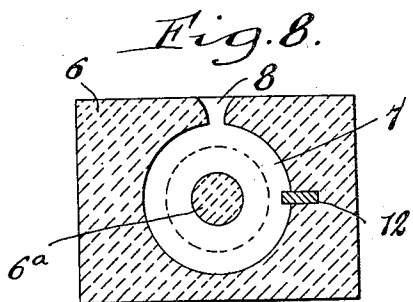
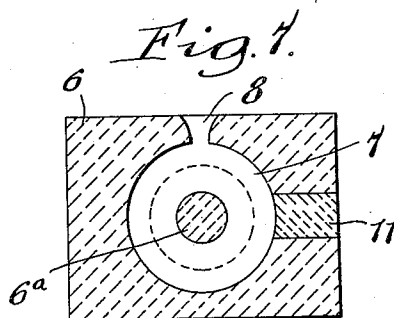
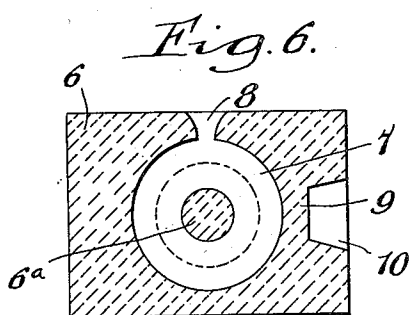
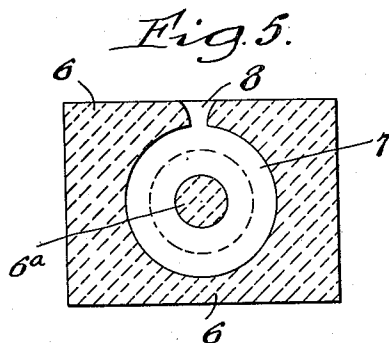
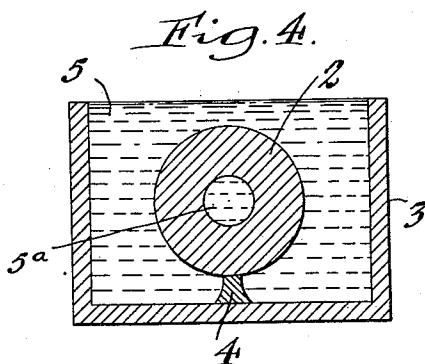
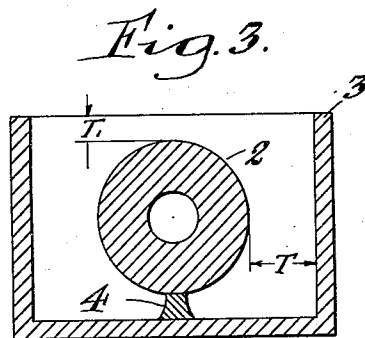
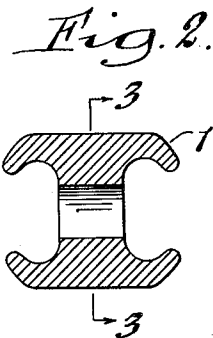
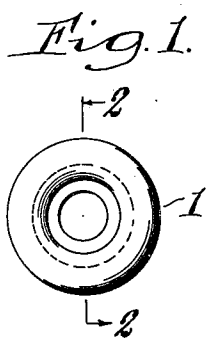


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METHOD OF MAKING MOLDS

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METHOD OF MAKING MOLDS

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This invention relates to a method of making molds for the casting of metal, plastics, fused refractories, and the like.

The invention has for its object the production of seamless molds or mold parts which conform exactly in shape to the pattern or model employed regardless of its intricacy. The mold of the present invention is simple and cheap to make; its porosity and consequently its heat conductivity can be predetermined within wide limits. The mold material after being used may be, if desired, reincorporated as a substantial proportion of new molds made in accordance with the present invention, thereby effecting a saving in the cost of materials as well as adding certain properties to molds which are desired in some cases.

