United States Patent

[11] 3,630,268

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[73] Assignee **The Sherwin-Williams Company**
Cleveland, Ohio

[54] **FOUNDRY MOLDING MACHINE WITH MEANS TO ALTERNATELY INDEX COPE AND DRAG FLASKS BETWEEN MOLDING AND CLOSING UNITS**
31 Claims, 25 Drawing Figs.

[52] **U.S. Cl.** **164/181,** 164/183, 164/224, 164/226, 164/409
[51] **Int. Cl.** **B22c 11/10,** B22c 15/34, B22c 17/00
[50] **Field of Search** 164/181, 180, 183, 192–194, 213, 224, 214, 402, 339, 37–39, 409, 226

[56] **References Cited**

UNITED STATES PATENTS

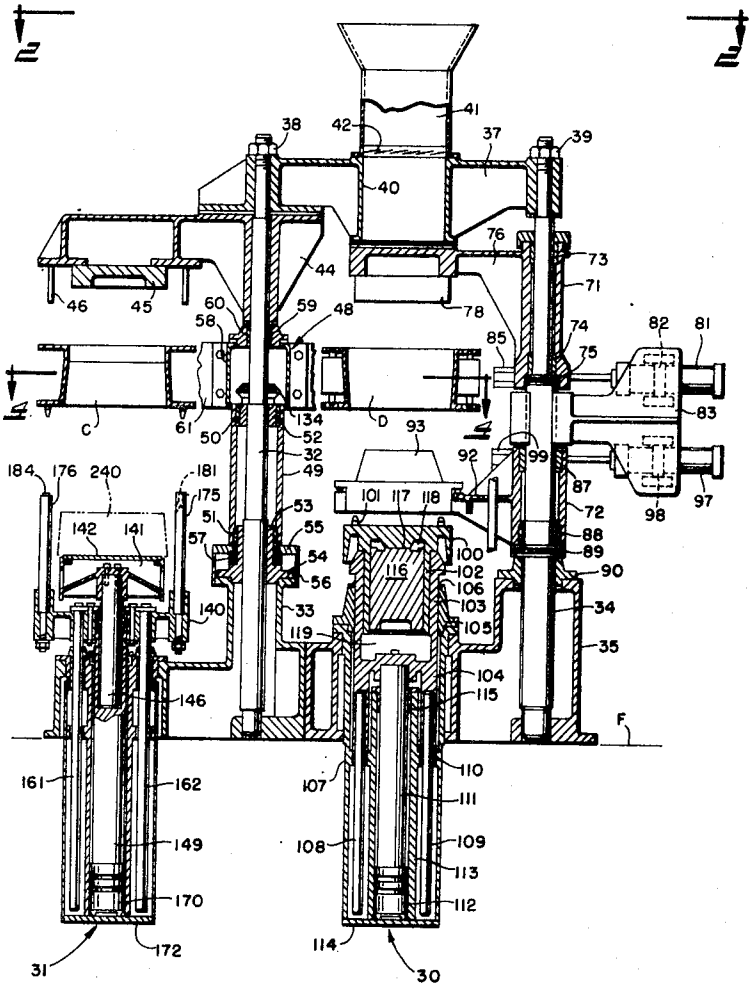
2,879,564	3/1959	Miller	164/409 X
3,181,207	5/1965	Schiable et al.	164/181 X
3,406,738	10/1968	Hunter	164/193 X

FOREIGN PATENTS

343,964	6/1904	France	164/226

Primary Examiner—Robert D. Baldwin
Attorney—Oberlin, Maky, Donnelly & Renner

ABSTRACT: A foundry molding machine utilizing one cope and one drag flask alternately indexed between a jolt-squeeze molding station and a stripping and closing station, the drag being inverted during the index and molded upside down; a shuttle for the cope and drag patterns as well as a sand chute and squeeze board is provided at the molding station while the stripping and closing station automatically opens the specially built drag flask for stripping and supporting the same for coring before assembling with the cope to form a flaskless mold which is then removed from the machine.



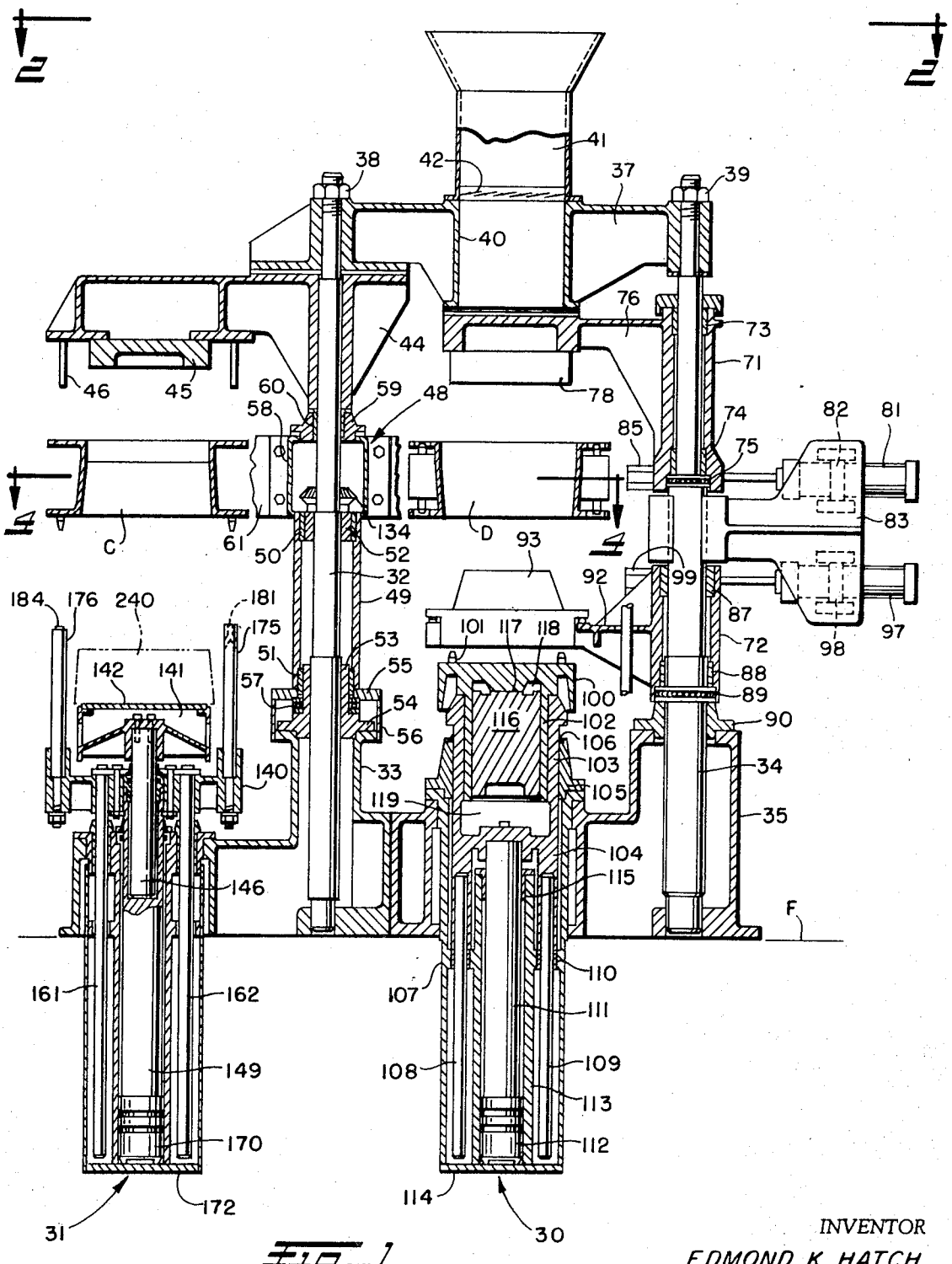
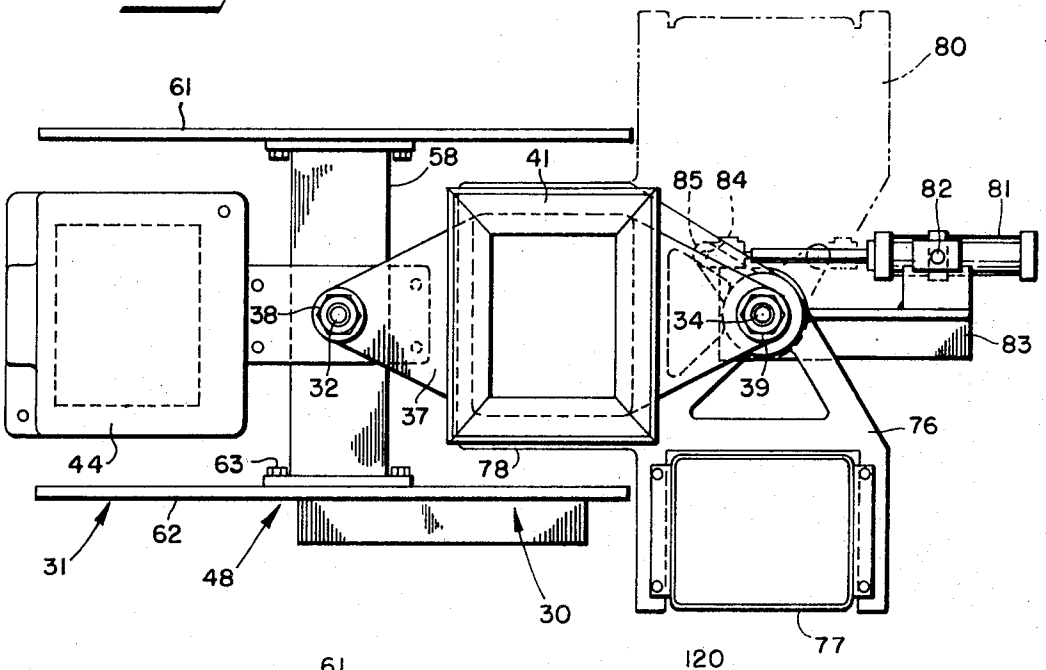


