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PROCESS AND PRODUCT FOR COATING MOLDS AND CORES

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(GRANTED UNDER THE ACT OF MARCH 3, 1883, AS AMENDED APRIL 30, 1928; 370 O. G. 757)

My invention relates to a new and useful method of making molds and cores for metal castings.

Previously in this art the hot metal coming in contact with the mold and core surfaces caused the sand in contact to burn into the adjacent surfaces of the metal and produced castings of rough exterior and interior surfaces, which surfaces are formed of an integral film of mixed metal and sand. This, as well as the removal of the cores and the cleaning of the un-integral sand from the casting, has heretofore been an expensive, laborious and dusty task frequently requiring the use of pneumatic chisels and other tools, while in the machining of such castings the integral film of sand and metal is difficult to machine unless the tool in its first cut penetrates beyond the depth of such film.

In the prior art many cracked castings have been produced due to hard cores and molds which do not crush readily as the metal casting cools, contracts and solidifies, and such castings are a constant source of substantial loss in all foundries but more especially in aluminum and kindred metal castings.

A further constant source of substantial loss in the prior art of metal casting has resulted from mold and core blows due to the low permeability of the sand forming such molds and cores.

The oxidizing of the surfaces of castings, especially of the more oxidizing metals, due to contact with the prior art molds and cores has many disadvantages.

In the past many endeavors have been made to overcome these very objectionable conditions and losses. Some of these attempts have been to form the molds and cores of green sand, which is the ordinary molding sand of commerce, but the liability of such molds and cores to be washed in part into the molten flowing metal being cast prevents, or renders hazardous, their use in many cases.

To provide molds and cores of more strength than possessed by green sand molds and cores, it heretofore has been common practice to embody a binder in the sand of, either or all, clay, molasses and water, flour and water, and oil, and to indurate such molds and cores by baking. Such molds and cores have all the aforesaid defects except the tendency to wash into the flowing molten metal, while the thus formed harder molds and cores increase the cracking liability of the castings as well as tend to increase the liability of the castings to blow due to the lesser porosity of such molds and cores.

Heretofore volatile substances have been employed in and about the foundry in the molding and core rooms, for instance in applying the same to the mold or core as a whole or to the surfaces thereof and then ignited to dry the mold sufficiently before the molten metal was cast therein or thereabout; but such a practice adds a very substantial fire hazard and explosion hazard. Furthermore, such volatiles become impregnated in the air, breathed by the operatives, which tend to harmfully affect the operatives physically and in their efficiency.

My present invention relates to an improved method and means for foundry practice. Its object is to overcome the aforesaid conditions, to cheaply and readily produce a mold or core of as great, and even greater, strength, durability and permeability than normal strength, to produce a mold or core which may be used advantageously at very later periods of time than is possible with molds or cores of the prior art.

To attain these and other objects, and in accordance with the general features of this unitary invention of related and interdependent components, my improved method contemplates the employment of latex. This substance is the natural rubber substantially as it comes from the plant, usually with the addition of a preservative, and which normally contains a substantial water content. In some rubber growing regions the water content of the latex is reduced substantially by evaporation in order to avoid the substantial shipping cost of the water content.

This material, instead of being mixed with the sand or other constituents of the mold and/or core, as my companion application likewise entitled and executed under the same date herewith, is applied upon the surfaces of the molds and/or cores which may come in

contact with the casting being cast. This application may be by brushing, spraying, or otherwise applying this material to such surfaces of the mold and/or core after the same have been made pursuant to the prior art. This material so applied penetrates into the surfaces to which the same has been applied to a depth proportionate to the amount so applied to a given surface. In penetrating into the surfaces to which the same is applied more or less of the rubber or rubber-like content of the material is carried beneath the surface to which the same is applied and more firmly binds the particles of the mold and/or core in contact with said material. Thus, when the impregnated surfaces become dry the particles thereof are more firmly bound together by this rubber or rubber-like material so applied to and penetrating such surfaces. This may be said to substantially case harden the surfaces of the mold and/or core adapted to come in contact with the casting when being made.

As the latex is coated upon the surfaces of the mold and/or core it penetrates to a substantial extent. In such penetration, the sand or other content so penetrated tends in some respects to act as a filter and cause a larger proportion of the solids to be deposited upon or near the surface to which the same was applied and the depositing of a proportionately lesser extent of said solids in the deeper penetration. This obtains a further binding of the particles at and near the outer surfaces so that the same are stronger and more resistant to deformation by handling, erosion by the casting or otherwise. This condition progressively decreases substantially throughout the depth of said penetration into such surfaces, until the point is reached where the penetration terminates, from which point the remainder of the mold and/or core may be of the consistency and strength normal in the prior art. This substantial progression substantially tends to prevent any tendency to peel or scale off the coated surface.

