United States Patent

Bowling, Jr.

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[54] **ABRASIVE BLAST CLEANING SYSTEM**

[72] Inventor: **Joseph E. Bowling, Jr.,** Waynesboro, Pa.

[73] Assignee: **The Carborundum Company,** Niagara Falls, N.Y.

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[52] **U.S. Cl.** **51/9**

[51] **Int. Cl.** **B24c 3/08**

[58] **Field of Search** 51/9, 8, 14, 319, 320; 241/DIG. 10, 77

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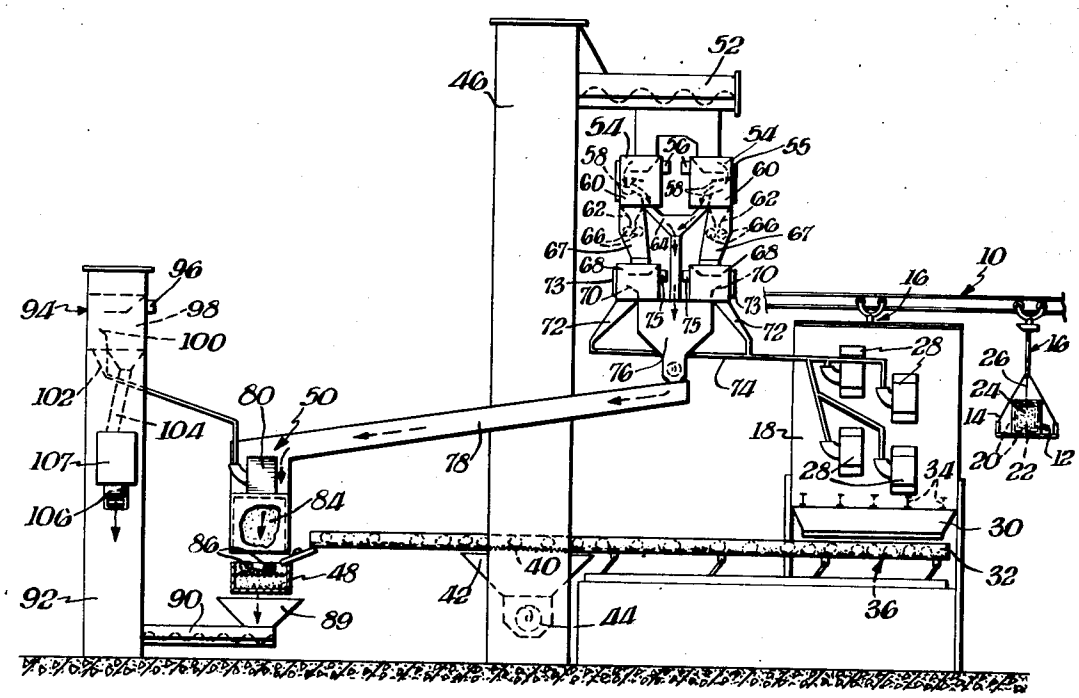
Primary Examiner—Donald G. Kelly

Attorney—David E. Dougherty and Robert E. Walter

[57] **ABSTRACT**

An abrasive blast cleaning system includes a pair of separators for separating sand from abrasive particles in conjunction with a no-bake molding procedure with crushing rollers being provided between the separators to crush small lumps of pea size sand.