Fig. 1

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Fig. 2



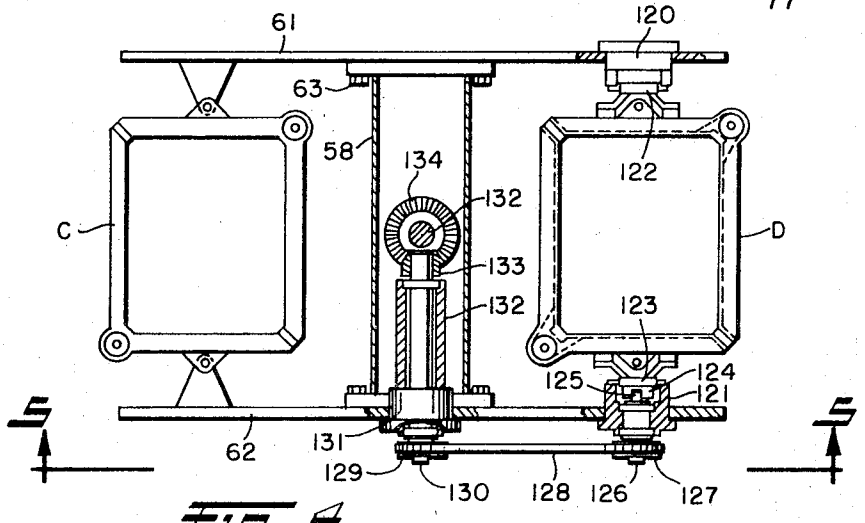


Fig. 4

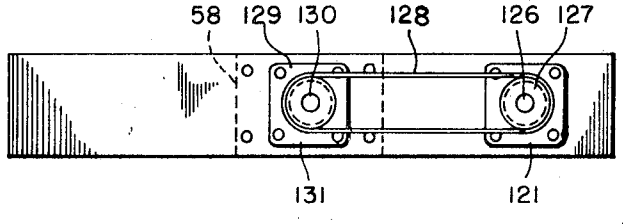


Fig. 5

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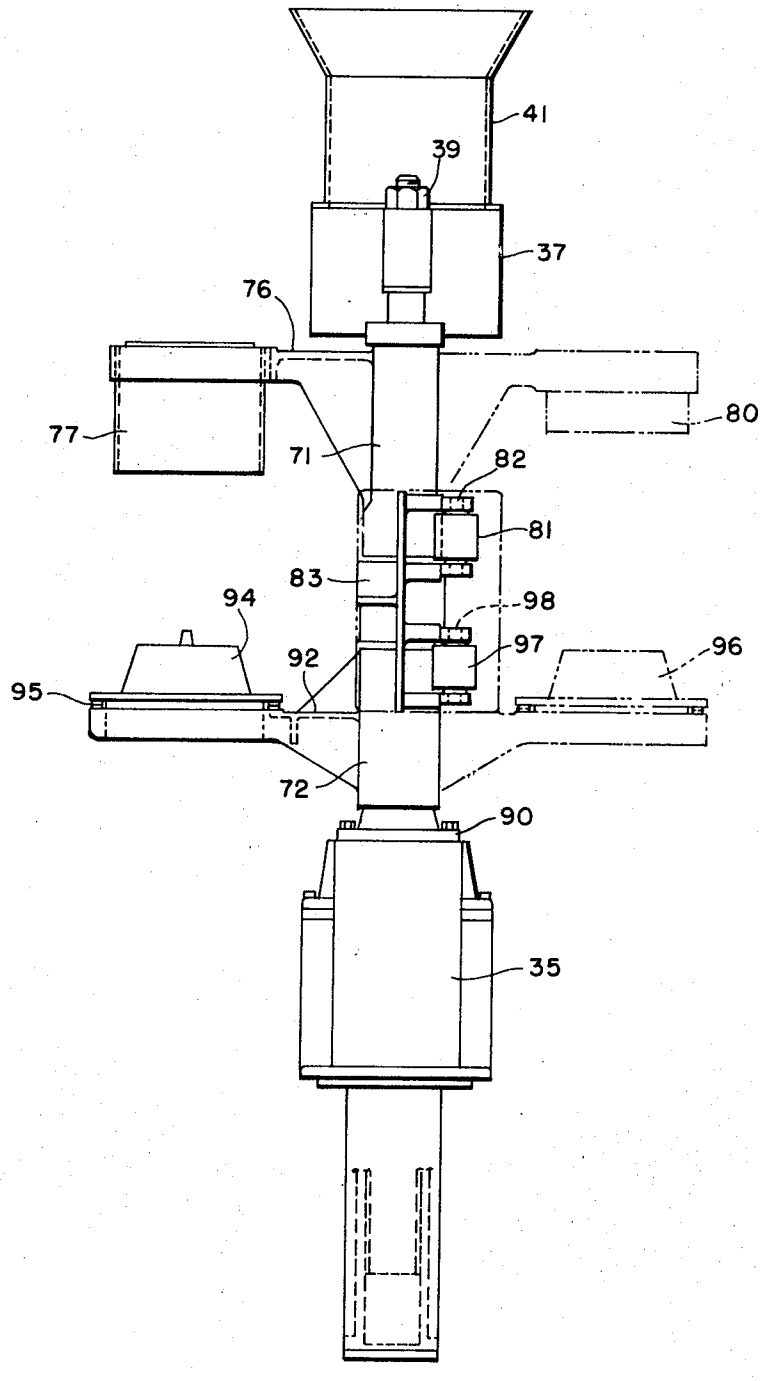
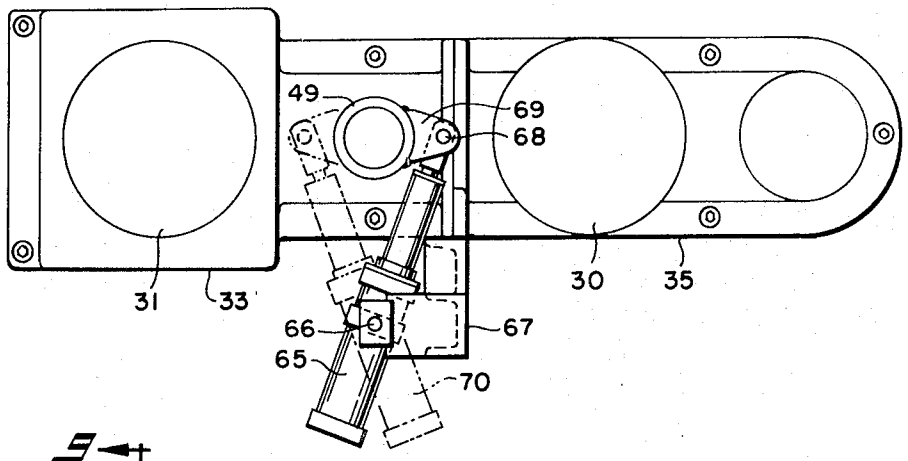