An efficient coating of the latex upon the mold and/or core surfaces as well as the said penetration thereof, by mixing with the latex a suitable protective colloid such as gelatin, agar agar, glue, sodium soap and ammonium soap, extract of quince seed, and the like, water soluble substances. Such colloids added to the latex reduces the surface tension of the water content of the latex and of the solid contained in the latex and liquid, which colloid holds said solids more effectively and efficiently in suspension as well as increases the permeability of this mixture into the surfaces of the mold and/or core to which the same is applied.

The amount of the protective colloid to be added to the latex depends upon the extent desired of the penetration of the normal solid constituents of the latex into the surfaces to which the same are applied, while some of the colloids which may be employed also tend to increase the binding effect of the mixture upon the constituents of the mold and/or core surfaces to which same are supplied.

It is further contemplated that the latex mixture above stated may be employed with or without the addition of any of the well-known vulcanizing ingredients. When such vulcanizing ingredients are added, they may be either of the atmospheric or the artificial air curing or heat curing variety. Where the air curing variety may be applied, the mold or core is subjected to atmospheric conditions for a sufficient period to vulcanize the sand, and where the heat curing vulcanizing agent is employed, the mold or core is subjected to the requisite elevated temperature to cure the same to the degree of strength required by each particular mold or core or class thereof. During such vulcanizing period, or during the period between the making and the using of the unvulcanized molds or cores, the surfaces thereof have their moisture contents reduced by evaporation.

The mold or core thus produced is then used in the making of a casting, most usually by having the molten metal poured thereon or thereabout. Where molten metal is poured into or about the mold or core, its heat coming in contact with the surfaces of the molds and/or cores causes a gas to be formed which permeates the cavity in the mold to be occupied by the molten metal. This gas is in direct contact with the surfaces of the metal in the mold and through which gas the metal is being poured or is otherwise maintained in intimate contact with said gas. As the metal is poured into the molds this gas attains a pressure in the mold cavity but such pressure is higher between the molten metal and the surface or surfaces of the mold covered thereby. This gas pressure causes the mold or core to become more or less permeated by said gas. This permeation tends to filter or condense, either or both, from the gas the constituents thereof and to deposit the same upon the walls of the mold or core. This gas and/or said filtration or condensation product prevent the sand or other earthy constituents of the mold or core from becoming embedded into or adhering to the surfaces of the casting when made with a mold or core in the practice of my method.

This result is also contributed to by the fact that the heat of the molten metal applied to the surfaces of the mold and/or core tends to decompose some or all of the said materials coated upon the sand and upon other earthy content of the mold or core. This decomposition in whole or in part tends to form a protective, insulating or other coating or medium intermediate the juxtaposed surfaces of the molten metal and the mold

and/or core which substantially tends or contributes to the prevention of the normal tendency of the earthy particles of the mold and/or core from being embedded into or adhering to the surfaces of the casting.

My method also substantially reduces or practically eliminates the tendency toward oxidization of the surfaces of the cast metal.

My method further substantially decreases the normal tendency of the metal surfaces of the casting in contact with the mold, particularly iron castings and the like, from peeling or hardening and thus making thin castings more brittle and all castings' surfaces more difficult to machine than heretofore.

The aforesaid steps may also be said to be included in, or to comprise the method of, slowing up the cooling rate of the castings made in or about such mold or cores and which substantially contributes to the avoidance of said brittleness of thin iron castings and the machining difficulties of other iron castings, and which also substantially contributes to the prevention of the earthy particles of the mold or core from being embedded into or adhering to the surfaces of the casting. This latter result is contributed to by the formation of an insulated gas film beween the juxtaposed surfaces of the casting and the mold or core and/or the decomposition in whole or in part upon the surfaces of the mold or core of some one or more of the aforesaid ingredients coated upon the earthy particles forming the main body of the mold or core.

Castings of all kinds, and more especially of molten metal, made in the practice of my method may be cleaned at a fraction of the cleaning cost required by the practices of the prior art.

To demonstrate the practical utility of my said method, I employ a mold and/or core constructed in accordance with my said method and have made and caused to be made many kinds of castings in such molds and/or cores of many different kinds of metals and their alloys and other cast substances.

