

UNITED STATES PATENT OFFICE

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FOUNDRY CORE

No Drawing.

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The present invention relates to foundry cores and molds which are employed for the casting of metals and alloys, and which ordinarily are made of sand, or other comminuted refractory material bonded by means of an adhesive material.

While the greatest benefits of my invention are obtainable in the fabrication of foundry metal casting cores, some of its benefits can be obtained in the fabrication of foundry external molds, particularly in the treatment of mold surfaces which come into contact with molten metal. For the sake of brevity I will use the term "cores" generally herein to indicate external as well as internal members employed in the casting of metals.

A core for metal casting purposes must withstand the erosive or cutting action of the molten metal which is being cast and must hold together during the casting operation for a sufficient length of time to permit the molten metal to acquire a set. On the other hand, an ideal core should disintegrate after the metal has been cast so as to be readily removable from the solidified cast metal object.

Two classes of core bonds which have been employed in common practice may be conveniently classified as non-heat-hardening and heat-hardening. Linseed oil is an example of a common non-heat-hardening bond. Rosin and other natural resins also have been used as core bond and belong to this class. Linseed oil bonded cores are baked to accelerate their hardening by oxidation but this is not heat-hardening in the sense that the term is used herein. Clay is an example of a common heat-hardening binder. It becomes brick-like when subjected to the heat of the cast metal.

Cores bonded by means of a non-heat-hardening bond or adhesive do not well withstand the erosive or cutting effect of molten metal, such as steel or iron. As a consequence serious defects are present in the finished casting due to the local disintegration of the core and imbedding of core material in pockets in the casting adjacent the core. The sand, or other core material, also adheres to and becomes im-

bedded in the entire surface of contact of the cast metal and the core. In many cases expensive chipping of the casting and filling in of cavities by local deposition of fused metal is required. An organic carbonizable core bond consisting of such material as linseed oil leaves a hard carbon residue in the sand and hence the carbonized core is removable only with great difficulty. Unless the cross-section of the core is so small that the carbon is more or less burned out, it must be chipped or broken out of the casting. Its adherence to the casting makes cleaning of the casting very laborious and expensive.

In the case of some castings, particularly large castings, an inorganic heat-hardening bonding agent such as clay has been found necessary to impart sufficient strength to the core employed. While cores so bonded better withstand the erosive effect of hot metal, they become hardened by heat into a very hard, brick-like material which is removable only with extreme difficulty from castings. Power drills are required in most cases to remove such a brick-like material.

In accordance with my invention foundry cores to be employed in the casting of metals are bonded with an organic heat-hardening material which at the temperature of the molten metal is decomposed. Such a bond forms a hard, erosive-resisting body which is capable of maintaining its strength and coherence during the initial period of the casting operation or until the molten metal has filled the mold and taken the initial set. Thereafter, as it is subjected to the high temperature of the hot casting metal, it becomes disintegrated by thermal decomposition and evaporation of the bond, leaving the sand or other core body in a loose, pulverulent condition, making removal of the core from the finished casting an easy operation. Examples of such a bonding material are compositions of the alkyd resin class, that is a material constituted of the reaction product of a polyhydric alcohol and a polybasic acid, with or without other reacting ingredients. The bonding agent preferably is employed in solution as hereinafter described.

The preferred embodiment of my invention

includes foundry cores bonded with a resin comprising a polyhydric alcohol, such as glycerine, and a vaporizable resin-forming acid, such as phthalic acid or its anhydride. chemical modifying constituents which facilitate the distribution or wetting of the bond in the sand or other core material also may be present, as for example monobasic acids such as the acids derived from vegetable oils, and in particular the acids derived from castor oil or linseed oil.

In some cases an alkyd resin may be employed as a bond in which rosin, or other natural resin, is substituted for a part of the organic acid ingredient. A vegetable oil, such as Chinawood oil, may in part replace the acids derived from a drying oil in the resin composition. Other alcohols may be used in place of glycerine, either polyhydric or monohydric. For example, ethylene glycol may be substituted for part of the glycerine. In some cases, a resin may be prepared suitable for the purposes of my invention by combining or associating a vegetable oil with a resin made from a polyhydric alcohol and a polybasic acid, as described for example, in U. S. Patent 1,739,447 issued Dec. 10, 1929.

In the preparation of foundry cores embodying my invention a suitable core material, such as sand, zirconia, alumina, or the like, is mixed with an alkyd resin in suitable proportions, the resin preferably being in solution, the mixture then being formed into cores by known methods, and baked to produce an initial set of the bond. I have used successfully a resinous composition made up as described in British Patent 284,349 accepted Sept. 20, 1928, replacing in part the drying oil acid entering into composition described in this patent with Chinawood oil, using if desired also a small percentage of rosin.

