Nov. 24, 1942. W. J. RAPHAEL 2,303,092

METHOD OF PREPARING METAL MOLDS

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Fig. 1

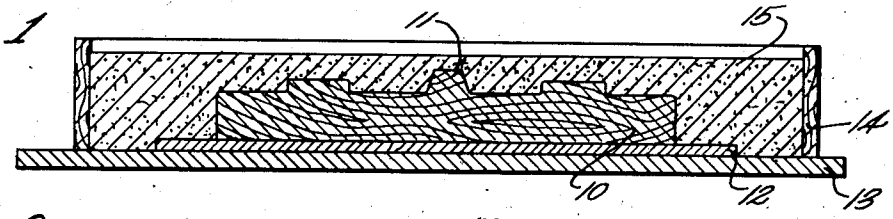


Fig. 2

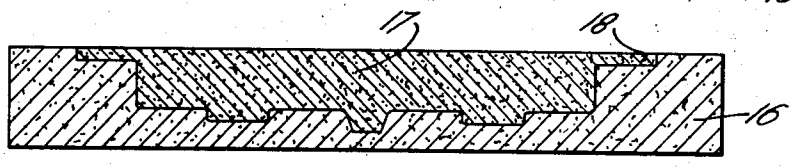


Fig. 3

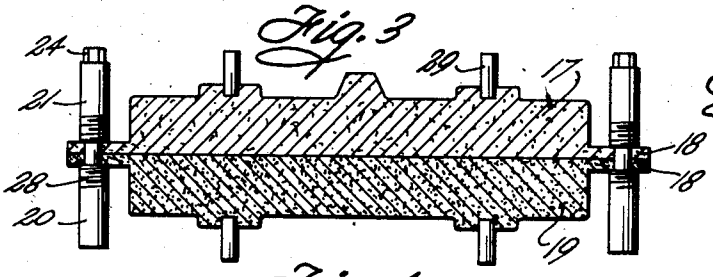


Fig. 4

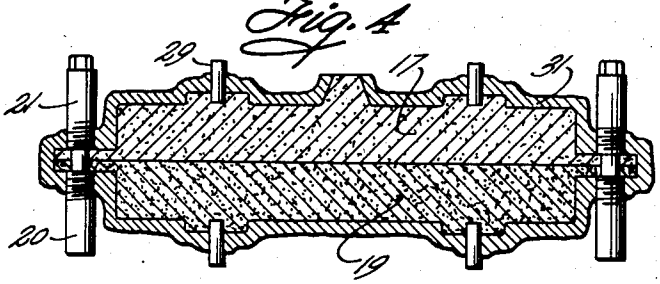


Fig. 5

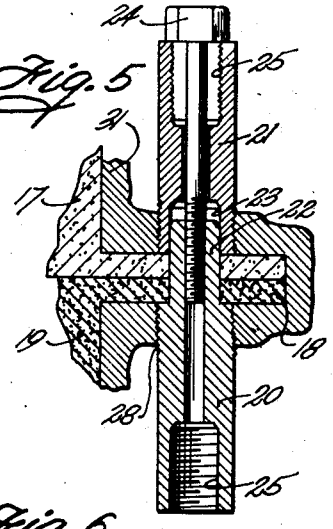


Fig. 6

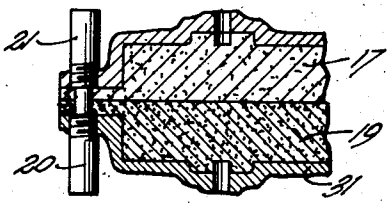


Fig. 8

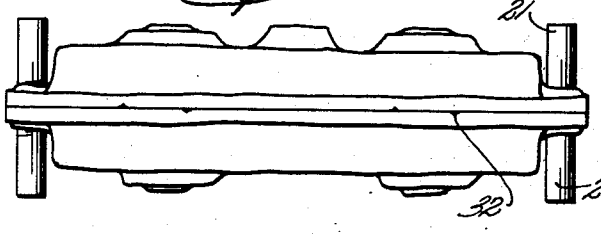


Fig. 7

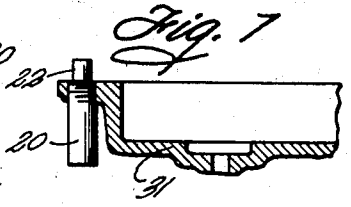
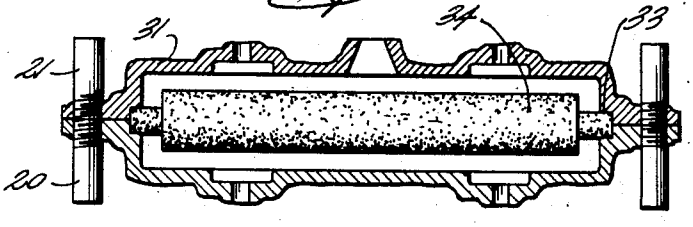