Instead of the employment of latex as above described the practice of my method may be advantageously accomplished by the employment of latex embodying the particles or a rubber solution that had been vulcanized to the desired degree or the employment of artificial latex and/or rubber or rubber-like dispersions and/or the product or products of latex, rubber, or rubber-like substances in dispersion or otherwise, including such substances or the rubber base thereof, as may have been treated by another substance such, for instance, as a sulphonic acid, a halogen, or a substance which may have modified some of the properties which ordinarily characterize rubber or rubber-like substances. The amount of the latex rubber or rubber-like substance or the derivative thereof employed in the practice of my method depends upon the degree of strength required in the mold and/or core required for the efficient production of a casting of given characteristics. For instance, molds and/or cores having relatively thin areas which are more liable to crumble or be broken off in normal handling or production, or to wash into the fluid material being cast should have greater strength. Such greater strength may be obtained at will by the employment of a greater percentage of a more concentrated solution, a variation of the ingredients of the mixture, including the possible increment of the amount of accelerant of vulcanization, or the increment of the period or rate of the curing or vulcanization of the mold and/or core, which those having skill in the art may readily determine from the characteristics of the desired casting and/or the characteristics of the metal, alloy or substance to be cast. This greater strength may be afforded any particular part, area, or portion of the mold and/or core by applying to each such part, area, or portion more of my said coating. This may be done all at one operation or the coating may be applied uniformly and then subsequently increased at the point or points desired.

In the attainance of molds and/or cores of greater strength, where the aforesaid substance or substances employed therefor may in any case result in the constituents of the mold or core becoming too moist for advantageous construction of the mold or core therefrom, which condition is readily recognizable by those skilled in the art, the excess moisture may be readily removed therefrom by any of the practices employed in the art, including its being subjected to normal atmospheric or an elevated temperature.

In this specification and its appended claims where the term rubber is employed it is intended to include rubber either as latex, coagulated rubber, rubber dispersions, artificial latex, or sap from trees such as *Hevea braziliensis*, or from vines or shrubs, as well as from other kindred vegetation such as guayule containing more or less rubber hydrocarbon. The rubber may be unvulcanized or consist of vulcanized soft rubber, and may have been previously subjected to an elevated temperature.

It is to be understood that wherever in this specification and its appended claims the expression "rubber-like" is used, it is to include only materials which are like rubber in that they afford substantially the same reaction as the rubber to the heat of the cast metal, and which reaction is new and unexpected in this art. It may also include any rubber or scrap rubber, either or both, that has been subjected to an elevated temperature alone or in the presence of sulphuric

acid or a sulphonic acid or a sulphonyl halide or it may also include a substance such as is an article of commerce under the name "Thermoprene." It may also include dispersions of one or more of said substances. Wherever the prior art permits, the terms "rubber" and "rubber-like" are to be construed as referring to substantially the same material or composition. A number of the foregoing materials come within the heat plastic grouping. A number of the before stated materials, including those subjected to the action of sulphuric acid, or a sulphonic acid or a sulphonyl halide, and the stated "Thermoprene" and the like, fall within the less chemical unsaturation than rubber grouping, the heat plastic grouping, and the rubber isomer groupings.

In this art, coatings, binders or paste for application to cores and molds are recognized compositions of commerce used in the production of molds and cores for the making of castings of molten metal.

In the development of my present invention I have made or caused to be made many molds and/or cores for different types of castings of different metals, compositions, or materials, and I have coated the same, separately and in combination, the various materials hereinbefore stated, and have attained satisfactory results in substantially all respects therewith.

In this art, binders for the constituents of molds and cores are recognized articles of commerce exclusively used in the production of molds and cores only for the making of castings of hot metal.

The molds and/or cores made in accordance with my invention are not required, as in the prior art, to be used soon after their production nor are they required to be handled with the care of such production of the prior art, and that the molds and/or cores produced in accordance with my method possess substantially greater strength and equal or superior permeability and may be used in forming a casting at a remote period after their production.

The material with which they are coated tends to prevent the absorption of moisture by the molds and/or cores and hence does not require the care with respect to moisture proof storage nor as to the humidity of their surrounding atmosphere as do molds and/or cores of the prior art.

While the ingredients which I employ in coating the molds and/or cores are higher in cost than the mold and/or core binders of the prior art, yet the percentage of such materials added to the mold and/or core material is relatively small even with castings requiring the greatest strength of mold and/or core. The difference in the cost of my binding materials is very much less than the saving which their use entails even in the one item of the cleaning cost of the castings. This renders the use of my method and means profitable even in the one item of casting cleaning costs while its numerous other advantages constitute additional gains and savings ordinarily and usually occurring from the practice of my said method.

