March 24, 1953 R. L. LEE 2,632,215

PACKAGE MEANS FOR SAND MOLDS

Filed Sept. 26, 1949 3 Sheets-Sheet 1

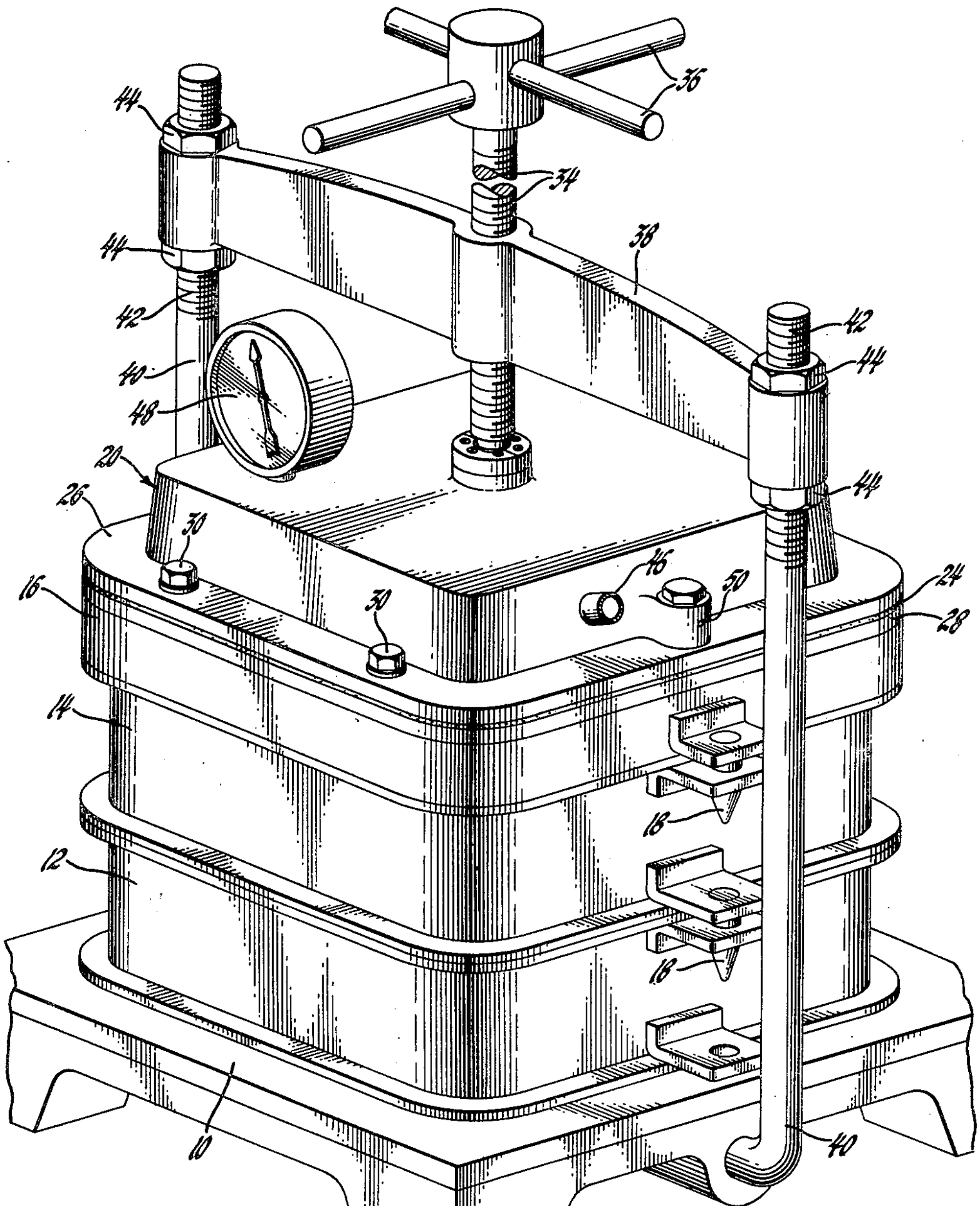

Fig. 1

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