In the prior art casting of metals, plastics, and fused refractories, various types of molds have been used. The so-called permanent mold, usually made of metal, must, except in the case of very simple shapes having no reentrant angles, be made in two or more parts to allow the withdrawal of the finished casting. This inevitably results in lines or ridges on the casting at the meeting plane of the mold parts. The removal of such lines or ridges from the casting entails considerable expense. In permanent molds for the casting of complex shapes numerous cores must be employed; this adds to the complexity and expense of the dies or molds. In the casting of art work such as ornamental designs, the dies must be made largely by the process of die sinking, which is an expensive process.

It is known in the art to use mold material initially plastic such as a slurry of clay, water, and a binder, which is cast about a pattern or model of the desired shape and then allowed to dry. The drying of such material takes a rather long time, however, and must be carefully done in order to avoid cracking or checking of the resulting mold. Such mold material is relatively impermeable and requires the provision of numerous venting means therein to allow the escape of air so that the material cast in such mold will be free from air bubbles and will faithfully conform to the contour of the mold. Such slurry, because of its large content of solid material, will not flow into small restricted spaces, and so will not reproduce accurately fine details of a model.

Sand molds, which are widely used in casting of metals, require the use of a pattern corresponding to the shape of each part cast. The preparation of sand molds for the casting of other than simple shapes requires the use of skilled labor, and because it is a relatively slow process, this contributes largely to the ultimate cost of the cast article. In the case of objects

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having holes or reentrant angles therein, pre-formed cores must be positioned accurately in the mold in order that the resulting mold cavity may have a shape corresponding to the shape of the object desired to be cast.

The method of making a mold of the present invention avoids the difficulties attendant upon the use of prior art methods of making molds. The materials from which the molds of the present invention are formed are initially liquid or are predominantly liquid with a suspension of finely divided material therein, so that they may be cast or poured into a container having a cavity or shape of the desired mold. Being liquid, they will flow in such manner as completely to fill the container cavity regardless of its complexity of shape. The initially liquid mixture of mold forming ingredients is formed at, or substantially near, room temperature and so the container into which it is poured and any insert or pattern in it may be composed of, among other things, low melting point materials which may be easily shaped and fashioned by hand.

Molds made in accordance with the present invention contain only carbon, or carbon and a highly refractory loading material such as alumina. In either case they contain no foreign binder whatsoever. Since carbon has no known melting or softening point, almost any pourable melt regardless of temperature may be cast into such molds. The mold material of the present invention is distinctive in that a substantial amount of it is composed of carbon in a continuous but reticular and skeleton structure. It is to be understood that molds or mold parts made in accordance with the present invention may be composed wholly of such continuous but reticular and skeleton form of carbon, made in the manner set out below, or that they may be composed of other refractory material such as finely divided carbon or alumina, substantially uniformly distributed throughout the mold or mold part, and held in place by a substantial amount of carbon in the continuous skeletal form. The finely divided carbon or other refractory material may be derived from crushed used molds made in accordance with the present invention.

The continuous skeletal carbon is made by reacting certain kinds of carbonaceous liquids with a proper reagent whereby the carbonaceous liquid releases carbon in such a manner that it entirely and uniformly fills the container with a porous skeletal form of carbon. Not all carbonaceous liquids are suitable for this purpose. In the most of them, the carbon, when released, is precipitated as a sludge which sinks to the bottom of the residue liquid. A carbonaceous liquid admirably suited for the purpose of producing the desired form of carbon is furfural or

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some of its derivatives such as, for example, furfuryl alcohol. Mixtures of furfural and furfuryl alcohol may also be employed. Many of the mineral acids will release the carbon from the furfural compounds, among them being hydrochloric and sulphuric acids.

When hydrochloric acid or sulphuric acid is mixed with furfural, furfuryl alcohol, or a mixture of the two, the liberation of carbon commences at once, proceeding slowly to completion in a period ranging from 10 minutes or less to many hours depending upon the ratio of the acid content to the furfural compound content. This feature conveniently allows adequate time for mixing, stirring and pouring before the congealing action has progressed beyond the "ink" stage.

