy plates 25 and 26. Such parallel plates are somewhat closer together than the columns and bridge the top transverse frame members 20 and 21.

Trunnion pins 30 and 31 extend from the lower ends of pneumatic piston-cylinder assembly 32 and are journaled in plates 25 and 26, respectively, providing a pivot support for such piston-cylinder assembly. Secured to the inside of the plates 25 and 26 are upstanding cylinder support bars 34 and 35, the tops of which have journaled therein trunnion pins 36 and 37 pivotally supporting the lower end of pneumatic piston-cylinder assembly 38.

A pivot shaft 40 extends between such plates 25 and 26, such shaft being journaled in such plates as seen more clearly at 41 in FIG. 5. Secured to such pivot shaft is horizontal offset cylindrical portion 42 of the upper cylindrical portion 43 of the reservoir shown generally at 44. The reservoir may be secured to such pivot shaft for pivoting movement by a suitable device such as the setscrew seen at 45 in FIG. 5.

Secured to the top of the plates 25 and 26 are upstanding plates 50 and 51 which are joined by heat shield front plate 52, the latter including a depending inclined portion 53. From the tops of such side plates 50 and 51, inwardly extending brackets 54 and 55 support sand chute 56. Better detail of this construction is seen in the embodiment of FIGS. 7 and 8.

The sand chute 56 includes a bottom opening 57 which fits within the upwardly flaring sand hopper 58 secured to the top of the reservoir 44. The sand hopper 58 is secured to and funnels into butterfly valve assembly 60 which is in turn secured to the top of upper sand reservoir 43. The valve assembly includes a circular plate valve member 61 surrounded by inflatable resilient seat 62. The valve member includes a projecting rotatable stem 63, the end of which is secured to link 64. For convenience of illustration, the link is shown 90° out of position in FIG. 3. The end of the link 64 is connected to the bent end 65 of link 66 as indicated at 67 in FIG. 3. The upper end of the link 66 is connected to an eccentric pin 68 mounted in block 69 secured to the wall 70 of the fixed sand chute 56. Rotation of the eccentric pin will, of course, vary the effective length of the link and thus obtain an adjustment of its operative function to open and close the valve member 61 against the resilient seat 62.

The upper sand reservoir portion 43 includes on one side the offset 73 connecting the cylindrical center portion 74 thereof with the sleeve 42 supporting the reservoir on the pivot 40. The opposite side of the upper portion 43 is provided with a blow valve indicated at 75. Also on such side of the reservoir portion 43 is a pair of ears 76 to which the eye 77 of rod 78 of piston-cylinder assembly 38 is pivotally connected. The upper reservoir portion 43 is provided with a cylindrical perforated sleeve 79 sealed at both vertical extremities. The blow valve 75 may be of the diaphragm type which when opened introduces air under pressure through the passage 80, such air pressure passing about the sleeve and through the perforations therein. Such blow valve may also be used to inflate the resilient seat 62 of the cutoff valve assembly 60 in the

same manner as illustrated in the above noted copending application.

Referring now additionally to FIGS. 3 and 4, it will be seen that the reservoir 44 includes a lower reservoir portion 82. Such lower reservoir may be a casting somewhat in the shape of a vacuum cleaner nozzle and includes an upper rectangular plate portion 83 which may be provided with pivotally mounted latch bolts indicated at 84 for quick removal from or connection to the upper reservoir 43. Such plate 83 is provided with a circular port 85 of the same I.D. as the perforated sleeve 79. Such port forms the upper end of elbow passage 86 which flares into horizontally elongated passage 87. The end of such passage is flanged as seen at 88 and blow plate adapter 89 is secured to such flange. The blow plate adapter is provided with a horizontally elongated slot 90. Secured to the face of the adapter are blow plate retainers 91 and 92 between which is secured blow plate 93. The blow plate projects slightly beyond the retainers and may be provided with a series of apertures or an elongated slot providing sand flow communication with mold or core box halves as hereinafter described.

