

[54] **METHOD OF MOLDING ARTICLES AND RECLAIMING THE FOUNDRY SAND USED**

[76] Inventor: **James M. Planten**, Deep Brook Road, Wyckoff, N.J.

[22] Filed: **Dec. 23, 1971**

[21] Appl. No.: **211,323**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 73,909, Sept. 21, 1970, abandoned.

[52] U.S. Cl. **164/5, 51/320**

[51] Int. Cl. **B22d 29/00, B24c 3/00**

[58] Field of Search **164/4, 5; 264/37; 51/320**

References Cited

UNITED STATES PATENTS

2,261,947 11/1941 Barnebl et al. 164/5

3,540,156 11/1970 Stebbins et al. 51/320 X

FOREIGN PATENTS OR APPLICATIONS

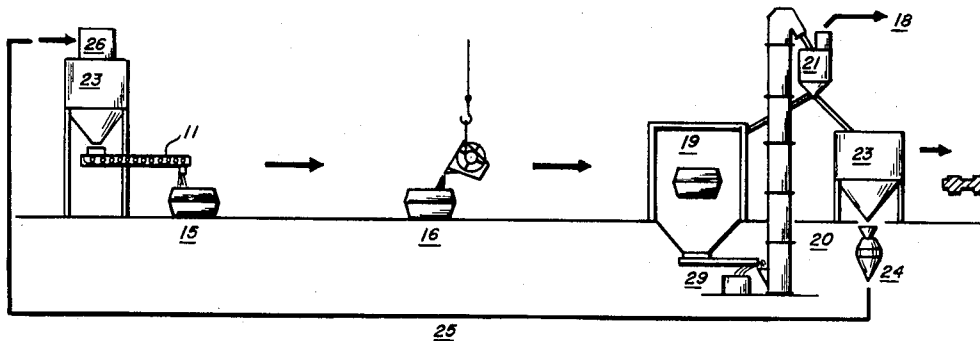
144,072 11/1951 Australia..... 51/320
626,704 9/1961 Canada..... 51/320

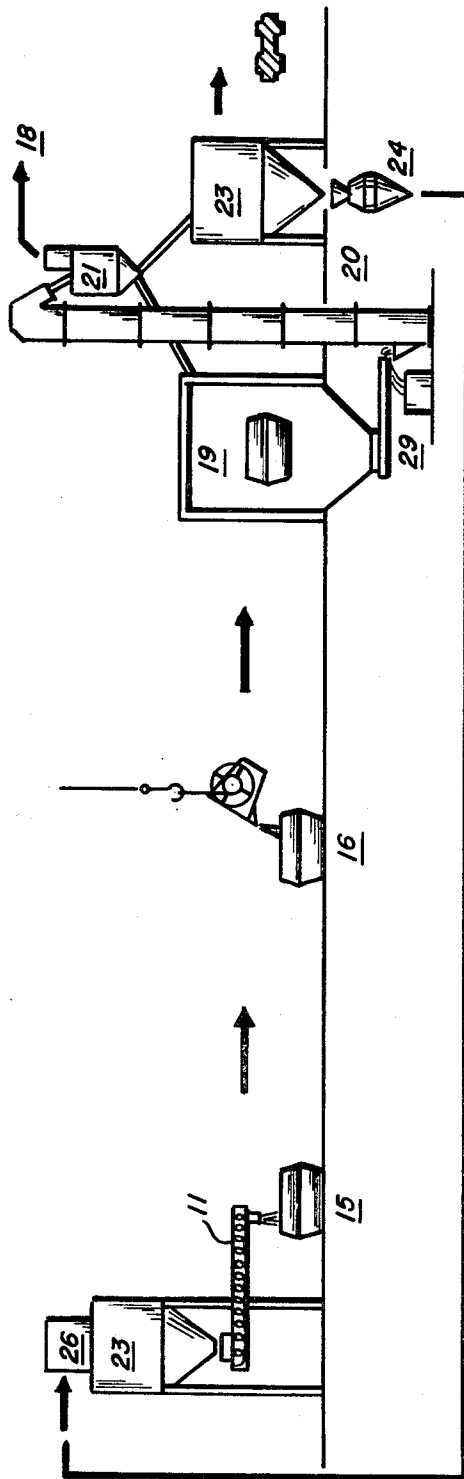
Primary Examiner—R. Spencer Annear
Attorney—George V. Woodling, Bruce B. Krost, Louis V. Granger and Charles R. Rust

[57] **ABSTRACT**

A unique method of molding articles is provided, which comprises forming a chemically bonded sand mold, casting an article therein and then subjecting the article while in the sand mold to a blasting force sufficient to remove the sand from the molded article and also essentially destroy the bond which holds the sand particles together to thereby render the sand reusable in a subsequent mold forming operation.