My present invention is also more economical in the production of molds and/or cores of large areas than in my aforesaid accompanying application because in the present application the substances coated to the desired extent and quantity only beneath surface or surfaces of the mold and/or core to come in contact with the casting, whereas in said accompanying application, my binder is mixed throughout the sand or other ingredient of the body of the mold and/or core, or a substantial portion thereof.

This invention is in furtherance and continuance of, and an improvement upon, the invention set forth in my pending application likewise entitled and bearing Serial No. 332,226.

I have found it advantageous in the production of molds and/or cores for certain types of castings to construct the mold and/or core in accordance with my aforesaid accompanying application and then to coat the surfaces thereof or some portion or portions thereof as herein stated to attain a greater strength of such coated surfaces or portions thereof.

I have obtained satisfactory results by mixing with the hydrated rubber or rubber-like mixture a substantial amount of solids in the form of small particles of graphite or other facing material, the amount of such facing material added being interdependent upon either or both the percentage of other solids in the rubber or rubber-like mixture or the required strength of the mold or core; the object being to lessen the amount of the rubber or rubber-like material employed, which is usually the most expensive constituent, and yet not to so lessen to the degree of unduly weakening the resulting mold or core. Such added facing material further tends to control the amount of gas formed by the hot metal against the surfaces of the mold or core by lessening substantially to the extent of the added facing material the rubber or rubber-like material that is decomposed by the heat of the metal.

The invention herein described may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon or therefor.

Having now so fully described my invention that others skilled in the art may therefrom make and use the same, what I claim and desire to secure by Letters Patent is

1. The method of producing molds or cores consisting of selecting the molding sand or components, tempering same, making the

mold or core, coating one or more surfaces of the mold or core with a hydrated rubber mixture, and dehydrating said coating to the desired extent.

2. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a hydrated rubber mixture.

3. The method of producing molds or cores consisting of selecting the molding sand or components, tempering same, making the mold or core, coating one or more surfaces of the mold or core with a hydrated rubber mixture containing an added colloid, and dehydrating said coating to the desired extent.

4. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a hydrated rubber mixture containing an added colloid.

5. The method of producing molds or cores including the step of coating one or more surfaces of the molds or cores, with a hydrated mixture containing a substance selected from the class of artificial and natural rubber and derivatives thereof, and an added colloid.

6. The method of producing molds or cores consisting of selecting the molding sand or components, tempering same, making the mold or core, coating one or more surfaces of the mold or core with a hydrated rubber mixture containing a facing material, and dehydrating said coating to the desired extent.

7. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a hydrated rubber mixture containing a facing material.

8. The method of producing molds or cores consisting of selecting the molding sand or components, tempering same, making the mold or core, coating one or more surfaces of the mold or core with a hydrated rubber mixture containing a facing material and an added colloid, and dehydrating said coating to the desired extent.

9. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a hydrated rubber mixture containing a facing material and an added colloid.

10. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a mixture containing substantially hydrated rubber, a facing material, and a colloid selected from the class of water soluble colloids.

11. The method of producing molds or cores including the step of coating one or more surfaces of the mold or core with a mixture containing substantially hydrated rubber in small particles, a facing material in small particles, and an added colloid selected from the class of adhesive colloids.

12. A mold or core having a coating containing hydrated rubber.

13. A mold or core having a coating containing hydrated rubber mixed with a colloid.

14. A mold or core having a coating containing hydrated rubber and a facing material.

15. A mold or core having a coating containing substantially hydrated rubber, and a graphite facing material.

16. A mold or core having a coating containing hydrated rubber mixed with a colloid and a facing material.

17. A mold or core having a surface adapted to be subjected to molten metal, said surface having associated therewith substantially hydrated rubber mixed with a colloid and a graphite facing material.

18. The method of casting in a mold comprising the steps of pouring molten metal in a mold, and by the heat of said poured metal combusting substantially hydrated rubber between the metal and the mold surfaces.

19. A coating, binder or paste (for molds and cores for making molten metal castings) comprising a suspension containing an adhesive binder selected from the class comprising substantially natural and artificial rubber and a derivative thereof, and a colloid selected from the class comprising substantially gelatin, agar agar, glue, sodium soap, ammonium soap, and extract of quince seed.

20. A coating, binder or paste (for molds and cores for making molten metal castings) comprising a suspension containing an adhesive binder selected from the class comprising substantially natural and artificial rubber and a derivative thereof, a facing material in small particles, and a colloid selected from the class comprising substantially gelatin, agar agar, glue, sodium soap, ammonium soap, and extract of quince seed.

21. A mold or core coating, binder or paste, comprising dispersions of rubber and a facing material suspended in a liquid containing a colloid.

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