METHOD OF MAKING METAL MOLDS

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This invention is in the art of manufacturing molds for castings and is particularly concerned with the problem of manufacturing such molds utilizing a metallizing gun or other instrument adapted to spray molten metal. It is also concerned with the product resulting from the practice of the method as hereinafter disclosed.

It has been suggested in the past that metal molds may be formed conveniently by spraying molten metal particles on to a core and, within limitations, a certain degree of success has attended efforts to manufacture molds in this way. However, there has been a number of difficulties which have prevented widespread use of the practice. In the first place, the sprayed metal must necessarily be brought to a comparatively high temperature prior to spraying and the combination of this temperature with the force impact of the spray tends to prevent the use of a core formed from any material other than one having considerable strength and rigidity and preferably having a melting point substantially higher than that of the molten metal. All efforts to use plaster or wooden cores have not been satisfactory.

In the second place, in order to get sprayed metal with a high melting point to adhere to and conform with the core it is necessary either to roughen the surface of the core or to heat the core to a comparatively high temperature. If the surface is roughened it becomes quite difficult to remove the mold from the core particularly in the case of objects having irregular contours; even when removed the inside of the mold has the same roughened surfaces as those of the core. If, on the other hand, the core is heated, the operation is cumbersome and expensive and there are many classes of cores in which it is impossible to apply the desired degree and uniformity of heat.

In accordance with the present invention, metal molds may be formed by spraying, utilizing plaster or wooden cores, and if it is desired to use a metal core there is no necessity for roughening or heating it. The resultant molds have an inner surface exactly corresponding to the surface of the core and the entire mold may be formed from the same metal or, if desired, from different metals, each having a melting point well above that of the objects to be cast. Any metal which may be sprayed in molten form is adapted to be used in the method of the invention. The cost of mold manufacture is insignificant and in the case of many molds it has been found entirely practical to remove the mold from the casting by simply breaking it off and destroy-

ing it. However, as will be subsequently pointed out, it is not at all necessary to follow this practice unless it should prove commercially economical to do so.

Briefly stated, the method invention includes the steps of, first, applying to the core a protective coating of an insulating material, preferably one in liquid form and having adhesive properties, second, imposing on the core so coated a layer of finely divided metal particles or dust, and third, spraying the core with molten metal particles in the conventional way. It has been found that the insulating coating completely disappears as a result of the spraying action performed during the final step and that it, together with the layer of metal dust, protects the core sufficiently to prevent disintegration even when the core is formed from plaster, wood or other materials not greatly resistant to the action of heat. The individual particles of metal dust become bonded together as a result of the heat and impaction resulting from the spray but, to a certain extent, their original identity and contours are preserved, particularly on the very innermost surface of the mold. For this reason the resultant mold product has certain physical characteristics not heretofore found in molds formed as a result of the practice of any of the prior art methods.

In the drawings there is illustrated the successive steps involved in the practice of the method utilizing, in the first instance, a plaster core selected for illustrative purposes because of its particularly irregular contours and, in the second instance, a machine part of rather conventional type formed of steel or other hard surface material.

All of the illustrations are to a certain degree diagrammatic and are purely for the purpose of providing a clearer understanding of the invention in conjunction with the further and more detailed description thereof.

Figure 1 is a perspective view of a small plaster figurine adapted to serve as a core for a mold to be formed in accordance with the method of the invention.

Figure 2 is a similar view showing the figurine coated with an insulating material having adhesive qualities.

Figure 3 shows the same figurine after the application of a layer of metal dust.

Figure 4 represents the final step after the molten metal has been sprayed completely over the upper surface of the core.

Figure 5 is a sectional view of Figure 4 along a
median line and illustrates the plaster core intact inside of the metal mold formed in accordance with the steps illustrated in Figures 1-4. Figure 6 is a perspective view of a conventional machine part formed of steel or similar hard surface metal having a high melting point.

Figure 7 illustrates the same part with the insulating adhesive applied and a divider disposed centrally on the part for separating the mold into two sections after it has been formed. Figure 8 illustrates the part after the application of the metal dust.

Figure 9 illustrates the final step of spraying the molten metal.

Figure 10 shows the mold sections separated by the divider and removed from the core in finished condition.

The core illustrated in Figure 1 which has been designated generally as 10 is formed from plaster of Paris and is one which because of its exceedingly irregular contours would present a difficult casting problem. If this core were formed from metal and dividers were positioned on it so that the mold could be removed in sections, it would be necessary to remove it in at least four separate sections and the resultant molding problem would be a difficult one. Since, in accordance with the technique of the present invention, it is possible to utilize a plaster core, this core can be broken up and destroyed after the mold has been completed and in subsequent molding operations the mold can in each instance be destroyed provided, of course, that the value of the object to be molded is sufficient to justify the relatively low cost of replacing the mold.

It is essential that the material which is applied to the core 10 in Figure 2 have insulating qualities and it is preferable that it have adhesive qualities also. Preferably, it should be in a liquid state at the time of application, particularly if the material has the desired adhesive qualities. The materials which we have found to be most effective for this purpose are urea formaldehyde resins reduced to powdered form and dissolved or suspended in an aqueous solution. One particular product which has been found to be entirely satisfactory is a powdered adhesive preparation which has recently been introduced on the market under the trade name of “Weldwood.” This material has a plastic resin base which endows it with substantial insulating qualities. It is highly adhesive and is soluble or at least suspensible in water. There are doubtless other materials now available or which may hereafter become available which possess the desired qualities.

In the preferred technique of the method, utilizing a plaster core one coating of the insulating solution is first applied to the core 10 by dipping or brushing and is permitted to dry. This coating tends to close the pores of the plaster and to improve the surface insulation. A second coating is then applied and left tacky for the application of the metal dust. The coating, whether single or double, is designated generally as 11, Figure 2.

