July 23, 1968 S. C. SCHOTT 3,393,726

METHOD FOR MAKING LARGE PRECISION DIE CASTINGS FROM CAVITYLESS CASTING MOLDS

Filed May 9, 1966

FIG. 1

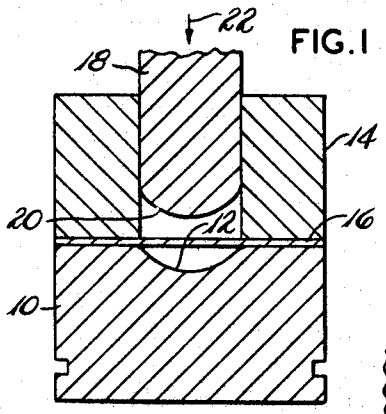


FIG. 2



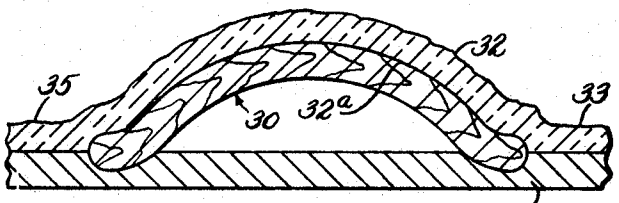


FIG. 3

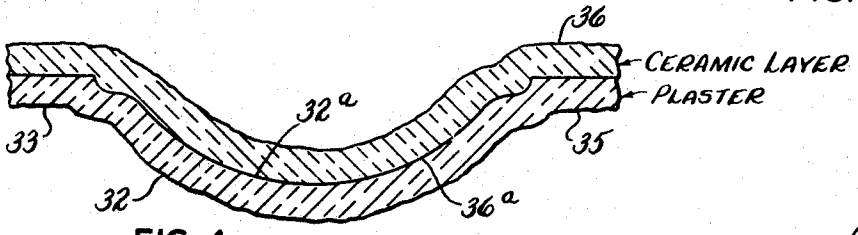


FIG. 4

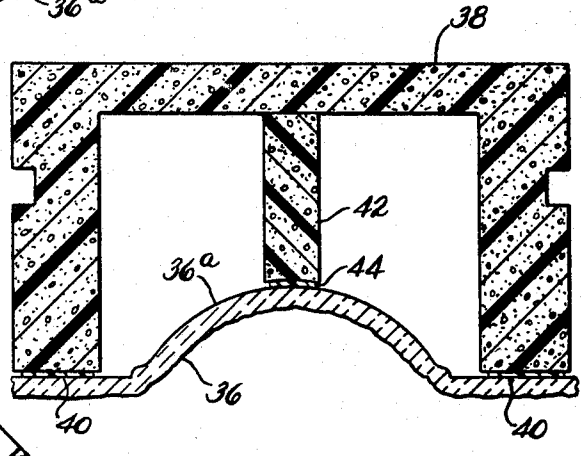


FIG. 5

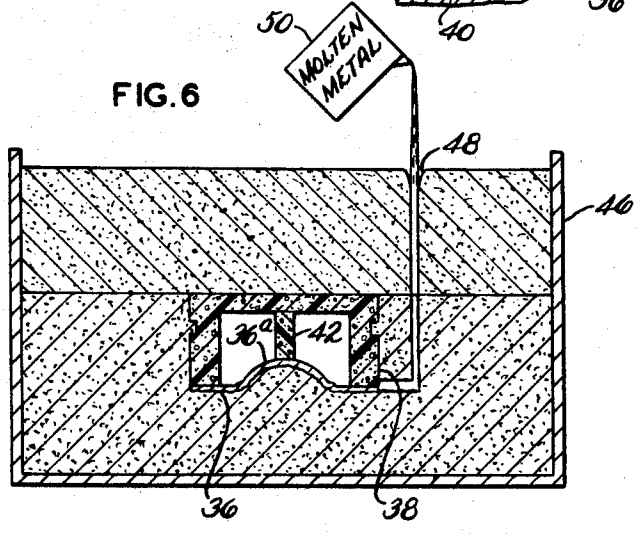


FIG. 6

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METHOD FOR MAKING LARGE PRECISION DIE CASTINGS FROM CAVITYLESS CASTING MOLDS

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This invention relates to a method for making large precision castings from cavityless casting molds, and more particularly to the combination of a ceramic or other refractory type facing layer with build up by a suitable expanded plastic foam to achieve a casting having the surface adjacent the facing layer of high quality.

