Jan. 18, 1966 J. KOPERA 3,229,338

MANUFACTURING PROCESS FOR RE-USABLE MOLDS

Filed March 31, 1965

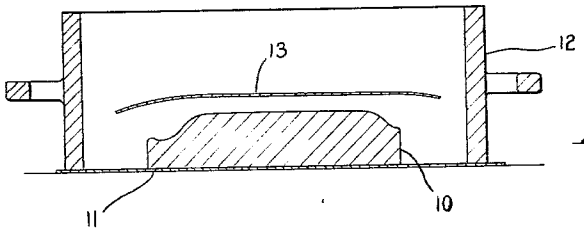


FIG 1.

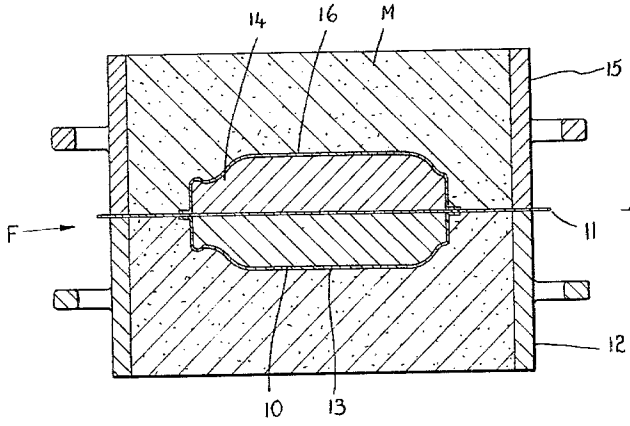


FIG 2.

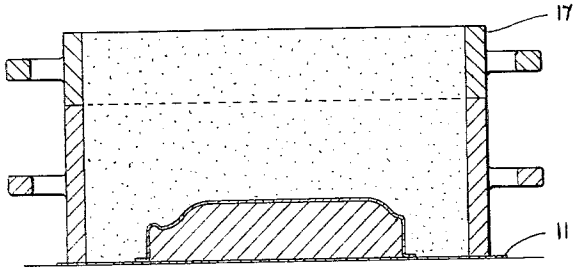


FIG 3.

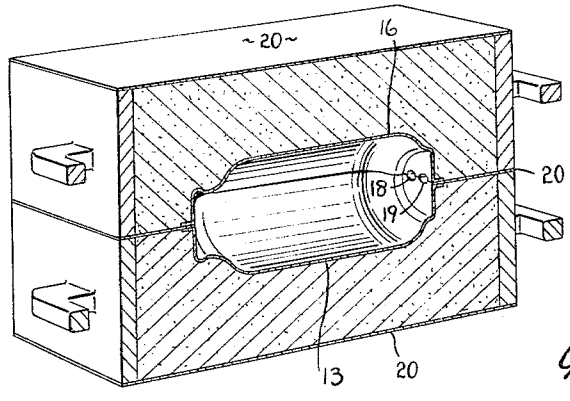


FIG 4.

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MANUFACTURING PROCESS FOR RE-USABLE MOLDS

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4 Claims. (Cl. 22—193)

This is a continuation-in-part application of U.S. patent application Serial Number 324,426, filed Nov. 18, 1963, now abandoned, which, in turn, is a continuation-in-part of U.S. patent application Serial Number 137,845 filed Sept. 13, 1961, now abandoned.

This invention relates in general to foundry practices and more specifically to a novel and unique preparation of re-usable molds for casting aluminum and its various alloys.

While the invention is primarily directed to re-usable molds for simple castings, that is, for molds not destroyed of necessity by the removal of peculiarly shaped castings, those skilled in the art will appreciate that the characteristics of the molds of this invention render them highly desirable for widespread use even with custom or single applications.

It has long been known that castings could be mass produced using permanent metal molds but in many instances where the production run is to be relatively short, the costs involved are prohibitive and there is no recourse but to use the old sand molding expedient.

