United States Patent

Zifferer

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[54] **METHOD OF MAKING A COMPOSITE SAND MOLD INCLUDING RECYCLING THE LAND**

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[51] **Int. Cl.** **B22c 5/18,** B22c 9/12

[58] **Field of Search**.....164/5, 16, 23, 33, 43, 165, 164/361; 106/38.3

[56] **References Cited**

UNITED STATES PATENTS

2,748,435	6/1956	Hackett	164/23
2,861,307	11/1958	Froberger	164/43 X
2,873,493	2/1959	Thompson et al.	164/43 X
3,131,999	5/1964	Suzuki et al.	164/16
3,309,212	3/1967	Lubalin	106/38.3 X
3,318,712	5/1967	Zifferer	164/16 X
3,447,589	6/1969	Planten	164/361 X

FOREIGN PATENTS OR APPLICATIONS

1,121,473	4/1956	France	164/33

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[57] **ABSTRACT**

A precision-type composite mold or core for foundry use comprising a body formed from relatively inexpensive coarse sand bonded with sodium silicate cured by reaction with CO_2 and a relatively expensive facing integral with said body and composed of a lesser amount of relatively fine sand than the coarse sand of said body, said fine sand being bonded by a synthetic resin cured by reaction with an amine, at least said coarse sand and sodium silicate bond being recoverable following the use of the mold or core formed therefrom and reconstituted for further use to decrease the overall cost of making and using molds and cores of such type.

1 Claim, No Drawings

METHOD OF MAKING A COMPOSITE SAND MOLD INCLUDING RECYCLING THE LAND

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention comprises a product which is capable of being formed by the apparatus and process comprising the subject matter of a companion application filed on even date herewith, Ser. No. 22,586, now abandoned, and replaced by a continuation-in-part application, Ser. No. 172,524, filed Aug. 17, 1971 which includes all of the subject matter of the original application, Ser. No. 22,586, the same being a joint invention in regard to which the present applicant is one of the co-inventors, said application being entitled "-PROCESS AND SYSTEM FOR FORMING FOUNDRY CORES AND MOLDS".

BACKGROUND OF THE INVENTION

In certain types of metal castings, it is essential that dimensions be very precise, as well as the shapes of surfaces thereof being held within very close tolerances. It also is desirable in many castings that the surface of either internal spaces or outer surfaces thereof be very close tolerances. It also is desirable in many castings that the surfaces of either internal spaces or outer surfaces thereof be very smooth so as to minimize finishing costs. Castings of this type heretofore have required the use of shell molds which, for example, utilize phenolic binders. The cost of preparing and consequently the cost of using the same and the pattern cost to produce them is relatively high as compared with molds and cores formed primarily from sand which is bonded by less expensive binders.

SUMMARY OF THE INVENTION

It is the principal purpose of the present invention to produce composite molds and cores by processes and the use of apparatus such as those, inter alia, comprising the subject matter of said co-pending application, such molds and cores comprising a body portion formed from inexpensive relatively coarse sand which comprises the majority of the sand bulk of the same, and said body having a more expensive facing portion integral therewith and composed of relatively fine and in substantially smaller quantities then said coarse sand. The coarse sand, for example, may be bended with sodium silicate cured by passing CO_2 therethrough to effect a rapid and satisfactory stabilizing of the shaped sand core or mold, while the facing of fine sand is bonded by an appropriate synthetic resin mixed therewith and cured, for example, by reacting the same with an appropriate amine of the type referred to in said co-pending application so as to form a core or mole having operative surfaces possessing a very high degree of smoothness as well as dimensional stability in order to produce a precision-type cast product.