Heretofore it is well known that there have been many and various methods for casting to achieve end products of great resolution and precision. It has been recognized for a long time that conventional sand casting techniques do not provide a high precision or very smooth surface effect simply because of the limitations in the sand material itself, and the necessity for using core washes, which in effect destroys all precision detail in the sand. Efforts have been made to overcome this deficiency in said castings by the commonly known lost wax process, such as shown in U.S. Patents Nos. 2,948,032 and 3,022,556. This lost wax technique does allow precision casting of intricate designs, but is necessarily limited to very small articles because of the expense of the process, and the difficulty in handling the process on large forms. The Shaw process utilizing a gel ceramic, such as illustrated in U.S. Patent No. 3,022,555 also is limited to rather small articles and is considerably more expensive than the conventional sand casting technique. Attempts to improve and simplify the conventional sand casting techniques have been made by utilizing a fully embedded form which is substantially completely combustible upon the pouring of the casting, thereby eliminating the requirement for removal of the form from the sand, and the inherent difficulties associated therewith. This process is illustrated and described in Patent No. 2,830,343. However, none of these processes are adaptable to providing large castings with high precision and extremely smooth surfaces at low cost.

Therefore, it is the general object of the present invention to improve upon the above mentioned casting processes by the provision of a low cost, extremely simple, and highly effective technique to provide large castings with precision surfaces thereon.

A further object of the invention is to provide a casting process wherein a ceramic or other similar type refractory facing layer is formed representing on one surface thereof a desired face for a large precision casting, and wherein a combustible material is built up on this face of the ceramic layer to provide a body to allow cavityless casting to be effected and still provide the desired precision face adjacent the refractory facing layer.

The aforesaid objects of the invention and other objects which will become apparent as the description proceeds are achieved by providing a method for making large precision castings for dies and molds comprising the steps of making an impression of the surface of a model with a material to provide a smooth precision surface, coating the impression with a ceramic layer of sufficient thickness to provide sufficient strength for mechanical handling when fired, firing the impression and the ceramic layer until the ceramic layer is inert and the impression has disintegrated, building up the face of the ceramic layer representing the impression with a form being combustible substantially without residue on the subjection to a molten casting charge and shaped to give a desired body and bulk to a casting having a forming surface defined by the face of the ceramic layer representing the impression,

embedding the ceramic layer and built up form in a mold body, providing in the mold body a passage for a molten casting charge to the embedded layer and form, and pouring into the passage a molten casting charge for burning and replacing the embedded form in the mold body.

For a better understanding of the steps comprising the process of the invention reference should be had to the accompanying drawings wherein:

FIG. 1 is a cross sectional elevation of the casting used to perform a standard metal stamping operation;

FIG. 2 is a cross sectional elevation of a wooden model from which the female die casting and male punch are eventually formed by the process of the invention to in effect produce metal representations of the wooden model;

FIG. 3 is a cross sectional elevation, partially broken away, showing the first step in the process which comprises producing a plaster splash impression of the top surface of the model;

FIG. 4 is a cross sectional elevation, partially broken away, illustrating the next step in the process which comprises forming a ceramic layer from the plaster impression;

FIG. 5 is an enlarged cross sectional illustration of the next step in the process, partially broken away, and showing a build up on the impressed face of the ceramic layer with a combustible material to provide a body or bulk to carry the surface to be defined by the impressed face of the ceramic layer; and

FIG. 6 is a cross sectional elevation showing the form and ceramic layer embedded in a mold body with a mold charge being poured to provide the desired female die casting.

While it should be understood that the method of the invention can be used to make castings, which castings may be utilized for any purpose, the invention was first conceived for making cast dies utilized in metal stamping processes, and hence it has been so illustrated and will be so described.

With reference to the process of the invention illustrated in the drawings, FIG. 1 illustates a conventional set up for stamping metal, which in this instance is particularly designed to stamp for a bumper, for example. Specifically, the equipment includes a female die **10** having a precision formed die surface **12**. A large metal draw ring **14** holds a sheet of metal **16** to be stamped in position on top of the surface **12** of die **10**. A male punch **18** having a contoured precision bottom surface **20** is then rammed in a direction indicated by arrow **22** to suitably form the sheet metal **16** to the desired contour of the female die **10**. None of the hydraulic rams or other control mechanism normally associated with the die castings of FIG. 1 are illustrated, as they form no part of the invention.