Fig. 9



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Fig. 10

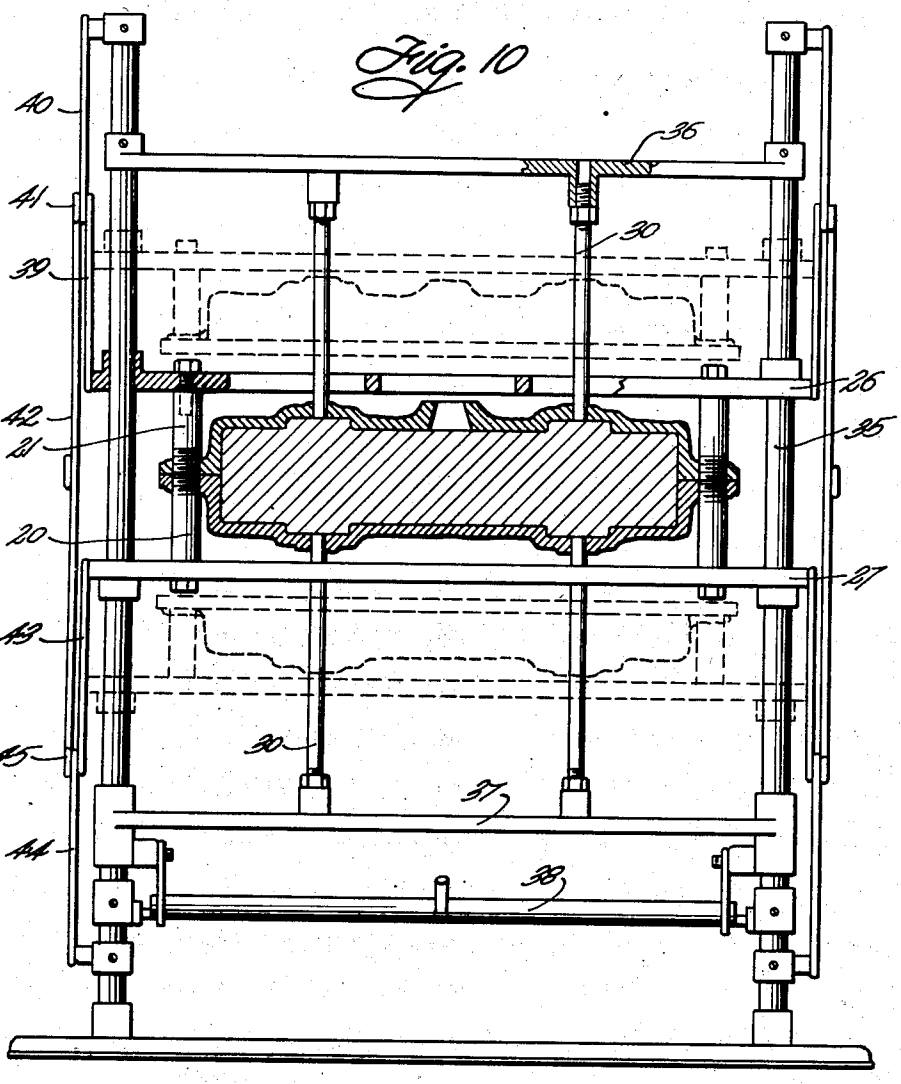
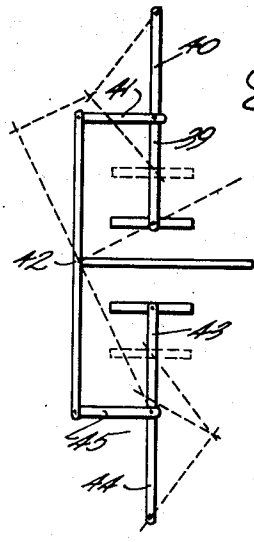


Fig. 11



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METHOD OF PREPARING METAL MOLDS

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Application August 4, 1941, Serial No. 405,317

9 Claims. (Cl. 22—193)

This invention relates to a method of preparing metal molds used for producing castings.

