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METHOD OF MAKING MOLDS

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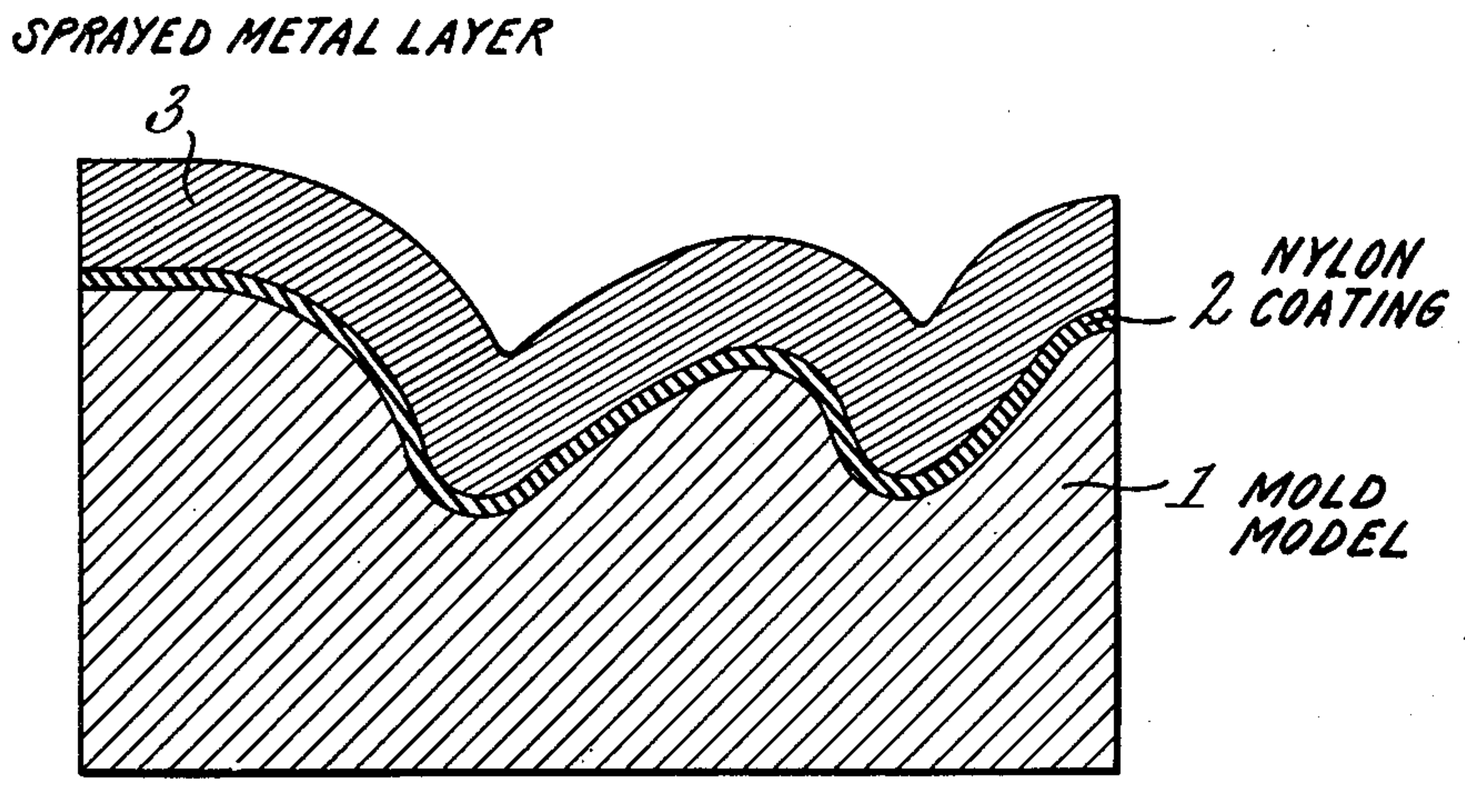

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METHOD OF MAKING MOLDS

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This invention relates to the manufacture of molds wherein a metal negative of a mold model is prepared by spraying metal upon the mold model which may be of any suitable material such as rubber, metal, plaster, wood, etc. After building up the metal negative to a suitable thickness and strength, either by continued spraying of the same metal or of a different metal or by electro-deposition or in any other suitable manner, the sprayed metal negative is separated from the mold model.

In attempting to make molds by the process just described, a number of serious difficulties arise and as a consequence no entirely satisfactory method of making sprayed metal molds has been known to the art. The principal difficulty is that of separating the sprayed metal negative from the model; usually the sprayed metal adheres so tightly to the model that separation is very difficult or often impossible. Another difficulty arises from the fact that at the start of spraying the metal does not adhere to the surface of the model because of the force of the blast and the lack of adhesion to the surface; expressed otherwise, the deposit efficiency at the start of the spraying is objectionably low. As a result, a great deal of metal is wasted and an excessive amount of time is consumed.

Because of the foregoing phenomena, it is almost impossible by prior methods to successfully make a sprayed metal negative on a smooth or highly finished metal model unless resort is had to complicated and expensive procedures such as use of an intermediate metal covering on the mold model or of a metal mold model which is heated to an elevated temperature at least until the model has been entirely covered with sprayed metal.