Sand molding is of course very slow and does not yield the precision and high quality finish obtainable with more sophisticated and expensive methods. To prepare sand molds rapidly, a substantial labour force and numerous patterns are required together with considerable floor space, and further, with respect to the casting of aluminum and its alloys, the surface finish is dependent upon the class of sand used. All these factors add up to high costs and prices disproportionate to the product's face value.

In order to better understand the applicant's invention, reference is made to United States Patent 1,984,905, issued Dec. 18, 1934 to Weatherford. In this patent is to be found the teaching of the use of powdered milk as a binder in the manufacture of cores. Weatherford found that by adding powdered milk to core mixtures there would occur, during baking, a migration of water from the centre of the core material to the surface thereof carrying the powder with it to form a concentration in consequence of which a hard smooth casing is imparted to the core surface. Apparently this is due to what is termed as caramelization of the carbohydrate content of the binder.

Weatherford's disclosure while adequate in the making of cores has an inherent characteristic which renders it unsuitable for re-usable molds. As is well known, core material must permit, after the cooling of castings, ready removal and Weatherford's material does permit of a comparatively free pouring of the core sand or material from the recesses of castings, thus, it will be appreciated that the material, in this major respect, is unsuitable for re-usable molds.

Following considerable experimental work the applicant has found that by mixing hard-coal ash with fire clay in certain proportions and then adding sufficient liquid milk to moisten the mixture to a consistency similar to that of green sand, molds may be prepared having qualities of great hardness and strength plus smoothness and the porosity necessary in a mold which is to be re-used. During his experiments, the applicant manufactured 3,000 castings from a single mold and this mold, at the end of the period of use was neither cracked nor damaged in any way.

Applicant further found that while soft-coal ash could be used in place of hard-coal ash, it was necessary to add either 10% by weight of the mixture of asbestos powder or 5% by weight of the mixture of fish powder in order to obtain results equivalent to those when using hard-coal ash. It is clear from this that hard-coal ash is to be preferred.

The fish powder is obtained by drying and grinding any available type of whole fish and is, of course, a very inexpensive additive. The reasons for the ability of fish powder to perform the same or a similar additive function as asbestos in this composition is not known, nor is the initial reason for the necessity of including such additives to a "soft coal ash" mixture. It is only known that experimental work has proven that one of such additives is required when soft coal ash is used in the re-usable mold mixture of the present invention to obtain results comparable with those obtained when using a "hard coal ash" mixture.

Further, when a mold finally cracks or becomes damaged, the material when ground may be used repeatedly without loss of mold quality.

It is an object of this invention to provide a material suitable for the production of re-usable molds, such material being a mixture of relatively inexpensive ingredients.

It is a further object to set forth a method of producing molds using the above-noted material to provide the strength, porosity and fine surface finish required in re-usable molds.

The invention will be more readily and clearly understood from the following description and the drawings appended thereto.

FIGURE 1 shows positioning of pattern in drag and placing of wax paper;

FIGURE 2 shows the mold and flask prior to removal of pattern;

FIGURE 3 illustrates use of an extension section as a material gauge;

FIGURE 4 shows mold prior to baking but minus pattern.

The material used in the preparation of the molds consists of a mixture of hard-coal ash and fire-clay in the proportion of three parts ash to one part clay. This mixture is moistened to a consistency similar to that preferred in the well known green molding sand by addition of approximately 25% by mixture volume of milk, either skimmed or whole milk being suitable.

While hard-coal ash is preferred, it has been found by experimentation that soft-coal ash may also be used, but to obtain results comparable to the above defined material, certain additives are necessary. Specifically, it was found that either 10% by weight of the mixture of asbestos powder or 5% by weight of the mixture of fish powder was required when using soft-coal ash. The reason for this is not clear but in tests made using the soft-coal ash, clay and milk alone the results were somewhat inferior to those obtained using hard ash in the material.

As for the type of clay, many of the well-known bonding clays may be used such as bentonite, china or kaolinite down to more "lean" clays, that is, those clays having lower bonding power.