Heretofore metal molds have usually been produced by shaping the mold cavity in the sections of the mold by routing or milling out the mold cavity in a block of metal that forms a part of the mold. Such procedure usually requires considerable labor of a highly skilled type and involves the expenditure of a great amount of time. Sometimes the block of metal from which the mold section is to be formed is cast to approximate shape and then finished by routing or milling out the mold cavity to the desired formation.

An object of the present invention is to provide a new method for constructing the sections of a metal mold whereby the parts of the mold can be easily shaped to conform to the shape of the pattern or the casting that is to be produced.

More specifically, an object of the invention is to provide a method of preparing metal molds wherein the mold sections are produced by spraying molten metal around a pattern so as to coat the pattern with metal conforming on its interior to the pattern shape. It has long been desirable to be able to produce metal molds by spraying molten metal around a pattern, but heretofore attempts made in this direction have proven unsuccessful due to the fact that the sprayed-on metal either does not closely adhere to the pattern or it warps on cooling so that the mold sections do not accurately conform to the pattern shape because of warpage.

It is, therefore, another object of the invention to provide a method of producing metal molds by spraying molten metal over and around a pattern wherein the sprayed-on metal will be caused to closely adhere to the pattern so as to accurately conform to the pattern shape and warpage is effectively eliminated.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a sectional view illustrating one-half of an original pattern being employed to produce a negative pattern;

Fig. 2 is a sectional view illustrating the negative pattern being employed to produce a positive pattern half which is employed in the construction of the mold in accordance with the present process;

Fig. 3 is a sectional view illustrating the assembly of two positive pattern halves preparatory to the application of sprayed-on molten metal;

Fig. 4 is a sectional view illustrating the positive pattern halves as having been coated with metal applied thereto by spraying;

Fig. 5 is a partial view in vertical section illustrating the details of the construction of the fastening studs or inserts which are attached to the positive pattern and which become parts of the mold sections providing for their attachment to a suitable machine for supporting the mold sections;

Fig. 6 is a partial view in vertical section illustrating the manner in which the mold is divided or separated into its sections;

Fig. 7 is a partial view in vertical section illustrating a separated lower portion of the mold;

Fig. 8 is a view in side elevation of the completed mold, the sections of the mold being illustrated in abutting relationship;

Fig. 9 is a vertical section through a mold made in accordance with the present invention but illustrating the mold as having been slightly modified so as to receive a core;

Fig. 10 is a view in front elevation of a machine illustrating the mold made in accordance with the present invention as having been installed therein, the mold being illustrated in vertical section; and

Fig. 11 is a diagrammatic view in side elevation of the machine illustrated in Fig. 10, the positions capable of being assumed by the linkage connection being illustrated in full and in dotted lines.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, 10 indicates an original half of a pattern of the casting that is to be produced. This pattern may be of any desired configuration or shape and may be formed of wood, plaster, plastic, or other material conventionally employed for this purpose. In accordance with conventional pattern making practices the original pattern is divided usually into halves the upper half being illustrated at 10 and the bottom surface thereof being arranged on a plane that is to be coincident with the parting plane or parting surfaces of the mold.

The pattern 10 not only conforms to one-half or one portion of the finished casting but preferably has formed thereon a pattern portion 11 that is to provide the gate for the mold. If risers are to be present in the mold riser patterns are also formed on the upper pattern half 10 in a similar manner to the gate pattern portion 11. The pattern section, the gates, and

risers are all shaped with draft in the conventional manner.