The instant furfural compound and the acid are stirred together, an "ink" is formed by simultaneous release of atomic carbon in every portion of the mix. Subsequent action proceeds somewhat more slowly and operates to increase the size of and to knit together the "ink" aggregates produced during the primary reaction. During this stage of the reaction the carbon appears to "grow," much as a tremendously accelerated vegetable growth might be expected to proceed. In this manner a self-supporting carbon structure occupying the total volume of the liquid is built up, so that when the action is complete the resultant product may be likened to a wet sponge of the desired shape in which the sponge is analogous to the carbon body and the wetness to the residue of hydrochloric acid and/or furfural compound.

The wet carbon shape is dried at a temperature high enough to drive off all moisture and other volatile matter. The shrinkage during this step is uniform in all directions and relatively small, varying slightly for different mix ratios. By the reaction above described between furfural compounds and acids, bodies consisting of 100% carbon may be produced having any desired structure varying from one imperviously dense to one having such porosity that only 5% of the total volume is carbon and 95% is air. In general, density increases with an increase in the proportion of the furfural compound in the mix.

As set out above, the mold may if desired consist of such skeletal carbon and a finely divided loading material. When the mold is to consist of material such as finely divided carbon incorporated in the network of the skeletal carbon derived from a furfural compound, such finely divided material is mixed with either the furfural compound or the acid. The loading should be in such fine state of sub-division that it does not settle appreciably before sufficient reaction has taken place between the furfural compound and the acid, after the two have been mixed together, to hold the finely divided material in place. This insures that such material will be uniformly distributed throughout the mold. Besides carbon, other solid or liquid materials may be used as a loading, for instance, finely divided alumina or glycerine. The latter adds toughness to the carbon derived from the furfural compound, which, in the case of mixtures employing relatively small amounts of furfural compound, are otherwise rather delicate and require careful handling.

It has been indicated above that, by the proper choice of the ratio of the furfural compound to acid in the mixture, a mold having any desired porosity from one imperviously dense to one having such porosity that only 5% of the total vol-

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ume is carbon and 95% is air, may be produced. The more porous the mold the better heat insulator it is. In accordance with the present invention therefore, molds having a predetermined heat conductivity or, conversely, chilling rate may be produced. The porosity of the mold which will result from any given ratio of furfural compound to acid can be ascertained very accurately and can always be exactly reproduced. Thus the present invention affords an easy means of obtaining castings, both metallic and non-metallic, having predetermined properties as a result of subjecting them to a predetermined rate of cooling after casting.

To aid in the comprehension of the invention, the following examples of typical methods of making molds are given. These examples are illustrative only; it is to be understood that the scope of the invention is defined by the appended claims.

Example I

A mold suitable for the casting therein of molten metal or cast refractory is made by stirring together:

	Cc.
Furfural	25
Hydrochloric acid	75

Such a mixture is then poured into a container having a cavity with the shape of the desired carbon mold. Reaction between the furfural and the hydrochloric acid to form the carbon structure comprising the mold to be made is completed after several hours. The wet carbon mold is then removed from the container in which it was formed and is ready for calcining, but may be stored for any length of time prior to calcining. The calcining step consists of heating the body in a neutral atmosphere at a temperature high enough to drive off substantially all moisture and other volatile material. A temperature of 1200° F. has been found sufficient to accomplish such result.

Example II

Loadings of materials such as finely ground carbon, for instance, ground used molds of the present invention and/or glycerine may be included in the mixture of the furfural compound and an acid for the purpose of obtaining modified characteristics in the resulting mold. A typical mix of this character consists of:

Furfural	cubic centimeters	33
Hydrochloric acid	do.	67
Finely ground carbon	grams	35
Glycerine	do.	30

The finely ground carbon and the glycerine are, in this example, thoroughly mixed with the hydrochloric acid. Such mixture is then mixed with furfural, the material thoroughly stirred, and then poured into a container having a desired shape of cavity. The remainder of the procedure is the same as that in Example I. The furfural employed in Examples I, II, III, and IV, is the ordinary commercial furfural. The concentration of the hydrochloric acid is not critical. In Examples I, II, and IV, however, the hydrochloric acid is ordinary commercial concentrated hydrochloric acid containing about 35% HCl.