A pair of exhaust valves 95 and 96 are provided on the lower reservoir as seen in FIG. 4. The casting of the lower reservoir may also be provided with cooling passages as seen at 97 and 98. The blow plate adapter 89 may similarly be provided with cooling passages seen at 99. Such passages may be formed by using stainless steel pipe in the casting.

The reservoir assembly 44 accordingly includes the hopper 58, the fill cutoff valve assembly 60, the upper reservoir 43, and the lower reservoir 82 on which is mounted the blow plate adapter and the blow plate. The lower reservoir 82 is readily removable from the assembly for cleaning purposes and the blow plate may readily be changed with a change of tooling or different mold box halves.

The entire assembly is pivotally mounted on the pivot 40 by extension and retraction of the pneumatic piston-cylinder assembly 38.

The other piston-cylinder assembly 32 of the machine includes an elongated rod 105 projecting downwardly through a slot in the tubular frame member 21 and the eye 106 of such rod is pivotally connected at 107 to one end of cradle lever assembly 108. Such assembly includes a main casting having a central hub portion 109 through which extends a pivot shaft 110 journaled at 111 and 112 in the diagonal frame members 22 and 23, respectively. The cradle lever assembly is in the form of a Y-yoke with the stem being connected to the rod of the piston-cylinder assembly and the two legs 114 and 115 projecting from the hub in the opposite direction.

Referring now additionally to FIG. 6, it will be seen that each leg is provided with a guide slot 117 enclosing cradle guide blocks 118 and 119 which are in turn mounted on cradle pins 120 and 121, respectively. Such pins support the cradle assembly 122. Guide block retainers 123 are provided on each side of the guide slot for retention of the cradle guide block.

The cradle pins 120 and 121 also extend through bushings 125 and 126 which ride in cam slots 127 and 128 in plates 129 and 130, respectively. As seen more clearly in FIG. 1, each cam slot includes an upper vertically extending portion 131, a middle arcuate portion 132, and a lower vertically extending portion 133 aligned with the upper vertically extending portion 131. The middle or arcuate portion of the slot is symmetrical with respect to a roller 134 which is vertically aligned with the upper and lower portions of the slot.

Each side of the cradle assembly 122 is provided with a vertical opened face slot seen at 135 and 136 in which the fixed guide roller 134 is confined. This causes the cradle to rock over or revolve about a horizontal axis as it is moved up and down by the rocking of the cradle lever assembly 108. Thus as the cradle pin 120 moves down the cam slot 127 and about the arcuate portion, the confinement of the slot 135 in the roller 134 will cause the cradle to pivot outwardly or to the left as seen in FIG. 1 and continued downward movement will cause the same to invert. This construction maintains the cradle in

vertically upwardly extending alignment or vertically downwardly extending alignment depending upon the vertical position thereof with respect to the fixed roller 134.

A lower or drag core or mold box half D is supported on the cradle by suitable removable clamps 140. The bottom of the box half as seen in FIG. 6 is provided with a plurality of stripping pins 141 which are urged by springs 142 to their retracted position flush with the bottom surface of the box cavity. Such stripping pins are supported by a universal strip plate 143 which is supported and guided by four corner guide pins, not shown, and actuated at both sides by strip plate rockers 144 intermediately pivoted to the cradle. The outer or opposite ends of the rockers are in contact with strip actuating rods 145 which project slightly above the top of the cradle assembly as seen at 146. It will be appreciated that there are two such rods and rockers, one on each side of the cradle assembly.

Rotary couplings 150 are provided on the cradle pins 120 and 121 providing communication as indicated by passage 151 leading to gas manifold 152 in the bottom of the cradle assembly. The manifold is covered by universal burner plate 153 provided with a plurality of tapped apertures which may either be plugged or provided with gas burners 154. Corresponding apertures may be provided in the universal strip plate 143. This provides direct gas flame impingement on the box half D for the curing of the sand resin mix blown therein.