Fig. 3

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FIG. 6



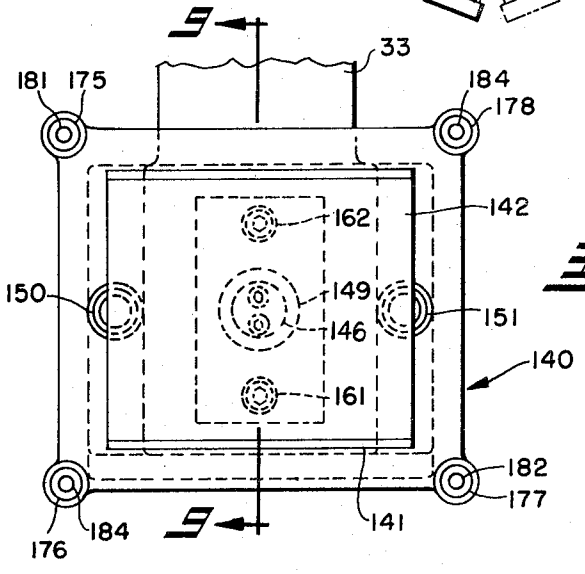


FIG. 8

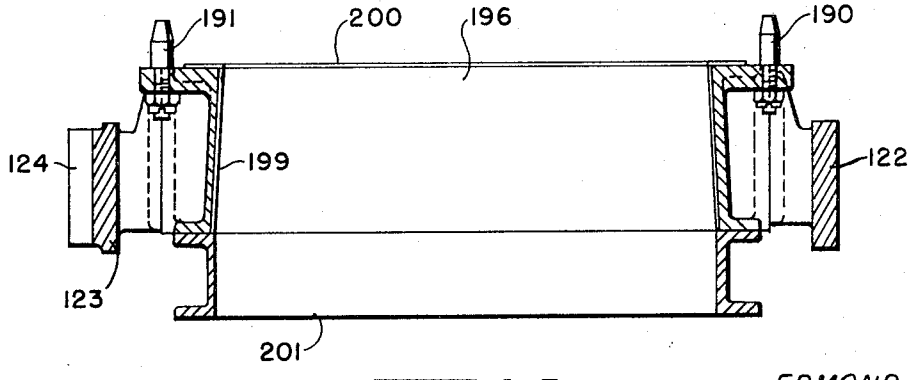


FIG. 13

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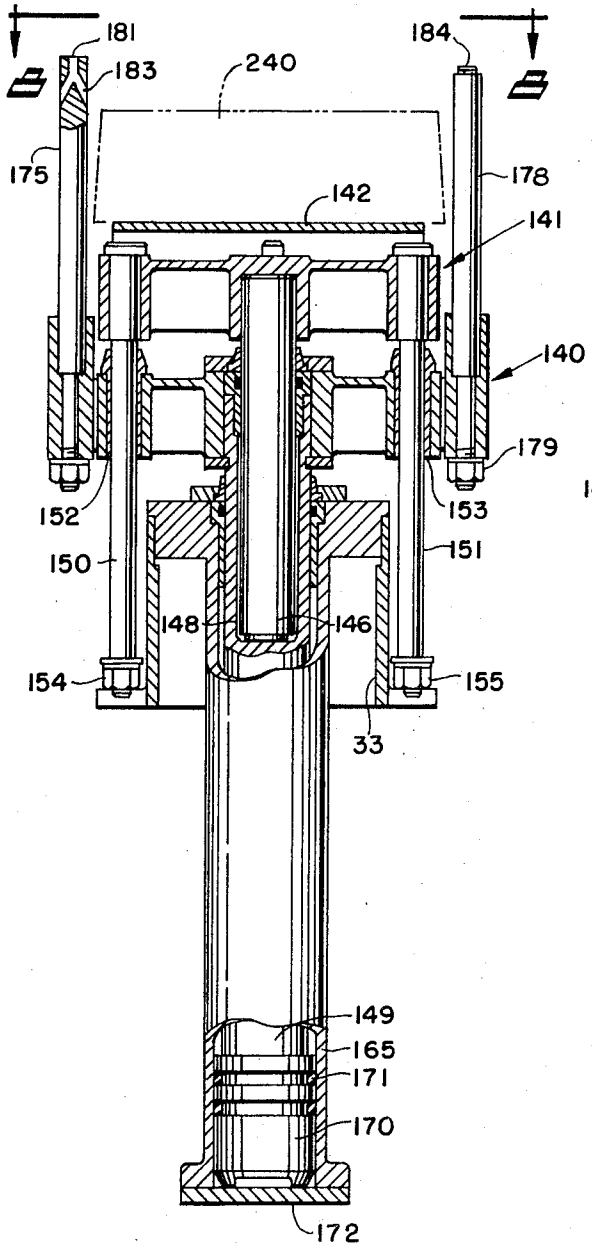