It is a further object of the invention to minimize the cost of producing and using molds and cores of the type referred to by effecting reclamation and reuse at least of the coarse sand of the body by disintegrating the molds and cores after use thereof, such as by using the equipment of applicant's prior U.S. Pat. No. 3,312,403, separating the fine from the coarse sand, and particularly reconditioning the coarse sand and cured sodium

silicate bond thereon by applying predetermined amounts of sodium or potassium hydroxide in accordance with the procedure set forth in applicant's prior U.S. Pat. No. 3,318,712, and thereby render said coarse sand and binder ready for reuse when the binder is again reacted with CO_2. If desired, the relatively fine sand having a resin binder thereon also may be recovered by burning the resin from the sand in a suitable thermal-type reclaimer.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Due to the improvement in vacuum gassing apparatus such as that comprising the subject matter of said co-pending application, it now is possible to produce a mold or core wherein sand-resin mix may be used as a facing on a mold or pattern which is backed up by a sand-sodium silicate mix, the composite mold or core thus formed being unitary and capable of being effectively cured and rendered stable by a single machine utilizing a stepwise process including two reagent gases respectively to cure the resin and sodium silicate binders of the respective sand mixes referred to above.

As shown in said companion application, Ser. No. 22,586 and the continuation-in-part application, Ser. No. 172,524 filed Aug. b **17, 1971** relatively extensive range of different resins may be used, preferred examples of which are epoxy, polyester, petroleum polymers, alkyd, and phenol formaldehyde thermosetting resole resin supplemented with additives including polyisocyanate, such as 4, 4 diphenylmethaneisocyanate, these resins being susceptable to reaction by a suitable amine, such as but not restricted to trimethylamine or triethylamine, which acts as a catalyst to effect reaction of the phenolic binder with the polyisocyanate to effect a rigid resin bond with the relatively fine sand used in the facing and bonded with said resin to provide a very smooth and fine finished surface on the mold or core which is to be contacted by molten metal, while such facing is backed up by a more extensive mass of relatively coarse sand mixed with sodium silicate and curing of the mold or core preferably is accomplished automatically in accordance with the procedure and the system comprising the subject matter of said co-pending application.

The use of sand of two different finenesses respectively in the facing body or back-up material not only produces a superior finish on a casting resulting from the use thereof but, in addition, facilitates the escape of detrimental gases. Further, a clean separation of the two types of sand is possible by disintegrating and simple screening of the mold or core following the use thereof, whereby either or both types of said sand can be subjected to reclamation and reconditioning for subsequent use. Disintegration of the mold material may be effected economically the machine of applicant's prior U.S. Pat. No. 3,312,403. In this regard, the resin-coated relatively fine sand can be processed in a thermal-type reclaimer in which the resin is burned off of the sand. In regard to the relatively coarse, back-up sand, it is only necessary to mix the sand which still has sodium silicate binder material thereon with predetermined quantities of either sodium hydroxide or potassium hydroxide to reconstitute the sodium silicate binder

and render it suitable for reuse, in accordance with the process comprising the subject matter of applicant's prior U.S. Patent No. 3,318,712.

In certain types of operation, particularly where a relatively small percentage of fine sand is used to formed the facing on a mold or pattern body primarily composed os a relatively coarse sand mass, such small amount of resin-bonded facing sand used in each mold or core does not justify reclamation operations. In substantially all circumstances, however, it has been found to be desirable to reconstitute the sodium silicate bond of the relatively coarse, back-up sand in view of the larger quantities of this material which are used in a composite mold or core of the type comprising the present invention.

Another attribute of the present invention comprises the fact that a composite mold or core, which embodies sand that is bonded by cured sodium silicate as a back-up material for an appropriate facing, is superior to a mold in which similar backup sand is bonded with clay because a rammed clay-bonded sand mold or core has very low compressive strength compared to that of a sand mold in which the sand is bonded by sodium silicate cured by reacting the same with CO_2. Also, not only must larger amounts of clay-bonded sand be used to provide suitable strength for core or mold, but the permeability thereof is much less than that of a sand mold or core bonded by cured sodium silicate. Also, more steam and gas is generated in such clay-bonded sand mold during the operation of pouring molten metal into contact with said molds or cores than in molds bonded by sodium silicate bonded by CO_2.