In the case of rubber mold models, it has been impossible to obtain satisfactory results because the metal spray blows off so that it is difficult to start the building-up of the sprayed metal layer and because the metal burns and penetrates the rubber surface with the result that even though separation be effected in spite of great difficulty, the impression surface of the sprayed metal is rough so that it is not satisfactory as a molding surface.

I have made the surprising and remarkable discovery that the foregoing difficulties in making sprayed metal negatives of mold models can be completely overcome in a simple and economical manner and without any disadvantages by coating the surface of the mold model evenly with nylon (which is a synthetic linear condensation

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polyamide) before beginning the metal spraying. The nylon coating exhibits the surprising result that the metal spray adheres at once and evenly over the area encountered by the metal spray. There is no tendency for the metal spray to blow off or bounce off. It is well known in prior practice that when a particle of molten metal hits a surface it splashes. However, when it strikes a nylon surface, it does not splash off but is retained uniformly at the instant of contact. As a result, there is no period of lessened deposit efficiency at the start of spraying; thus, greater production is made possible.

Furthermore, in the case of rubber mold models made of ordinary soft vulcanized rubber and coated with nylon, there is no burning of the rubber, so that the sprayed metal surface obtained on separation is smooth and unbroken and free from rubber particles, and the rubber mold model is uninjured and can be used again and again. This is in marked contrast to the results obtained when the nylon coating of my invention is omitted; in such case it is so difficult to get the metal spray to "take" that the surface of the rubber is actually burned and decomposed before adhesion begins.

Also the use of nylon makes possible easy separation of the sprayed metal from the mold model. Thus nylon exhibits the surprising advantages of causing much better adhesion of molten metal spray and at the same time permitting subsequent clean separation.

In addition to the foregoing advantages brought about by the use of a nylon coating on the mold model in accordance with my invention, many other advantages are obtained. The coating of nylon may be made very thin, and in this way details of the mold model are accurately preserved and reproduced in the sprayed metal negative surface. It would be difficult to accurately state the exact thickness of the nylon coating applied, for it may vary within very wide limits. Usually the coating has a thickness such as is obtained by applying one coating of a 1% to 20% solution of nylon in a suitable organic solvent and evaporating the solvent.

A nylon coating provides the necessary high film strength and thermal stability to withstand the impingement of the molten metal from the metal spray gun. Nylons are readily available which exhibit the desired high softening point required to withstand the molten metal spray. I prefer to employ those nylon polymers which have softening temperatures of 300° F. or higher in order that the coating obtained shall not be

melted and deformed to an objectionable extent upon the impingement of the molten metal particles.

As a result of the foregoing advantages, a nylon coating gives very remarkable results as a parting agent in the manufacture of sprayed metal molds.

In making sprayed metal molds in accordance with my invention, inexpensive mold models are almost invariably used and in fact are required for commercial production. Such models may be made of plaster, rubber, wood or metal, including metals of low melting point such as lead and low melting point alloys. The mold models used may be rough or may have any surface configuration whatsoever. For example, the method of my invention enables the most minute patterns or structures in the surface of the model to be accurately reproduced, even though the model be made of rubber or a low melting point metal. The invention is equally applicable to highly finished, i. e., smooth, mold models.

In practicing the present invention, I apply a uniform nylon coating over the entire surface of the mold model in any suitable way. I may apply the nylon in any manner which gives an unbroken film of nylon over the face of the mold model. I find it most convenient to apply the nylon in the form of a solution in any suitable organic solvent which can be volatilized by drying at room temperature or at an elevated temperature. The solids content of the solution used may vary as desired according to the mode of application and the thickness of the coating desired. The solution may be applied to the mold model in any suitable manner, as by dipping, brushing or spraying. For brushing, the nylon content of the solution may typically range from 5–15% by weight. For spraying application, a somewhat lower nylon content, say 1–4% by weight is generally desirable.

Any solvent for nylon may be used in making up the solution. I often use an alcohol-soluble nylon polymer and use a solvent comprising a lower aliphatic saturated monohydric alcohol to dissolve it. Very often I use a mixture of solvents.

A single coating with the nylon solution is sufficient. However, if desired a plurality of coatings may be applied with drying after each application. The thickness of the nylon coating applied should be sufficient to give good parting of the sprayed metal mold, but not so great as to obliterate the surface detail of the mold model. The coating should be applied in such manner that the surface of the nylon coating accurately conforms to the surface of the mold model.

After application of the nylon solution, it is dried. As soon as the coating is dry, spraying with the molten metal spray can be begun. After a sprayed metal layer of the desired depth has been built up, with or without further deposition of metal upon the spray deposit in any suitable manner, for example by continued spraying with the same or a different metal or by electro-deposition, the sprayed metal layer is separated from the mold model by simple mechanical separation.

