June 24, 1930. J. T. STONEY 1,768,429

METHOD FOR FORMING SAND MOLDS

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Fig. 1.

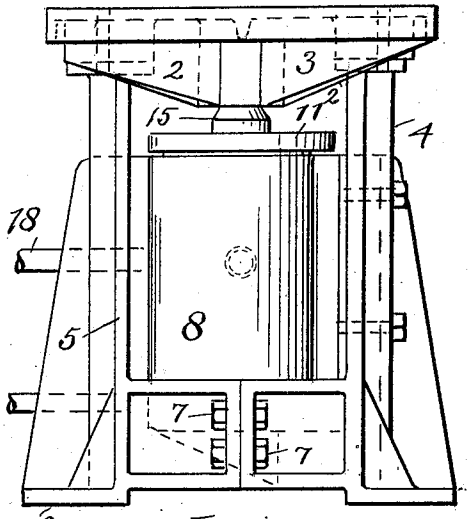
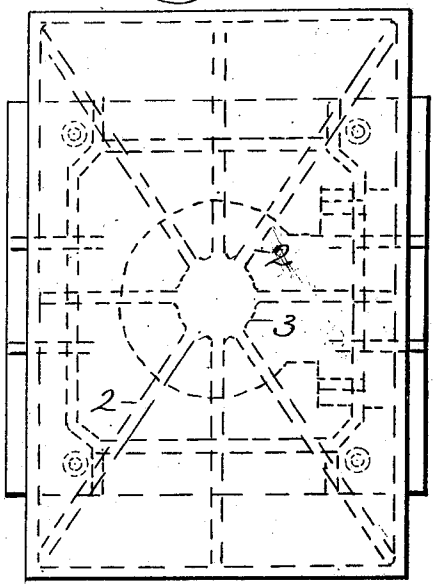


Fig. 2.



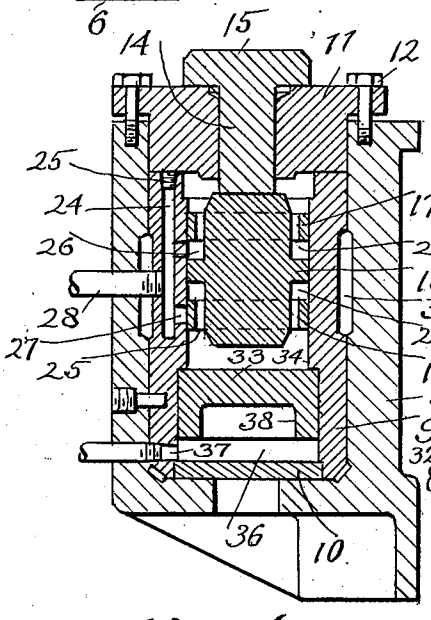


Fig. 4.

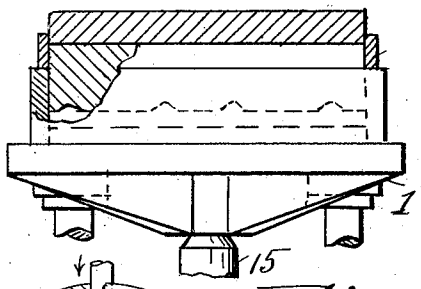


Fig. 3.

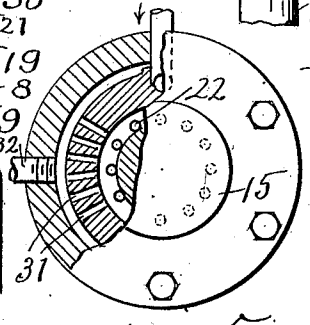


Fig. 5.

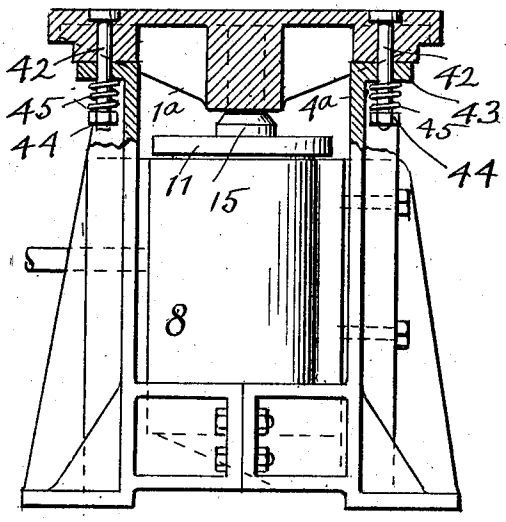
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Fig. 7.



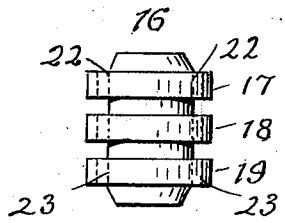


Fig. 6.