FIG. 7

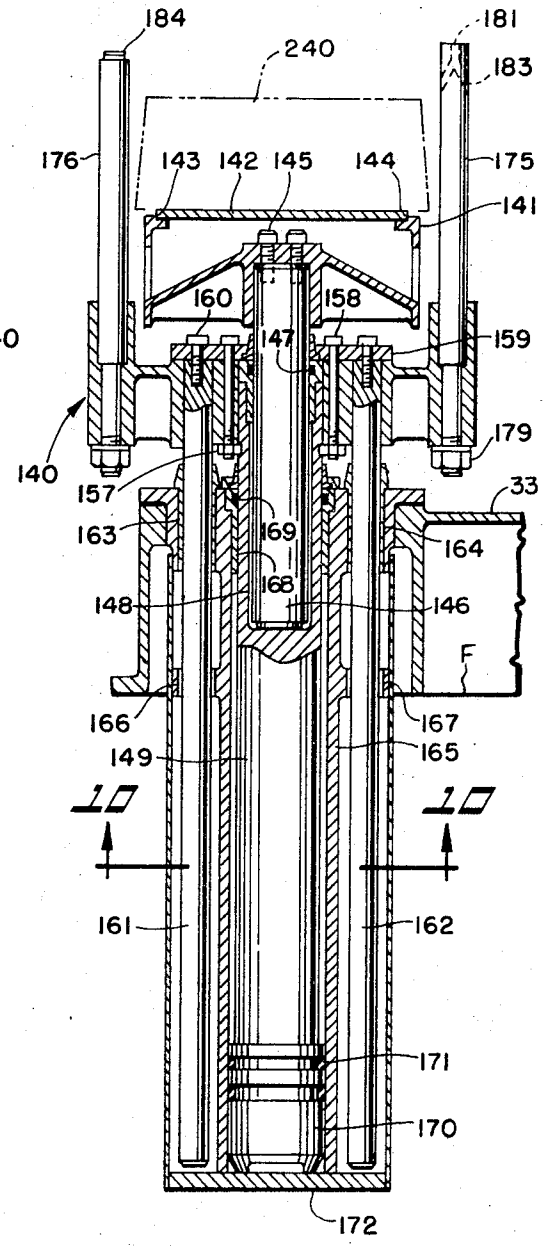


FIG. 9

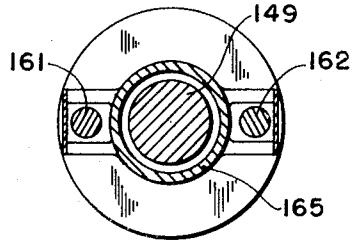


FIG. 10

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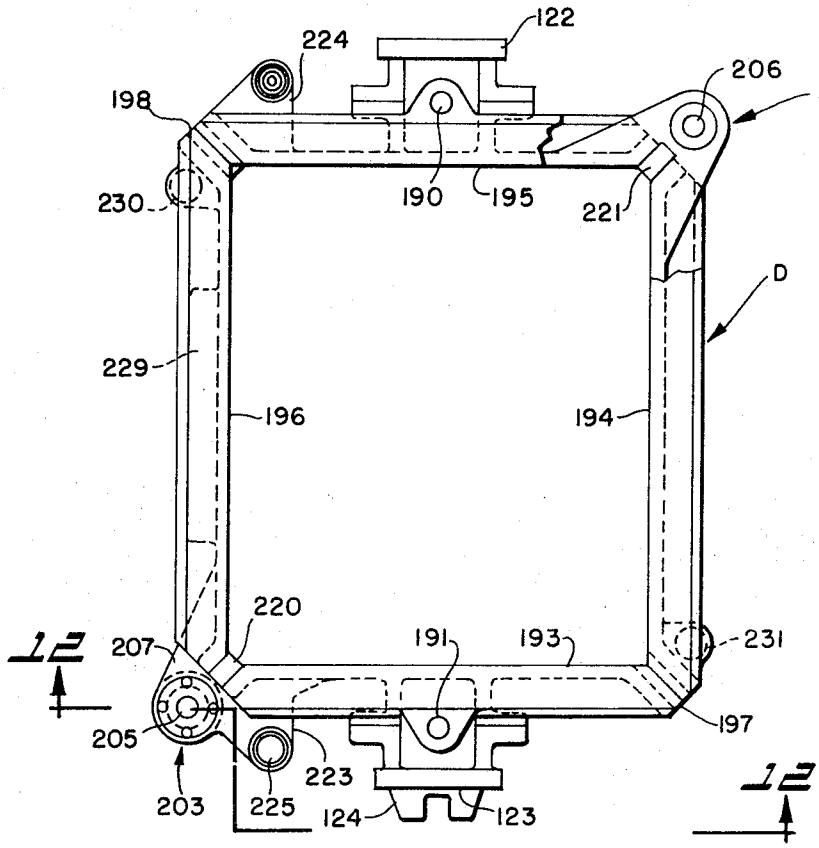


FIG. 11

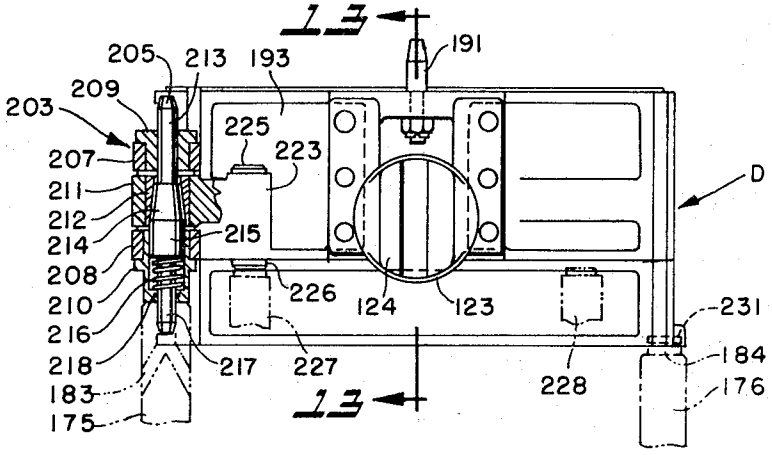


FIG. 12

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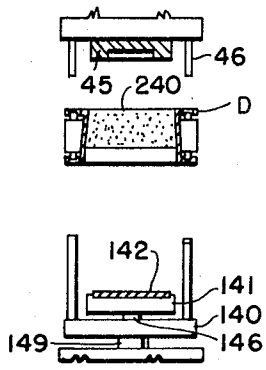


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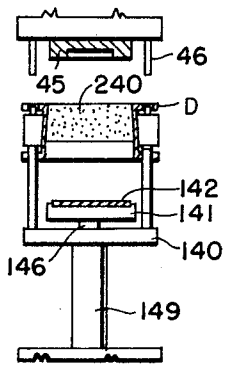


Fig. 15

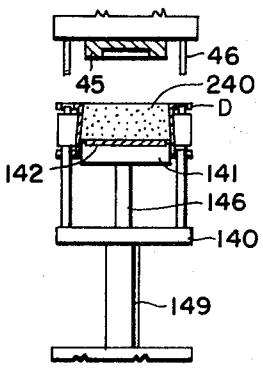


Fig. 16

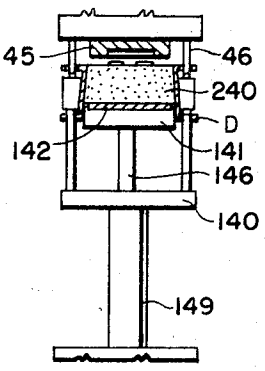


Fig. 17

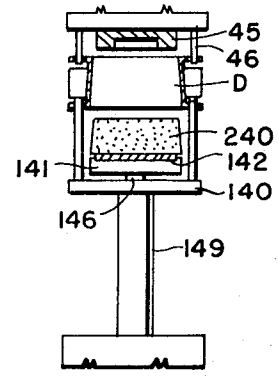


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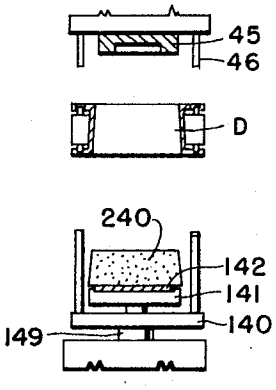


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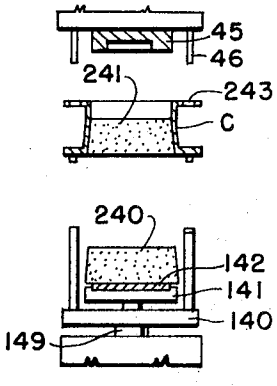


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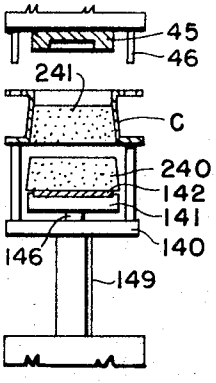


