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Carpenter

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[54] **APPARATUS FOR GRANULATING MOLDED SAND**

[75] Inventor: **James H. Carpenter,** Hagerstown, Md.

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

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[52] **U.S. Cl.** **241/301,** 241/DIG. 10

[51] **Int. Cl.** **B02c 19/00**

[58] **Field of Search** ..... 241/5, 22, 68, 69, 241/77, 263, 264, 265, 273.1, 274, 301, DIG. 10; 51/9, 14

[56] **References Cited**

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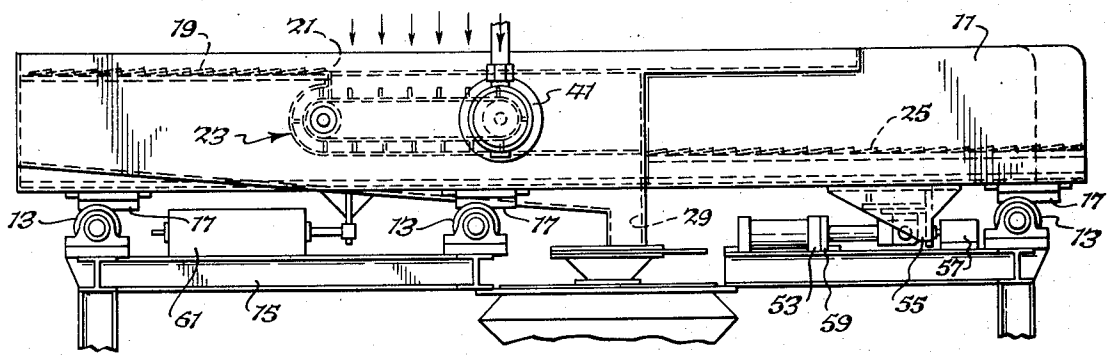
Primary Examiner—Granville Y. Custer, Jr.

Attorney—David E. Dougherty et al.

[57] **ABSTRACT**

In an apparatus for granulating molded sand, the feed material including lumps of molded sand from a first conveying surface are discharged onto the upper section of an endless conveyor which moves the material through a stream of abrasive particles and discharges the granulated sand and accumulated abrasive particles on a second conveying surface.

13 Claims, 4 Drawing Figures



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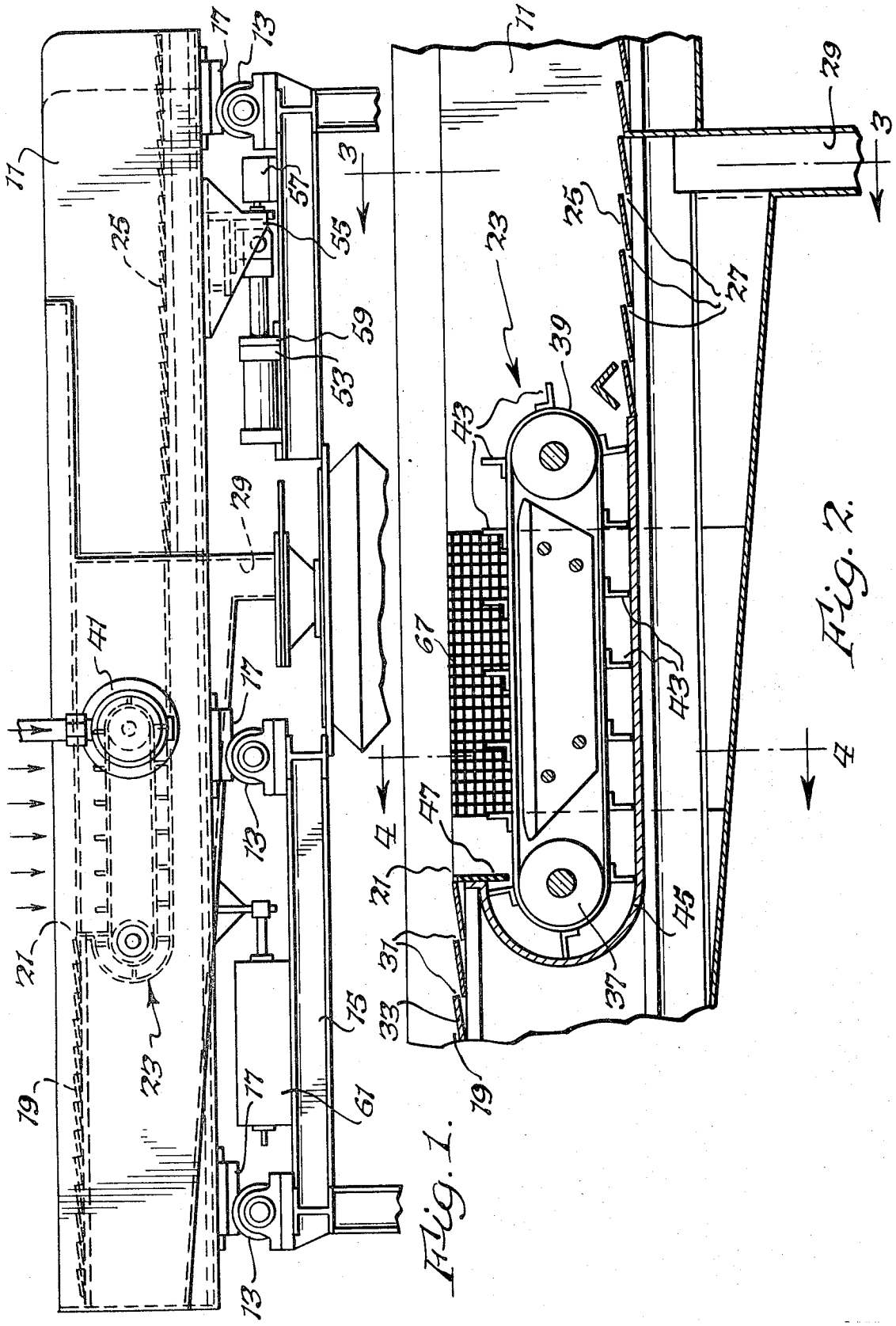