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Patented June 24, 1930 1,768,429

UNITED STATES PATENT OFFICE

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METHOD FOR FORMING SAND-MOLDS

Application filed August 16, 1924. Serial No. 732,358.

This invention relates to a method and apparatus for forming molds, cores and similar devices from sand or any material which is analogous for the purpose. The principal object of the invention is to provide method and apparatus whereby the material of which a mold or core is made, as for instance sand, may be readily compacted in the flask or box in which the mold or core is made, by imparting, in a suitable manner, to the flask, a series of percussive impulses imparted successively, which act upon the sand or analogous material to cause it to settle.

A further object of the invention is to impart the percussive impulses of the sand in one direction only and this direction of application being such as to cause the sand to settle and compact in a minimum space of time.

I am aware that it is common in the molding art to prepare molds of sand and compact the sand by jarring the sand in a flask, around a pattern. This jarring method has proven quite satisfactory in the art, but the new method herein proposed has many distinct advantages over the jarring method to which reference has been made.

In the jarring method of compacting sand in molds, the table of a molding machine and mold thereon is elevated and then dropped. The jarring takes place when the table reaches the end of its downward movement and the jar imparted is momentary. Subsequent to the jarring the table is raised to its upper limit of movement, then released and moves by gravity to its low limit of movement. Therefore, there is between successive impulses or impacts in the jarring method a period of rest in which the sand is quiescent. In other words, the sand is jarred and is moved to cause the settling of the sand only at the time of impact and between the impacts there are periods when there is no movement of the sand.

In the proposed method of molding, a great number of impacts per unit of time, by use of a vibrator or similar mechanism, is given to the table on which the flask is supported. The impacts are sufficiently frequent so that the sand is continually in agitation during the period of compacting, and the particles of sand in movement, seek to find the most advantageous and compacted relation with respect to adjacent particles of sand.

It will, of course, be apparent that the impacts delivered to a flask or the table upon which the flask is placed, in the making of a mold, must be sufficiently heavy to accomplish the purpose which has been described and I say this to distinguish my present invention from the common practice of using a small vibrating machine, which is used during a drawing operation to secure a good parting between the pattern and the mold, such a vibrator being used sometimes in connection with a pattern plate, or being connected directly with a flask or the table upon which the flask rests.

Furthermore, as before stated, in the sand compacting operation, I employ a series of rapidly recurring impacts, in one direction only, as for instance, impacts against the under side of a table upon which a flask or sand therein rests, whereby such blow imparted, causes agitation of the sand with the ultimate effect of causing it to settle more compactly within the flask.

The difference in action between the vibrating method and the jarring method, in compacting of sand in a mold, produces the result that the vibrated mold is compacted in a much shorter period of time than could possibly be accomplished with the jarring method of compacting sand. For instance, on making the cope or drag half of a four cylinder automobile engine mold, the sand by the vibrating method will be compacted in a period of time approximating one second, whereas the same mold made on a jarring machine would require a jarring operation during a period of some eight seconds.

There is another and equally important advantage gained by the vibrating method and that is that the sand is compacted much more uniformly throughout all portions of the flask than is possible to obtain with the jarring method of making molds.

Furthermore, I have found that with the vibrating method it is quite possible to use flasks in which the cross bars or plates are dispensed with. In other words, a flask may be employed without the use of bars or plates to support the sand when compacted within the flask. In the jarring method the use of bars or plates for supporting the sand and holding it in the flask is absolutely essential.

Another advantage in the method is the saving of time in making the mold due to the fact that in the vibrating method of making the mold it is not necessary to sieve the sand onto the pattern before shoveling in the large bulk of sand which forms the body of the mold within the flask. With the proposed method any sand that is at all suitable for molds may be used and it may be directly shoveled into the flask without previous hand sieving. This is a distinct saving in time.

Additionally, it is found that in the majority of cases at least it is not necessary to use a stripping plate, even with a pattern which is quite complicated, or, to state it another way, it is possible in many instances to omit the use of a stripping plate when making the mold by the vibrating process where, under the same conditions, in making the same mold by the jarring process it would be absolutely impossible to do without the stripping plate.

The advantages which are gained by the vibrating method of making molds are, therefore, very pronounced and certain and I attribute these results to the entirely different action obtained in the vibrating of the mold as distinguished from the jarring of the mold; that is to say, maintaining the sand in an agitated condition with the grains of sand free to move with respect to adjacent grains of sand during the entire compacting operation, as distinguished from the intermittent compacting operation which is incident to the making of molds by the jarring method.

All of these improvements which have been discussed have a very decided effect upon the cost of making molds, not only in the matter of lower labor costs and the ability to produce more molds per unit of time, but also better molds, better compacting and less likely to require patching up.

In quantity production of castings, the saving of time and labor is a very important item.