The manner of spraying the molten metal to build up the sprayed metal layer need not be set forth in detail because it is the well-known and conventional method of spraying molten metal. In the case of porous mold models, especially those made of plaster, separation of the metal negative from the model can be facilitated by application of a solvent to the interface through the porous mold model. Any inert solvent for the nylon may be used for this purpose, the lower aliphatic saturated monohydric alcohols, for example isopropyl alcohol, being usually employed.

The accompanying drawing is a vertical sectional view of a mold model upon which a sprayed metal negative has been deposited in accordance with my invention. The mold model is designated by reference numeral 1. To model 1 there is applied a coating 2 of nylon in the manner described above, the thickness of this coating 2 being greatly exaggerated. Thereafter molten metal is sprayed onto the surface of the coated mold model until a layer 3 has been built up. If desired, the application of the sprayed metal layer 3 may be followed by electro-deposition of more metal in order to make a mold of still greater thickness. Alternatively, there may be superimposed upon layer 3 a sprayed metal layer of another metal. For example, it is often highly desirable to have an initial layer of zinc backed by a sprayed layer of aluminum for strength.

The following formulations are typical of those which may be used to form the nylon coating of my invention.

Example 1

	Parts by weight
Nylon powder (softening point at least 300° F.)	20
Isopropyl alcohol	176
Denatured ethyl alcohol	44
Furfuryl alcohol	10
Water	5

This formulation may be prepared by heating a mixture of the liquids to 160° F. and adding the nylon powder thereto with vigorous agitation until complete solution is effected. The solution may be used upon cooling to room temperature. This solution is particularly suitable for application by brushing.

Example 2

	Parts by weight
Nylon powder (as in Example 1)	2
Isopropyl alcohol	98
Furfural	1

The foregoing ingredients are mixed in the same manner as in Example 1. The resulting formulation is especially suitable for application by spraying.

Example 3

	Parts by weight
Nylon powder (as before)	5
Isopropyl alcohol	76
Water	19

These ingredients are mixed as before and give a brushing solution which evaporates somewhat more rapidly than the formulation given in Example 1.

From the foregoing description it will be seen that the present invention provides a very successful solution of the problem of making sprayed metal models. The process of my invention is particularly advantageous because of the ease and rapidity of parting of the sprayed metal mold from the mold model and the uniform and unbroken surface of the sprayed metal mold obtained. The process is simple and economical and is such that the operator can consistently obtain excellent molds without special training. Many other advantages of my invention will be obvious to those skilled in the art.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A method of making a sprayed metal mold which comprises coating a mold model with a thin, continuous, uniform, smooth coating of a

synthetic linear condensation polyamide, spraying molten metal upon the polyamide-coated surface obtained until a sprayed metal layer of the desired thickness has been built up, and subsequently separating said sprayed metal layer from said mold model.

2. A method as set forth in claim 1 wherein said polyamide is applied to said mold model as a solution in an organic solvent which is thereafter volatilized, thereby forming a thin, continuous, uniform, smooth coating of said polyamide accurately reproducing the surface of the mold model.

3. A method as set forth in claim 1 wherein said polyamide has a softening point of at least 300° F.

4. A method as set forth in claim 1 wherein said polyamide has a softening point of at least 300° F. and is applied as a solution in a solvent comprising a lower aliphatic saturated monohydric alcohol which solvent is thereafter volatilized.

5. A method as set forth in claim 1 wherein said mold model is of rubber and wherein said polyamide protects said rubber against thermal decomposition and causes substantially more rapid adhesion of the molten metal spray and formation of a smooth, unbroken surface of sprayed metal over the rubber mold model.

6. The method which comprises spraying molten metal upon a mold model having over a substantial area thereof which is to be reproduced a thin, continuous, uniform, smooth surface coating of a synthetic linear condensation polyamide until a sprayed metal layer has been built up upon said surface coating, and subsequently separating said sprayed metal layer from said mold model.

7. The method of claim 6 wherein said polyamide has a softening point of at least 300° F.

8. A method of making a sprayed metal mold which comprises coating a porous mold model with a thin, continuous, uniform, smooth coating of a synthetic linear condensation polyamide, spraying molten metal upon the polyamide-coated surface obtained until a sprayed metal layer of the desired thickness has been built up, subsequently applying a solvent for said polyamide to the polyamide coating through the porous mold model and thereby softening said polyamide coating, and separating said sprayed metal layer from said mold model.

9. A method as set forth in claim 8 wherein said solvent is a lower aliphatic saturated monohydric alcohol.

10. As an article of manufacture, a mold model, over a surface of said mold model a thin, uniform, unbroken, smooth coating of a synthetic linear condensation polyamide accurately reproducing said surface, and superimposed upon said coating a sprayed metal layer deposited directly upon said coating by a molten metal spraying operation, said metal layer being readily separable from said mold model as a result of the presence of said coating and also having a smooth unbroken surface adjacent said mold model as a result of the presence of said coating.

11. An article as set forth in claim 10 wherein said polyamide has a softening point of at least 300° F. and wherein said coating is deposited from a solution of said polyamide in a solvent comprising a lower aliphatic saturated monohydric alcohol which is volatilized after application of said solution and prior to the metal spraying operation.

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