Example III

Sulphuric acid may be employed to free carbon from furfural, furfuryl alcohol, or mixtures there-

of. A typical example of the use of sulphuric acid in such reaction employs a mixture of:

Furfural.....	cubic centimeters..	40
Dilute sulphuric acid.....	do.....	60
Finely divided carbon.....	grams.....	20

The sulphuric acid employed consists of 60% water and 40% commercial concentrated sulphuric acid by volume. The carbon is mixed with the furfural, and the resulting mixture is in turn mixed with the sulphuric acid. After being thoroughly stirred, the mixture is poured into a container with a desired shape of cavity and the setting and drying procedure outlined in Examples I and II followed thereafter.

Example IV

A typical example of a relatively dense mold is made by use of a mixture of:

Furfural.....	cubic centimeters..	88
Hydrochloric acid.....	do.....	20
Finely divided graphite.....	grams.....	60

The graphite may be mixed with either the furfural or the hydrochloric acid and such resulting mixture is in turn mixed with the other component. After the mixture of furfural, hydrochloric acid, and graphite has been thoroughly stirred, it is poured into a container with the desired shape of cavity and the setting and drying procedure outlined in Examples I and II followed thereafter.

The mixtures employed in Examples I, II, and III yield structures which are of medium porosity but of successively increasing densities, that is, the mold obtained from the mixture in Example II is more dense than that obtained in Example I, and that yielded by the mixture in Example III is more dense than that resulting from Example II. The structures of the mold obtained from Examples I, II, and III are all sufficiently pervious to the passage of air so that no special air vents need be provided to prevent "air locks" while casting intricate shapes. The mixture set out in Example IV yields a structure of great density and refractoriness. Such a structure may require air vents at points of greatest likelihood of "air locking" while casting intricate shapes.

As has been stated above, instead of furfural, furfuryl alcohol or a mixture of furfural and furfuryl alcohol may be used in this and similar reactions. In general for slow setting mixes, furfural alone is used. When furfuryl alcohol alone is used, the reaction is very rapid and hard to control and the acid must be used in diluted concentrations. For rapid setting mixes, a mixture of furfural and 4% furfuryl alcohol has been found to work very well. However, any desired proportion of furfuryl alcohol may be used with furfural to obtain the desired results.

In order that the procedure followed in making molds according to the present invention may be better comprehended, reference is made to the accompanying drawing in which

Figure 1 is an end view of a typical body which may be cast in a mold of the present invention.

Figure 2 is a view in cross-section of the article shown in Figure 1, the section being taken on the line 2-2.

Figure 3 is a view in cross-section of a container having a replica or positive of the article shown in Figures 1 and 2 positioned therein.

Figure 4 is a similar cross-sectional view of the container, there having been a mixture of mold forming ingredients poured into the container.

Figure 5 is a view in cross-section of a mold of the present invention after the container and the positive have been removed therefrom.

Figure 6 is a cross-sectional view of a modification of the mold shown in Figure 5.

Figure 7 is a view in cross-section of a modification of the mold shown in Figure 5.

Figure 8 is a view in cross-section of still another modification of the mold shown in Figure 5.

The object shown in Figures 1 and 2 and designated by the reference character 1 is a shape chosen at random. Because of its complexity, with the hole through the axis and the overhanging round lips or ears at its ends, the casting of it either in a permanent or sand mold would require the mold to be split and to have a rather involved system of cores. For purposes of illustration, the object shown in Figures 1 and 2, positives or replicas of it, and carbon molds for casting such shape, are illustrated and described throughout the specification. However, it is to be understood that a mold for casting any desired shape whatsoever may be made in accordance with the present invention.

