April 5, 1938. A. T. JEFFERY 2,112,910

METHOD AND APPARATUS FOR MAKING MOLDS

Filed Oct. 23, 1935 2 Sheets-Sheet 1

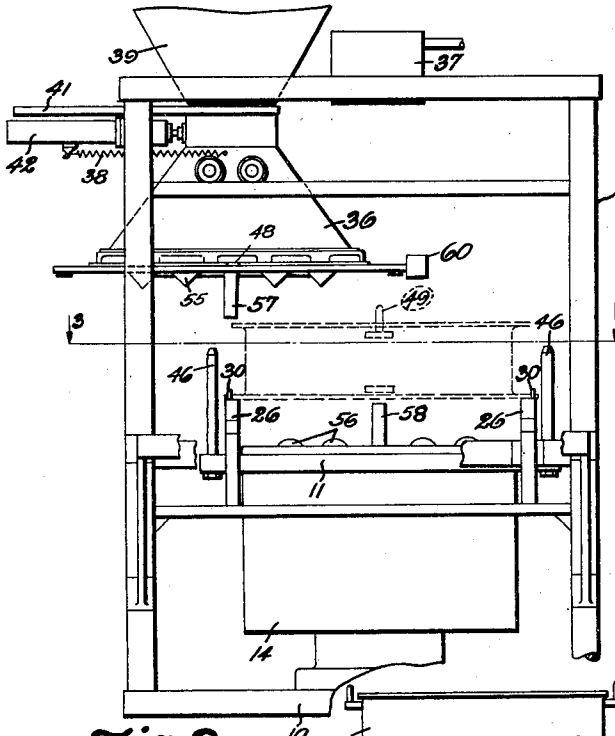


Fig. 2

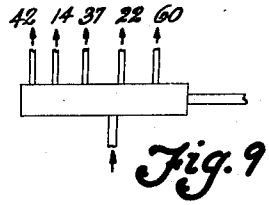


Fig. 9

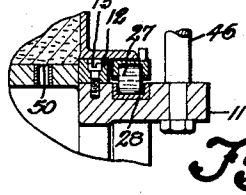


Fig. 4

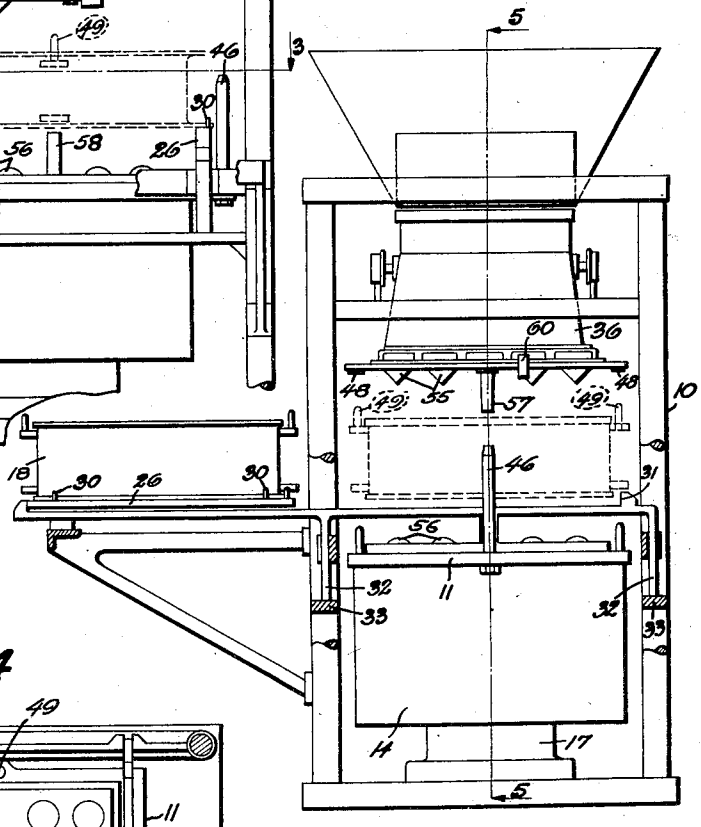


Fig. 1

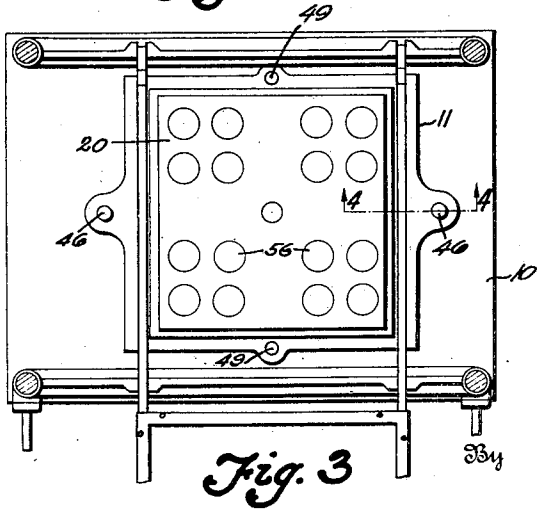


Fig. 3

Inventor

Allen T. Jeffery

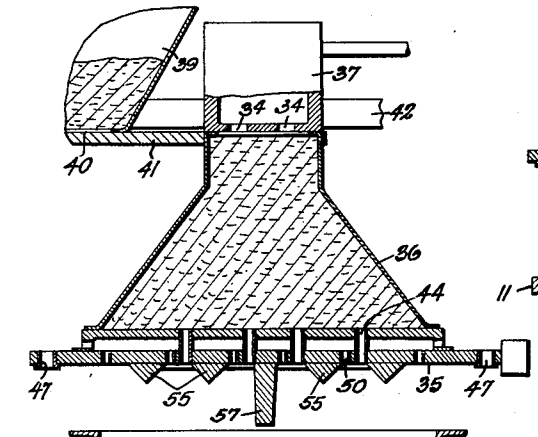
By Maréchal & Noé

Attorney

April 5, 1938. A. T. JEFFERY 2,112,910

METHOD AND APPARATUS FOR MAKING MOLDS

Filed Oct. 23, 1935 2 Sheets-Sheet 2



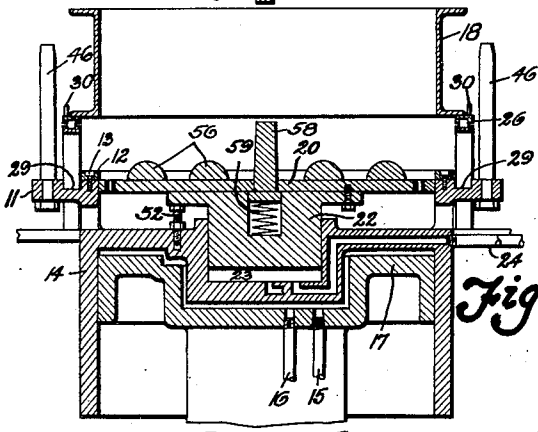


Fig. 5

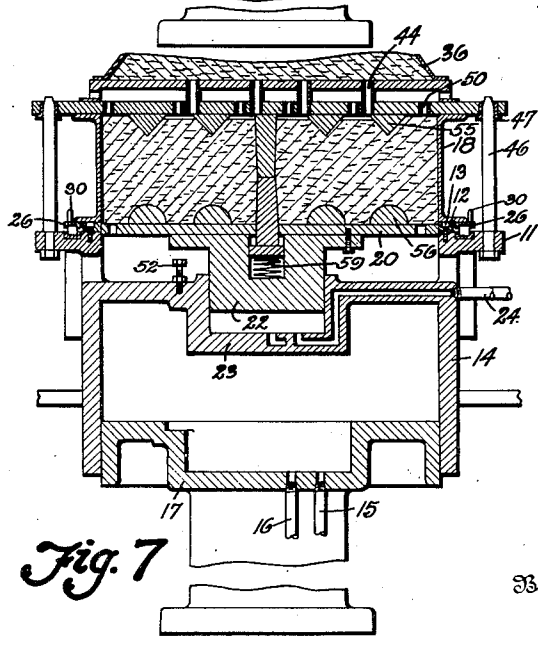


Fig. 7

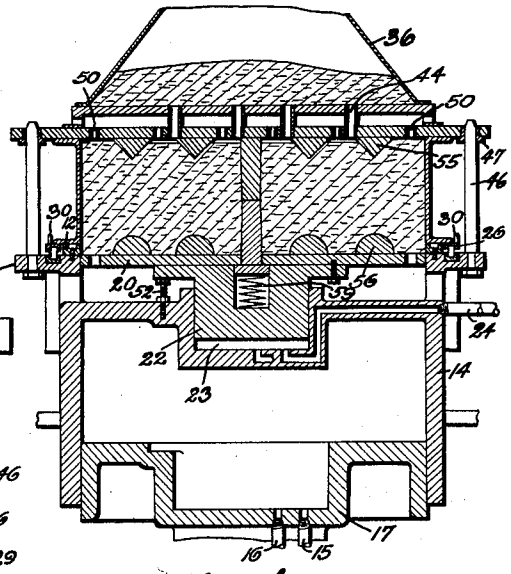


Fig. 6

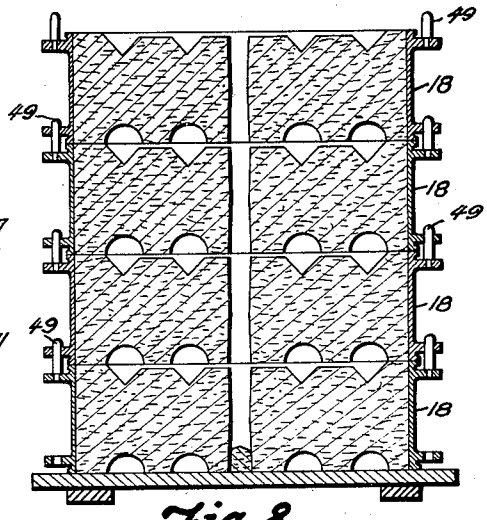


Fig. 8

Inventor

Allen T. Jeffery

By Maréchal & Noé

Attorney

Patented Apr. 5, 1938 2,112,910

UNITED STATES PATENT OFFICE

2,112,910

METHOD AND APPARATUS FOR MAKING MOLDS

Allen T. Jeffery, Dayton, Ohio, assignor to The Dayton Malleable Iron Company, Dayton, Ohio, a corporation of Ohio

Application October 23, 1935, Serial No. 46,267

7 Claims. (Cl. 22—36)

This invention relates to the founding art and more particularly to the making of molds from sand or the like, for use in metal casting.

One object of the invention is the provision of a novel method, and apparatus for carrying out such method, whereby sand molds may be produced at very high speed, and in an economical manner.