The upper box half or cope C may be secured to head 160 of the machine frame and optionally, the top half of the pattern or box may be provided with gas burners, again to facilitate curing of the sand resin mix blown within the mold box.

Referring again to FIG. 1, it will be seen that the cradle lever assembly 108 is provided with a pair of downwardly extending arms 162, such arms extending generally normal to the plane of the lever. To the distal end of each arm is pivotally connected a conveyor index dog 163, the outer ends of which are interconnected by conveyor index rod 164. Each dog is provided with an inwardly extending plate functioning as a lift cam as seen at 165.

The conveyor index rod is adapted to engage behind lugs 167 on conveyor transfer belt 168. Such belt is trained about idler pulleys 169 and 170 at each end of the conveyor frame 171. The upper flight of the belt moves on top of support plate 172. The conveyor is also provided with an index dog stop seen at 173 to prevent the dog from moving beyond the phantom line position indicated at 174. The conveyor frame may be supported at its inner end by the shaft of pulley 170 and intermediately by tie rod 175, the latter also supporting the lower end of the plates 129 and 130. The upper ends of such sideplates may be secured to the head 160 as seen in FIG. 1. The slots seen in FIG. 1 in the conveyor frame allows it to be adjusted by a suitable adjusting screw or belt tightener. This moves forward pulley 169 to obtain proper belt tension.

In FIGS. 7 and 8 there is illustrated an option which may be used with the machine and that is a chopper gate for the bottom of the sand chute 56 also operated by the piston-cylinder assembly 38. The chopper gate is in the form of an arcuate bottom cutoff plate seen at 180 which is supported by bent side plates 181 and 182 which are pivotally connected at 183 and 184 to the sides of the sand chute 56. Also pivoted to such side plates at 185 and 186 are links 187 and 188. The opposite ends of such links are pivotally connected at 189 and 190 to the ends of transverse bracket 191 secured to the front wall of sand hopper 58 which, of course, forms a part of the reservoir 44. Accordingly when the reservoir 44 is tilted about the pivot 40 by retraction of the piston-cylinder assembly 38, the hopper will move to the phantom line position 193 and the links 187 and 188 to the phantom line position 194 thus pivoting the cutoff 180 about the pivots 183 and 184 permitting sand to be discharged from the chute 56 through the opening 57 into the hopper 58.

## OPERATION

In a typical machine cycle, the piston-cylinder assembly 32 will be extended rocking the cradle lever assembly 108 about its pivot 110 elevating the lower box half D which is supported by the cradle assembly 122 to clamp the same against the upper box half C which is mounted on the machine frame or head 160 to form a mold or core box as seen in FIG. 6. The force exerted by the assembly 122 is increased approximately one and one-half times due to the moment arm ratio of the lever assembly 108.

The sand reservoir, having been retracted by retraction of the piston-cylinder assembly 38 and automatically filled by the opening of the valve member 61 due to the line 66 pivoting the same to the phantom line position 196 seen in FIG. 7, now swings with extension of the piston-cylinder assembly 38 and clamps the blow plate 93 against the edge of the now formed box. The blow plate thus moves from the phantom line position 197 seen in FIG. 1 to the full line position seen in such figure. This action by the cylinder assembly 38 also closes the butterfly member 61 through the linkage 66. This action is obtained by the valve stem 63 moving about an arc about the pivot 40 and forcing the link 64 from the nearly vertical phantom line position seen at 198 to the horizontal phantom line position 199 indicated in FIG. 7. Since the valve member 61 extends parallel to the link, the valve member will move from its opened to its closed position seated against the resilient seat 62. This pivoting of the reservoir forces the pivot 67 to the right as seen in FIG. 7 with the link 66 pivoting slightly about its upper eccentric pin pivot 68.

If the cutoff plate 180 option is employed, the cutoff plate will then pivot also to its full line or closed position beneath the chute 56 as seen in FIG. 7.