8 Claims, 1 Drawing Figure





25
FIG. 1

INVENTOR.

JAMES M. PLANTEN

BY

Woodling Kerst Thence Rent
Atty c

METHOD OF MOLDING ARTICLES AND RECLAIMING THE FOUNDRY SAND USED

This application is a continuation-in-part of U.S. patent application Ser. No. 73,909 filed Sept. 21, 1970 entitled "Method of Molding Articles and Reclaiming the Foundry Sand Used." (now abandoned)

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to an improved method of molding metal articles by means of sand molds and to the reclamation of the sand used to form such molds. More specifically, the instant invention concerns a method of molding metallic articles which comprises forming a chemically bonded sand mold, casting the desired article in the so-formed sand mold and subsequently removing the sand from the article after it has solidified by subjecting the mold while it contains the formed article to the action of a blasting or "shot" force, which is sufficient in strength to remove the sand particles from the formed article and essentially concurrently destroy the chemical bond which holds the sand particles of the mold together to thereby render the sand reusable in subsequent mold forming operations.

The increased cost of molding and core sands used by the foundry industry as well as the difficulty of disposing of used or spent sands, has led to evolution of many methods and types of equipment to render these sands reusable.

Methods known to those skilled in the art to break up lumpy conglomerates of sand include grinding, crushing, sieving, wet scrubbing, air scrubbing and the like. These methods may or may not be followed by calcining to remove carbonaceous material and the like so as to restore the sand to its original condition. All methods involve some type of agitation to cause rubbing together of the sand conglomerates so as to separate them essentially into the individual grains of which they are composed. This is usually followed by air or water treatment to remove particles of small size and spent binders, whose presence may be undesirable in any sand or core mix made from thus processed sand. This treatment of used sands, with or without calcining, comes under the general heading of sand reclamation.

In the use of the so-called chemically bonded sands which include furan resins, furfural, alcohol, isocyanate, oil urethane and etc., which are mixed with activators so that they set chemically without the application of external heat, it has always been considered that calcining or some means of completely removing the organic bond from the sand grains, is a necessary part of successful reclaiming. Uncontrolled carbon and organic deposits left on the sand grains have been regarded as inhibiting the binder action and general practice in chemically bonded sands has consisted of using all new clean sand or, at the most, a relatively small percentage ... say 25 percent ... of old, used sand in the binder-sand mixture.

In actual fact, sand reclamation begins at the time that the casting is removed from the sand mold and, therefore, usually involves several steps.

An object of this invention is to provide a sand reclamation method in which the sand is rendered immediately reusable, for self-hardening, chemically bonded sand mixes.

Another object is to eliminate the individual steps of casting shakeout, sand removal from the casting and sand reclamation and replace them with a new step which accomplishes the function of the individual steps in an essentially concurrent manner.

Another object is to do away with the individual steps of shakeout, sand reclamation and casting cleaning and replace them with a single step which accomplishes all of the functions of the individual steps in an essentially concurrent manner.

Still another object is to provide a combined method of shakeout, cleaning and sand reclamation conducted in a closed chamber, so as to eliminate air pollution and noise.

Other objects of this invention will be immediately apparent from a reading of the specification and claims.

In the prior art, when a mold is cast in a foundry it is necessary to first remove the solidified metal casting from the sand and then return this sand directly to the sand system or to a reclaiming system, if available, or to the dump, where no reclaiming method is available.

In the case of green sand systems, using clay as the sand binder, the only sand that is usually discarded would be that which tends to adhere to the casting and goes with the casting to the cleaning room. In the case of dry sands or baked molds, the sand tends to lump together at the shakeout point and the lumps must either be broken down or screened out before the sand can be returned to the sand system for reuse.

In the case of core sands, particularly, internal cores, a great part of this sand goes with the casting to the cleaning room, where it must be separately handled, before it can be returned to the sand system. In many cases some of the core is completely burnt and this burnt sand tends to go directly into the sand system, where it may or may not be desired.

Sand binders, with the exception of some of the clay binders, where present, tend to be destroyed by the heat from the casting and are not normally reclaimed. In my invention I am concerned only with the reclamation of chemically bonded sand of the self-hardening organic types. My method relates, generally, to baked molds and, more particularly, to flaskless molds made from oil or chemically bonded sands, where the sand has to be subjected to some conditioning before it can successfully be reused.

I have discovered that sand of the organic chemically bonded self-hardening type may be reclaimed for reuse by abrading it with metallic particles while cleaning the castings, which it has been used to make and then separating the metallic shot from the sand. Hitherto, such separation has been conducted only with a view to reclaiming the metallic shot for reuse. No consideration has been given to the reuse of the sand in the making of organically bonded self-hardening sands.