In order that the sheet metal **16** will have a high precision surface, the corresponding surfaces **12** and **20** of the female die **10** and male punch **18** must be of high polished and smooth precision. Heretofore, with conventional sand molding techniques, these surfaces had to be machined to obtain the desired precision surfaces. The technique of the invention described hereinafter avoids this requirement for this large type cast die.

Specifically, the technique is illustrated in FIGS. 2–6. FIG. 2 illustrates in cross section a wooden bumper model, indicated generally by numeral **30**. Normally, these models are handcrafted by mold or pattern makers to the exact configurations, shapes, etc. which are desired for the final end product, normally to be stamped from metal. While a wooden model is illustrated, these models may also be made from plaster, wax, or other suitable materials.

The steps in the invention illustrated are used to make the female die **10** of FIG. 1. It should be understood

that to make the male punch **18** similar techniques could be utilized except using the other side of the model. Specifically, FIG. 3 illustrates that a plaster splash **32** is made as an impression of the top surface of the model **30** in any conventional manner by coating the surface of the model as illustrated. In order that the model **30** can be removed from the plaster splash **32**, there cannot be any undercut surfaces, and hence the model **30** is positioned on a table **34**, or other suitable surface so that the plaster splash actually comes only about to the center of the rounded end portions of the model, as clearly illustrated. Normally, it is contemplated that the splash **32** extends out to each side to provide handling flaps or surfaces **33** and **35**. The splash **32** provides an impressed surface **32***a* of the top or outside surface of the model **30**.

The next step in the process after the model **30** is removed from the plaster splash in the usual manner known in the art involves simply coating the plaster splash **32** with a suitable ceramic layer **36**. Normally, for simplicity, the plaster splash **32** is turned over so that the impressed surface **32***a* thereof representing an impression of the top surface of the model **30** faces upwardly. Thus, because of gravity, the forming of a ceramic layer **36** is greatly simplified. The invention contemplates that the ceramic layer **36** may be poured, sprayed or brushed onto the impressed surface **32***a* of the plaster splash **32**. However, any other suitable manner may be utilized. Normally, the thickness of the ceramic layer **36** will depend upon the overall size of the casting to be made since the layer **36** will have to be mechanically handled, and it should be sturdy enough so that it will not break or deform under these handling conditions. Thus, the thickness may perhaps vary between about ¼ inch to 1½ inches depending on the particular application and the size of the die casting to be formed.

While the layer **36** is described as ceramic, any suitable refractory material which will produce a precision or very smooth surface, and can be applied in a moldable non-fired condition would meet the objects of the invention. Also, of course, it should be recognized that another suitable material to form the splash **32** such as wax could also be utilized for that step of the process.

The next step in the process involves firing the combined ceramic and plaster layers until the layer **36** is cured or in effect has become inert, or reduced to a very low moisture content. The temperature required for this step will depend upon the particular characteristics of the refractory material used in the layer **36**. It should be understood that the layer **32** must substantially completely disintegrate during this step so that only the ceramic layer **36** will remain. Thus, the properties of the material in layer **32** must be compatible with the firing temperature and time of firing so as to be substantially completely combustible. If a residue remains, it must be able to be easily removed to provide the ceramic layer with the smooth precision top surface **36***a* representing the impression of the plaster layer **32** and the true shape of the surface of the model.

Then, with the ceramic layer **36** alone, as illustrated in FIG. 5, in order to provide a body or base to the die casting to be made, the invention contemplates building up from the impressed surface **36***a* of the ceramic layer **36** with a suitable combustible material, preferably of an expanded plastic foam, easily positioned thereon. A material suitable for this purpose is Styrofoam, as made by the Dow Chemical Company, or Styrofoam beads made in large sheets which can be cut and fit to substantially coincide with the impressed surface **36***a* of the layer **36**. The build up of the material will be in any desired form as represented by numeral **38** to achieve a desired body or base for the precision surface to be formed by the impressed surface **36***a* of layer **36**. The invention does contemplate, however, that the form **38** should extend substantially to the edges of layer **36** all around so that no sand or other foreign matter other than the charge can enter into these areas to deform the precision surface to be defined by the surface **36***a* of layer **36**. To this end, a suitable adhesive **40** may be used to secure the form **38** in position.

An important feature of the invention, however, is that the form **38** does not have to be in intimate contact with the surface **36***a* over the entire surface thereof to achieve the objects of the process. Thus, the inner portion of material **38** may be hollow, as indicated and only suitable support, such as block **42**, is necessary to be positioned to insure that the form **38** retains substantially the desired shape when it is positioned in a sand mold body. Note the use of adhesive **44** to retain the Styrofoam block **42** in position. Again, it is repeated that it is not necessary to have intimate contact between the form **38** and the surface **36***a* of layer **36**, but care must be taken to insure that sand or other foreign matter cannot get in to interfere with the surface **36***a*.