In carrying out the present invention, the object to be cast is reproduced in any suitable material, such reproduction being designated as a positive. For ease of removal of the positive from the carbon mold after the latter is formed, it is preferably made of material which may be melted or dissolved by treatments which leave the carbon mold uninjured. In a typical procedure, the positive is preferably made from a wax. Such wax is most suitably one which is rigid but not brittle under widely varying climatic temperatures, and which has a melting point preferably below the boiling point of water. Such positive may be made by any suitable means known to the art; in mass production the positives may be formed in quantities with the aid of inexpensive auxiliary tools and, where retouching or decorative effects are to be added, this can be readily done by relatively unskilled workers.

A positive, shown as 2 in Figure 3, having been formed of the article 1, such positive is placed in a container 3 in a suitable position. As shown, it is supported by a small wax stem 4 which is attached to the positive as by dipping the stem 4 in hot wax and quickly pressing it onto positive 2. Stem 4, which in the modification shown also serves to form a pour hole in the mold, is attached to the container 3, also in such manner as by being heated and pressed against the container. The only requirement made of container 3, aside from its being of suitable size and shape to yield carbon mold walls of the desired shape and thickness, is that it be substantially liquid tight. It may be made of wax, wax coated cardboard, wax coated sheet metal or the like. The dimensions T and T' illustrate the thicknesses of the subsequent mold wall at the points designated, that is, T' is the difference in height between the assembly of the positive 2 and stem 4 and the inner wall of the container 3, and will be the minimum thickness of the bottom of the carbon mold to be produced, and T represents the thickness of the side walls of the mold to be produced. The container 3 is now ready for the introduction of the desired mold mixture of a furfural compound and an acid according to the present invention.

Although the drawing shows the above procedure as applied to the production of a mold having but one mold cavity, it is evident that container 3 may be made relatively long and/or wide,

and may contain a multiplicity of assemblies of positives on supporting stems. Moreover, the stems of the various positives may be interconnected to yield in the finished mold a common duct and a single pour hole for the resulting "gang" mold. It is also evident that all positives employed in the one container in the formation of a "gang" mold need not be of similar shape, but may be of a variety of shapes and sizes so that the resulting carbon mold will yield a variety of different cast objects.

The positive 2 and supporting stem 4 become, in effect, after being mounted in container 3, a part of the container. The open space in the container between its side and bottom walls and the positive and its supporting stem defines a cavity which corresponds exactly to the shape of the carbon mold to be produced. In some cases, particularly where mold parts are to be made, it may not be necessary to employ a positive in the container, the container walls being so shaped that a cavity of the desired shape is produced. It is therefore to be understood that, when the cavity in the container is spoken of, it means the free space within the container, said space being between the container walls, if no positive is used, or between the container walls and a positive if a positive is employed in the container.

Figure 4 shows the container 3 after a mold producing mixture 5 has been poured therein. Mixture 5 flows about and intimately contacts positive 2 on every exposed area thereof. It also flows into the hole in the positive as shown at 5a in Figure 4. As has been explained before, the porosity of the resulting carbon mold can be accurately predetermined by the use of a suitable ratio of furfural compound to the acid in the mixture. A mixture having a low ratio of furfural relative to the acid content yields a relatively porous mold having high thermal insulating properties, and a high ratio mix, that is, one in which the furfural compound is comparatively high relative to the acid content, yields a relatively dense mold having greater thermal conductivity. The volume of the mix batch used is approximately the difference of volume capacity of container 3 and the sum of the volumes of all the positives plus the supporting stems which are installed therein.

After the mixture has been poured into the container 3, it is allowed to stand until the reaction has proceeded sufficiently so that the resulting carbon mold body 6 may be handled. Mold 6, which conforms perfectly to the shape of the cavity in the container before mixture 5 was poured therein, has a core 6a therein resulting from the mixture at 5a. Container 3 is then removed, and the still wet carbon mold 6 resulting from the reaction of the mixture 5 is treated to remove the positive 2 therefrom. When the positive is made of wax, mold 6 may be boiled for a short time in water. This operation completely melts the wax positive, the liquid wax floating to the surface of the water where it can readily be recovered for reuse.