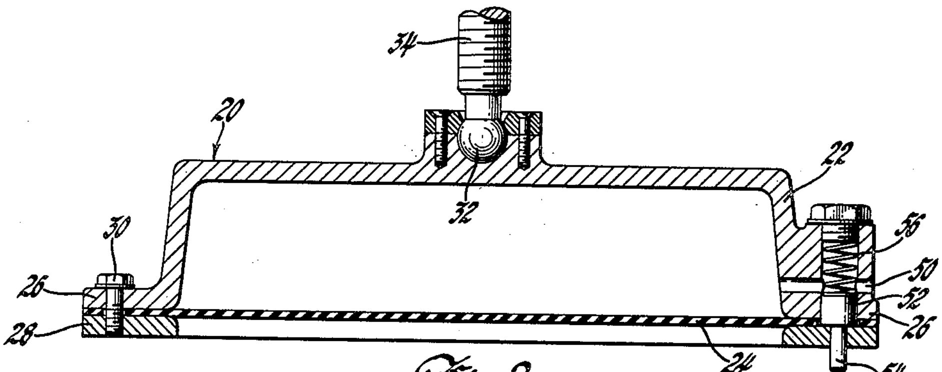

Fig. 2

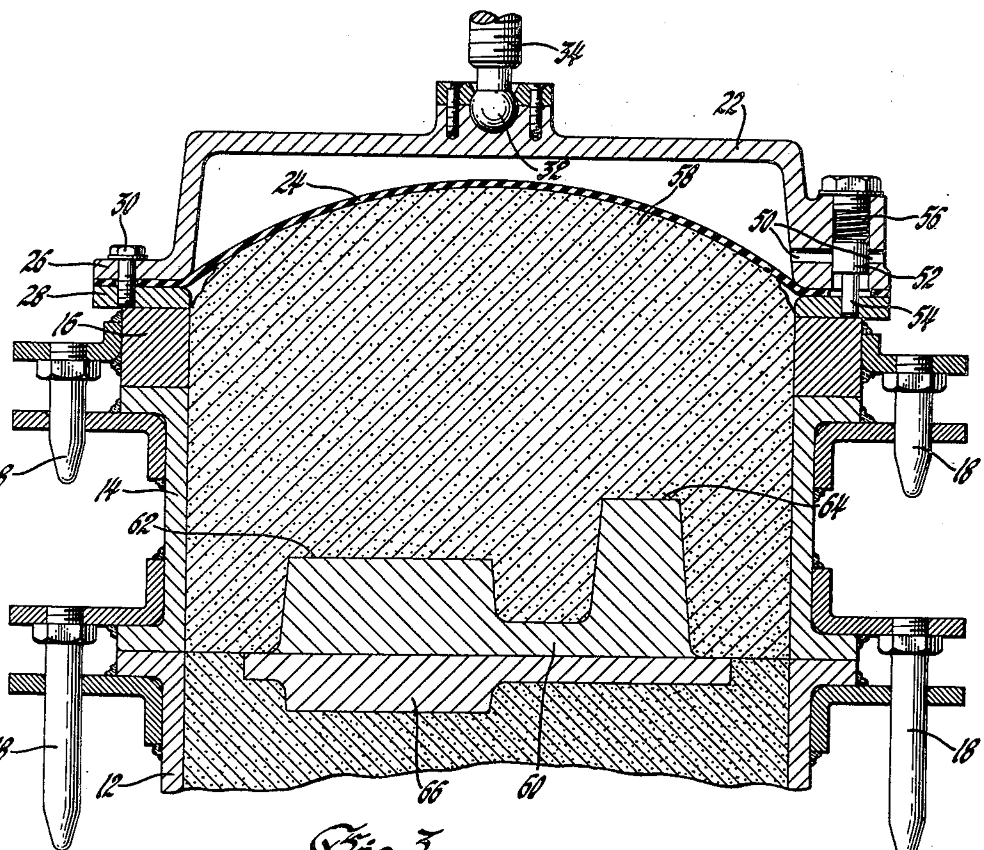

Fig. 3

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March 24, 1953 R. L. LEE 2,632,215