The final step in the invention then comprises inserting the layer **36** and form **38** into a sand mold body **46**, wherein the sand is completely formed around the layer **36** and form **38** to the extent indicated in FIG. 6. A suitable passage **48** is provided to receive a molten metal **50** comprising a molten casting charge, all as illustrated in FIG. 6. The entrance of the molten charge then effectively burns out the form **38** allowing the molten charge to fill the cavity thus created by the burning, and allowing the surface **36***a* of layer **36** to provide a precision surface to the casting formed thereby. The layer **36** because of its ceramic firing and refractory nature resists the heat of the molten charge and does provide the high precision smooth surface to the casting formed thereby. The layer **36** is usually discarded after the casting has been cooled and formed, as it is not necessary nor desirable to use it again.

Thus, it is seen that the objects of the invention have been achieved by providing a ceramic facing layer in combination with a predetermined combustible form to achieve large precision castings, where the form burns away by the molten charge with the precision ceramic facing providing a smooth contoured surface as desired to the casting. This process lends itself to a one of a kind tooling process for making large precision dies and molds. While only a simple contoured bumper casting has been illustrated as being formed by the process of the invention, it should be understood that the process will form any other complex surfaces as desired for the many and complicated tooling processes currently in use for stamped metal or for other casting uses today. In particular the process has application to making castings for practically every metal part to be stamped with regard to automobile manufacture.

While in accordance with the patent statutes only one best known embodiment of the invention has been illustrated and described in detail, it is to be understood that the invention is not to be limited thereto or thereby, but that the inventive scope is defined in the appended claims.

What is claimed is:

1. A method for making large precision castings comprising the steps of:

making an impression of the surface of a model with a material capable of representing such surface with a smooth precision facing,

coating the impression with a layer of refractory material of sufficient thickness to provide sufficient strength for mechanical handling when fired,

firing the impression and the refractory layer until the refractory layer is inert and the impression has disintegrated,

building up on the face of the refractory layer representing the impression with a form combustible substantially without residue on subjection to a molten casting charge and shaped to give a desired body and bulk to a casting having a forming surface de-

fined by the face of the refractory layer representing the impression,

embedding the refractory layer and built up form in a mold body,

providing in the mold body a passage for a molten casting charge to the embedded layer and form, and

pouring into said passage a molten casting charge for burning and replacing said embedded form in said mold body.

2. A method according to claim 1 where the material to provide a smooth precision surface is plaster, and the form is made from an expanded plastic foam being combustible substantially without residue.

3. A method according to claim 1 where the building up with the form defines the edges of the refractory layer, but is without intimate contact with the form over the entire surface of the refractory layer.

4. A method according to claim 3 which includes the step of securing the form in position with respect to the ceramic layer so as to define a continuous surface between the edges of the layer and the form before embedding the combined layer and form in the mold body.

5. A method according to claim 1 where the refractory mateal is a suitable ceramic capable of representing the impression with a smooth precision facing.

6. A method for making large precision castings comprising the steps of:

forming a desired impression on one surface of a heat resistant refractory material,

building up on the impression surface of the refractory layer with a form combustible substantially without residue on subjection to a molten casting charge and shaped to give a desired body and bulk to a casting having a forming surface defined by the face of the refractory material,

embedding the refractory layer and built up form in a mold body,

providing in the mold body a passage for a molten casting charge to the embedded layer and form, and

pouring into said passage a molten casting charge for burning and replacing said embedded form in said mold body.

7. A method for making large precision castings comprising the steps of:

forming a mass of heat resistant refractory material which has a complex shape on one surface thereof complementary to a desired shape, which surface is the impression surface thereof,

providing the impression surface of the refractory mass with a form engaged therewith and extending therefrom to provide an enclosed volume therewith, said form being made from a material combustible substantially without residue at molten metal casting temperatures,

embedding the refractory mass and form in a mold body which supports such mass with the impression surface thereof uppermost, the mold body having therein a passage for a molten casting charge to the embedded mass and form,

pouring into said passage a molten casting charge for covering said impression surface, said charge burning away and replacing said form in said mold body, and

solidifying said charge to obtain a casting with one surface thereof of the desired shape.

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