Reference should be had to the accompanying drawings forming a part of this specification in which Fig. 1 is a side elevation of the apparatus employed in forming sand molds which consists of a flask supporting table and a fluid operated vibrator by which percussive impulses are imparted through the table to the mold part supported thereon; Fig. 2 is a top plan view of the table; Fig. 3 is a fragmentary side elevation showing a flask containing sand mounted on the table; Fig. 4 is a vertical section taken axially of the vibrator; Fig. 5 is an end view of the vibrator with a portion broken away to show the exhaust ports in section; Fig. 6 is a side elevation of the piston or striker; Fig. 7 is a sectional elevation showing a modified form of flask supporting table.

Referring to the accompanying drawings, which embody the best way of carrying the invention into effect, as far as I now know, the flask supporting table consists of a top 1 which has a flat top surface to receive the flask and which is preferably in the form of a casting with downwardly projecting reenforcing ribs 2 on its under side which radiate from a central thickened impact receiving portion 3. The table top 1 may be rigidly supported, as shown in Figs. 1, 2 and 3 or yieldably supported as shown in Fig. 4. In Figs. 1, 2 and 3 the table is shown rigidly supported upon legs 4 which project upwardly from a supporting stand 5 which is rectangular in form and which is preferably formed of two castings each provided with base flanges 6 adapted to be bolted or otherwise rigidly secured to the floor, the castings being detachably connected by bolts 7. Mounted within the stand 5 and rigidly secured thereto is a vertically disposed fluid pressure operated vibrator which has an outer cylindrical casing 8 which is open at its upper end and in which is mounted the reciprocating piston or striker by which percussive impulses are imparted to the table. Within the casing 8 there is an inner cylinder 9 which is closed at its lower end by a bottom plate 10 which bears against the integral lower end of the casing 8. The inner cylinder 9 is held in place within the casing 8 by means of a top closure member 11 which bears against the upper end thereof and is secured to the casing by means of tap bolts 12. The cylinder 9 is held against rotation within the casing 8 by means of a screw stud 13 which is screwed into a threaded opening in the outer casing 8 and projects into an opening in the inner cylinder. Extending through the closure member 11 at the center thereof is a percussion member 14 which has a substantially fluid tight fit in the closure member but is not secured thereto and projects beyond the inner face thereof to receive the impact of the piston. At its upper end the percussion member 14 has an enlarged head 15 which bears upon the upper surface of the closure member 11 and against the bottom of the thickened portion 3 of the table top 1. Within the cylinder there is mounted a piston or striker 16 which has two spaced peripheral grooves forming three spaced circumferential flanges 17, 18 and 19 which are of the same diameter and have a sliding fit within the inner cylinder 9. Between these

flanges the annular grooves form with the wall of the cylinder 2 annular chambers 20 and 21. The chambers 20 and 21 are separated by the central flange 18 which is imperforate but are in communication with the interior of the cylinder at opposite ends of the piston through annular rows of ports 22 and 23 in the flanges 17 and 19 respectively. An air inlet chamber is formed in the wall of the inner cylinder by a bore 24 extending longitudinally from the upper end thereof, the open end of the bore being closed by a screw plug 25. The inlet chamber 24 communicates with the interior of a cylinder through two longitudinally spaced ports 26 and 27 which are so spaced that as the piston reciprocates they are alternately opened and closed by the flanges 17 and 19 and are placed alternately into communication with the annular chambers 20 and 21 to move the piston in opposite directions. Air under pressure is supplied to the inlet chamber 24 through an inlet pipe 28 which extends through the wall of the casing and communicates with the chamber, the supply of pressure to the cylinder being controlled by a valve (not shown) in the pressure supply line as well understood in the art. An annular exhaust chamber 30 surrounds the inner cylinder 9 substantially midway between the ends thereof, the chamber 30 being formed by complementary grooves formed in the inner surface of the outer casing and the outer surface of the inner cylinder. Communication between the interior of the cylinder and the exhaust chamber is established through either of two parallel circumferentially extending rows of exhaust ports 31 and the air escapes from the exhaust chamber through an exhaust pipe 32 which is attached to the outer casing and communicates with the exhaust chamber adjacent the ports 31. The two rows of ports 31 are so positioned that as the piston moves past the ports pressure is exhausted alternately from opposite sides of the piston so that as pressure is admitted to one side of the piston, air is permitted to escape from the opposite side. Whenever the supply of pressure to the cylinder is cut off the piston drops to the lower end of the chamber where it is so positioned with respect to the inlet and exhaust ports that it will be operated upon admission of pressure to the cylinder. Once the piston is started it will continue to reciprocate as long as pressure is supplied to the cylinder due to the automatic reversal of pressure by the movement of the piston past the ports. A cushioning plunger 33 is mounted within the bottom end of the cylinder, the plunger 33 having a sliding fit within a counterbore at the lower end of the cylinder which provides a shoulder 34 to limit the upward movement of the plunger. The plunger 33 is normally held against the shoulder 34 by air pressure supplied through an inlet pipe 35 which communicates with the chamber 36 between the plunger and bottom plate 10 through a port 37 adjacent the bottom plate, the chamber 36 preferably containing a body of liquid such as oil. The plunger 33 is cup-shaped and has a downwardly extending skirt or flange 38 which serves to guide the plunger. As the piston impinges against the plunger 33, the plunger is moved slightly, but the air and oil behind the plunger quickly absorb the impact. The vibrations caused by the impact of the piston 16 against the plunger 33 are entirely taken up and dissipated by the fluid cushion so that the only vibrations transmitted to the table are those due to the impact of the piston 16 against the percussion member 14. There is sufficient working clearance between the plunger and the wall of the cylinder to permit small quantities of oil to be forced past the plunger into the main chamber of the cylinder to lubricate the piston. Some air will leak past the plunger when the vibrator is not in operation but the weight of the piston is sufficient to overcome the leakage pressure.