Still further, especially in regard to using molds made from clay-bonded sands, it is often essential to reinforce such molds by expensive jackets during the pouring operation in order to withstand the hydraulic pressures generated by molten metal. In contrast to this, sand molds bonded by cured sodium silicate to not require jackets of the type referred to and can be clamped mechanically during a pouring operation.

A composite mold of the type comprising the present invention which is made in accordance with the procedures described above may be fabricated very largely by equipment presently existing in foundries in which conventional clay-bonded sand is employed.

The fine sand-resin mix is first placed either in the mold for a core or adjacent the pattern in a flask to form the operative surface of the core or mold, after which the coarse sand-sodium silicate mix for the body of the core or mold is placed against the fine sand mix to be integrally connected thereto incident to the binders of the respective sand and binder mixed being cured. Then, by reacting the binders preferably sequentially with the amine and CO_2 gas curing agents, the formed core or mold is cured. Accordingly, the making of molds and cores by conventional clay-bonded procedures may be converted to adapt then to a process for making precision-type casting through the use of composite-type molds and cores described above. In this regard, the only equipment required for such conversion is the use of a vacuum gassing unit such as of the type illustrated and described in said co-pending application. THe sand of either type may be recovered by use of a sand reclaimer and the type described in applicant's prior U.S. Pat. No. 3,312,403.

Reconstituting of the sodium silicate bond of the relatively coarse sand may be achieved by reacting predetermined quantities of either sodium hydroxide or potassium hydroxide therewith in accordance with applicant's prior U.S. Pat. 3,318,712. This may be done by conventional mulling equipment normally available in foundries employing clay-bonded sand molds and cores. To recover the fine facing sand, the resin may be removed by a suitable thermal reclaimer. Also, from the standpoint of operating costs, the use of alkali metal hydroxides as additives to reconstitute the silicate binder referred to above is less expensive than that of the clay plus new sand additives required to replace burned out clay and spent sand when attempting to reuse sand employed in clay-bonded molds and cores.

Considering the present invention also from the standpoint of capital investment in a new foundry designed to utilize composite molds of the type comprising the present invention, and including the reconstituting of sodium silicate binder generally, is equal to or less than the investment required for a clay-bonded sand foundry because additional investment in vacuum gassing effected by requiring less sand-handling equipment and by the elimination of the jackets required to contain clay-bonded molds during pouring operations in a foundry using the same.

Additional savings exist due to the fact that smaller flasks may be used in the molding operation employing such composite molds or cores and less gases are required to the vented from the pouring stations. Therefore, in general, superior castings are obtainable by using composite molds of the type comprising the present invention and substantially the same operation costs as those existing in the operation of foundries employing clay-bonded molds and cores, while, the same time, equal or less capital expenditures are necessary in practicing the process described above in which composite molds of the type described are employed rather than conventional clay-bonded molds used for foundry operation.

While the invention has been described in its several preferred embodiments, it is to be understood that the same is not to be limited to the precise details herein described since the same may be carried out in the other ways falling within the scope of the invention as described.

I claim:

1. A method of economically producing metal castings having high precise dimensional characteristics and a high degree of surface smoothness comprising the steps of:

a. forming a composite bonded sand member to produce desired smooth and precisely dimensioned surfaces on said casting by

b. forming a body of desired shape composed of relatively coarse sand mixed with sodium silicate binder,

c. applying a facing to said body composed of relatively fine sand mixed with synthetic resin binder to form a composite member,

d. curing said binder of said body by reacting CO_2 therewith and curing said facing binder by reacting an amine therewith,

f. mechanically disintegrating said member after use thereof to impart a precise shape to molten metal flowed against at least certain surfaces thereof,

g. separating said relatively fine and coarse sand from each other by sifting,

h. reconstituting said relatively coarse sand and sodium silicate binder remaining thereon for reuse by reacting the same with a predetermined amount of metal hydroxide selected from the class consisting of sodium hydroxide and potassium hydroxide, and

i. burning said relatively fine sand to remove the curled resin binder therefrom to condition it for reuse.

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