As solvents, various ordinary organic solvent liquids, may be employed, as for example, naphtha, toluol, acetone, or denatured alcohol. I prefer to employ a mixture in substantially equal proportions of kerosene and crude coal tar distillates comprising crude toluol, crude xylol or crude solvent naphtha. Such crude solvents contain some tar and in some cases naphthalene. A small proportion of tarry material gives added hardness and strength to cores bonded with alkyd resin. Kerosene acts as a lubricant.

The following is an illustrative example of the fabrication of my improved core. About 50 parts by weight of core sand and one part of a solution, containing by weight about 4 parts of an alkyd resin, and preferably an alkyd resin containing rosin as well as a drying oil acid, together with about 6 parts of solvent, are thoroughly mixed to form a molding composition. These proportions may be varied to suit conditions. In some cases a small amount of an adhesive

cereal binder may be added to the sand. For example about 1250 to 1300 pounds of core sand may be put into a sand mixer and given "green strength" by the addition of cereal binder, such as flour or Mogul which is a corn product. About 23 pounds of an alkyd resin solution of the proper viscosity, then are added and the entire mass is thoroughly mixed.

In some cases an unmodified alkyd resin, made from glycerine and phthalic anhydride in molecular proportions may be employed as a binder, a suitable solvent being employed, although the modified resin has been found to be superior.

After a molding mixture embodying my invention is formed into a core of desired shape, the core is baked at a temperature of about 350° F. to drive off solvent and to cause the resin partly to be converted from the sol to the gel state to render the core hard and capable of resisting heat without fusion or softening. The length of time required for baking varies with the size of the core, its shape and other conditions. In some cases the core need be baked for only 15 or 20 minutes while in other cases several hours may be required. The length of the baking period is in any case much shorter than is required when employing such bonding agents as linseed oil, especially in the case of large cores. Complete conversion of the alkyd resin during the baking period to the most highly polymerized state is not required as such a core bond is further hardened and heat converted by contact therewith of the molten metal.

It is not necessary that in the entire mass of the core the bond should have been given a set or that all of the solvents should have been removed in the interior portion prior to the use of a core for casting purposes as the heat of the molten cast metal will complete the removal of solvent and will further polymerize the bond.

When molten steel, iron, brass, or other high heat cast material comes into contact with cores embodying my invention the first effect of the molten material is, I believe, to make the heat-convertible binder still stronger and harder by further polymerization. Whatever the true action may be it is a fact that the core withstands the heat and erosive action of the cast metal sufficiently long to avoid trouble from premature breakdown. Thereafter the core reaches the break-down point of the bond, and the disintegration and volatilization of the bond leaves the sand dry and loose.

In some cases, particularly in the fabrication of large cores, a facing of a suitable refractory material such as silica sand, pre-fired graphite, or fine carbon which is free from combined water or other volatile matter bonded with clay may be applied upon the surface of cores further to strengthen

the cores against the penetrating action of the cast metal. Such a facing may be applied by spraying on the mold, either on a green sand mold, or a dry sand mold or core, a suspension of carbon silica flour or other suitable refractory in a solution of a suitable alkyd resin. The interior mass of the core which is bonded with alkyd resin, or other bond which is capable of being decomposed at high temperatures, then may be easily shaken out of the casting and the clay-bonded facing then may be more easily removed than would be the case were the entire core clay-bonded.

My improved cores not only have greater cohesion, hardness, and greater mechanical strength initially than cores made with the use of binders formerly employed, but they retain their shape until the cast metal has taken an initial set. They are not cut by hot flowing metal under conditions which would cause complete failure of similar cores bonded with a non-heat convertible material. The cores have a smooth, hard surface which withstands erosion by the cast metal and against which the cast metal will closely lie thus producing castings of accurate surface configuration.

A most striking advantage of cores embodying my invention results from the volatility of the binder when in contact with the hot metal. As above indicated, when internal cores are employed which are imbedded in the cast metal, the binder is so completely volatilized by the hot metal that the sand, or other body material of the core, is left in such loose state that it may be readily poured, or blown, out of the completed casting. My improved cores vent more readily, that is, release gas more evenly and the amount of gas produced is not great. Blow holes are therefore practically eliminated. Practically no ill smelling or otherwise obnoxious gases or fumes are given off from my improved core bond either during casting or when the core material is removed from the casting, thereby conducing to the comfort and health of the workmen.

The cores also are more resistant to moisture and can be stored for longer periods without warping or disintegration. As the cores are mechanically stronger and harder, breakage in handling and in storage is reduced. The greater strength of members made in accordance with my invention makes it possible to dispense partly or wholly with reinforcing rods which ordinarily are required in the case of large or complicated cores.