SUMMARY OF THE INVENTION

Broadly stated, the instant invention and its attendant objects are accomplished by a process wherein a complete sand mold may be treated in such a way that the casting is blasted and the sand is reclaimed in a closed container in a single step, thereby avoiding the separate steps of casting shakeout, casting cleaning by blasting and sand reclamation to make the sand usable.

In practicing my invention, the complete mold (flaskless) containing the solidified casting, is placed in a

convenient holder in a blasting room and is subjected to the blasting action of a suitable cleaning medium such as metallic shot. This blasting action disintegrates the molds, removes all sand lumps and abrades the sand grains. At the same time, it cleans the surface of the casting. Subsequently, the sand and metallic shot are passed through a magnetic and then air separator, where the shot is removed and the sand, thus treated, is ready for immediate use.

In another embodiment of my invention the sand and shot are conveyed to a tower by means of an oscillating conveyor and bucket elevator. The mixture of sand and shot is then caused to fall through this tower and is subjected to a controlled air blast, where the sand and the metallic shot become effectively separated by virtue of the considerably higher specific gravity of the metallic shot.

The main feature of my invention is to subject the complete mold to the action of abrasive metallic shot, so that this sand is broken down and abraded to the point where it becomes reusable in a sand mixture. Shot blasting cabinets for cleaning castings are in common use, but any sand removed from castings is only that which has been unavoidably left on the casting and this sand is usually discarded because the sand reclamation power of an abrasive shot machine has never previously been properly regulated and employed to accomplish the objects of my invention.

I have found that eliminating the shakeout and cleaning operations in this way saves considerably extra handling, eliminates the noise and air pollution attendant with the shakeout operation and is an extremely rapid method of removing the casting from the sand mold; thus, in addition to being able to clean and scrub the sand, I am able to considerably reduce the cost and, in effect, virtually eliminate the cost of the shakeout operation as applied to flaskless molds made in cake cores. I do not want to limit myself to flaskless molds, because a casting contained in a flask or molding box could also be cleaned by my method, but I prefer flaskless molds to avoid the necessity of extra handling of these molding boxes.

I prefer, also, to use chemically bonded sands ... that is, sands containing oil, along with a chemical hardener, to eliminate the step of baking the molds. For example, furan-acid combinations or iso-cyanate combinations are particularly useful in practicing my invention.

BRIEF DESCRIPTION OF THE DRAWING

The attached drawing is a flow diagram which illustrates in a graphic manner the preferred practice of my invention.

Now referring to the drawing in more detail, there is shown a flow diagram representing the preferred embodiment of my invention using cake molds made from chemically bonded sands. The ribbon flow mixer 11 prepares the sand and molds at position 15. The mold is cast in position 16 and the mold and casting together are moved to the abrasive blasting cabinet 19, where the mold is disintegrated and the casting is cleaned in a single step. The sand and shot pass through an oscillating conveyor and magnetic separator 29, a bucket elevator 20, an air separator 21 and a fume and dust remover 18. Reclaimed sand passes into a hopper 23, a pneumatic transporter 24, and through pipes 25, to a pneumatic receiver 26 and the storage hopper 23.

From this hopper it then passes through the ribbon flow mixer 11, to make a new mold.

DESCRIPTION OF THE PREFERRED PRACTICE OF THE INVENTION

It may be seen from the foregoing description of the preferred flow cycle of the invention that I have considerably simplified the procedure for making a casting compared to a conventional dry sand molding system. In particular, I have eliminated the conventional shakeout system which is a prime source of fumes and noise and I have been able to render the molding sand reusable by the action of the abrasive shot in the cabinet and dust removal action in the separator. This elimination of steps in the procedure and prices of equipment, considerably lowers the cost of the overall operation. Particularly the method of reclaiming sand reduces cost and eliminates noise pollution and air pollution.

In order to determine the effect of the cleaning action of metallic shot on the properties of a typical sand, I conducted a series of experiments. I made a sand mix using an isocyanate binder system, made a casting, reclaimed the sand according to the process of my invention, prepared a sand mix from this reclaimed sand and made another casting. I repeated the steps of reclaiming the sand, making another mix and another casting eight times. Each time I prepared a sand mix I removed a sample of sand for testing, so that I could determine the properties of the reclaimed sand and those of the sand mix. A measurement of the loss on ignition, to determine the extent of build-up of organic carbon on the sand grains and a measurement of the tensile strength of the mix, made from the reclaimed sand, give the results tabulated below:

	Loss on Ignition	Tensile Strength
ORIGINAL SAND MIX	1.1%	240
SECOND SAND MIX	2.0%	230
THIRD SAND MIX	2.4%	225
FOURTH SAND MIX	2.4%	210
FIFTH SAND MIX	2.6%	225
SIXTH SAND MIX	2.5%	210
SEVENTH SAND MIX	2.4%	240
EIGHTH SAND MIX	2.4%	220

It may be seen that the buildup of organic carbon is not progressive, but is kept at a relatively constant value of approximately 2 ½ percent and is preferably always kept below 3 percent. It may be seen, also, that the tensile strength of the sand mix was not affected by using the reclaimed sand and compares very favorably with that obtained in the original sand mix, which had not been reclaimed.