Another object resides in the method of making sand molds in which sand is blown under pressure into a cavity having a wall shaped to the desired formation to be reproduced, this step being followed by a squeezing action to compress or compact the sand in the cavity.

A further object of the invention resides in an apparatus for making molds in which there is a flask supporting portion that can be moved so as to press the flask against a sand supply part, and in which there is provision for moving the pattern plate with respect to the flask so as to compress sand that has been blown into the flask from the sand supply part.

Other objects and advantages of the invention will be apparent from the following description, the appended claims, and the accompanying drawings, in which—

Fig. 1 is a side elevation of a mold making machine embodying the present invention, a portion of the machine being shown in section;

Fig. 2 is a front elevation of the machine;

Fig. 3 is a horizontal section on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged section on the line 4—4 of Fig. 3;

Fig. 5 is a central vertical section on the line 5—5 of Fig. 1 showing the relationship of the parts before bringing the pattern plates and the flask together;

Fig. 6 is a corresponding section but with the parts shown after the mold forming cavity has been closed and the sand supplied to the flask but before the sand is mechanically compacted;

Fig. 7 is a corresponding section but with the lower pattern plate in its raised position with respect to the flask;

Fig. 8 is a vertical section showing a series of superimposed molds produced in accordance with the present invention; and

Fig. 9 is a diagrammatic view of the air supply connections.

Referring to the drawings the apparatus of the present invention is particularly adapted for the production of sand molds, at a rate far in excess of that attainable in accordance with the usual present-day practice. Ordinarily sand molds, employed in the casting of metals, have been made by dumping sand into a flask and mechanically pressing or compacting the sand by a pressure board applied to the sand on the side opposite the pattern or pattern board. Or, in multiple molding where the pattern is of a simple character, top and bottom pattern boards of complementary form have been employed for compacting between them the sand that has been applied to the flask before the top pattern board is placed in position. In accordance with the present invention, however, the sand for making a green sand mold or the like, for simple or multiple molding, is blown by means of an air stream or streams, through a top plate into a mold cavity provided by a flask, the top plate and a bottom pattern plate, so that the cavity is completely filled with sand. The top plate through which the sand is forced into the flask, in the case of multiple molding, is a pattern plate that is so formed as to produce an impression that will cooperate with the impression produced by the bottom pattern plate to form the complete mold outline. The sand that is blown into the flask is then compacted as by moving one of the pattern plates towards the other, the sand thus being made hard enough to resist deforming or bulging of the walls of the mold cavity by the pressure of the poured metal.