The pattern 10 is positioned on a spacer pattern 12 which may consist of a flat plate or flat board or a plate whose surfaces conform to the parting line of the casting to be made which preferably projects outwardly beyond all portions of the pattern half 10. The spacer pattern 12 rests upon a suitable supporting surface or table 13. A flask 14 is positioned on the supporting surface 13 to surround the pattern half 10 and the spacer pattern 12. The pattern 10 and spacer pattern 12 are coated with oil or stearic acid or other separating material and the flask is then filled with a self-hardening plastic material 15 which may be a rubber composition, plaster of Paris, or any plastic such as for example a phenolic resin. When the material 15 has hardened or set around the original pattern half 10 it is removed from the flask 14 and the original pattern half 10 and the spacer pattern 12 are removed therefrom, thus producing a negative pattern 16 as illustrated in Fig. 2. The interior of this negative pattern is then coated with oil, stearic acid, or other separating medium, and a positive pattern 17 is produced therein by filling the cavity in the negative pattern with a self-hardening plastic material which may or may not be of the same character as that employed to make the negative pattern 16. The positive pattern 17 conforms in shape to the original pattern half 10 except that there is integral therewith a spacing portion 18 equal in thickness and of the same size and shape as the spacing pattern 12.

In Figs. 1 and 2, I have illustrated the construction of the positive pattern 17 corresponding to the upper half 10 of the original pattern, it being understood that the upper half of the original pattern is usually that which carries with it the gate or riser pattern portions 11. The lower half of the original pattern, not shown, is likewise employed to make a negative pattern corresponding to negative pattern 16 and from this negative pattern a positive pattern 19 is produced in a similar manner.

When these positive pattern halves are produced they are assembled together in abutting relationship as illustrated in Fig. 3. Their spacer portions 18 are apertured at suitable locations and fastening studs are applied thereto, the details of which are illustrated in Fig. 5.

The fastening studs comprise male and female parts 20 and 21, respectively, the male part 20 having a pilot 22 receivable in a socket 23 in the female part 21. The pilot 22 extends through the apertures formed in the projecting portions of the spacer portions 18 of the positive pattern halves and is internally threaded to receive a bolt 24 which fastens the parts together and thus hold the positive pattern halves in abutting relationship. The outer ends of the fastening studs are internally threaded as at 25 to provide for attachment to vertically movable mold section holders 26 and 27 as illustrated in Fig. 10. Each fastening stud adjacent its inner end is externally roughened as at 28 so that the sprayed-on metal that is to coat the positive pattern will firmly adhere thereto. The roughening may be accomplished by sandblasting or threading or grooving the exterior of the fastening studs with a dull threading or grooving lathe tool. Inserts 29 may be recessed in the positive pattern at suitable locations to provide cores through the walls of the mold which forms holes therethrough for the reception of ejector rods 30, see Fig. 10. With the positive mold thus constructed as illustrated in Fig. 3, those portions of the mold that are to be coated with sprayed-on metal are first coated with a composition that will tend to cause the sprayed-on metal to firmly adhere to the positive mold. I find that for this purpose one such composition that may be employed consists of one to two parts of flowers of sulphur and eighty parts of iron filings with sufficient water added to render the mixture a thin paste or paint that can be brushed on to the surfaces of the positive pattern that are to be sprayed with molten metal. Another composition that may be employed consists of ten parts of iron filings and three parts chloride of lime with sufficient water added to render the mixture a thin paste or paint that can be brushed onto the positive pattern. In some instances the composition may be mixed with the plaster that forms the positive pattern, or if desired, the entire positive pattern may be cast of said composition.

If the positive pattern is made of plaster of Paris it is desirable to thoroughly dry the positive pattern following its production. This may be dried in a baking oven or may be air dried if sufficient time is permissible for this method of drying. The application of the coating which tends to cause the sprayed-on metal to adhere to the pattern may take place before or after the drying of the pattern but if the coating is applied after the drying of the pattern it likewise should be dried before metal is sprayed onto the pattern. Those portions of the pattern that are not to be coated with the sprayed-on metal are masked. In other words, the projecting portions of the inserts 29 may be masked such as by cementing or tie wiring on asbestos sheet or the equivalent which will resist deterioration under the sprayed-on metal. The projecting portions of the fastening stud elements 20 and 21 are similarly protected by masking.

With the pattern thus completed a coating of metal is applied thereto as indicated at 31. This coating is applied by any conventional apparatus for metal spraying such as the oxy-acetylene torch method. The sprayed-on metal is applied so as to completely cover the positive pattern being applied to all exposed surfaces thereof and around the inserts 29 and around the bases or roughened portions 28 of the fastening studs 20 and 21. When the coating of metal 31 is applied entirely around the positive pattern it will be found that any tendency of warpage or for the coating to pull away from the positive pattern is effectively eliminated. If the external surface of the positive pattern has concavities I find that the coating applied to the pattern tends to cause the sprayed-on metal to firmly adhere to the positive pattern even in the concavities so that there is no tendency for the sprayed-on metal to shrink or retract from the concavities in the pattern. When the positive pattern sections have been completely coated with the sprayed-on metal the metal is then normalized to relieve all strains that may be developed during the spraying operation. This normalizing is usually done by heating the metal to approximately 1100° F. and then permitting it to slowly cool such as in a bed of lime.