7 Claims, 2 Drawing Figures



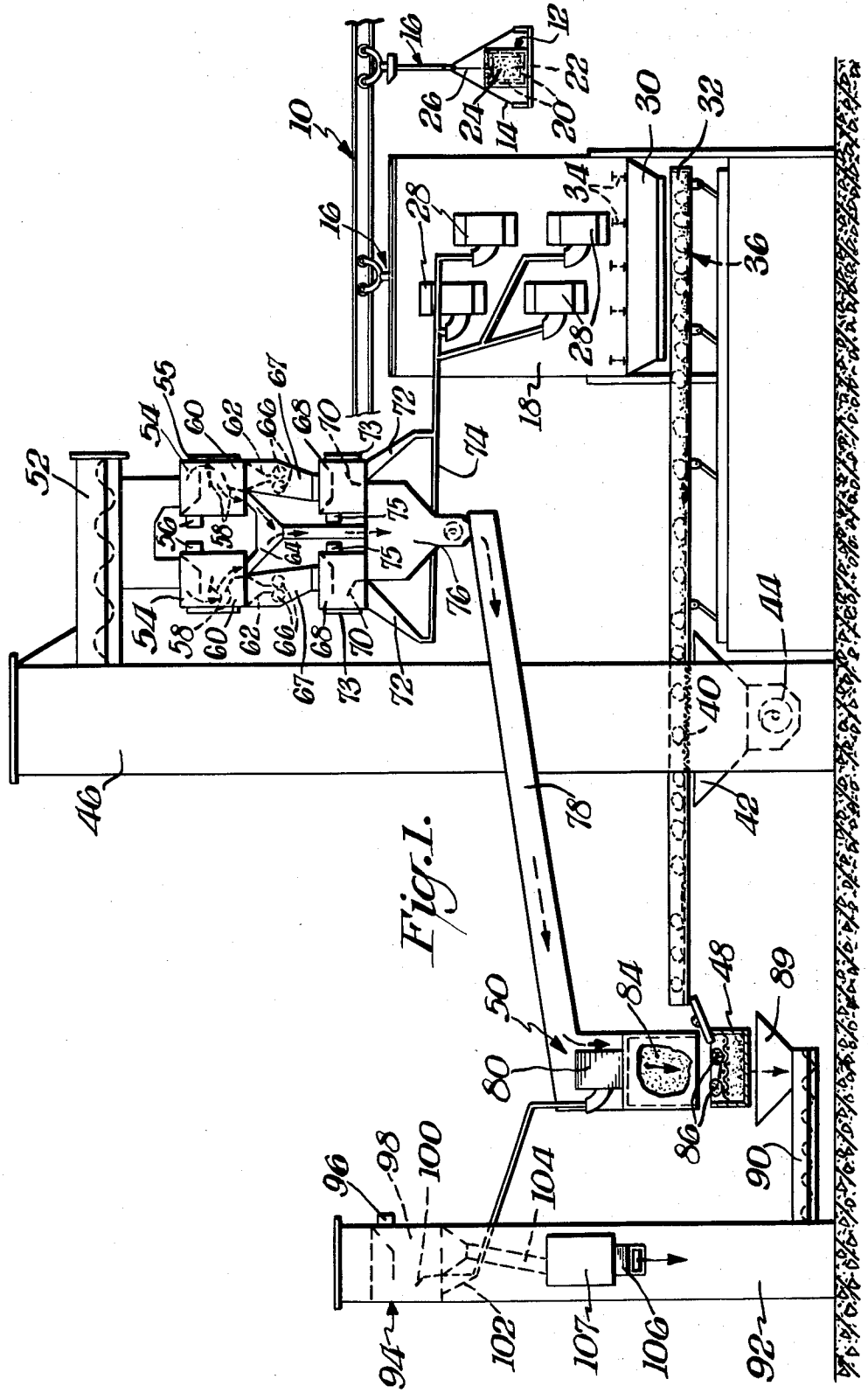