The cavity 7 left in mold 6 by removal of the positive is an accurate, seamless negative of the positive 2, regardless of the intricacy of design or complexity of contour of the positive 2.

As was indicated above, positive 2 need not be made of wax. In some cases it may be desired to form it of such water soluble substance as sugar, and in others from low melting point metal such as Wood's metal. The Wood's metal may, of course, be likewise removed by boiling the mold

in water, and the positive made of sugar may be removed by dissolving it in water or other suitable solvent.

Mold 6 is dried and calcined in the manner previously described, and is then ready for the casting of any desired melt into cavity 7 through the pour hole 8. Almost any known melt may be cast into such mold, since the mold is composed of pure carbon with no binder, or of such carbon with included highly refractory material. It is immune to any temperatures found in the art of casting; hence the highest temperature melts such as molten alumina may be cast into such molds as readily as melts of metals or alloys such as iron or bronze.

In the procedure above set out, the entire mold 6, being formed from one uniform mixture of mold forming ingredients, will be of substantially identical structure in every zone thereof. Consequently, except by reason of different mold wall thickness, cooling of the casting made in such carbon mold 6 will take place uniformly. In some cases, however, it may be desired that the casting resulting from casting metal, a fused refractory, or a plastic in the carbon mold of the present invention shall be cooled in some locations at a rate different from that in other locations. This may be accomplished in various ways.

In cases in which the zones in which the desired temperature rates of cooling occur in strata located uniformly at different heights, the carbon mold producing such castings may be made by first pouring into the container 3 a predetermined amount of a specific mixture of furfural compound and acid which will fill the container to a predetermined height and which will yield a carbon body having a known degree of porosity. When the carbon body resulting from such mixture has set sufficiently to be self-sustaining, but is still soft and moist, an additional predetermined amount of a different mixture of furfural compound and acid may be poured into container 3. This will yield an upper zone in the carbon mold which has a different degree of porosity from the lower first poured one. Because the second mixture contacts the carbon body resulting from the first mixture while it is still moist and soft, a joining of the two mold portions results so that they are integral and differ only as to the porosity. Obviously such procedure can be repeated as many times as desired, yielding a mold with any new desired number of strata having different porosity and consequently different rates of thermal conductivity.

In cases in which the locations at which it is desired to cool the metal, refractory, or the like casting at a rate different from the rate of cooling of the rest of the casting do not occur in uniformly located horizontal zones, other procedures such as illustrated in Figures 6 and 7 are resorted to.

In Figure 6 there is illustrated a mold which has a variation in wall thickness for the purpose of inducing more rapid cooling at predetermined areas of the casting than at others. As shown in Figures 6, mold 6 has a mold wall 9 which is thinner than the mold wall at other locations. Such thin mold wall position or positions may be made by attaching to the inner wall of the container 3 a wax positive of the cavity 10, shown in the side wall of the mold in Figure 6. This will yield a mold having the relatively thin wall at point 9. Consequently the casting made in mold 6 will cool more rapidly in the location opposite mold wall 9 than it will elsewhere.

In Figure 7 there is illustrated another method of producing a mold which will yield localized different rates of cooling. In this modification instead of varying the mold wall thickness, the mold wall density is changed. The mold shown in Figure 7 is made in the manner generally similar to that previously described in connection with Figure 6. There is provided, however, in this modification, a slug of wax in container 3 pressing upon but not attached to positive 2 and attached to the wall of container 3. A furfural-acid mixture such that it produces a body of the density desired for the larger part of the mold is then poured into container 3 and allowed to congeal. After the resulting carbon mold has set sufficiently to be self-sustaining, container 3 is removed and the wax slug previously described is withdrawn from the carbon mold. This leaves a cavity in the carbon mold open at the outer wall of the mold and closed by positive 2 at the inner end. The mold is then turned so that the cavity resulting from withdrawal of the wax slug faces upwardly. A furfural-acid mixture to produce a carbon body having a predetermined density, which may be either greater or less than that of the rest of the carbon mold, is then poured into such cavity in the carbon mold. The resulting carbon is shown at 11 in Figure 7. Upon completion of the congealing action of such second poured mix, the main mold body 6 and mold portion 11 will be integrally united. Cooling of the casting produced in such mold at a point opposite mold part 11 will be more rapid or less rapid than that of the casting of the other portions depending upon the chosen porosity of mold portion 11. As many portions 11 as are desired may be provided in the mold.