Fig. 1.

Fig. 2.

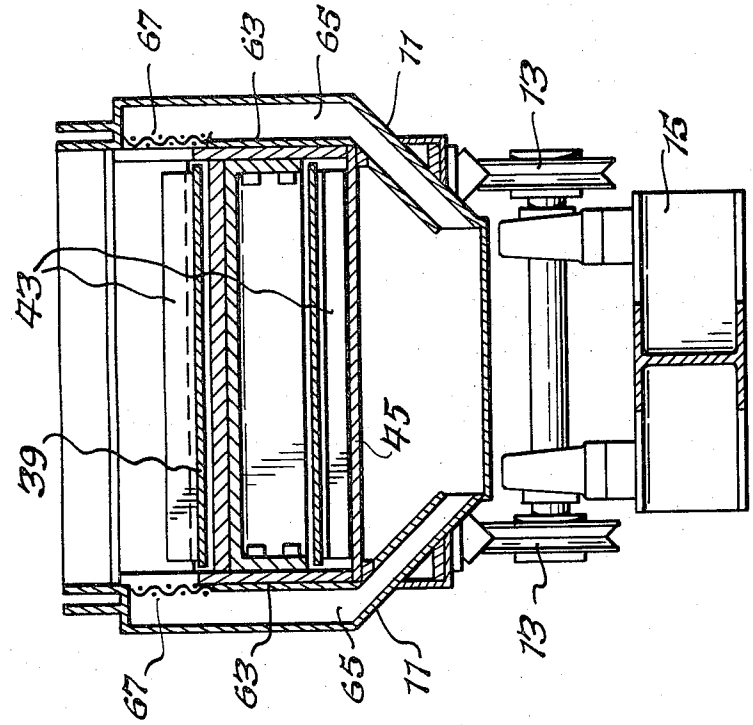

Fig. 4.