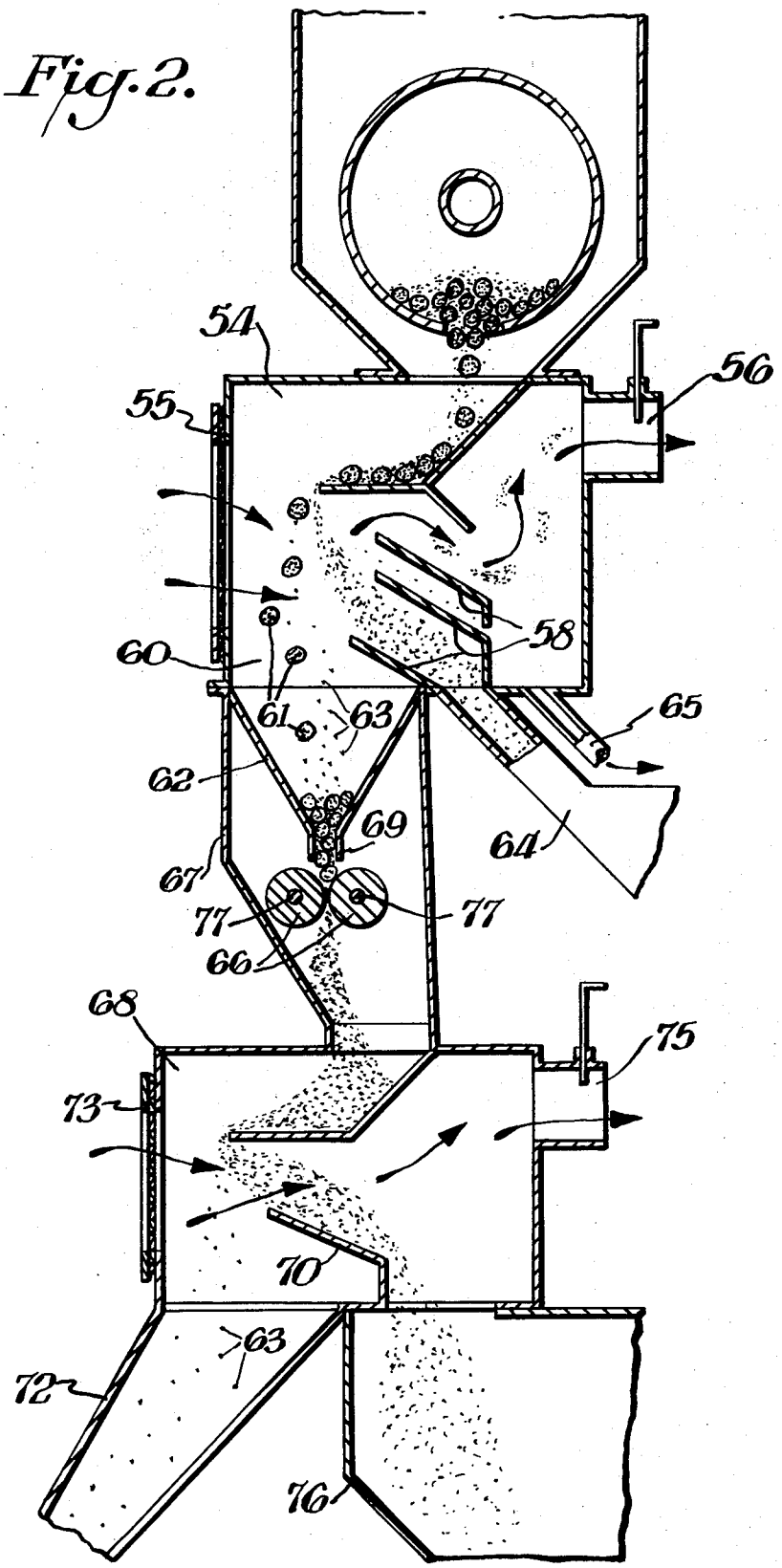