As an example of the practice of the invention, I prepared several molds from a sand mix containing 1 ¾ percent furan resin and 0.75 percent phosphoric acid, as a setting agent. The sand used for this had the grain size distribution shown in Column A of the Table. The molds in the form of cake cores were cast and the complete molds and castings were placed in an abrasive shot cabinet, where they were blasted for three minutes. The castings were removed from the cabinet and were found to be completely clean by normal blasting standards. The mixture of sand and shot was passed through an air separator and the sand was returned to the sand mixer. A sample of this sand was tested and was found to contain 0.2 percent metallic shot and exhibited the grain size shown in Column B of the Table. Several more molds were made from this sand and the cycle was repeated. The castings produced in this sec-

ond cycle were to the same standard of quality as the castings produced in the first cycle and the sand was considered suitable for reuse.

T A B L E
% RETAINED ON EACH MESH

AFS GRAIN SIZE	COLUMN A Original Sand	COLUMN B After 1 Cycle
6 mesh		
12 mesh		
20 mesh	0.20	0.48
30 mesh	1.10	1.36
40 mesh	3.84	4.96
50 mesh	14.90	15.70
70 mesh	37.26	36.42
100 mesh	25.10	25.74
140 mesh	9.90	9.30
200 mesh	3.80	3.70
270 mesh	1.90	1.20
PAN	2.00	1.14

In the process of my invention substantially all the sand contained in the mold is passed through an abrasive grit (metallic shot, as shown above) blasting cabinet for the purpose of reclaiming this sand for future use. This reclaiming action controls the residual carbon on the sand grains, rendering them suitable for reuse. I have found, in fact, that it is possible to reduce the amount of binders used in the sand mix slightly when the mix is made from this reclaimed sand. I have also found that some loss of total sand volume occurs and this has to be replaced by new sand additions. This seldom amounts to more than 10 percent, but in any case, this small dilution of the system sand with new sand does not basically detract from the sand properties of mixes made from the reclaimed sand. I have, in general, not found it necessary to resort to calcining to remove carbon deposits from the sand grains.

Although the instant invention has been described herein in its preferred form with a certain degree of particularity, it is to be understood that the present disclosure is illustrative only and that numerous changes in the details of the practice of the invention can be made without departing from its spirit and scope as is hereinafter claimed.

What is claimed is:

1. A method for molding articles which comprises forming a chemically bonded sand mold of the desired

configuration, casting an article therein, and subjecting said sand mold while containing said cast article to a metallic shot blasting force in a dry environment sufficient to remove the sand mold from said article and clean the sand from said article and essentially concurrently destroying the chemical bond which holds the individual sand particles together during the mold forming and casting operation whereby the sand used to form said mold is rendered reusable for subsequent mold forming operations.

2. The method of claim 1, wherein the sand mold is a flaskless mold.

3. The method of claim 1, wherein the duration of the exposure of said mold to said metallic shot is approximately three minutes.

4. The method of claim 1, wherein the resultant mixture of mold sand and metallic shot is passed through an air separator to remove the bulk of the metal shot from the reusable sand.

5. The method of claim 1, wherein the resultant mixture of mold sand and metallic shot is subjected to the action of a magnetic separator to remove the bulk of the metallic shot from the usable sand.

6. In the process of forming metal articles by casting them in an organic chemically bonded sand mold of the self-hardening type, the improvement which comprises subjecting the cast metal article while substantially entirely contained in the chemically bonded sand mold to a metallic shot blasting force in a dry environment for a time which is sufficient to remove the sand mold from the cast article and clear the sand from the cast article and concurrently disintegrate the binder phase found in the chemically bonded sand to thereby render the mold sand immediately reusable without further treatment other than separation of the metallic shot in subsequent mold forming operations, the above treatment keeping the organic build-up on the sand resulting from the chemical bond to less than 3 percent based on the weight of the sand.

7. The process of claim 6, wherein the sand mold is a flaskless mold.

8. The process of claim 6, wherein said time is approximately 3 minutes.

* * * * *

45

50

55

60

65