June 3, 1969 J. M. PLANTEN 3,447,589

SHELL MOLDING METHOD

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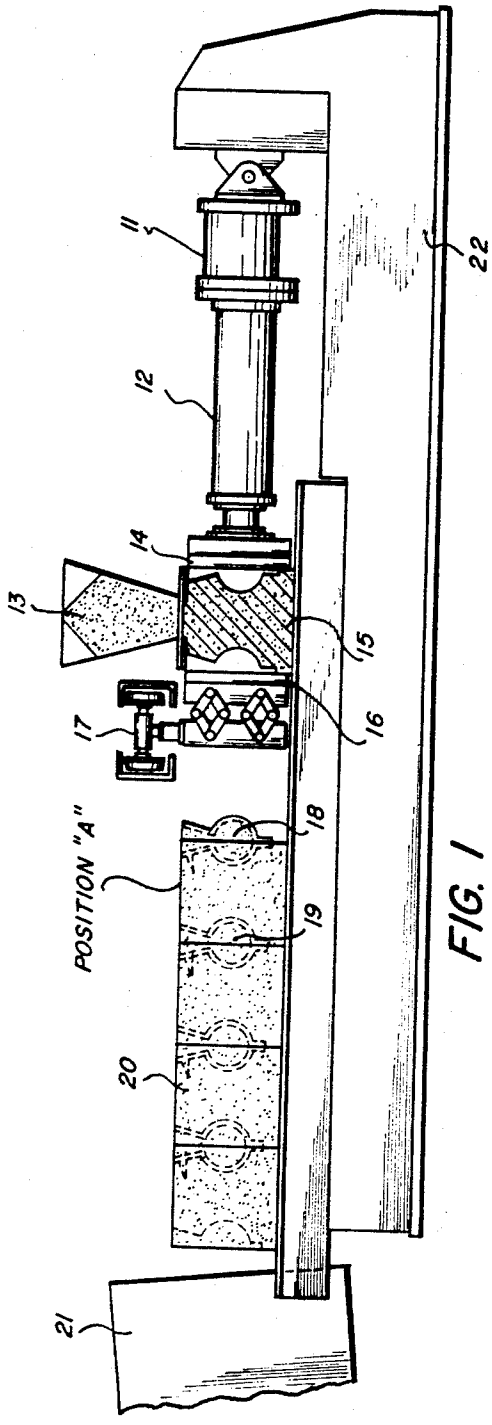


FIG. 1

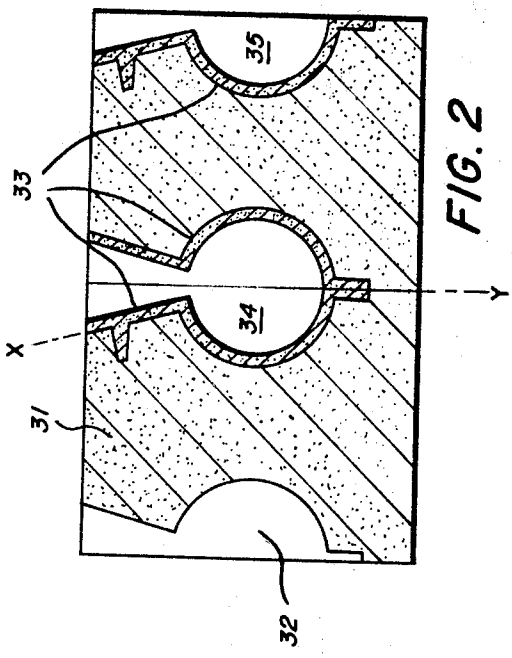


FIG. 2

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SHELL MOLDING METHOD

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ABSTRACT OF THE DISCLOSURE

The method of making castings comprising the steps of making two shell mold halves and also preparing two green sand back-up molds each contoured to fit one of the back faces of a shell mold half. Placing the back-up molds and shell mold halves into a mold assembly with the shell mold halves together and a back-up mold engaging the back face of each shell mold half. The assembly is held firmly together and molten metal is poured into the assembled shell mold halves.

My invention relates to a method of making castings from foundry shell molds; and more particularly, to an improved method of handling and securing these foundry shell molds during the casting operation.