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Fig. 1.

Fig. 2.



ABRASIVE BLAST CLEANING SYSTEM

BACKGROUND OF INVENTION

A recent development in the casting industry is the use of chemical bonded molds. Essentially this practice utilizes quality sand, a chemical binder and a catalyst which are mixed together and hardened into a solid cake at ambient temperatures. Accordingly, baking is not required for such molds and the practice is, therefore, known in the art as "no-bake" molding. Generally the base binder used in no-bake molding is either an acid base such as a chemical binder with phosphoric acid as the activator or is an oil base. In practice the no-bake mold pattern is disposed in a topless frame on, for example a support table with the no-bake ingredients being added to form a cavity corresponding to one portion of the casting and with rigidifying rods added thereto. The mold is then inverted and the complementary portion of the no-bake mold is formed thereon so that the resultant composite cavity corresponds to the casting. Suitable gating is of course also provided. This practice is generally similar to standard foundry techniques but thus differs in at least one major respect, namely, the no-bake molding equipment does not require a heavy flask in which to house the sand when the molten metal is subsequently applied to the cavity. Even the topless frame used initially in the process is not needed during the casting forming step.

The no-bake molding process potentially represents a significant advancement in the foundry art since it offers a number of distinct advantages. For example the molds are easier to make without requiring a skilled molder. There is a cleaner environment with less dust and spillage than with green sand molding. The no-bake technique is quicker since jolt mechanisms are not required. Simple form boxes or topless frames are merely necessary to shape the mold rather than the conventional heavy flasks. The molds can be handled without breaking apart by providing a grid plate or strapping and thereby the mold with its casting can be moved to a shaker or cleaning process without breaking apart. It has been suggested that the mold shell or sand can be removed by blasting and in such case the mold shell and core can be handled to the interior of a blast machine where the sand and dust can be contained and shakeout noise eliminated. Moreover, the casting finish is thereby improved and casting tolerances can be tightened with the castings matching the pattern. The castings can go directly to numerically controlled machines, thereby obviating the need for rough cuts on manual machines.

Despite, the numerous advantages such as indicated above which are possible with no-bake molding, there are a number of serious disadvantages which might cause this process to meet stiff acceptance by the foundry art. These disadvantages include the increased costs for quality grade sand which might cost three or four times more than the cost of green sands. Since quality sand is used this sand must be reclaimed for reuse to make the entire process economically feasible.

Although attempts are being made at reclaiming and reusing the sand, experts cannot agree on the percentage of reclaiming possible with a system nor the qualities needed or obtained by a system. The publication, Foundry, September 1970, pages 83—89, for example, describes one such attempt at sand reclamation. The

reclaimed sands with the present systems, however, are not uniform in qualities. In this respect the build-up of fines and/or organics seriously affects the molds using reclaimed sands. Moreover, proposed reclaiming systems require shakers, crushers or Muller type units which are noisy and dusty and also require rather large floor space and head room with high maintenance and capital costs.

SUMMARY OF INVENTION

An object of this invention is to provide an abrasive blasting system which includes means for effectively separating sand from abrasive particles.

A further object of this invention is to provide such a system which is particularly adapted to be used in conjunction with the no-bake molding process.

In accordance with this invention an abrasive blast cleaning system includes a pair of separators for separating sand from abrasive particles in conjunction with a no-bake molding procedure with crushing rollers being provided between the separators to crush small lumps of pea size sand.

The separators may be of the air wash type which include skimmer plates for dividing the mixture passed thereto into the individual streams. The lowermost separator of each pair need only include one skimmer plate since the mixture passed through that separator contains only sand and abrasive particles. The crushing rollers may be made of a wear resistant material such as polyurethane.

THE DRAWINGS

FIG. 1 is a side elevation view schematically showing one embodiment of this invention and

FIG. 2 is a cross-sectional elevation view on an enlarged scale of a portion of the embodiment in FIG. 1.

DETAILED DESCRIPTION

Recently filed application Ser. No. 108,417, filed Jan. 21, 1971, in the names of James H. Carpenter and Joseph E. Bowling, Jr., is concerned with a comprehensive abrasive blast cleaning system used in conjunction with the no-bake mold process. The system of that application generally includes means for the granulation and scouring of the sand used in a no-bake mold for ultimate reuse of the sand. In conjunction with that system separating means are disclosed for effectively separating the granulated sand from abrasive particles. This application is concerned with a particular aspect of that system, namely, the means for assuring complete separation of the sand from the abrasive particles by the inclusion of crushing means between a pair of air wash separators for crushing pea sized lumps of sand discharged from the first separator and prior to its passage into the second separator.