As shown, the apparatus comprises a machine frame 10 having a movable table 11 carrying a flask supporting portion preferably in the form of a detachable ring or frame 12 which is fixed on the table as by means of suitable screws 13. The table 11 is carried by a movable pressure element such as the cylinder 14, which may be connected to the foundry air line by pipe 15 so as to be raised or lowered by air pressure. The cylinder is guided by a fixed piston 17 which is suitably supported on the base of the frame 10.

The flask 18 in which the mold is formed preferably comprises four side walls and is rectangular in form, the top and bottom of the flask being open. The flask opening corresponds in size and shape with the opening in the ring 12, the flask being adapted to rest upon this ring while the sand is being introduced into it. The lower pattern plate 20 is also of such length and width as to conform to the opening in the ring 12 and to the opening in the flask so that the pattern plate can be moved up relative to the table 11 into the ring from a normal position as shown in Figs. 5 and 6. In its raised position the top of the pattern plate is about even with or slightly below the bottom of the flask 18 but

during the supply of sand to the flask the pattern plate 20 is some distance below the level of the bottom of the flask. The pattern plate 20 is carried by a plunger or piston 22 that operates in a cylinder 23 provided in the cylinder 14. The supply of air under pressure to the pipe 24 causes the piston 22 to be moved upwardly from its normal position shown in Fig. 5 thus moving the pattern plate upwardly in order to compact the sand that has been supplied to the mold cavity provided by the flask, top pattern plate 35 and bottom pattern plate 20 fitting upon one another.

When the table 11 is in its normal or lowered position, the flask 18, as shown in Fig. 5, is supported on a flask holding frame 26 which holds the flask some distance above the top of the pattern plate 20. The opposite sides of the flask holding frame 26 are preferably provided with rotatable rollers 27, see Fig. 4, which operate along tracks 28 in the form of channel irons extending horizontally the desired distance above the top of the table when the latter is in its normal position. These tracks project so that the holder 26 can be run out, carrying the flask 18 with it, to the position shown in solid lines in Fig. 1. In this position the flask may be readily removed from the machine and another flask placed on the holder in proper position as determined by locating pins 30 which extend upwardly on the flask holder 26 in such position that when the latter is moved inwardly and stops against the stop projection 31, shown in Fig. 1, the flask will be located approximately in vertical alignment with the pattern plate 20, but some distance above the pattern plate. This distance is determined by the length of the arms 32 that are fixed to and project downwardly from the lower side of the tracks 28, and that normally rest against fixed lugs or ledges 33 provided on the machine frame.

When the table 11 is raised, it moves up until it strikes the under side of the tracks 28, which it receives in the channels or grooves 29 that are of such depth as to cause the flask to be picked up by the ring 12. The weight of the flask is thus relieved from the holder 26 when the table is raised. The holder itself is also picked up by the table 11 and is moved upwardly with the flask until the upper side of the flask is brought to bear against the top plate 35 which is carried by a sand supply part 36.

Where the apparatus is to be used in simple molding a plurality of machines are employed, one for making the cope section and the other for making the drag section of the mold, and in such case the lower surface of the plate 35 is flat on its lower side instead of being provided with the pattern portions illustrated. Where the apparatus is to be used in multiple moulding the lower surface of the plate 35 is provided with pattern sections which form a part of the impression. The lower sand retaining wall of the sand supply part 36, in apparatus for making either simple or multiple molds, is fixed a small distance above the plate 35 to provide a space for air removal as will be referred to in further detail. This sand supply part 36 embodies a horizontally movable container, the top of which registers with a considerable number of air supply holes 34. The top of the container registers with air supply holes 34 provided in an air valve designated generally by the reference numeral 37. Normally the sand distributor 36, which is slidably supported at its upper end on horizontal tracks on the frame 10, is held by a spring 38 in the position shown in Fig. 2, where the upper end of the container registers with a sand supply hopper 39. The opening 40 at the lower side of sand hopper 39 is normally closed by a plate 41 provided on the container and extending to the left so as to close the sand hopper 39 when the sand container 36 is moved to the right to the position shown in Fig. 5. This movement is effected against the action of the spring 38 by means of a suitable air cylinder 42 or the like. In its left-hand position, the sand flows by gravity from the sand hopper 39, filling the space within the container 36. The latter then moves to the right and registers with the air valve 37 so that when air under pressure is supplied to the top of the sand column, the sand will be blown out of a large number of openings 44 that are provided in the pattern plate 35, the particles of sand being carried along by the blast of air issuing from these holes so as to entirely fill the flask.

