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METHOD OF FORMING MOLDS FOR CASTING

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FIG. 1.

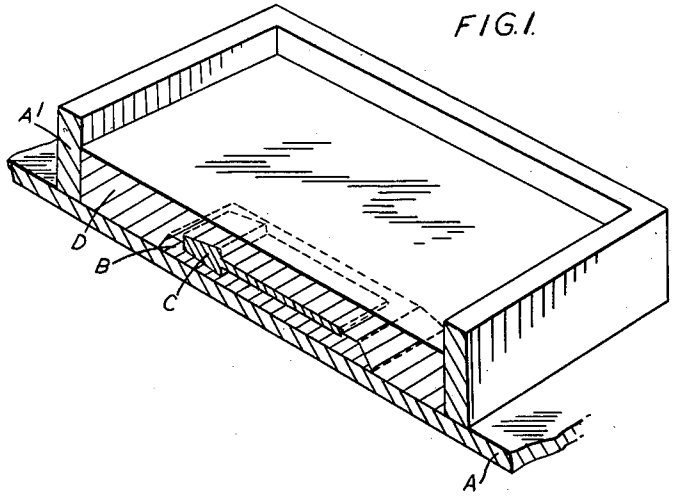

FIG. 2.

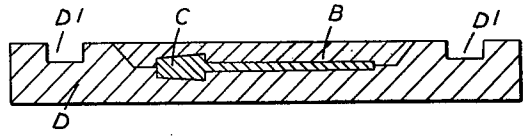

FIG. 3.

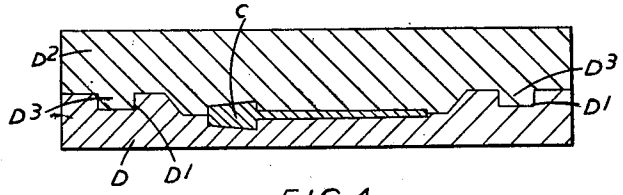

FIG. 4.

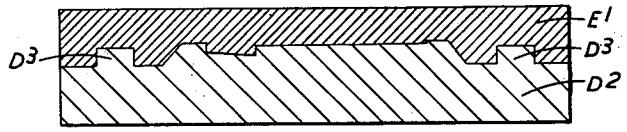

FIG. 5.

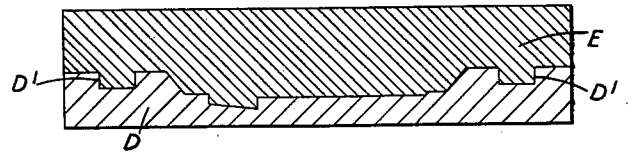

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FIG. 6.

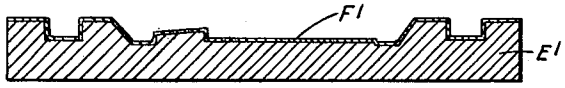


FIG. 7.

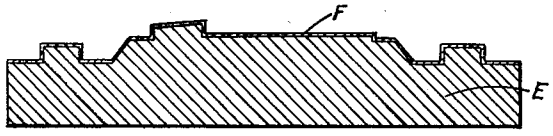


FIG. 8.

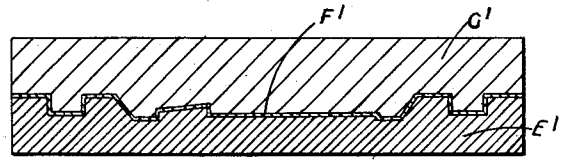


FIG. 9.

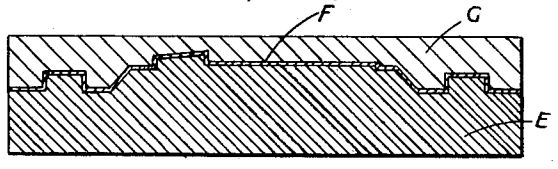
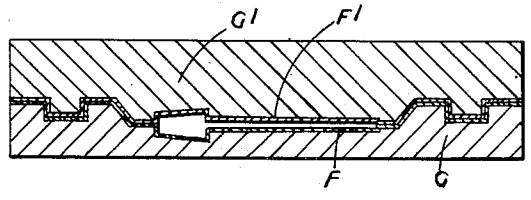


FIG. 10.



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UNITED STATES PATENT OFFICE

2,540,212

METHOD OF FORMING MOLDS FOR CASTING

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4 Claims. (Cl. 204—6)

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The present invention relates to moulds for castings and particularly the production of moulds which may be employed in the casting of patterns which are used in the precision casting of small parts.