PACKAGE MEANS FOR SAND MOLDS

Filed Sept. 26, 1949 3 Sheets-Sheet 3

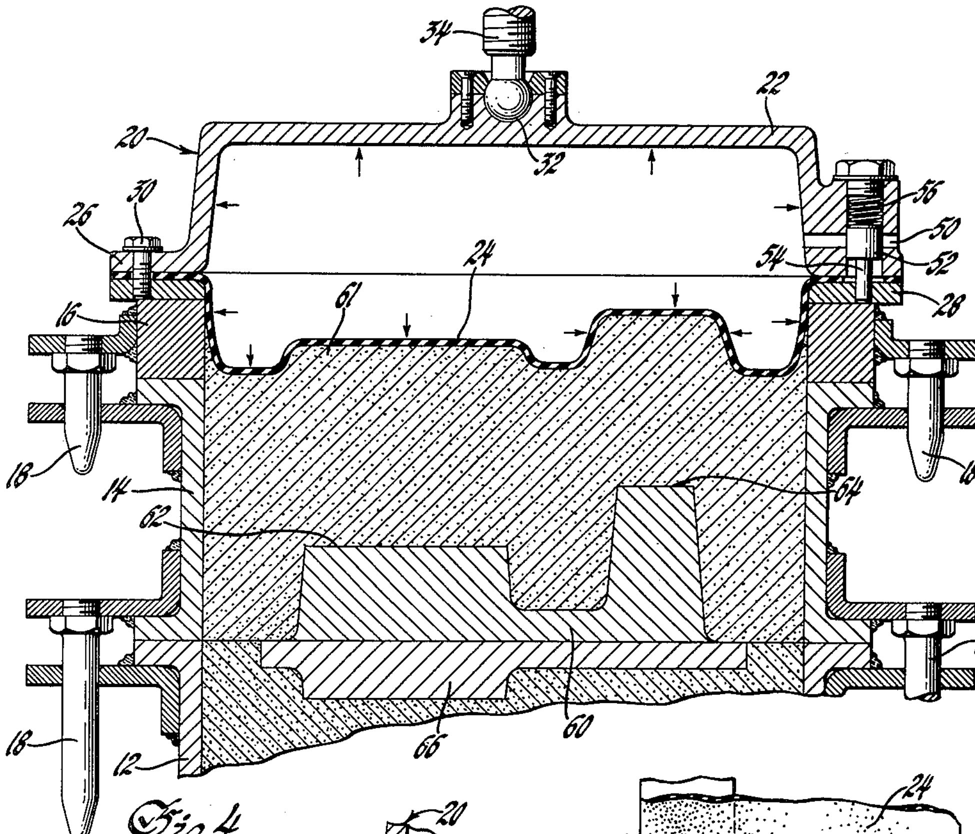

Fig. 4

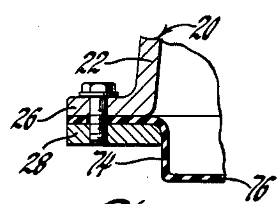

Fig. 6

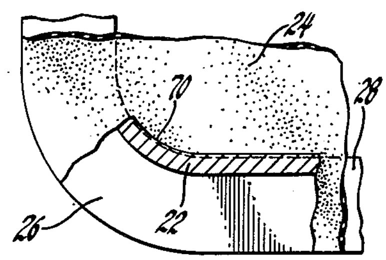

Fig. 5

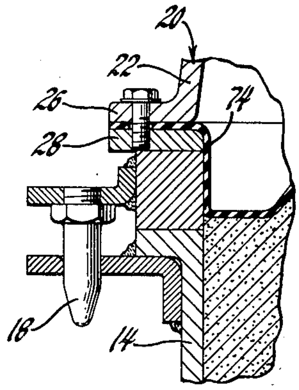

Fig. 7

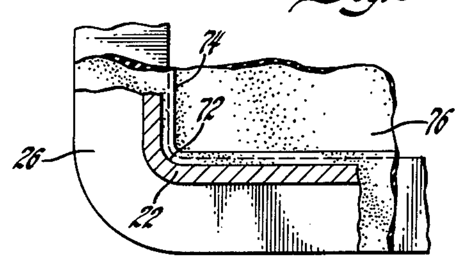

Fig. 8

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PACKING MEANS FOR SAND MOLDS

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5 Claims. (Cl. 22—40)

1

This invention has to do with formation of sand molds and the like as used in foundries for casting molten metal therein. More specifically the invention is directed to a new and improved method and apparatus for forcing molding sand into intimate contact with a pattern and over its entire surface with the same or substantially the same pressure regardless of variations in pattern contour wherein the resulting mold will be of uniform hardness throughout.