The blow valve 75 is now opened pressurizing the sand reservoir and simultaneously inflating the seat 62. Sand is blown into the box cavity to form the sand article. Pressure in the reservoir is vented through the exhaust valves 95 and 96 and immediately following the blowing operation, the piston-cylinder assembly 38 is retracted to swing the reservoir about the pivot 40 with the blow plate being retracted to the phantom line position 197 seen in FIG. 1. This opens the butterfly valve through the linkage and permits sand to be gravity fed from the hopper into the reservoir. This retraction of the reservoir may be also open the gate 180 to permit the hopper to be recharged. Such retraction also removes the blow plate and reservoir from the heat zone of the box.

The box halves may be continually heated and when the sand article blown therein has cured sufficiently to permit the same to be removed from the box, the piston-cylinder assembly 32 is retracted to lower the lower box half D. This strips the article from the upper half C and continued retraction of the cylinder assembly 32 causes the cradle to roll over 180° through the action of the cam and guide slots.

With the cradle inverted and moving downwardly toward the conveyor 18, adjustable stops adjacent the conveyor contact the projecting ends 146 of the strip actuating rods 145 causing the stripper plate 143 to move toward the box extending the pins 141 against the pressure of the springs 142. This releases the finished article from the box half D allowing it to be deposited on the belt of the conveyor 18. Downward movement of the cradle is stopped by contact between stops 200 on each side of the cradle and adjustable stops on the machine frame adjacent the conveyor.

In this position depositing the now formed sand article on the conveyor, the dogs 163 will be in the phantom line position 174 seen in FIG. 1. The piston-cylinder assembly 32 is now extended and the cradle lever assembly 18 lifts the lower box half D, still inverted, and when sufficient clearance has been obtained, the conveyor index rod 164 will engage the lug 167 of the conveyor indexing the finished sand article out of the machine to the position seen at 201 in FIG. 1. The rod 164 is, of course, lifted over lugs 167 by cams 165 as the box half

comes down. Continued extension of the piston-cylinder assembly 32, while indexing the conveyor, also inverts the lower box half D and complete extension of the rod clamps the box half against the upper half to form the mold box. The reservoir is now ready to be shifted into position for the blow operation by extension of the piston-cylinder assembly 38, such extension automatically closing the valve member 61.

It can now be seen that there is provided a highly simplified machine for producing foundry sand articles with power to all of the machine motions including the indexing of the conveyor being provided by the two operating pneumatic cylinder assemblies 32 and 38. The tooling, such as the boxes, blow plate, as well as the lower sand reservoir 82, are held in position by fast acting clamps and may readily be removed or changed.

To remove the tooling from the machine, both box halves may be latched together and moved down by the cradle as an elevator to be set on a dolly moved into position above the conveyor.

I claim:

1. A machine for producing foundry sand articles comprising means to clamp box halves together to form a mold box, a blow reservoir operative to blow sand generally horizontally into such assembled halves, a butterfly valve at the top of said reservoir, means responsive to the shifting of said reservoir to open said valve for filling of the reservoir, generally horizontal pivot means for said reservoir, and a piston-cylinder assembly operative to pivot said reservoir.

2. A machine as set forth in claim 1 including a valve stem for said butterfly valve, and linkage means interconnecting said valve stem and a fixed pivot operative thus to open and close said butterfly valve as said reservoir shifts.

3. A machine as set forth in claim 2 including an eccentric pivot in said linkage to obtain adjustment of the effective length thereof.

4. A machine as set forth in claim 1 wherein said reservoir includes a horizontally directed blow plate adapted to be laterally clamped against the side of the clamped box halves when said reservoir is shifted.

5. A machine as set forth in claim 1 wherein said blow reservoir includes an upper cylindrical portion having a blow valve therein, and a removable lower elbow portion having an exhaust valve therein.