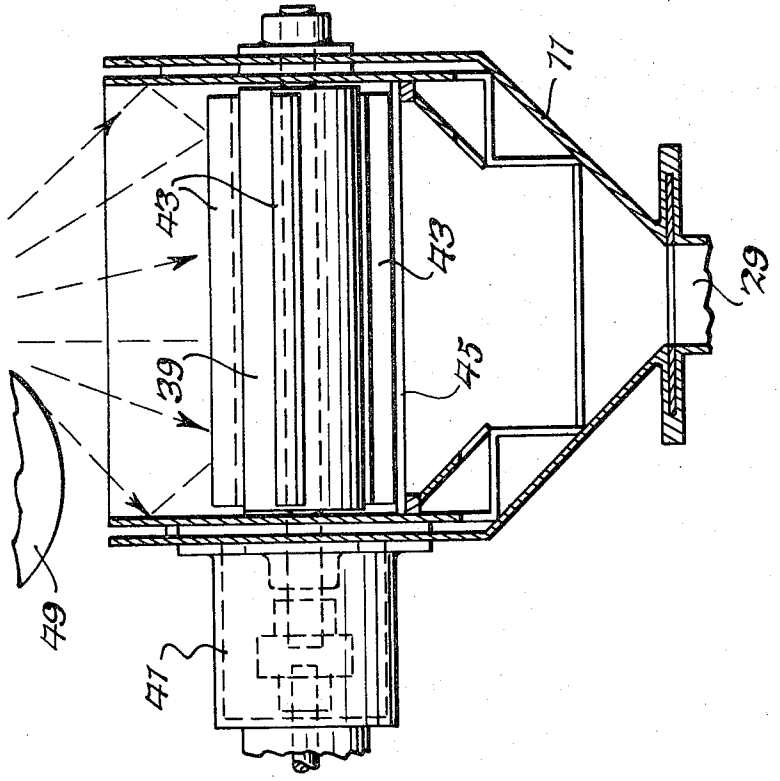

Fig. 3.

APPARATUS FOR GRANULATING MOLDED SAND

BACKGROUND OF THE INVENTION

The present invention relates to the reclamation of sand used to produce molds for foundry castings.

Reconditioning of used sand involves reducing molded sand lumps to individual sand grains and removing metallic particles, sintered clusters of said grains, excessive fines and other tramp and objectionable material. The quality of reclaimed sand must be comparable to that of new sand so that it may be satisfactorily substituted for new sand in sand mixtures without appreciably changing the proportions of sand, chemical binders and catalysts.

More foundries are adopting a practice utilizing quality sand, a chemical binder and a catalyst which are mixed together and hardened into a solid cake at ambient temperatures to form a chemically bonded mold. Since baking is not required, this process is known in the art as "no-bake" molding. The no-bake molding process has distinct advantages such as ease of making a mold, a cleaner environment, ease of handling a completed mold and improved casting finishes and casting tolerances.

Despite the numerous advantages, there are a number of disadvantages such as the increased cost of quality grade sand. Therefore, the effective and efficient recycling of sand can play a significant part in making the no-bake process economically attractive. One of the steps in the reclamation of sand used in no-bake molding is the reduction of lumps of molded no-bake sand. Prior art apparatus include hammer mills, ring crushers, jaw or roll crushers. The use of these prior art apparatus generally result in the generation of excessive amounts of dust which is an undesirable pollutant and is evidence that sand grains which might otherwise be reused are being crushed. Furthermore, these devices of the prior art subject moving parts to excessive wear and stresses which can decrease machine life while increasing the frequency of repair. Heretofore, apparatus of the prior art have not effectively and efficiently reclaimed sand devoid of objectionable material.

SUMMARY OF THE INVENTION

In an apparatus for granulating lumps of molded sand, a first conveying surface is provided for transporting lumps of molded sand onto the upper section of an endless conveyor which provides for a positive drive of the lumpy material through a stream of projected abrasive particles. The granulated sand and spent abrasive is deposited on a second surface for subsequent separation.

The use of the apparatus of the present invention results in a good yield of granulated sand without excessive wear on machine parts. The removal of objectionable material is also achieved. Therefore, many of the deficiencies of prior art devices are obviated by the apparatus of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings which illustrate a preferred embodiment of the present invention are as follows:

FIG. 1 is a side elevational view of the apparatus of the present invention;

FIG. 2 is a side elevational view in section showing a portion of the apparatus of FIG. 1 in detail;

FIG. 3 is an end elevational view along section 3—3 of FIG. 2; and

FIG. 4 is an end elevational view along section 4—4 of FIG. 2.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Referring to FIG. 1 in more detail, a rectangular trough 11 having a closed bottom and an open top is supported for horizontal oscillation. A plurality of wheels or rollers 13 are mounted for rotation on a frame 15 or support member. The trough 11 rides on a plurality of tracks 17 which are attached to the bottom of the trough 11 and contact the rollers 13 for permitting horizontal movement.