Prior to the present invention the conventional methods employed for making sand molds and cores fell into five general classes as follows:

1. Hand and pneumatic hammer ramming
2. Jolt method
3. Squeeze method
4. Sand slinging
5. Air blowing

In the first of the foregoing methods the flask is filled with loose sand and the sand packed in close contact with the pattern by individual blows. Great care has to be taken lest sections of the mold are rammed too hard and others not hard enough. If the sand is rammed too hard throughout the mold it will not have sufficient flexibility to withstand the strain set up by the shrinking metal during cooling. If the sand is not rammed hard enough it will not have sufficient strength to stand the weight of the molten metal cast therein. In addition if the mold is not rammed hard enough it will wash with the running stream of molten metal as it fills the mold.

In the jolt method the flask with its pattern in place is filled with loose sand and is placed upon the table of a jolt machine which is operated by an air system and cylinder. The table with the flask, pattern and sand is alternately raised and lowered with a violent jolt in which the body of sand through inertia is packed against the pattern. The resulting hardness of the mold is determined by the height of the sand above the varying contour of the pattern. The greater the height of sand above the pattern the harder the surface of the mold will be and the lesser the height the lesser the hardness. The constant jolting is extremely destructive of the pattern, flask and the machine itself. The noise developed by the operation of such apparatus is hard for the operator or others to bear.

In the squeeze method the flask is filled with loose sand over the pattern and pressed or squeezed by a board actuated by means such as a pneumatic cylinder or by hand through a rack and pinion. Where the contour of the pattern does not vary in height a great deal the sand will conform sufficiently to provide a reasonably even mold hardness. However, when there are large differences in height the pressure boards must be provided with protuberances arrived at through cut and try so that the sand will be forced into the deeper cavities. It is common practice to combine the squeeze method with jolting in the same machine.

2

In the sand slinging method a high speed impeller drives a stream of sand with great velocity against the pattern into the flask until the flask is filled. Due to the abrasiveness of the sand the equipment is subjected to severe wear. The cost of the equipment is high and as a result becomes impracticable for small castings and moderate quantities of large castings.

The air blowing method is used almost exclusively in the making of cores. A hopper designed in such manner as to become air tight is placed over the opening of a core box or mold. High pressure air is then applied to the upper surface of the sand in the hopper. The sand then is pushed and blown by the velocity of the air into the cavity of the core box or mold. Vents must be provided in corners and pockets so that the velocity of air will not be diminished. In most instances the air blowing process does not lend itself to the making of molds. In many cases the blowing process for large cores must be supplemented by hand tucking and ramming.

An object of the present invention is to overcome objections and disadvantages arising in connection with methods and machines heretofore employed for making sand molds and cores. In accordance with the present invention there are provided a novel method and apparatus for forcing molding sand into contact with a pattern by employing direct air or fluid pressure to force molding sand into intimate contact with a pattern and over its entire surface with the same or substantially the same pressure regardless of variations in contour of the pattern whereby the resulting mold will be of uniform, or substantially uniform, hardness throughout.

To prevent the pressure medium from forcing its way through the molding sand to the surface of the pattern there is provided an elastic membrane to separate the pressure medium from the molding sand. For accomplishing this result a pressure chamber is provided with the elastic membrane forming one of the sides. A suitable frame or the like is used to clamp the membrane to the chamber thus providing an air or liquid type seal. Due to the pressure exerted on the molding sand a means is provided to clamp the flask between the pressure chamber and a base on which it rests. The shape and size of the pressure chamber will vary in relation to the type of molding to be done and the shape and thickness of the elastic membrane can change in shape and thickness as may be required.

The process can be applied to otherwise conventional molding practice. With the pattern in place in the flask, the flask is filled with molding sand. The pressure unit is then placed upon the flask and held or clamped against the flask in operating position with the elastic membrane in juxtaposition to the molding sand. Air or other suitable pressure medium is then admitted to the pressure chamber to build up pressure therein. The pressure in the pressure chamber of course acts equally in all directions and the elastic membrane is forced against the molding sand in the flask with equal pressure exerted on each square inch of the molding sand, the elastic membrane being stretched as determined by the contour of the pattern. The sand thus is pressed to a uniform compactness against the pattern regardless of peaks, valleys or pockets in its contour. This automatically provides equal or substantially equal mold hardness throughout which in prior practice requires practice, skill, judgment and cut and try development. After the sand has been compacted the pressure in the pressure chamber is released. The unit is then removed from the flask.