FIG. 1 illustrates the general arrangement of the system disclosed in the copending application. As indicated therein a no-bake mold **12** is held in an open frame **14** and conveyed on monorail **16** into blast chamber **18**. As is conventional with such no-bake molds rigidifying rods **20** as well as a casting **22** are embedded in the sand **24**. Means **26** are provided to suspend the casting when the sand is later removed.

Blast chamber **18** is provided with a plurality of centrifugal throwing wheels **28** which project abrasive particles against the mold to remove the sand and rods therefrom and thereby clean the then exposed casting in one operation. When the sand is removed from the mold it has been found that about 25 percent of the sand is in lump form while the remaining 75 percent is in granular form. The falling sand, rods, spent abrasive, fines and other contaminants fall through the bottom **30** of chamber **18** and are received on oscillating conveyor **32**. To facilitate the discharge of this mixture of sand, abrasive, etc., from chamber **18** the floor of the chamber is made with maximal open area. Ideally chamber **18** would be completely floorless. It is generally desired, however, to have some structural members at the bottom of chamber **18** to permit workmen to enter for various purposes. Thus as shown in FIG. **1** spaced I-beams **34** are provided so that the mixture **36** can be received on the oscillating conveyor **32** by falling through the large open areas between I-beams **34**.

The entire mixture **36** is conveyed on oscillating conveyor **32** until the mixture reaches a portion of the conveyor which includes a screen **40** of appropriate mesh size to permit the fine grain abrasives, fines, and other contaminants to fall into hopper **42** and thence to screw conveyor **44** where it is received by elevator **46** for separation as later described. The remaining portion of mixture **36** which includes lumps, rods, and any other elements which may be carried with the mixture is conveyed to the end of oscillator **32** and drops onto generally perpendicular oscillating conveyor **48** until it reaches the second blast station **50**.

Blast station **50** includes a conventional centrifugal throwing wheel **80** which uses generally large size metal shot projected at a high flow rate at for example 1,200 to 1700 rpm or lower. The metal shot strikes the lumps to granulate them while also knocking the organics off the grains of sand. Advantageously the sand which had been separated by the separators **54** and **68** (as later described) is also passed into the blast stream from wheel **80** so that the organic binder is removed from this sand. For example the falling sand from conduit **78** may drop between the blast stream from wheel **80** and a strike plate **84**. In this manner the abrasive particles from a portion of the blast stream hit the falling sand and causes the sand grains to strike each other and to ricochet against the strike plate **84**. The resulting impacts effectively remove the organic binder. In the meantime the remaining portion of the blast stream granulates and scours the lumps **86** and cleans the rods **20** which are moving on oscillating conveyor **48**. A portion of oscillating conveyor **48** is provided with a screen deck of appropriate mesh size to permit the granulated sand and abrasive particles to fall into hopper **89** to screw conveyor **90**. The larger rods, however, continue to flow on oscillator **48** and are ultimately discharged and collected in any suitable receptacle (not shown). Thus the rods are received from blast station **50** in a cleaned condition for reuse.

From screw conveyor **90** the mixture of granulated reconditioned sand and abrasive particles are fed to elevator **92** and then to separator **94** which also is of the air wash type previously described including air curtain inlet **96** and skimmer plate **100** in separation chamber **98**. The mixture is thereby divided into one stream of abrasive particles which is received in spout **102** and conveyed back to abrasive blast wheel **80** while the stream of reconditioned sand is received in spout **104** and discharged from outlet **106** and into any suitable receptacle (not shown) for reuse.

Prior to discharge from outlet **106** the sand may pass through magnetic drum separator **107** to remove the small quantity of metal abrasive that may be mixed in with the otherwise substantially pure sand.