The procedure commonly followed in the making for this purpose hollow casting moulds involves first the setting of the pattern in plaster of Paris which forms a block. A thin rubber sheet is then placed over the pattern and plaster block and held in close contact therewith by suction. The mould is then formed by casting over the rubber a low temperature fusible alloy under a considerable pressure.

The object of the present invention is to produce such moulds by a process which results in the obtainment of an accurate mould with a harder working surface, the mould not only being readily manufactured but being light and consequently easy to handle and particularly useful in the process of precision casting of small components, as for instance, turbine blades.

For convenience in the present specification and appended claims a mould or part of a mould containing a recess or cavity of the shape of the article or part of the article to be cast will be referred to as "positive" while a mould or part of a mould having a projection of the form of part of the article to be cast will be referred to as "negative." Further the word "metal" used herein is to be understood as including alloys.

In the method of forming a mould for casting according to the present invention a pattern is placed on and partly pressed into a plastic substance mounted on a supporting surface, a low temperature fusible metal is applied to the exposed surface of the pattern and the surrounding surfaces of the plastic substance and the support, the positive half mould thus formed in low temperature fusible metal has the plastic substance removed therefrom and then has low temperature fusible metal applied to the exposed surface of the pattern and the surrounding surface to form a second positive half mould in low temperature fusible metal, the pattern is removed from the positive mould thus formed, each half of this positive mould is then coated with a low temperature fusible metal to form two corresponding negative half moulds in low temperature fusible metal, the surface of each of these negative half moulds is plated with a layer of hard metal, each of these layers has applied to its exposed surface a backing of a metal having a higher melting point than the low temperature fusible metal, and the low temperature fusible

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metal is removed by melting from the other surfaces of the hard metal layers, which then with their backings together constitute a hollow positive mould from which can be produced multiple patterns in wax or other suitable material.

In order to ensure proper location of the two halves of the various moulds throughout the above method of manufacture, the first half of the positive mould formed in low temperature fusible metal has holes or depressions formed in or projections formed on or secured to the surface surrounding the pattern constituting locating means for registering the cooperating pairs of half moulds. Thus, the second half of this positive mould to be formed automatically includes corresponding projections or depressions, as the case may be and all subsequently formed half moulds are thus provided with appropriate cooperating locating holes and depressions in their appropriate halves.

It will generally be preferred to form holes in the surface surrounding the pattern and plastic material of the first half of the positive mould formed in low temperature fusible metal before forming the second half of this mould but, as an alternative, pins or projections might be applied to the surface in question at this stage or the surface of the support around the plastic material might be formed with holes or depressions or be provided with pins or projections so that during the formation of the first half of the positive mould in low temperature fusible metal holes or projections are formed in or on the surface surrounding the plastic material.

In carrying out the method according to the invention the low temperature fusible metal may be applied by casting or spraying while the metal backing is conveniently applied by spraying so as to reduce risk of the temperature of the adjacent surface of the low temperature fusible metal on the opposite side of the hard metal layer being brought to its melting temperature.

The invention may be carried into practice in various ways but the various steps in carrying out one example of a method according to the present invention are illustrated somewhat diagrammatically in the accompanying drawings as applied to the manufacture of a mould from which can be formed multiple wax patterns for use in the production of turbine blades. In the drawings, Fig. 1 is a perspective cross-sectional view, the section being taken in the vertical plane transversely of the face of the blade pattern, which is shown lying horizontally in a suitable support, and Figs. 2 to 10 are cross-sections taken

on the same plane as Fig. 1, illustrating successive stages in the method of producing the mould.

The method is not restricted to making moulds for turbine blades as it can be applied to many other small articles wherein accuracy of form and a smooth surface are desiderata.

Referring to Figure 1, which shows the third stage in the complete method but from which the preceding stages can readily be envisaged, the first stage in the method of production is the mounting on the support A, which may be a sheet of steel or glass, of a layer B of plastic material of appropriate thickness such as that known under the trade name "plasticine" consisting of zinc oxide and sulphonated olive oil. Into the exposed surface of this plastic material is pressed a master pattern C in the form of the wax patterns eventually to be produced from the mould to be formed, the master pattern being pressed into the plastic material in the example shown to the point at which substantially half the pattern is left above the surface of the plastic material. The plastic material with the pattern pressed therein is then surrounded by a retaining wall A^1 resting on the surface of the support A and the whole of the exposed surfaces of the pattern C, the plastic material B and the support A within this wall have applied to them by spraying or casting, a low temperature fusible metal D which thus forms a positive half mould in which the pattern and the plastic material lie.