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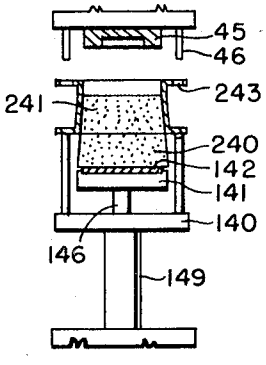


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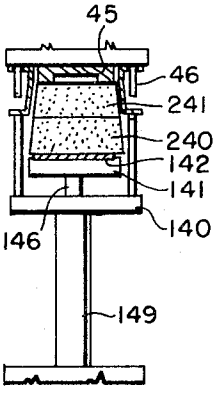


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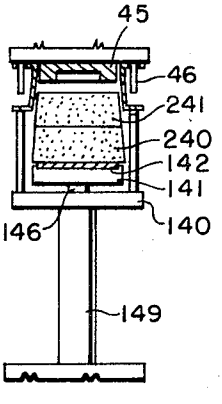


Fig. 24

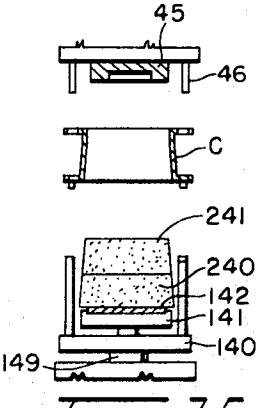


Fig. 25

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FOUNDRY MOLDING MACHINE WITH MEANS TO ALTERNATELY INDEX COPE AND DRAG FLASKS BETWEEN MOLDING AND CLOSING UNITS

This invention relates generally as indicated to a foundry molding machine and more particularly to a high-speed automatic molding machine and process for producing flaskless molds.

Flaskless molds are highly desirable since they avoid a substantial investment in flasks and flask-handling equipment. To be effective, however, flaskless molds must be of uniform high hardness and density which is believed by many to be accomplished only by jolt and high-pressure squeeze. Also, to be economical a foundry molding machine producing flaskless molds should be able to produce a great many completed molds per hour. By completed molds it is meant molds which are assembled, cored and ready for pouring.

While this can be accomplished with certain types of match-plate molding machines as seen for example in the copending application of Leon F. Miller et al., Ser. No. 672,063, filed Oct. 2, 1967 entitled "Foundry Molding Machine and Method," there are complexities in match-plate molding that make it difficult to achieve economical mold output with a low cost machine.

It is accordingly a principal object to provide a foundry molding machine which will produce flaskless complete molds having the desired uniform density and hardness at a highly economical rate.

Another principal object is the provision of a flaskless molding machine utilizing only one cope flask and one drag flask, with molds being formed therein by a jolt-squeeze operation.

Another important object is the provision of a flaskless molding machine which first produces the drag stripping it from its flask then holds the same in a position for the setting of cores while the cope is being completed.

Another object is the provision of a special drag flask which will automatically open to permit the drag mold easily to be deposited on a bottom board or pallet.

A still further object is the provision of a flaskless molding machine having a molding station and a stripping and closing station with the cope and drag flasks being alternately indexed to and from such stations, the drag flask being automatically inverted during such index.

A further object is the provision of a flaskless molding machine of simplified nature yet still providing a jolt and squeeze to obtain molds of high uniform density and hardness.

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 a certain illustrative embodiment of the invention this being indicative, however, of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

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

FIG. 2 is a top plan view of the machine of FIG. 1 taken substantially from the line 2—2 of FIG. 1;

FIG. 3 is an end elevation of the machine as seen from the right in FIG. 1 illustrating more particularly the sand chute-squeeze board and pattern shuttles;

FIG. 4 is a fragmentary horizontal section of the flask index turret taken substantially on the line 4—4 of FIG. 1;

FIG. 5 is a front elevation of the drag rollover mechanism as seen from the line 5—5 of FIG. 4;

FIG. 6 is a section through the turret index illustrating the turret index cylinder assembly;

FIG. 7 is an enlarged end elevation partially broken away and in section of the stripping and closing table assembly as seen from the left in FIG. 1;

FIG. 8 is a fragmentary top plan view of the assembly of FIG. 7 as seen from the line 8—8 of FIG. 7;

FIG. 9 is a vertical section taken on the line 9—9 of FIG. 8;

FIG. 10 is a horizontal section taken on the line 10—10 of FIG. 9;

FIG. 11 is a top plan view of the drag flask;

FIG. 12 is an end elevation partially broken away and in section of such drag flask taken substantially on the line 12—12 of FIG. 11;

FIG. 13 is a vertical section of the drag flask taken on the line 13—13 of FIG. 12; and

FIGS. 14 through 25 are schematic illustrations showing the sequence of the closing cycle.

THE MACHINE—GENERAL ARRANGEMENT

Referring first to FIGS. 1 through 3 and 6, it will be seen that the machine of the illustrated embodiment comprises a molding station shown generally at 30 and a stripping and closing station shown generally at 31. Such stations are laterally spaced and equidistant between such stations is a vertically extending column 32 supported in base frame 33 mounted on floor F. A further column 34 is mounted in base frame 35 joined to the frame 33, such column 34 being symmetrically spaced about the center of the molding station with respect to the column 32. The stripping and closing station 31, the column 32, the molding station 30 and the column 34 are in line in the plane of FIG. 1. The columns 32 and 34 are joined at the top by a head frame 37 secured to the columns by the large nuts indicated at 38 and 39. The frame 37 includes a rectangular opening 40 vertically aligned with the molding station 30 and supports above such opening sand hopper unit 41, at the lower end of which is louvered gate 42. When the gate 42 is opened, a measured amount of sand is permitted to fall from the hopper unit 41 through the opening 40.

As seen more clearly in FIG. 1, the columns 32 and 34 are in the form of cylindrical rods appropriately shouldered to support the frame 37 as well as the other components mounted thereon. The head frame 37 is secured to frame 44 mounted on the column 32 which cantilevers over the stripping and closing station 31 supporting on the underside thereof stripping head 45 and pins 46. Journaled on the column 32 beneath the frame 44 is turret frame 48 which includes center cylindrical column 49 journaled by bushings 50 and 51 on sleeve spacers 52 and 53, respectively, on the column 32, the latter sleeve spacer 53 being provided with a flange 54 secured to the top of base frame 33. The cylinder column 49 includes an annular base 55 provided with depending skirt 56. A thrust roller bearing 57 is provided between the sleeve spacer and the base 55 of the turret column 49.

Supported on the cylindrical column 49 is transverse frame 58, the top of which is provided with spacer 59 journaled on column 32 with thrust bushing 60. Secured to the outer ends of the transverse frame 58 are side frames 61 and 62 by the fasteners indicated at 63. The side frames support the cope flask C and the drag flask D for alternate indexing between the jolt squeeze molding station 30 and the stripping and closing station 31.

Indexing of the turret frame 48 is obtained by indexing piston-cylinder assembly 65 seen more clearly in FIG. 6. Such piston-cylinder assembly is pivotally mounted at 66 on bracket 67 projecting from base frame 33. The rod of such piston-cylinder assembly is pivotally connected at 68 to clevis 69 secured to the cylindrical column 49. The piston-cylinder assembly may be of the construction shown, for example, in the aforementioned Miller et al. application being provided with a decelerator or cushion on extension. To index the turret frame 180°, the piston-cylinder assembly is initially retracted and then extended to shift to the phantom line position 70 seen in FIG. 6. In this manner the frame 48 supporting the cope and drag flasks may be oscillated 180° alternately to position the cope and drag flasks either at the molding station 30 or the stripping and closing station 31.