As previously described a portion of the mixture is received in elevator **46**. This portion is discharged into screw conveyor **52** and into any suitable number of separators **54**. FIG. **2** shows the details of this portion of the arrangement, of which this invention is particularly concerned. As shown therein separators **54** are of the air wash type such as described and illustrated in U. S. Pat. No. 3,368,677 the details of which are incorporated herein by reference thereto. In general the air wash separator **54** subjects the falling mixture to an air curtain supplied for example at inlet **55**. A number of skimmer plates **58** are provided in the separating chamber **60** to facilitate a separation of the mixture into individual streams in accordance with their weight. In this respect the abrasive particles are heavier than the sand which in turn is heavier than the fines. Thus the abrasive particles fall generally directly downward into discharge conduit **62** while the fine grained sand is slightly diverted and received in discharge conduit **64**. Discharge conduit **65** is provided for the fines and other contaminants, while dust in the air curtain exits through outlet **56** to a dust collector (not shown).

It has been found that the sand in the mixture fed to separators **54** is not always of the desired size of fineness but frequently is in smaller lumps **61** which may be termed pea size. Generally such pea sized lumps are about 3/16 – ¼ inch in diameter. Since this pea size lumps of sand is heavier than the fine grain size lumps of, the pea size sand **61** will also go into conduit **62** with the abrasive particles **63** which are large size metal shot. Accordingly, it is necessary that this sand be separated from the abrasive particles if the sand recovered is to be maximized not only for reuse of the sand but also for reuse of the abrasive particles. Accordingly, the mixture of pea size lumps of sand **61** and abrasive particles **63** undergoes a second separation process. This second separation process includes feeding the mixture of abrasive particles and pea size lumps of sand through pairs of juxtaposed rollers **66** which may be made of wear resistant polyurethane. The cylindrical rollers **66** may be mounted on shafts **77** in housing **67** at the mouth **69** of spout **62**. The closely positioned rotating rollers crush the pea size lumps of sand **61** into its fine granular form **71** while of course permitting the abrasive particles **63** to retain their normal size. This mixture of crushed sand and abrasive particles is then fed into separator **68** which is of the air wash type similar to separators **54** except that only one skimmer plate **70** is necessary since the mixture will be divided into only two streams. Air is supplied through inlet **73** and is discharged along with any airborne contaminants through outlet **75**. The substantially pure abrasive particles are received in spout **72** for reuse by blast wheels **28** by conveyance through pipes **74** (FIG. **1**). The fine grain sand is received in hopper **76** where

it mixes with the fine grain flowing from conduits **64** and is conveyed through conduit **78** to the blast station **50** (FIG. **1**).

What is claimed is:

1. An abrasive blast cleaning system comprising abrasive blast means for removing a casting from a no-bake mold and creating a mixture which includes fine granulated sand and pea size lumps of sand and abrasive particles, separating means, conveying means for transporting at least a portion of said mixture to said separating means, said separating means comprising a first separator for receiving the portion of said mixture and separating it into individual streams which includes one stream of abrasive particles and pea size lumps of sand, a second separator under said first separator, crushing means between said first separator and said second separator for granulating the pea size lumps of sand in the one stream and feeding the one stream to said second separator, and said second separator separating the one stream into individual sub-streams of abrasive particles and granulated sand.

2. The system of claim **1** wherein said crushing means includes a pair of juxtaposed rotatable rollers.

3. The system of claim **2** wherein each of said first and said second separators is an air wash separator with an air curtain inlet and an air curtain outlet.

4. The system of claim **3** wherein said first separator includes a plurality of skimmer plates, and said second separator including a single skimmer plate.

5. The system of claim **4** wherein each of said separators includes discharge means for discharging a stream of granulated sand, and both of said discharge means communicating with a common hopper.

6. The system of claim **5** wherein said rollers are made of wear resistant polyurethane.

7. The system of claim **6** wherein said second separator includes means for feeding its stream of abrasive particles to said abrasive blast means.

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