When this step is completed the mold has the appearance as illustrated in Fig. 4, following which the edges of the mold surrounding the spacer portions 18 are removed as illustrated in

Fig. 6. The removal of these edge portions may be accomplished by grinding or cutting. If the metal has been applied over the gate or riser portions 11 of the positive pattern this metal is also removed so as to open the entrances to the gates and risers. Thus, by the removal of the edge portions the mold is divided into upper and lower sections constituting the cope and the drag of the mold. They may then be separated from each other and the positive pattern removed therefrom. Those portions of the mold sections that were formed by the spacer portions 18 provide the parting surfaces of the mold sections and when the mold sections are assembled together in abutting relationship as illustrated in Fig. 8, the cavities in the mold sections will then each accurately conform to the halves of the original pattern. If it is desired to vent the mold, small grooves may be cut or ground in the parting surfaces as illustrated at 32, and if vent holes are desired in the body portions of the mold sections these may be cut or drilled therein.

The thickness of the metal coating 31 may vary. However, for ordinary purposes this need not exceed one-quarter or three-eighths inch. The metal used for the coating may likewise vary depending upon the nature of the material that is to be cast. For example, if the casting is to be of aluminum, the initial spraying of the positive pattern may be performed with a chromium steel alloy and the balance of the coating 31 may be formed of low cost, low carbon steel so that the chromium steel alloy which forms a facing on the interior of the mold cavity will effectively resist any pitting effect of the molten aluminum. The coating 31 need not be formed, however, of a ferrous material. Bronze or other metals may be substituted therefor if desired, depending upon the nature of the material that is to form the casting.

In the event that the casting that is to be produced is to be cored, the pattern 10 is equipped with core prints which define portions of the mold indicated at 33 to receive portions of the core illustrated at 34 so that the core which may be a sand core or heat resistant plaster, is properly supported within the closed mold. Where the shape of the core permits, metal cores may be used in the conventional way.

With the mold thus completed it may be mounted within any suitable holder or a casting machine such as that illustrated in Fig. 10, wherein the lower mold section is fastened by means of its fastening studs to the lower holder 27 and the upper mold section is fastened by those fastening studs to the upper holder 26. These holders are movable toward and away from each other upon suitable vertical guides 35. Ejector rods 30 are suitably mounted on supports 36 and 37 and extend into the openings in the mold walls formed by the inserts 29, or holes which may have been drilled for the purpose. The lower ejector support 37 is vertically movable by means of links which connect it to an eccentric shaft 38. The upper mold support 26 is connected by means of links 39 and 40 to the top of the machine. Links 41 connect the pivotal connection between links 39 and 40 to an operating link 42. Similarly, the lower mold support is connected by means of links 43 and 44 to the bottom of the machine and links 45 connect the pivotal connection between these links to the operating link 42. As illustrated in Fig. 11, when the operating link 42 is swung from the full line position to the dotted line position, the mold sections are caused to simultaneously separate. When the operating link 42 is in the vertical position or full line position the mold sections are brought into abutting relationship in which position the molten material that is to be cast may be poured into the mold through the gate. The ends of the ejector rods 30 which are exposed on the interior of the mold chill the casting in the localities of their ends, and when the mold sections are separated they slide upwardly and downwardly respectively on these ejector rods so that when the molten material has been poured into the mold to form the casting and the mold sections are separated the ejector rods serve to support the casting between the separated mold sections. Thereafter, rotation of the eccentric shaft 38 produces a lowering of the lower ejector rods and permits withdrawal of the casting therebetween. Similar machines may be used which have the guides 35 set in a horizontal plane. This type of machine is adapted to be used thereon, molds having parting planes and gates or risers in a vertical plane rather than in the horizontal plane illustrated. It will also be understood that in making the mold in accordance with the present invention that it is not restricted to the use of patterns divided into two parts but patterns divided into additional parts may be used if desired. The nature of the mold and pattern to some extent will affect the type of machine used, that is whether the mold will be mounted on a machine which separates the mold vertically as shown, or horizontally.