Preferably while the coating 11 is still sticky the layer of metal dust 12 is then applied over the entire core surface. This metal dust is preferably the same metal from which Figure 1 is to be made and may be obtained if desired by simply spraying a metalling gun into a container of cold water. The dust may be applied by dusting or spraying or in any other convenient way and should be of a depth sufficient to conceal completely the inner core material.

In the step of spraying illustrated in Figure 4, the mold shell 13 has been formed completely around the core. In the preferred technique the molten metal is first sprayed from a considerable distance until a thin shell has been formed over the entire core. Thereafter further metal may be applied in layers desired for ordinary molding purposes a very light shell approximately .020 inch is all that is required.

In certain applications of the invention it may be possible to dispense with the step of applying the metal dust to the greater advantage inso far. However, the results obtained by this method are at present inferior to those in which the full preferred series of steps is utilized.

The process steps illustrated in Figures 6-10 are substantially the same as those just described with reference to Figures 1-4 except that a metal core such as 14 the insulating properties of the primary coating 15 may be minimized and the adhesive qualities emphasized. One coating of the material is all that is required. The divider 16 is unnecessary and is of a conventional type. The application of the metal dust coating 17 (Figure 8) is the same as that described in connection with Figure 3 and the mold 18 (Figure 9) is of the same general type as that shown in Figure 4.

As illustrated in Figure 10, after completion, the mold may be separated into two parts 19 and 20 for subsequent use. At the time of the separation it will be found that the adhesive coating has wholly disappeared and that the mold may be removed from the core as easily as if the coating had never been applied and considerably more easily than would have been the case had it been necessary to roughen the outer surface of the core as in earlier practices. Where the core which has been utilized has a taper or “draw” it is usually possible to remove the mold in one piece after each casting operation.

Obviously, it is possible to use metals in the application of the dust layer illustrated in Figures 3 and 8 which are of a different type from those utilized in the spraying step illustrated in Figures 4 and 9. However, except to the extent dictated by convenience or economy there is no particular advantage in using the dust formed from metal having a high melting point is preferable so that the inner surfaces of the resultant mold will not be affected by the molten metal poured therein.

The invention has a particular application to centrifugal casting in that the production of steel molds which are practically essential in this operation, at a very low cost. In making castings of this type a very thin steel shell may be provided and reinforced by a backing of sand or plaster. Since centrifugally molded castings command a substantially higher price than ordinary castings, in this instance particularly it is possible to destroy the mold in order to remove it from the core provided the configuration of the core is such that the removal operation is a difficult one. It will be apparent from the description that the entire method operation is a very simple one and that the entire mold cost may be kept to a figure only slightly greater than that of the metal utilized.

Obviously, metal dies can be formed by a process similar to that described except that in the
case of a die it is necessary to build up a very heavy coating of metal.

Having described the invention, we claim:

1. The method of making metal molds which includes the steps of coating a metal core with an adhesive film, applying to the coated core while the adhesive is still tacky a dust formed from metal having a melting point at least as high as the metal from which the mold shell is to be formed, and thereafter forming a mold shell over the coated core by spraying thereon molten metal particles.

2. The method of making metal molds which comprises the steps of applying a coating of a material having adhesive qualities to a core, covering the coated core with a layer of finely divided solid metal particles, and then spraying molten metal particles onto the core to the desired depth.

3. The method of making metal molds which includes the successive steps of coating a core with an adhesive film, applying to the core so coated a layer of metal dust in the form of solid particles, and then spraying molten metal particles over the core for a period of time sufficient to build up a said core a metallic shell.

4. The method of making metal molds which includes the step of coating a core with a plastic resin film having adhesive qualities, applying to the core so coated a layer of metal dust in the form of solid particles, and then spraying molten metal particles over the surface of the coated core.

5. The method of making metal molds which includes the step of coating a core with a film of urea formaldehyde resin, applying to the core so coated, while the film is still tacky, a layer of finely divided solid metal particles, and then spraying molten metal particles onto the surface of the coated core and thereby forming a metallic shell on said core.

6. The method of making metal molds which includes the steps of coating a plaster core with an adhesive film having a plastic resin base, applying to the core so coated, and while the adhesive is still tacky, a layer of metal dust in the form of solid particles, and thereafter spraying molten metal particles onto the coated core.

7. The method of making metal molds which includes the steps of coating a plaster core with a film having a base substantially formed from urea formaldehyde resin, drying the core, applying a second film of the same coating, applying to the core a layer of finely divided solid metal particles while the second film is still tacky, and thereafter spraying molten metal particles over the surface of the coated core.

8. The method of making molds which includes the steps of coating a metal core with an adhesive film, applying to the coated core while the adhesive is still tacky a metal dust formed of solid particles and thereafter spraying molten metal particles over the surface of the coated core.

9. The method of making metal molds which includes the successive steps of applying a coating of a hardenable liquid material having adhesive and insulating properties to a core, applying to the core so coated and while the adhesive is still tacky a layer of dust in the form of solid discrete particles continuously over the entire surface, and finally spraying the core with molten metal particles at sufficient temperature and pressure to dissipate the adhesive and insulating material and to compact the metal dust directly around the outlines of the core.

10. The method of making metal molds which includes the successive steps of coating a core with an adhesive film, applying to the coated core while the adhesive is still tacky a preformed, non-molten, solid metal dust formed from metal having a melting point sufficiently high to preserve substantially the original identity and contours of said dust at the innermost surface of the mold during the subsequent application of spray metal, and then spraying molten metal particles over the dusted core for a period of time sufficient to build up on said core a metallic shell.

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