-It is obvious that this method will be varied by first forming mold portion 11 of a predetermined shape and porosity, positioning it in the desired relation to positive 2 in container 3, and, while it is still soft and moist, pouring about it a furfural-acid mixture such that the main body portion of the mold will have the desired rate of cooling.

It may be desired to incorporate in a particular place in the casting, made in the carbon mold, an insert of a different material from the material cast in such mold. In Figure 8 there is shown such insert 12, which in this instance is one which extends both into and outside the casting. This insert is incorporated in the casting by the simple expedient of introducing it into the wax positive in the desired location and to the desired depth in the positive. Upon pouring the furfural-acid mixture, allowing it to congeal, and removing the container 3 and positive 2 in the manner above described, there will be produced a mold such as shown in Figure 8 with insert 12 attached thereto. Upon pouring the desired material into the mold shown in Figure 8, insert 12 will become incorporated with the resulting casting to the extent to which it extends into the cavity in such mold and will protrude from such casting to the extent to which it is embedded in the carbon mold.

Cooling of castings of molten materials may be accomplished when any one of the molds of the present invention is employed merely by contact of such mold with the atmosphere, by such means as a liquid or fluid jet, or by dipping the entire mold with the included casting in a fluid bath. After the casting has been cooled sufficiently to be handled, the carbon mold may be removed as by tapping with a hammer.

If desired, however, in the case of the higher

melting point materials such as metals and refractories, the mold may be removed merely by allowing it to burn away spontaneously, after it has become ignited by the melt. Such burning away proceeds from the outside of the mold since the inner surface of the mold, being in contact with the casting, has no access to air. Such burning proceeding as it does from the outside of the mold does not affect the shape of the casting which solidifies before the burning has reached the inner wall of the mold, but it retards cooling or chilling of the casting to a degree depending upon the initial wall thickness and density of the mold. Such retardation of the cooling rate is accurately controllable within time periods ranging from less than one hour to several days. It is evident then that this expedient may be used to advantage as an automatic annealing means for casting shapes of high melting point materials such as metals and refractories.

It is to be understood that whereas the production of complete seamless molds in accordance with the present invention has been described above, the method is useful when molds having two or more parts are to be made. In such cases the mold parts are made separately in the manner described and are held together by various conventional means when assembled to form a mold. Such mold will exhibit the advantages of the integral one piece mold except for the fact that means for holding the mold parts together must be provided and that markings may be produced on the casting made therein along the line or lines of juncture of the mold parts.

Having thus fully described the invention it is desired to claim:

1. The method of making molds or mold parts for casting fluid material therein, which mold or mold part is composed principally of carbon, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises reacting in a container having a cavity of a shape conforming to the desired carbon mold or mold part a mixture with an acid of a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, and, after such furfural compound-acid mixture has reacted sufficiently to form a self-sustaining mold or mold part consisting principally of carbon, removing such carbon mold or mold part from the container.

2. The method of making molds or mold parts for the casting of metals, fused refractories, plastics and the like, which mold or mold part is composed principally of carbon substantially uniformly distributed throughout each zone of said mold or mold part, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises reacting in a container having a cavity of a shape conforming to the desired carbon mold or part a mixture with an acid of a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, and, after such furfural compound-acid mixture has reacted sufficiently to form a self-sustaining mold or mold part consisting principally of carbon, removing such carbon mold or mold part from the container.

3. The method of making molds for the casting of metals, fused refractories, plastics and the like, such mold being composed principally of carbon substantially uniformly distributed throughout each zone of said mold at least a substantial amount of said carbon being in the form

of a continuous skeletal structure, which comprises reacting with an acid a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, in a container having a cavity therein of the shape of the desired carbon mold, the acid or the furfural compound or both containing prior to their mixing a substantial amount of finely divided loading material, and, after the carbon mold resulting from such reaction has become self-sustaining, removing it from the container.