In forming a sand mold, a flask 39 or other container in which the mold is to be formed is placed upon the table 1 as shown in Fig. 3. The amount of sand ordinarily required to form the mold when in a loose condition is more than can be contained within the flask. To retain the necessary amount of excess sand, a rectangular frame 40 is provided which rests upon the open top of the flask and forms an extension thereof. The sand is filled to a suitable height within the flask and retaining frame 40 and in order to cause a more rapid and uniform packing of the sand, a weight 41 which fits within the frame 40 is preferably laid upon the top of the sand and follows the sand downwardly as the sand is compacted in the flask. The packing of the sand in the flask is accomplished by admitting fluid pressure to the vibrator cylinder which causes the piston 16 to reciprocate rapidly and to impart sharp percussive impacts in rapid succession to the percussion member 14. The vibrations due to these impacts are transmitted through the table 1 and flasks 39 to the sand within the flask. The impulses imparted to the particles of sand are all in an upward direction since all vibrations in the frame work except those due to the impact of the piston in an upward direction against the percussion member are eliminated by the fluid cushioning device at the bottom of the cylinder. These rapidly succeeding impulses in an upward direction cause the sand to rapidly settle and form itself into a compact mass and the packing action is materially hastened due to the fact that all of the percussive impulses are in one direction only. The

weight acting as a follower prevents disturbance of the sand at the top of the flask and causes the sand to settle evenly and to pack uniformly throughout the entire mass.

In Fig. 7 there is shown a modified form of flask supporting table in which the top or flask support 1^a which is similar in construction to the top 1 above described is yieldably supported upon the upper end of posts 4^a. The top 1^a is connected to the upper end of the posts by bolts 42, which extend through the table and through flanges 43 at the upper ends of the posts. The bolts 42 have nuts 44 at their lower ends and interposed between the nuts and underside of the flanges 43 are coil spirngs 45 which serve to yieldably hold the plate upon the posts and permit a slight upward movement of the flask support upon impact of the piston.

It will be understood that the invention is equally applicable to the making of cores and in referring to the molds, I include cores, and further in the use of the term "sand" in the specification and claims, I intend this use in a generic sense and to include other materials which would function in the same manner so far as concerns the method herein disclosed.

Having described my invention, I claim:

1. The method of forming sand molds or cores, which comprises placing sand within a flask or box and subjecting the flask or box to a series of rapidly recurring impacts, in one direction only, thereby to cause the sand to settle in the flask or box.

2. The method of forming sand molds or cores, which comprises placing sand within a flask or box, placing pressure upon the top of the sand and subjecting the flask or box to a series of rapidly recurring impacts, in one direction only, thereby to cause the sand to settle within the flask or box.

3. The method of forming sand molds or cores, which comprises placing the sand within a flask or box, placing a weight upon the top of the sand and subjecting the flask or box to a series of rapidly recurring impacts, in one direction only, to cause the sand to settle in the flask or box.

4. The method of forming sand molds which comprises supplying a flask with sand and imparting thereto a series of percussive impulses in rapid succession and in one direction only.

5. The method of forming sand molds which comprises supporting a flask containing sand upon a supported table, and imparting to said table a series of percussive impulses in rapid succession and in an upward direction only.

6. The method of forming sand molds which comprises supporting a flask containing sand centrally upon a table, and imparting to the table directly beneath the flask a series of percussive impulses in rapid succession and in an upward direction only.

7. The method of forming sand molds which comprises filling a flask with loose sand, confining excess sand above the top of the flask, imposing a weight on the body of sand, and imparting to the flask and the sand therein a series of percussive impulses in rapid succession and in an upward direction only.

In testimony whereof, I hereunto affix my signature.

JOHN T. STONEY.