Foundry shell molds are sand shapes of limited thickness containing a cavity representing the casting to be poured and produced by mixing thermo-setting or chemical setting type binders with the sand. In this method of molding, sand containing a suitable binder is poured into a pattern and allowed to harden. The shell formed is subsequently stripped from the pattern and is suitably clamped and/or weighted, prior to casting of molten metal.

Those skilled in the art normally use a thermo-setting binder in the sand such as resin, and apply the sand-binder mix to a pattern which has been heated. The binder thus hardens, starting at the pattern, to give a half shell—the thickness thereof being a function of the thermo-setting characteristics of the binder, the temperature of the pattern and the dwell time or length of contact time between the heated pattern and the sand-binder mixture.

As those skilled in the art will appreciate, the making of the shell or half shell is a relatively straightforward matter, but the suitable, rapid, effective, and economical clamping of the half shells, to form a mold capable of withstanding the pressures and heat action of molten metal, is quite difficult and may exert considerable influence on the cost and quality of the resultant casting.

Many methods of clamping have been devised; for example, the half molds are loosely clamped and are then stacked in a vertical position, so that they may be surrounded with gravel or metal shot. This method may not always give sufficient pressure against the shell to withstand the ferrostatic pressure of the metal, but in any case, is expensive and time consuming because the shell molds and casting have to be separated from the gravel or shot so that it may be re-used.

Another popular method consists in gluing the shell halves together with an adhesive and placing them in a horizontal position with a weight on the shell assembly, to withstand casting pressures. Such a method is time consuming and requires a good deal of floor space in the foundry for a given rate of production.

Still another method contemplates the use of back-up metal plates contoured to fit the interior configuration of the shell mold and with the plates being clamped together and being sufficiently rigid to withstand molten metal pressures. Such a method is expensive, in that it requires a very large number of contoured plates, each

being suitable for the particular casting made, and it is somewhat unsatisfactory to provide adequate venting of mold gases during the pouring operation.

Because of the limitations existing in present methods of preparing shell molds for the pouring process, an object of my invention is to provide a rapid, high production method of securing and clamping shell molds during the pouring operation.

Another object of my invention is to provide a means of clamping molds with a material compatible with the sand mixture used for the shells, eliminating the need for separating shell sand from back up media for re-use of the same.

Another object of my invention is to provide a clamping method, utilizing minimum floor space and being independent of the contour or configuration castings involved.

Another object of my invention is to provide a method of clamping and handling shell molds which may be varied, to provide a molten metal pressure resistance related to the configuration of the castings being poured.

Another object of my invention is to eliminate the need for pasting, clipping or otherwise holding half shell molds together, prior to stacking or placing for pouring.

Another object of my invention is to provide a means whereby a foundry may produce green sand molds and shell castings in the same production molding equipment, thereby reducing the capital investment required for a foundry wishing to produce a limited number of shell molds.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 of the drawings is a side elevational view of the equipment used in the process of this invention.

Referring to FIGURE 1, **22** is a bed plate for holding the molds **15**, **18**, **19** and **20**, the compression cylinder **11**, the positioning cylinder **12**, the rear impression plate **14**, the front impression plate **16**, the front plate transfer **17**, and the shakeout device **21**.

Sand having a moldable quality known in the trade as "green sand" flows from the hopper **13** to fill the cavity between the rear impression plate **14** and the front impression plate **16**.

The compression cylinder **11** is activated, so as to compress the sand between the two impression plates, to form a first green sand shape **15**.

The front plate transfer **17** is activated so as to withdraw the front plate from the shape **15** and the transfer **17** is moved in a horizontal position away from the compressed green sand shape **15**.

The positioning cylinder **12** is activated, so as to move the green sand shape into position "A" and a shell mold half **18** is placed in position "A," so that it fits in the contour formed by the rear impression plate. A second shell mold half is then placed in position adjacent to the first shell mold half, to give the complete shell mold **18**. These two shell mold halves are normally initially positioned relative to each other by way of locating projections and corresponding openings formed from the sand in a manner familiar to those skilled in the art. More sand is run from hopper **13** and the cycle is repeated to form a second green sand shape. This is pushed into position against the complete shell mold **18**, which is then moved to the left, to occupy the pouring position at reference numeral **19**.