With the pressure chamber and elastic membrane taking the place of heavy, cast cylinders, pistons, frames and extension arms as now employed on conventional machines, the present apparatus for carrying out the process weighs and costs only a fraction of the former. In the present invention the molding action is extremely rapid and practically effortless, thereby increasing production with a given amount of human effort and time. The operation is also silent, whereas the noise due to conventional jolt-squeeze molding machines poses a serious employe relations problem. With mechanical parts reduced to a minimum and the smooth molding action provided by air or other fluid, wear and tear on the apparatus is drastically reduced over that of machines employed theretofore.

Reference is herewith made to the accompanying drawings in which:

Figure 1 is a perspective view of one form of an apparatus in accordance with the invention which is adapted to carry out the process forming a part of this invention.

Figure 2 is a sectional view of the pressure chamber of the apparatus of Figure 1.

Figure 3 is a sectional view showing the relation of the pressure chamber and filled flask prior to admitting air or other pressure fluid to the pressure chamber.

Figure 4 is a sectional view generally similar to Figure 3 with the arrangement of parts as they appear after entry of air or other pressure fluid to the pressure chamber.

Figure 5 is a view with parts broken away and in section showing the relation of the elastic membrane and other parts of the form of pressure chamber shown in Figure 2 and showing adjacent side walls of the pressure chamber meeting one another on a relatively large radius.

Figure 6 is a sectional view of a portion of a modified form of elastic membrane which may be employed when adjacent side walls of the pressure chamber have a relatively sharp radius at the junction thereof, the elastic membrane being shown in free position prior to entry of air or other pressure medium to the pressure chamber.

Figure 7 is a view in section of the form of pressure chamber and elastic membrane of Figure 6 in operative position on the filled flask and after entry of air or other fluid to the pressure chamber.

Figure 8 is a view with parts broken away and in section of the form of construction of Figure 6 and showing adjacent walls of the pressure chamber meeting one another on a small or sharp radius.

Referring to the drawings there is shown a base **10** on which rests a drag **12**. On the drag rests a cope **14** and on which in turn is a flask extension **16**, the several parts of the flask being held in position by pins **18**.

Above the flask is a pressure chamber indicated generally by **20**. The pressure chamber is made up of an inverted box-like member **22** of metal or other suitable rigid material of sufficient strength to withstand the required pressure and a thin rubber membrane **24** secured at its periphery to a flange **26** on the inverted box-like member by means of frame **28** and cap-screws **30**. The thin elastic membrane thus forms the lower wall of the pressure chamber and the frame clamps the elastic membrane to the flange to form an air or liquid seal. Above the pressure chamber and connected thereto by a ball and socket connection indicated generally by **32** is a screw **34** having at the upper end thereof handles **36** whereby the screw can be rotated in either direction. The screw passes through a bridging member **38**, the outer ends of which are adjustably held in position by rods **40** extending upwardly from the base **10**, said rods having threads **42** at the upper portions thereof which pass through the ends of the bridging member **38**. Nuts **44** secure the bridge to the threads on the rods. By means of the construction just described the pressure chamber can be raised and lowered as will be readily apparent.

The pressure chamber has an opening **46** (see Fig. 1) therein for entry and release of air or pressure fluid to or from the pressure chamber. Also shown is a pressure gage **48**. The pressure chamber also may be provided with one or more vent passages **50**. The vent passages are closed when the pressure chamber is lowered into contact with the flask by means of a valve **52** which is moved by means of a finger **54** contacting the flask. A spring **56** behind valve **52** is adapted to bias the valve toward open position. The purpose of the vent passages is to prevent damage to the elastic membrane should air or other pressure medium be accidentally admitted to the pressure chamber before it is firmly in contact with the flask.

Figure 2 shows the pressure chamber with the rubber membrane in its free position. Figure 3 shows the pressure chamber forced into contact with the flask with the elastic membrane in contact with loose or non-compacted sand **58** in the top portion of the flask and before air or other fluid has been admitted to the chamber. The rubber membrane **24** is stretched and curved upwardly as indicated. Also shown in Figure 3 is a pattern **60** having upwardly projecting portions **62** and **64**. The drag also has a pattern **66** therein about which sand has been previously compacted and on which pattern rests the pattern **60**.