The half mould D with the plastic material and the pattern therein, is now removed from the support A, and the half mould is turned over as indicated in Figure 2, and the plastic material is then removed from the surface of the pattern and locating holes D^1 are formed in the surface surrounding the cavity thus left.

Low temperature fusible metal D^2 is now applied to the upper surface of the pattern and the half mould so as to form the second half of a positive mould containing a cavity of the shape of the pattern and with locating projections D^3 cooperating with the holes D^1.

The pattern is now removed from the positive mould D, D^2 thus formed.

Each of the halves D and D^2 of the positive mould is now disposed with its operative moulding surface upwards and has low temperature fusible metal applied to it as indicated in Figures 4 and 5 respectively so as to form two negative half moulds E and E^1 in low temperature fusible metal.

The positive half moulds D and D^2 are now removed from the negative half moulds E and E^1 and the latter are turned over so that their shaped surfaces are exposed. Each of these surfaces is now coated with a layer F, F^1 of a hard metal, preferably nickel or chromium, by electrodeposition, as indicated in Figures 6 and 7, the backs of the half moulds E and E^1 being conveniently coated with wax or the like prior to this operation to prevent unwanted deposition thereon.

The exposed surface of each of the layers F and F^1 of hard metal now has applied to it, by spraying, a backing of a metal having a higher melting point than that of the metal of which the half moulds E and E^1 are formed as indicated at G and G^1 in Figures 8 and 9. Preferably the surface to receive the backing is shot-blasted except over the part forming the actual moulding cavity before applying the backing in order to key the backing to the hard metal layer.

Finally the fusible metal of which the half moulds E and E^1 are formed is removed by melting at a temperature below the melting point of the metal forming the backings G and G^1. This leaves a complete positive mould as indicated in Figure 10 each half of which consists of one of the hard metal layers or shells F and F^1 with its backing G or G^1.

The thickness of the layers F and F^1 may vary but in the example given a suitable thickness would be approximately 0.03 inch.

A mould made by the method above described can be completed in about 48 hours, a period which would have been substantially absorbed with the old method referred to above in the setting of the plaster in the first stage. In the method according to the invention above described each spraying of a half mould takes approximately 15 minutes, the longest step in the process being the application of the layers of hard metal by electro-deposition which, for a thickness of 0.03 at the rate of 0.001 per hour hour which is a usual rate, would take 30 hours. Further a mould made by the method according to the invention is much more durable than one made by the old method and may have a useful life ten or more times as great as one made by such old method. Further the forming of the various half moulds by metal spraying reduces the risk of blow holes or other imperfections affecting the perfection of the final product.

What I claim as my invention and desire to secure by Letters Patent is:

1. A method of forming a mould for casting which includes placing a pattern on and partly pressing it into a plastic substance mounted on a supporting surface, followed by applying a low temperature fusible relatively soft metal to the exposed surface of the pattern and the surrounding surfaces of the plastic substance and the support, removing the plastic substance from the pattern and the positive half mould thus formed in low temperature fusible relatively soft metal and applying to the exposed surface of the pattern and the surrounding surface of said positive half mould low temperature fusible relatively soft metal to form a second positive half mould in low temperature fusible relatively soft metal, removing the pattern from both halves of the "positive" mould thus formed, separately coating each half of this positive mould with a low temperature fusible relatively soft metal to form two corresponding "negative" half moulds in low temperature fusible relatively soft metal, separating these negative half moulds from the positive half moulds, electroplating the surface of each of said negative half moulds with a layer of relatively hard metal, applying to each of said layers of relatively hard metal a backing of a metal having a higher melting point than the low temperature fusible metal, and removing by melting the low temperature fusible relatively soft metal from the other surfaces of the relatively hard metal layers which will then with their backings together constitute a hollow positive mould from which can be produced multiple patterns in wax or other suitable substances.

2. A method for forming a mould for casting as set forth in claim 1 in which complementary shaped locating means are provided on the surfaces surrounding the pattern portions of the two halves of the positive mould formed in low temperature fusible relatively soft metal.

3. A method of forming a mould for casting as claimed in claim 2, in which the low temperature

fusible metal is applied by spraying, the backing metal is applied by spraying and the hard metal layer is applied by electro-deposition.

4. A method of forming a mould for casting as claimed in claim 1 in which the low temperature relatively soft fusible metal is applied in liquid form, the backing metal is applied by spraying and the relatively hard metal layer is applied by electro-deposition.

GEOFFREY WILLIAM PAGET.

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