Mounted on the column 34 are two oscillating frames 71 and 72 seen more clearly in FIGS. 1 and 3. The frame 71 includes a cylindrical column portion journaled on the column

34 by bushings 73 and 74 with thrust roller bearing 75 being provided at the lower end of the bushing 74. The upper portion of the frame 71 includes a horizontal cantilevered portion 76 supporting sand chute 77 and squeeze head 78. As seen more clearly in FIG. 2, the squeeze head and sand chute are spaced 90° apart so that when the frame 71 is oscillated 90° the squeeze head will move to the phantom line position indicated at 80 while the sand chute 77 moves beneath the opening 40 in the head frame 37. The sand chute is of the same configuration as such opening. Indexing of the frame 71 is obtained by piston-cylinder assembly 81 pivoted at 82 to bracket 83 secured to the column 34. The rod of such piston-cylinder assembly is pivoted at 84 to clevis 85 secured to the frame 71.

The frame 72 includes an upstanding cylindrical portion journaled on column 34 by the bushings seen at 87 and 88 with ball thrust bearing 89 being provided between the lower end of the frame and annular spacer 90 secured to the top of the base 35. The frame 72 includes a horizontal portion 92 which includes arms projecting at a 90° spacing supporting the drag pattern 93 and the cope pattern 94 on the rest buttons indicated at 95. Oscillation of the frame 72 through 90° will shift the drag pattern 93 to the phantom line position 96 seen in FIG. 3 while simultaneously shifting the cope pattern 94 to a position aligned with the molding station 30. Indexing of the frame 72 through such 90° oscillation is obtained by piston-cylinder assembly 97 pivoted at 98 to the lower portion of bracket 83. The rod of such piston-cylinder assembly is connected to clevis 99 secured to the frame 72. It can now be seen that extension and retraction of the cylinders 81 and 97 obtains the oscillation or shuttling of the frames 71 and 72, respectively, the frame 71 supporting for alternate disposition beneath the head frame 37 the sand chute 77 and the squeeze head 78, while the frame 72 supports for alternate disposition in the molding station 30 the cope and drag patterns.

THE MOLDING UNIT

As seen in FIG. 1, the molding unit of the mold station 30 includes a table 100 provided with aligning pins 101 adapted to pickup the cope or drag patterns when elevated. The table includes a depending cylindrical portion 102 telescoped into the cylindrical top portion 103 of lift frame 104 which is mounted in annular cap 105, the top of which is provided with a sliding seal 106 riding against the cylindrical portion 103. The annular cap 105 is secured to the top of cylindrical housing 107 mounted in the base 35. Extending downwardly from the lift frame 104 are guide rods 108 and 109 slide-guided in the housing 107 as seen at 110. Also extending downwardly from the lift frame 104 is the rod 111 of piston 112. The piston 112 is mounted in cylinder 113 projecting upwardly from the bottom 114 of the housing 107. A bushing and retainer seen at 115 closes the top of the cylinder 113 about the rod 111.

Mounted within the depending cylindrical portion 102 of the table is a jolt ram 116 which is operated during the jolt to strike the bottom of the table 100 as indicated at 117. To operate the jolt, the chamber 118 above the ram is pressurized to drive the ram down against the pressure in plenum 119 to rebound against the table when the chamber 118 is vented. Reference may be had to the copending application of Edward D. Abraham et al., Ser. No. 629,599, filed Apr. 10, 1967 entitled "Shockless Jolt Molding Machine with Air Spring Means," now U.S. Pat. No. 3,461,947, for a more detailed disclosure of a jolt mechanism which may be used with the machine of the present invention.

DRAG FLASK TURNOVER

As seen in FIGS. 4 and 5, the drag flask D is supported on the frames 61 and 62 by trunnion supports 120 and 121 on which ride drag flask trunnions 122 and 123, respectively. The trunnion 123 includes a slotted keyway element 124 projecting therefrom. A key element 125 is mounted on shaft 126 journaled in the trunnion support 121, the outer projecting end of which is provided with a cog belt sheave 127. The cog belt 128 trained about such sheave is also trained about cog belt sheave 129 mounted on the projecting end of shaft 130. Such shaft extends radially of the column 32 and is journaled in hub 131 and at the end of sleeve spacer 132. The inner end of the shaft projecting from the sleeve 132 has secured thereto planetary bevel gear 133 which is in mesh with fixed bevel gear 134 surrounding such column. Accordingly, as the turret frame 48 indexes 180° about the vertical axis of the column 32, the drive illustrated will cause the drag flask D to rotate about its horizontal axis also 180° to be inverted.

THE STRIPPING AND CLOSING TABLES

As seen more clearly in FIGS. 1, 7, 8, 9 and 10, there is provided at the closing and stripping station 31 a flask table 140 and a somewhat smaller mold table 141. The mold table 141 is designed to support a bottom board 142, the board being guided between the shoulders seen at 143 and 144 in FIG. 9 for movement onto and off of the table by a mold pushoff mechanism, not shown, which may be of the type shown in the aforementioned Miller et al. application. The table 141 is secured by the large fasteners 145 seen in FIG. 9 to the top of piston 146. Such piston 146 extends downwardly through sliding seals 147 in flask table 140 and into cylindrical chamber 148 in the top of the operating rod 149 for the flask table 140. The mold table 141 is also provided with vertically downwardly extending guide rods 150 and 151 extending through bushings 152 and 153, respectively, in flask table 140. The lower ends of such guide rods are provided with stop nuts 154 and 155, respectively. The stop nuts limit movement of the table 141 with respect to the table 140.

The piston rod 149 for the flask table 140 is secured to the flask table by the clamping ring elements 157 secured in place by the relatively long fasteners 158 extending downwardly through top plate 159. Also secured to the flask table 140 by the fasteners 160 extending through such top plate are vertically elongated guide rods 161 and 162. Such guide rods extend through bushings 163 and 164 in the top portion of flask table cylinder 165. Such top portion is provided with a top flange by which the cylinder is connected to base 33. The cylinder also includes lateral projections accommodating bushings 166 and 167 also guiding rods 161 and 162, respectively. The top portion of the cylinder 165 is provided with a bushing 168 having sliding seals 169 therein. Piston 170 is provided on the lower end of the rod 149 within the cylinder 165 and includes piston rings 171. The bottom of the cylinder is closed by plate 172.

The flask table 140 is provided at its four corners with upstanding pins 175, 176, 177 and 178 which are held to such flask table by the nuts seen at 179. Diagonally opposite pins 175 and 177 have holes in the tops thereof as seen at 181 and 182, respectively, the lower ends of such holes being provided with diagonally downwardly directed lateral passages as seen at 183 to preclude sand from accumulating in such holes. The tops of the pins 175 and 177 are slightly higher than the pins 176 and 178 as seen more clearly in FIGS. 7 and 9. Such pins 176 and 178 are provided with rest buttons indicated at 184 on the tops thereof.

It can now be seen that the mold table 141 is carried by the flask table 140 and is designed to support on the bottom board 142 the finished or completed mold. The flask table 140, through the pins 175 through 178, engages and supports the cope and drag flasks to strip the same from such flasks onto the bottom board on the mold table. The mold table, while carried by the flask table, is itself movable independently within the limits noted.

THE DRAG FLASK

Referring now to FIGS. 11, 12 and 13, it will be seen that the drag flask D includes the oppositely directed trunnions 122 and 123, the latter being provided with keyway element 124. Aligned with and above the trunnions are laterally dis-

placed outwardly projecting guide pins **190** and **191**. Such pins engage the pattern plate supporting the drag pattern **93** precisely positioning the drag pattern with respect to the drag flask. This, of course, occurs when the drag flask is inverted from the position shown in FIGS. **11** through **13** and is in the molding station **30**.