In preparing a mold by the novel method the above material is used exclusively in contradistinction to the old molding procedures wherein facing sand is used to cover the pattern with floor sand filling the remaining flask space. There is thus less storage area required and no possibility of a reject through the inadvertent use of floor sand instead of facing sand.

In describing the preparation of a mold according to this invention reference is made to the drawings.

One half of a pattern **10** is placed, joint face down, on a piece of wax paper **11** and over the pattern is placed, also joint face down, the drag **12** of the flask F. A second sheet of wax paper **13** is then placed over the pattern within the drag and the material M is then poured over this and compacted under a pressure of roughly 5,000 p.s.i.

As is well known, the drag is then turned joint face up, the other half of the pattern **14** mated with the first half and the cope **15** positioned on top of the drag so that more material M may be added and the mold completed. The material in the cope is also subjected to a pressure of approximately 5,000 p.s.i. and the top half of the pattern is also covered with wax paper **16**.

The use of wax paper is found preferable to the usual parting powders although the more expensive powders will function adequately under the high pressures to allow a clean separation of the pattern and flask elements. However, wax paper is considerably less expensive and performs the separating function just as well as graphite or any of the other known parting or facing agents. If the pattern is of a rather complicated configuration, the paper may be torn or notched in order to roughly follow the said configuration but this is neither critical nor essential.

To facilitate production of a number of molds, the applicant places on the cope or drag, whichever is being filled, the extension section **17** of a flask, of such a height that the material may be poured in until level with the top of the extension and thus the operator knows that upon applying the requisite pressure, the final level of the material will coincide with the top or bottom face of the cope or drag.

In order to ensure that the finished mold has the characteristics required in a re-usable mold, it has been found that the pattern, usually a metal pattern, should remain in the mold during baking thereof. If the pattern is removed prior to baking, some failures can be expected. That is, some molds will not be properly be formed and hardened if the pattern is not present during baking to protect the inner mold surfaces and to maintain the mold material in compacted condition.

Suitable gates **18** and risers **19** may be formed before removal of the pattern. The mold is baked for approximately 6 to 7 hours at a temperature of approximately 800° F. These figures vary according to the size of mold involved. During baking it has been found essential to cover all material surfaces with a strip of aluminum foil **20** or the like, that is, aluminum foil sheets are placed between the cope and drag, on the lower face of the drag and the upper face of the cope.

The specific function of this covering is to prevent break-up of the mold material surfaces during baking.

After baking, the molding material exhibits a hard smooth dark surface and may be subjected to rapid and considerable changes in temperature without cracking. This means a more rapid mold cycling program since, immediately after a poured casting has cooled sufficiently for removal, the molds may be chilled in a refrigerator if desired and so readied for handling again in a short time.

Having described in detail what I regard to be the preferred manner of practicing the method of this invention and the preferred material, it will be appreciated that various changes and modifications may be made without departing from the scope of the invention and I wish to be limited only by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A method of preparing a re-usable mold including the steps of placing a pattern in a flask and covering said pattern with wax paper; filling the flask with a moist mixture of coal ash, fire clay and milk and compacting the mixture under high pressure; covering all surfaces of the compacted mixture, not covered by the flask and pattern, with aluminum foil and then baking said mold until the mixture forms a hard, porous mass.

2. A method of preparing a re-usable mold as defined in claim **1** wherein the mixture is compacted under a pressure of about 5,000 p.s.i.

3. A method of preparing a re-usable mold as defined in claim **1** wherein the compacted mixture is baked at a temperature of approximately 800° F. for about 5 to 8 hours duration.

4. A method of preparing a re-usable mold including the steps of placing a pattern in a flask and covering said pattern with a parting agent; filling the flask with a moist mixture of 3 parts soft coal ash, 1 part fire clay, 5% by weight of the mixture of fish powder, and milk, and compacting the mixture under a pressure of approximately 5,000 p.s.i.; covering all exposed surfaces of the mixture with aluminum foil and then baking said mold, without removing the pattern, until the mixture forms a hard, porous mass.

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