4. The method of making molds for the casting of metals, fused refractories, plastics and the like, such molds being composed principally of carbon substantially uniformly distributed throughout each zone of the said mold, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises preparing a container having a cavity therein of the shape of the desired carbon mold, the container having a positive therein of a material having a low melting point, causing to react in such first mentioned mold a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, with an acid, allowing the reaction to proceed until the carbon mold resulting therefrom is self-sustaining, removing the container, and positive from the mold and calcining the resulting carbon mold to drive off moisture and substantially all volatile materials.

5. The method of making molds for the casting of metals, fused refractories, plastics, and the like, such molds being composed principally of carbon distributed substantially uniformly throughout each zone of the mold, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises reacting with an acid a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, in a container having therein a positive composed of a material having a low melting point, allowing the reaction to proceed until the resulting carbon mold is at least self-sustaining, removing the container from the mold, placing the mold in a liquid having a boiling point above the melting point of the material of which the positive is made, and heating such liquid whereby the positive melts and is thus removed from the carbon mold.

6. The method of making molds for the casting of metals, fused refractories, plastics and the like, such molds being composed principally of carbon disposed substantially uniformly in each portion of the mold, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises allowing to react in a container having a cavity of the shape of the desired carbon mold a predetermined amount of a mixture of a substance selected from the group consisting of furfural, furfuryl alcohol and a mixture of furfural and furfuryl alcohol, with a predetermined amount of an acid, allowing the reaction to proceed until the carbon body resulting from such reaction has become self-sustaining but is still moist, then pouring into the container into contact with the moist carbon body, a predetermined amount of such a mixture of one of the following group: furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, with an acid that the carbon body resulting from such second reaction has a different

density from that resulting from the first mentioned reaction.

7. The method of making molds for the casting of metals, fused refractories, plastics and the like, such molds being composed principally of carbon which is distributed substantially uniformly throughout each zone of the mold, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises preparing a container having a cavity of the shape of the desired carbon mold, said container being provided in each location in the cavity where it is desired that the carbon mold shall have a density different from that of the rest of the carbon mold with a core filling a substantial part of the cavity of the container at such location, reacting with an acid a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol in the first mentioned mold, allowing the carbon body resulting from such reaction to become self-sustaining, but, while it is still moist, removing each core from the container, and pouring into each cavity in the carbon mold resulting from removal each of the cores and allowing to react such a mixture of one of the following group: furfural, furfuryl alcohol and a mixture of furfural and furfuryl alcohol with an acid, that the carbon body resulting from the second reaction has a different density from that resulting from the first reaction.

8. The method of making molds for the casting of metals, fused refractories, plastics and the like, such molds being composed principally of carbon, the carbon in each zone being distributed substantially uniformly therein, at least a substantial amount of said carbon being in the form of a continuous skeletal structure, which comprises forming a container having a cavity of a shape corresponding to the shape of the desired carbon mold, forming at least one insert composed principally of carbon by reacting with an acid a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, in suitably shaped containers allowing the reaction to proceed until the insert has become self-sustaining but is still moist, removing such insert or inserts from their containers placing such insert in the desired position in the first mentioned container and pouring into the container such a mixture of one of the following group: furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol, with an acid that the carbon mold resulting therefrom has a density different from that of the carbon insert, allowing the second reaction to proceed to such a point that the resulting body is self-sustaining, and removing the carbon mold from the container.

9. The method of making molds or mold parts for casting fluid material therein, which mold or mold part is composed principally of carbon a substantial amount of which is in the form of a continuous skeletal structure, which method comprises reacting with an acid a substance selected from the group consisting of furfural, furfuryl alcohol, and a mixture of furfural and furfuryl alcohol in a container having therein a positive composed of a substance having a low melting point, allowing the reaction to proceed until the resulting carbon mold is at least self-sustaining, and melting the positive and removing it from the carbon mold.

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