It will be understood, of course, that the invention does not require the specific form of apparatus just described and the pattern about which the molding sand is to be compacted may simply rest within the flask on a table supporting both the pattern and flask. With the parts in the positions shown in Figure 3, air or other pressure medium is then admitted to the pressure chamber and this forces the rubber membrane downwardly into the position shown in Figure 4, thus compacting the loose sand in the cope and flask extension and about the pattern 60. Since the pressure in the pressure chamber is equal in all directions the pressure applied to the sand is equal in all directions and the sand is compacted equally or substantially so about the pattern and the projecting portions thereof to provide a mold having substantially equal hardness throughout. The compacted sand is indicated at 61 in Figure 4. From the theoretical standpoint the less the thickness of the rubber membrane the better since the function of the membrane is simply to keep the air or other pressure medium from escaping through the molding sand. However, from the practical standpoint, an extremely thin membrane may be too easily ruptured by the fluid pressure. The preferred practice at present therefore is to employ a rubber membrane of approximately $\frac{1}{32}''$ in thickness. The pressure may vary with the type of sand and the degree of mold hardness required. A typical and illustrative example is an air pressure of about 75 pounds per square inch.

After the sand has been compacted by the fluid pressure as just described, the pressure in the pressure chamber is released and thereafter the pressure chamber removed from the flask. The molding operation then continues along conventional lines.

Where the side walls of the pressure chamber (and the corresponding flask) meet each other with a relatively large radius therebetween as illustrated at 70 in Figure 5, the rubber membrane may be simply a flat sheet as illustrated in Figures 2 and 5. Where the side walls of the pressure chamber meet each other with a relatively small or sharp radius therebetween as illustrated at 72 in Figure 8 it is preferred to employ a rubber membrane of a form illustrated in Figures 6 and 8 inclusive. Figure 6 illustrates the free position of the rubber membrane before pressure has been admitted to the pressure chamber. As seen in Figure 6, this form of rubber membrane is shaped with a downwardly extending portion 74 adjacent the frame 28. The remainder 76 of the rubber membrane of Figure 6 in its free position is similar to that of Figure 2. Figure 7 illustrates the shape of the modified form of elastic membrane after the pressure chamber has been secured to a filled flask and pressure admitted to the pressure chamber. This modified membrane provides more uniform compacting action at the relatively sharp corners of the form of flask shown in Figures 6 to 8 inclusive, than is obtained by the form shown in other figures.

Various changes and modifications of the specific embodiments of my invention described herein may be made without departing from the principles of the invention.

I claim:

1. In an apparatus for making sand molds, a flask for containing molding sand and a pattern, a pressure chamber having a thin elastic membrane forming one wall thereof, means for moving the pressure chamber relatively to the flask, means for holding the pressure chamber against the flask with the thin elastic membrane in juxtaposition to molding sand in the flask, a vent port in the pressure chamber, a valve for closing and opening the port, said valve being spring biased toward its opening position, means actuated by movement of the pressure chamber into contact with the flask for closing said valve, and means for admitting pressure fluid to the pressure chamber to apply pressure to the elastic membrane whereby molding sand is compacted about the pattern.

2. An apparatus as defined in claim 1 in which the elastic membrane is of rubber having an approximate thickness of $\frac{1}{32}''$.

3. In an apparatus for making sand molds, a flask for containing molding sand and a pattern, a pressure chamber having a thin elastic membrane forming one wall thereof, means for moving the pressure chamber relatively to the flask, means for holding the pressure chamber against the flask with the thin elastic membrane in juxtaposition to molding sand in the flask, a vent port in the pressure chamber, a valve for closing and opening the port, said valve being spring biased toward its opening position, a finger connected to said valve adapted to engage said flask upon movement of the pressure chamber into contact with the flask to move the valve to closing position, and means for admitting pressure fluid to the pressure chamber to apply pressure to the thin elastic membrane whereby molding sand is compacted about the pattern.

4. An apparatus as in claim 3, in which the thin elastic membrane is rubber having a thickness of approximately $\frac{1}{32}$ inch.

5. In an apparatus for forming sand molds, a flask for containing molding sand and a pattern, a pressure chamber having a thin elastic membrane forming one wall thereof, said membrane being located for juxtaposition with molding sand in the flask, an exhaust vent port in the pressure chamber, means for admitting pressure fluid to the pressure chamber to apply pressure to the elastic membrane whereby molding sand is compacted about the pattern, and valve means for said vent port connected to said pressure chamber actuated by relative movement between said chamber and said sand and flask assembly for preventing escape of said pressure fluid when said membrane is located in juxtaposition to said molding sand.

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