These advantages of the improved cores embodying my invention can be obtained without additional cost and in fact the cost is found in many cases to be materially lower than with cores made with other types of bonding agents. One of the savings effected

in the manufacture of cores containing an alkyd resin is ascribed to the shorter period required for baking the cores and the decreased cost of equipment in ovens and core pans which is required. Another saving is due to the lower breakage or loss of cores by warping.

The ease with which the core may be shaken or blown out of the casting results in a material saving of labor and time and facilitates the introduction of line production methods into the foundry. The time saved in removing the core may run from several to many hours with a saving in direct labor alone of many dollars for a single casting. The reduction in time in making the core and producing the completed casting ready for shipment in an emergency, involves an indirect saving which it is impossible to estimate. Material savings also are effected by the reduction of losses due to spoiled castings and the saving of labor formerly required in patching castings containing sand pockets.

For the fabrication of cores embodying my invention, sand from used cores can be used over again. In fact, it is possible to again use so-called "burned sand" without adding new sand as a raw material for the fabrication of cores. Formerly, used cores and dry sand molds had to be disposed of at considerable expense. They contained either a carbon residue from the breaking down of the oil, or other carbonizable binder, or contained the hardened clay. Sand derived from cores containing my improved bond contains little or no carbon and can be readily mixed with fresh bond for re-use.

My new form of bond is also applicable to external metal casting members. Heretofore, only so-called "green sand" molds have been believed to be practicable for external casting molds, that is, molds made from sand containing a natural bond. In accordance with my invention dry sand is mixed with a solution of alkyd resin as above described. The mixture is molded with a pattern in an external molding container to make an external mold of relatively small section which is then baked as above described. The baked mold may be inserted in a suitable container and carried by a conveyor to the cupola where the casting may be poured. Upon solidification the cast metal object may be cleaned from the adhering disintegrated mold material in any suitable way as, for example, in a tumbler or by a sand blast.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A composition for making foundry cores comprising a comminuted core body material suitable therefor, a binder constituted of a polyhydric alcohol-polybasic acid condensation product which is capable of being con-

verted to a strong, hard, heat-resisting state, and the constituents of which are largely volatilizable at the temperature of the molten metal for the casting of which such cores are intended and a volatile solvent therefor.

2. A strong, coherent casting core comprising a preponderant amount of a comminuted refractory material and a material cementing said particles comprising a heat-hardening resin which is capable of being volatilized at the fusion temperature of metal intended to be cast into contact with said core, and which contains in chemical combination glycerine and phthalic acid or its anhydride.

3. A foundry core for casting metals comprising a refractory material and an alkyd resin bond therefor.

4. A foundry core for casting metals comprising a refractory material and an alkyd resin bond therefor in a heat-hardened state.

5. A core for casting metals comprising a core body and a bond therefor constituted of a polyhydric alcohol-polybasic acid resin containing a fatty acid in combination therewith.

6. A core for casting metals comprising a core body and a polyhydric alcohol-polybasic acid resin containing in chemical combination a drying oil acid.

7. A core for casting metals comprising a core body and a glycerine-phthalic anhydride resin containing in chemical combination a drying oil acid and rosin.

8. The process of fabricating metal casting cores which consists in admixing sand with a solution of an alkyd resin, forming said cores, and baking at a temperature at which the solvent is eliminated and said resin is rendered hard and capable of resisting heat without fusion.

9. The process of fabricating cores for metal casting which consists in admixing a comminuted core body material with a solution of an alkyd resin which is capable of being heat-hardened into a strong, hard, heat-resisting state, and is capable of being disintegrated at a higher temperature, shaping said mixture into desired form, and baking the same at a temperature of about 350° F. to remove the solvent and to heat-harden the binder then flowing a fused metal into contact with said core at a temperature sufficiently high to eventually disintegrate said plastic material and render the core body capable of removal in a loose state from the solidified casting.

10. A core bond which is adapted to be admixed with a comminuted refractory core body comprising an alkyd resin and a crude volatile, organic solvent.

11. A core bond which is adapted to be admixed with sand for the manufacture of cores comprising an alkyd resin containing a fatty acid and a crude volatile, organic solvent.

12. A core bond which is adapted to be

mixed with a core body comprising an alkyd resin containing a vegetable oil acid, China-wood oil, a crude volatile solvent and kerosene.

13. A core bond which is adapted to be mixed with a core body in a comminuted state comprising an alkyd resin, a volatile solvent and kerosene.

In witness whereof, I have hereunto set my hand this 16th day of January, 1930.

ROBERT EARL, JR.