The drag flask D is basically a rectangular structure which includes four walls **193**, **194**, **195** and **196**. The walls **193** and **194** are rigidly secured together at the corner **197**. Similarly the walls **195** and **196** are rigidly secured together at the corner **198**. As seen more clearly in FIG. **13**, such walls are slightly tapered and provided with internal liners **199**. A wear strip **200** is provided around the top of the flask forming the parting line.

Such walls are flanged top and bottom as indicated in FIG. **13** and include bottom extensions forming fill frame **201**. The bottom extensions for the walls **193** and **194** are rigidly joined at the corner **197** while those of the walls **195** and **196** are rigidly joined at the corner **198**.

However, the walls and their lower extensions are hinged together at the corners **203** and **204** by the spring-loaded taper pins **205** and **206**, respectively. Such hinge construction is seen in more detail in FIG. **12**.

The wall **196** includes vertically spaced annular hinge knuckles **207** and **208** in which are secured flanged bushings **209** and **210**, respectively. The wall **193** includes hinge knuckle **211** situated between the hinge knuckles **207** and **208** of the wall **196**. Tapered bushing **212** is secured in the hinge knuckle **211** of the wall **193**. The pin **205** includes a reduced diameter upper portion **213** projecting through the bushing **209**, a tapered portion **214**, an enlarged diameter portion **215** forming a shoulder for compression spring **216**, and a reduced diameter lower portion **217** projecting downwardly beyond the necked extension of the flanged bushing **210** in which O-ring **218** is provided surrounding the lower extension **217**. The compression spring extends between the necked portion of the bushing and the shoulder between the enlarged portion **215** and the reduced diameter extension **217** urging the pin upwardly as seen in FIG. **12**. The tapered portion of the pin **214** may have the same taper as the bushing **212** and when the pin is seated in the tapered bushing by the spring **216** the flask will be closed and locked in such closed condition.

Rubber blocks or strips seen at **220** and **221** in FIG. **11** are positioned between the hingedly connected walls and when the hinge pins are seated in the bushings, such blocks will be slightly compressed. When such pins **205** and **206** are driven downwardly compressing the springs **216**, the spring blocks **220** and **221** will force the connected walls **195** and **196** away from the connected walls **193** and **194** thus opening the flask.

The drag flask D is also provided with projections seen at **223** and **224**, the top and bottom of each being provided with stop buttons as seen at **225** and **226** adapted to engage trunnion stops shown in phantom lines at **227** and **228** which may be mounted on the turret frame member **62**. A counterweight **229** ensures that the flask will remain in its correct position on such trunnion stops. The trunnion stop buttons **225** and **226** are, of course, symmetrical with respect to the trunnion axis. The underside of the drag flask D is also provided with buttons seen at **230** and **231** adapted to engage buttons **184** on the tops of the flask lifting pins **176** and **178**. The cope flask C may be of similar construction properly to engage the lifting pins of the flask table **140** but need not be provided with the special hinged opening features of the drag flask.

OPERATION

Referring first to FIG. **1**, with the cope and drag flask supported by the turret index frame **48** in the position shown with the cope flask empty and at the stripping and closing station **31** and the drag flask empty and inverted at the molding station **30**, the table **100** is elevated picking up the drag pattern **93** which in turn picks up the inverted drag D. After the drag flask has been picked up, the drag mold box is formed with the pattern closing the bottom. The piston-cylinder **81** is retracted to position the sand filling chute **77** beneath the opening **40** and the louver gate **42** is then opened to fill the drag with molding sand. The piston-cylinder assembly **81** is now retraced to position the squeeze board or head **78** in the position shown. The jolt action may commence as soon as the drag is filled with molding sand and the table **100** is now further elevated to squeeze the sand within the drag. The jolt may continue during squeeze. After the mold **240** has been rammed to the desired hardness, the table **100** is lowered replacing the drag on the indexing turret frame **48** and the pattern **93** is drawn from the mold **240** and repositioned on the pattern shuttle frame **72**. When the pattern has cleared the drag, the turret index frame **48** is indexed 180° simultaneously rolling over the drag mold **240** to its proper upright position. This, of course, simultaneously positions the cope flask C in the molding station **30** and the drag flask with the mold **240** therein at the stripping and closing station **31**. Also simultaneously, the piston-cylinder assembly **97** is employed to oscillate the pattern shuttle frame **72**, 90° to position the cope pattern **94** in line with the molding station **30**.

The same procedure is then repeated to form the cope mold **241**.

Referring now to FIGS. **14** through **19**, while the cope mold **241** is being made, the drag mold will be stripped from the drag flask D and positioned on bottom board **142**. FIG. **14** illustrates the start of the closing cycle with the drag mold **240** on the index arms at the closing station. Moving to FIG. **15**, the flask table **140** is elevated with the pins **175** through **178** contacting the drag flask. The pins with the holes in the tops thereof fit around the downwardly projecting ends of the taper pins **205** and **206** of the drag flask but do not actuate such pin mechanisms, there being provided sufficient clearance between the bottom of the holes and the projecting ends **217** of such taper pins.

In FIG. **16**, the mold table **141** is elevated with respect to the flask table **140** to contact the underside of the drag mold **240** with the bottom board **142**. The drag flask D with the drag mold **240** therein is now supported both by the flask table and the mold table.

Referring now to FIG. **17**, both tables **140** and **141** move upwardly until the pins **46** engage the tops of the taper pins **205** and **206** moving the taper pins downwardly compressing springs **216**. This opens the drag flask stripping the mold **240** from the drag flask D.

As seen in FIG. **18**, the mold table **141** now descends with the drag mold **240** on bottom board **142**. The drag flask D is maintained opened until the drag mold **240** has cleared the flask and now both tables descend. As soon as the pins **46** disengage the taper pins **205** and **206** of the drag flask, the flask recloses and further lowering of the flask table **140** repositions the drag flask D, now closed, on the arms of index turret frame **48** as seen in FIG. **19**. With the flask table **140** and the mold table **141** now down as seen in FIG. **19**, the top surface or parting line of the drag mold is approximately 3½ feet above the floor so that the operator may conveniently place cores therein. The drag mold may be in such position for approximately 7 to 10 seconds while the molding of the cope is completed.

The index turret frame **48** is actuated to replace the cope flask C with the cope mold **241** therein at the closing station while the drag flask D is inverted and positioned in the molding station when the cope mold **241** is completed and the pattern drawn therefrom. This initial condition of the closing cycle is seen in FIG. **20**. In FIG. **21**, flask table **140** is elevated with the pins contacting the cope flask C. In FIG. **22**, the mold table moves up with respect to the flask table the relatively short distance to close the drag mold **240** on the cope mold **241**.

In FIG. **23**, both tables move up now simultaneously. The top of the cope flask C is provided with apertures **243** permitting the cope flask C to bypass pins **46**. When the top of the cope mold **241** engages stripping head **45**, the cope mold **241**

is retained while the cope flask continues upwardly. This strips the cope mold from the cope flask as seen in FIG. 23. The mold table 141 may yield during such stripping. As seen in FIG. 24, the mold table now is lowered a relatively short distance and in FIG. 25, both tables are moved to the down position with the now closed mold on the bottom board 142. The empty cope flask C is set on the arms of the turret index frame 48. In the FIG. 25 position, the closed mold 240, 241 is pushed out of the machine and a new bottom board is placed on mold table 141. When the pushoff has retracted, the cycle will repeat. During the stripping of the cope mold and the closing as seen in FIGS. 20 through 25, another mold is being produced in the drag flask.