Before the air is supplied to the upper end of the sand column in the sand container 36, air is supplied under pressure to the pipe 15, raising the cylinder 14 and bringing the parts from the position in which they are illustrated in Fig. 5, to the position shown in Fig. 6. The air pressure is maintained in the table raising cylinder, thus holding the ring 12 against the flask 18 and holding the flask 18 against the lower side of the top pattern plate 35. Furthermore this air pressure serves to hold the sand container 36 firmly against the lower side of the air distributing valve 37.

As the table 11 is raised, the various parts if not already in their proper position of alignment with one another are brought into exact proper alignment, the top pattern plate being positioned with respect to table 11 by means of long locating pins 46 that extend upwardly from the table and which engage bushings 47 in the top pattern plate. The flask itself is shifted slightly if necessary to its proper position centrally of the pattern plates by means of locating fingers 49 that project upwardly from the flask and engage bushings 48 in the top pattern plate, while additional fingers 49 are provided on the table 11 for engagement with bushings 48 in the flask. The two pattern plates are thus located in exact alignment.

With the empty flask 18 held firmly between the top pattern plate and the ring 12, and the various parts in the position shown in Fig. 6, the air is turned on so as to subject the sand column in the container 36 to the factory air line pressure which may be of the order of about 75 pounds per square inch. The sand is thus supplied to the interior of the flask, the various joints between the engaged parts being small enough so that sand is not lost, although these joints permit the necessary flow of air out of the mold cavity as the sand is filling into the cavity. Additional means for facilitating the outflow of air from the mold cavity is also provided at places where the sand does not tend to flow, as for example the upper corner portions. At these portions and at other parts of the upper pattern plate and also in the lower pattern plate there are many holes of about 3/8" diameter, each hole being filled with a metal shell or ring having one end closed by a fine wire screen which is flush with the lower surface of the pattern plate. Such screened openings are indicated at 50 in Fig. 6.

After the sand is blown into the flask the sand is compacted, preferably by moving the bottom pattern plate towards the upper pattern plate. This is accomplished by supplying air to the pipe 24 so as to raise the piston 22, thus moving the

lower pattern plate 20 bodily upwardly and compressing the sand above it. A stop 52 determines the lower position of the pattern plate, while its upper position is such that its upper face is substantially flush with and preferably even a little below the level of the bottom of the flask 18 in order that a sand to sand joint will be insured when the flask 18 is removed and placed upon a similar flask containing a similar mold portion. While the upper position of the pattern plate 20 may be positively stopped the height of the ring 12 may be so chosen that for the particular air pressure employed the lower pattern plate will have just enough movement to bring its upper surface to the desired position substantially flush with the lower edge of the flask.

As will be apparent, the top and bottom pattern plates provide a suitable number of pattern portions 55 and 56 which correspond in form to the lower and upper halves of the article to be produced. Furthermore these pattern plates also incorporate sprue pouring portions 57 and 58, one of which is mounted for yielding movement. As shown the lower pouring sprue portion 58 is normally pressed upwardly by a spring 59 so that before the sand is blown into the flask the two sprue portions meet as shown in Fig. 6. Then when the lower pattern plate 20 is moved upwardly with respect to the table 11, the sprue portion 58 merely remains stationary.

After the mechanical compacting of the sand within the flask 18, the air pressure is relieved from below the piston 22 of the lower pattern plate 20. The lower pattern plate is thus moved downwardly in the table to its normal position, this action being followed by a lowering of the table itself, by relieving the air pressure below the table cylinder 14. The flask is thus lowered, separating the mold from the upper pattern plate until the flask weight is taken by the tracks 28, the arms 32 of which come up against the shoulders or abutments 33 that are fixed on the frame. The lowering movement of the flask then ceases although the table itself continues to move downwardly, taking the lower pattern plate with it. The various parts are thus returned to the positions shown in Fig. 5. From this position the flask itself is pulled horizontally so that the flask holder 26 rolls out on the tracks for as great a distance as desired, enabling the convenient removal of the flask with the mold contained in it. If the tracks are sufficiently long the filled flask may be moved far enough to permit an empty flask being applied before removing the filled flask. The air pressure is relieved from the cylinder 42 after the table is lowered so that the spring 38 returns the sand container 36 to the position shown in Fig. 2 in order that more sand can flow into the container ready for the next operation.