Repeating this cycle then produces a series of molds consisting of shell halves held together by compressed green sand shapes. When a shell mold with compressed green sand back-up shapes arrives at the pouring position,

molten metal is introduced into the shell mold cavity to form a casting. At the pouring position the molds are actually held together by friction. The molds stand on a bottom plate and the molds in the middle are supported by the molds on either side of them. When the very first mold reaches the pouring position, it is not poured, but is merely left as a support for the following molds and in this way the molds that are actually filled with molten metal are surrounded by adjacent molds which keep them in this position. The mold, containing the casting eventually arrives at the shakeout **21** to form a continuous process.

FIGURE 2 is an enlarged view of a completed mold. Referring to FIGURE 2, **31** is the compressed green sand shape originally formed between the front impression plate and the back impression plate. **32** is the cavity formed by the front impression plate, whereas the line "XY" is the limits of the cavity formed by the back impression plate. **33** are shell mold halves. **34** is the mold cavity formed by two shell mold halves, while **35** is a similar cavity not yet complete, but containing one shell mold half.

In the method of my invention shell mold halves may be prepared on any machine adapted for making same. These halves are then placed in a convenient plate adjacent to the back-up machine in FIGURE 1, so that they may then be rapidly inserted between the green sand back-up shapes as these are formed and mechanically pushed into position. The pressure exerted between adjacent green sand back-up shapes is sufficient to withstand all ferrostatic forces which occur during the pouring operation. As the insertion of shell mold halves may be done as rapidly as the green sand back-up shapes are made, the rate of production of shell mold castings in my invention is rapid and, therefore, economical.

Shell mold halves may also be inserted in position by mechanical means easily conceived by those skilled in the art and by synchronizing the rate of insertion with the rate of production of a shell mold machine and the rate of production of green sand back-up shapes, rates of production of shell castings not hitherto available to the art may be achieved. During shakeout the shell mold sand mixes with the green sand and this mixture may be returned mechanically to a sand preparation unit, where suitable binders may be added, to prepare the green sand for re-use.

As the method of this invention contemplates the simultaneous preparation of back-up shapes, while pouring and shakeout are proceeding, it follows that shell castings may be produced at a high rate of speed, without requiring the floor space needed for more conventional methods. This is particularly true as the shells are poured in a vertical position, thereby occupying less space and, as the back-up material is sand, which is re-used, rather than steel shot, which must be poured into position and then laboriously separated from the castings.

By contouring the front and rear impression plates to suit the contour of the shell mold halves and by applying the green sand back-up shapes under pressure where slight deformation may occur, it is easy to provide high back-up pressure over the complete contour of the shell mold. This alleviates run outs and other problems common to the art. It also eliminates the need for pasting, clamping, or otherwise holding shell halves together during the pouring operation.

By utilizing green sand production equipment in the manner of this invention, to make shell mold castings, it is possible to avoid heavy investment costs in foundries desiring to make both green sand castings and shell castings in the same facility. Thus, the method is flexible enough to allow shell mold casting production only when it is required, while using the equipment for green sand castings when green sand castings are required.

With my method it is also possible to make castings which are both shell molded and green sand molded at the same time. Thus the contours of the impression plates may suit the actual casting configuration in certain areas, whereas in other areas they may suit the back of the shell mold halves. In this way, a casting may be produced with certain critical areas in shell sand, but with other less critical areas in green sand. This will result in savings in casting production by eliminating expensive shell mold sand, where it is not actually needed.

Although my invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to, without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An improved method of making castings comprising the steps of preparing two shell mold halves, preparing two green sand back-up molds separately from said shell mold halves and contoured to fit the back face of said shell mold halves, alternately placing a first green sand back-up mold followed by two shell mold halves and followed by a second green sand back-up mold to form a mold assembly, holding said assembly firmly together and finally pouring molten metal into said shell mold halves.

2. In the method of making castings from molds of the type comprising a stack of generally similar mold parts in green sand, that improvement comprising separately preparing shell mold halves, defining the casting cavity, placing said shell mold halves between green sand half molds in a consecutive manner to form a shell mold green sand assembly and, holding said assembly firmly under pressure and pouring molten metal into the cavities formed by said shell mold halves.

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