With the machine of the present invention, approximately 150 complete molds per hour can be produced. With the high-pressure squeeze and jolt molding, such molds are of uniform high density and hardness. Even with the rapid production rate, there is sufficient time in the closing cycle to permit either manual or automatic coring of the drag mold.

I, therefore, particularly point out and distinctly claim as my invention:

1. A foundry molding machine comprising a pair of laterally spaced pivot columns, a molding unit between said columns, a turret frame on one of said columns operative to support a cope and drag flask, a closing unit positioned on the opposite side of said one column in line with said molding unit, means operative to index said turret frame 180° to position alternately such cope and drag flasks at the molding unit and closing unit, and a pattern shuttle on the other pivot column operative alternately to position cope and drag patterns in line with the molding unit.

2. A foundry molding machine as set forth in claim 1 including means responsive to the indexing of said turret frame to invert such drag flask so that it is upside down in said molding unit and right side up in said closing unit.

3. A foundry molding machine as set forth in claim 2 wherein said turret frame includes a pair of trunnion supports for such drag flask, one of said trunnion supports including a rotatable drive element engageable with such drag flask, and means responsive to the movement of said turret frame as aforesaid to rotate said drive element substantially 180°.

4. A foundry molding machine as set forth in claim 3 including a fixed bevel gear surrounding said one column, a shaft projecting radially from said column parallel to said drive element, a bevel gear on the interior of said shaft in mesh with said fixed bevel gear, and drive belt means interconnecting the outer end of said shaft and said drive element to rotate the latter as aforesaid.

5. A foundry molding machine as set forth in claim 4 including a head frame interconnecting said pivot columns, a sand hopper on said head frame, and a shuttle on said other pivot column operative alternately to position a sand chute and a squeeze head above said molding unit and beneath said hopper.

6. A foundry molding machine as set forth in claim 5 wherein said sand chute-squeeze head and pattern shuttles are oscillated 90° about said other pivot column.

7. A foundry molding machine as set forth in claim 1 wherein said molding unit includes a vertically movable squeeze table, and a jolt ram in said squeeze table.

8. A foundry molding machine as set forth in claim 1 wherein said turret frame is indexed 180° by a piston-cylinder assembly, said assembly first retracting and then extending to complete its stroke.

9. A foundry molding machine as set forth in claim 1 including table means at said closing unit operative to strip the drag mold from the drag flask and lower the same to a height suitable for coring.

10. A foundry molding machine as set forth in claim 1 wherein said closing unit includes means operative to open the drag flask to strip the drag mold therefrom.

11. A foundry molding machine as set forth in claim 1 wherein said closing unit comprises a flask table, and a mold support table mounted on said flask table and independently movably with respect thereto.

12. A foundry molding machine as set forth in claim 11 wherein said flask table has upstanding flask support pins, said mold support table being mounted within said pins on said flask table, said mold support pins extending above the drag mold in the lowermost position of the mold support table.

13. A foundry molding machine as set forth in claim 11 wherein said mold support table is mounted on a piston rod extending downwardly through said flask table and into the piston rod supporting said flask table for vertical movement.

14. A foundry molding machine comprising a pivot column, a molding unit and a closing unit on opposite sides of said pivot column, a flask supporting index frame on said column, means operative to oscillate said frame 180° alternately to position a cope and drag flask at the molding and closing units means responsive to the oscillation of said frame to invert the drag flask only, and a pattern shuttle operative alternately to position cope and drag patterns at said molding unit to be assembled with such cope and drag flasks, respectively.

15. A foundry molding machine as set forth in claim 14 wherein said last mentioned means comprises a fixed gear surrounding said pivot column, and a planetary gear in mesh with said fixed gear driving such drag flask for inversion.

16. A foundry molding machine as set forth in claim 15 wherein said planetary gear is mounted on a shaft extending radially of said pivot column, said shaft rotating 180° as said flask supporting index frame oscillates 180°.

17. A foundry molding machine as set forth in claim 16 including a rotatable drive element engaging such drag flask, and drive belt means interconnecting said shaft and said rotatable drive element to invert such drag flask as said flask supporting index frame oscillates.

18. A foundry molding machine comprising a pivot column, a molding unit and a closing unit on opposite sides of said pivot column, a flask supporting index frame on said column, means operative to oscillate said frame 180° alternately to position a cope and drag flask at the molding and closing units, means responsive to the oscillation of said frame to invert the drag flask only, a second pivot column on the opposite side of said molding unit as said first mentioned pivot column, and a pattern shuttle on said second pivot column operative alternately to position cope and drag patterns at said molding unit.

19. A foundry molding machine as set forth in claim 18 including a head frame interconnecting said pivot columns, a sand hopper on said head frame above said molding unit, and a shuttle on said second pivot column operative alternately to position a sand chute and squeeze head beneath said sand hopper at said molding unit.

20. A foundry molding machine as set forth in claim 14 wherein said molding unit includes a vertically movable squeeze table, and a jolt ram in said squeeze table and vertically movable therewith.

21. A foundry molding machine as set forth in claim 14 wherein said closing unit includes a vertically movable flask table operative to engage such flasks and strip the molds therefrom, and a mold support table mounted on and independently movable with respect to said flask table operative to support such molds stripped from such flasks.

22. A foundry molding machine comprising a molding unit and a closing unit, a flask shuttle operative alternately to position a cope and drag flask at each, a pattern shuttle operative to position cope and drag patterns at said molding unit to be assembled with such cope and drag flasks, respectively, and means responsive to the shuttling of the drag to invert the same.

23. A foundry molding machine as set forth in claim 22 including a pivot column between said molding unit and closing unit, a flask support frame mounted on said pivot column, and means to oscillate said flask support frame 180°.

24. A foundry molding machine as set forth in claim 23 including a piston-cylinder assembly operative thus to oscillate said flask support frame.

25. A foundry molding machine as set forth in claim 24 including a fixed gear surrounding said column, and drive means in said flask support frame in mesh with said fixed gear operative to invert the drag during oscillation of said frame.

26. A foundry molding machine including a molding unit for making cope and drag molds and a closing unit for assembling such cope and drag molds, said closing unit having a flask table with upstanding flask support pins, a mold support table within said pins mounted on said flask table, means operative vertically to move said flask table to pick up a flask with said pins and strip a mold therefrom, and means operative independently to move said mold support table to support the mold after removed from such flask.

27. A foundry molding machine as set forth in claim 26 including an elongated piston rod supporting said flask table for vertical movement, and a piston rod for said mold support table extending through said flask table and into the top of said elongated piston rod for said flask table.

28. A foundry molding machine as set forth in claim 26 wherein said pins extend above said mold support table in the lowermost position thereof a distance greater than the height of the drag mold above said mold support table.

29. A foundry molding machine as set forth in claim 31 including a flask having opening pins at diagonally opposite corners thereof, the corresponding flask support pins having vertical holes in the tops thereof accommodating said opening pins without axial movement thereof.

30. A foundry molding machine including a molding unit for making cope and drag molds and a closing unit for assembling such cope and drag molds, said closing unit having a flask table with upstanding flask support pins, a mold support table within said pins mounted on said flask table, means operative vertically to move said flask table to pick up a flask and strip a mold therefrom, means operative independently to move said mold support table to support the mold after removed from such flask, a flask having taper pins at diagonally opposite corners thereof, the corresponding flask support pins having vertical holes in the tops thereof accommodating said taper pins, and downwardly projecting fixed pins at said closing unit operative to engage said taper pins as said flask is elevated to open said flask to facilitate the stripping of the mold therein onto said mold support table.

31. A foundry molding machine as set forth in claim 30 wherein said taper pins fit within tapered bushings in said flask, and spring means holding said taper pins in said bushings.

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