The molds thus produced by a large number of flasks 18 of similar construction provide a large number of mold sections which may be stacked one upon the other as shown in Fig. 8, with the pins 49 of a flask engaging bushings in the flask above. The top of the upper mold and the bottom of the lower mold are not used but the remaining mold portions provide for simultaneous casting of a great many articles of the desired form. The pattern itself may be of any desired shape and adapted for use with or without additional cores. The various pouring sprues of the stacked molds of course register with one another, and the take-off channels leading from the pouring passage to the various patterns in any mold are provided in accordance with proper foundry practice and produced by one or the other of the pattern plates.

The various air supply valves may of course be individually operated if desired but Fig. 9 shows diagrammatically a form of control in which a single valve handle can be slowly turned or moved mechanically or manually to make the necessary air connections in proper sequence so that air is supplied first to the cylinder 42 and then in order to cylinder 14, air valve 37 and piston 22. The air may then be supplied to an air vibrator on the top or bottom pattern plate, which is diagrammatically represented by the reference numeral 60, which vibrates the plate so that the separation of the pattern from the mold can be more readily accomplished without any sticking of the sand. The supply of air through the air valve 37 continues only for a few seconds, and the air supply to the valve 37 is then shut off. The air pressure, however, is maintained on the pistons 42, cylinders 14 and piston 22 until after the vibrator 60 has been operated if such an air hammer is employed. The air is released from the various cylinders by successively cutting off the air supply to the cylinders 23, 14 and 42 in the order mentioned.

As will now be apparent, the invention makes it possible to make a very large number of molds in a very short time and with comparatively little manual labor. As it takes only a few seconds to completely fill the mold cavity with sand, and only a very short time for the movement of the various cylinders to bring the parts into their proper positions and to return the parts back to their original positions, it requires only a matter of a fractional part of a minute for an entire sequence of operations productive of a sand mold that can be immediately used for the reproduction of any desired pattern as finished castings.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. The method of forming sand to a predetermined shape for use in casting comprising combining a flask and a top pattern plate and a bottom pattern plate to form a cavity, blowing sand into the cavity through one of the pattern plates, and moving the other pattern plate to compress the sand to compact it while maintaining the engagement of the sand blown into the chamber with the top and bottom pattern plates.

2. The method of making multiple molds comprising blowing sand down into each of a series of similar flasks and against top and bottom pattern plates to give the desired formation to the sand at the top and bottom of each flask, compressing the sand between the pattern plates by a squeezing action while maintaining such desired formation of the sand and while maintaining the top and bottom pattern plates in contact with the sand, separating the pattern plates, and stacking similar molds thus formed one upon the other.

3. Apparatus for making molds comprising a table having a flask supporting portion, a flask adapted for support on said portion, a pattern plate, means supporting said plate for movement relatively to said table, a second pattern plate,

means for pressing the flask supporting portion and the flask against the second pattern plate, means for supplying sand under pressure to said flask, and means for moving the first mentioned pattern plate to squeeze the sand in the flask.

4. Apparatus for making molds comprising a frame, a flask support, a flask adapted for support thereon, means for locating said flask on said support, a bottom pattern plate, a top pattern plate, means for blowing sand through said top pattern plate, means for moving said support to clamp the flask against the top pattern plate, and means for moving said bottom pattern plate relatively to said support to squeeze the sand in said flask.

5. The method in multiple molding of forming green sand molds to a predetermined shape for use in casting comprising assembling a flask and top and bottom pattern plates to form a closed chamber in which sand will be trapped, blowing sand into the closed chamber to form both top and bottom of the mold to final contour, and moving one of the pattern plates toward the other while still maintaining the engagement of the sand blown into the chamber with the top and bottom pattern plates to compress the sand.

6. The method in multiple molding of forming green sand molds to a predetermined shape for use in casting comprising assembling a flask and top and bottom pattern plates to form a closed chamber in which sand will be trapped, blowing sand into the closed chamber through one of the pattern plates, and moving one of the pattern plates toward the other while still maintaining the engagement of the sand blown into the chamber with the top and bottom pattern plates to compress the sand.

7. Apparatus for making molds comprising a frame, a sand supply member mounted in said frame, a first pattern carried by said sand supply member, a table mounted in said frame for movement toward and away from said sand supply member and having a flask supporting portion, a flask adapted for support on said portion, a pattern support carried by and movable with said table and also having movement relative to said table, a second pattern carried by said support, said flask and said second pattern cooperating to form a sand receiver, means for moving said table to filling position to bring said flask and said second pattern into sand receiving relationship with said sand supply member and first pattern, means for blowing sand through said first pattern into said receiving means, and means for moving said second pattern toward said first pattern to compress the sand while said table remains in filling position.

ALLEN T. JEFFERY.