6. A machine as set forth in claim 5 including coolant means for said lower elbow portion.

7. A machine as set forth in claim 1 wherein said reservoir includes a top sand hopper flaring in the plane of shifting thereof to encompass the bottom of a sand chute regardless of the shifted position.

8. A machine as set forth in claim 1 including a fixed sand chute, a chop gate for said chute, and means responsive to the shifting of said reservoir to open and close said chop gate.

9. A machine for producing foundry sand articles comprising a head for supporting a first box half, a vertically movable cradle for supporting a second cooperating box half, a sand blow reservoir for blowing sand generally horizontally into such box halves when assembled, means to index said reservoir toward and away from such assembled box halves, generally horizontal pivot means for said reservoir, and piston-cylinder means operative to pivot said reservoir thus to index the same.

10. A machine as set forth in claim 9 wherein said blow reservoir includes an upper generally cylindrical portion and a lower elbow portion terminating in a generally horizontally directed blow plate.

11. A machine as set forth in claim 10 wherein said elbow portion flares horizontally.

12. A machine as set forth in claim 11 including exhaust valve means on said elbow portion.

13. A machine as set forth in claim 12 including a blow valve in said upper cylindrical portion.

14. A machine as set forth in claim 13 including a butterfly valve on the top of said upper cylindrical portion, and means responsive to the indexing of said reservoir toward such assembled box halves to close said butterfly valve.

15. A machine as set forth in claim 14 wherein said means responsive to the indexing of said reservoir comprises a pair of links connected to the valve stem of said butterfly valve.

16. A machine as set forth in claim 15 including a sand chute, a chop gate for said chute, and means responsive to the indexing of said reservoir to open an close said chop gate.

17. A machine for the production of foundry sand articles including a frame, a head on said frame for supporting a first box half, a vertically movable cradle for supporting a second cooperating box half, a sand reservoir mounted on a generally horizontal pivot means for blowing sand generally horizontally within such assembled box halves, and a pair of vertically oriented piston-cylinder assemblies on said frame, one for vertically moving said cradle for assembling and disassembling such box halves, and the other for indexing said reservoir to and from communication with such box halves.

18. A machine as set forth in claim 17 including a vertically extending guide at one side of said machine for guiding said cradle assembly, an intermediately pivoted lever, one end of said lever supporting said cradle assembly for movement along said guide, the opposite end being connected to the rod of said one piston-cylinder assembly.

19. A machine as set forth in claim 18 wherein said one end of said lever is provided with slotted laterally spaced arms, said cradle assembly being supported in the slotted portion of said arms.

20. A machine as set forth in claim 18 including cooperating means on said guide and cradle operative to roll said cradle about a horizontal axis.

21. A machine as set forth in claim 17 including a take-away

conveyor, and means responsive to the rocking of said lever in one direction only unidirectionally to index said conveyor.

22. A machine as set forth in claim 21 including a pivoted dog on said lever operative to obtain such conveyor movement.

23. A machine as set forth in claim 17 wherein said reservoir is pivotally mounted, said other piston-cylinder assembly pivoting said reservoir.

24. A machine as set forth in claim 23 wherein said reservoir is in the form of an L with the blow path thereof being vertically disposed at the bottom, said other piston-cylinder assembly extending to press the blow plate against the side of the assembled box halves.

25. A machine as set forth in claim 24 including a fill valve at the top of said reservoir, and linkage means to open said valve in response to pivoting retraction of said reservoir.

26. A machine as set forth in claim 25 wherein said fill valve is a butterfly valve having a rotatable valve stem, and said linkage means includes two interconnected links, the opposite end of one being secured to said stem while the opposite end of the other is pivoted to the machine frame.

27. A machine as set forth in claim 26 including an eccentric pin for said last mentioned pivot to obtain adjustment of said linkage.

28. A machine as set forth in claim 24 including a sand chute with a pivotally mounted chop gate thereunder, and link means interconnecting said reservoir and said chop gate to open the latter in response to pivoting retraction of said reservoir.

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