While it is advantageous to employ a coating on the positive pattern to cause the sprayed-on metal to adhere to the surfaces of the pattern in some instances this coating may be omitted, particularly where the casting is small, provided that the sprayed-on metal completely surrounds the pattern. I find that if the sprayed-on metal is not applied entirely around the pattern the warpage of the metal on cooling brings about distortion so that the mold does not conform to the pattern. In some instances, the sprayed-on metal need not completely surround the pattern provided that it sufficiently overlaps an exposed side, but under these circumstances the employment of the coating of composition previously referred to is highly important in that it causes the metal to firmly adhere to the positive pattern.

While it is possible to dispense with making a negative pattern and a positive pattern therefrom, and instead use the original pattern 16 and the spacer pattern 12 in place of the positive pattern 17, I prefer to make the negative and positive patterns so that if difficulty is experienced in removing the positive pattern from the completed mold the original pattern is in no way defaced or mutilated. In some instances the making of the original pattern and the production of a negative pattern therefrom can be dispensed with. The negative pattern may be made as the original pattern and a positive pattern or print may be obtained directly therefrom. It is also possible to make the positive pattern sections not integral with the spacer 18. Thus positive pattern sections can be produced conforming in shape to the original pattern sections and these pattern sections may then be cemented to a separate spacer with silicate of soda or the like.

From the above-described method it will be appreciated that a novel, simple, and advantageous method of preparing metal molds has been provided which eliminates the costly procedure of

routing or milling out the shape of the casting in the mold. Molds produced in this manner can be caused to accurately conform in shape to that of the original pattern 10.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. The method of making metal molds having partings which includes applying pattern sections to the sides of spacer patterns, which sides are to define parting surfaces of the mold, forming negative patterns from the pattern sections and spacer patterns producing positive patterns from the negative patterns, positioning the positive patterns in opposition with their spacer portions disposed together, coating the positive patterns with metal, dividing the mold around the spacer portion, and removing the metal that projects beyond the parting surfaces of the mold sections defined by the spacer portions.

2. The method of making molds which includes incorporating in the surfaces of positive pattern sections a material containing metal filings which will cause sprayed-on metal to firmly adhere to the surfaces of said sections, and spraying the sections with molten metal.

3. The method of making molds which includes incorporating in the surfaces of positive pattern sections a material containing metal filings which will cause sprayed-on metal to firmly adhere to the surfaces of said sections, assembling said sections in spaced relationship, spraying metal over the sections and over the intervening space therebetween, and removing the metal between the pattern sections.

4. The method of making molds which includes incorporating in the surfaces of positive pattern sections a material containing metal filings which will cause sprayed-on metal to firmly adhere to the surfaces of said sections, assembling said sections in spaced relationship, spraying metal over the sections and over the intervening space therebetween, normalizing the sprayed-on metal, and removing the metal between the pattern sections.

5. The method of making molds which includes assembling in spaced relationship positive pattern sections on which metal may be sprayed, applying to said sections holding or supporting inserts, masking protruding portions of the supporting inserts, and spraying metal over the positive pattern sections and across the space therebetween, and finally removing the metal between the pattern sections leaving exposed portions of the inserts embedded in the sprayed-on metal.

6. The method of making molds which includes applying to the surfaces of positive pattern sections a material containing iron filings which will cause sprayed-on metal to firmly adhere to the surfaces of said sections, and spraying the sections with molten metal.

7. The method of making molds which includes applying to the surfaces of positive pattern sections a material composed mainly of iron filings and a small amount of flowers of sulphur to cause sprayed-on metal to firmly adhere to the surfaces of said sections, and spraying the sections with molten metal.

8. The method of making molds which includes applying to the surfaces of pattern sections a material composed mainly of iron filings and a small amount of chloride of lime which will cause sprayed-on metal to firmly adhere to the surfaces of said sections, and spraying the sections with molten metal.

9. The method of making molds which includes incorporating in the material from which a pattern is made iron filings so that the iron filings on the surface of the pattern will cause sprayed-on metal to firmly adhere to the surfaces of the pattern, and spraying the sections with molten metal.

WALTER J. RAPHAEL.