A substantially horizontally disposed surface 19 is provided in the upper portion of the trough 11 between the vertical sides thereof. A feed mixture including lumps of molded sand to be granulated is deposited on the upper surface 19 by suitable means, such as a conveyor or hopper with a control valve.

One method of forming the feed mixture comprises projecting abrasive particles against a mold with a casting therein to remove the sand and rods from the casting and cleaning the exposed casting in one operation. This can be accomplished in a blast chamber with sand, rods, spent abrasive, fines and other contaminants falling through the bottom of the blast chamber from where it is conveyed to the surface 19 in the trough 11.

Oscillation of the upper surface 19 causes the feed mixture to move forwardly along the surface 19 to a discharge end 21. The feed mixture drops from the discharge end 21 onto an endless conveyor 23 which conveys the mixture through a stream of abrasive particles which granulate the lumps of molded sand. The granulated sand is discharged from the endless conveyor 23 onto a lower surface 25 which is supported between the sides of the trough 11. The granulated sand and shot which pass through apertures 27 in the lower surface 25 are carried along the bottom of the trough 11 by the oscillation thereof and exit via an opening 29 in the bottom of the trough 11. The particles of a size larger than the apertures 27 in the lower surface 25 are conveyed along the surface 25 for discharge into a suitable receptacle for storage or for further processing.

Preferably the sand and shot mixture discharged from the bottom of the trough 11 is passed through an air wash separator of the type described in U.S. Pat. No. 3,368,677 wherein the falling mixture of sand and shot is subjected to an air curtain. Skimmer plates are provided in a separating chamber 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. The abrasive particles fall generally directly downwardly into a discharge conduit while the sand is slightly diverted and received in another discharge conduit. Thus, an effective separation of the shot from the reclaimed sand is attained. The core rods, trash and other material which are discharged from the lower surface 25 can be reused or disposed of.

According to a preferred embodiment of the present invention, the upper surface 19 comprises a plurality of serrations 31 with each serration having a support surface 33 inclined upwardly toward the discharge end 21. The serrations 31 comprise a plurality of rectangular slats extending across the width of the trough 11 with

the forward edge tilted upwardly. The consecutive serrations **31** can be separated by a small amount so as to permit loose sand to fall to the bottom of the trough **11.** Preferably, the lower surface **25** is formed in this manner. The oscillations of the trough **11** cause the feed material to move forward. Lumps of the material are pushed forward by a leading edge of respective serrations **31** as the trough **11** moves forward. As the trough **11** moves backward during an oscillation, the feed material tends to slide over the incline support surface **33.** Therefore, a general forward motion is imparted to the feed material deposited on the upper **19** and lower **25** surfaces.

As shown in detail in FIG. **2,** the lumps are discharged from one end **21** of the upper surface **19** and dropped onto the upper section of an endless conveyor **23.** The conveyor **23** includes a pair of rollers **37** extending widthwise across the trough **11** and each have a shaft journaled for rotation in bearings on either side of the trough **11.** An endless belt **39** is trained around the rollers **37** so as to present a substantially horizontal upper and lower section of the conveyor **23.** A suitable drive means, such as an air driven motor **41** is provided for driving the conveyor **23.** The outer surface of the belt **39** includes a plurality of projections **43** which aid in driving the lumps through the blasting stream. As illustrated in FIG. **2,** the projections **43** are in the form of ribs which have straight surfaces extending outwardly from the belt **39.** A surface or plate **45** is provided to conform to the return portion of the belt **39** so that material received in the plate **45** is conveyed by the return section through the abrasive blast stream. A rubber skirt **47** is provided between the discharge end of the upper surface and the conveyor to prevent the loss of ricocheting abrasive particles.

A stream of abrasive particles is projected in a path toward the upper section of the belt **39.** Preferably an abrasive throwing wheel **49** mounted on the shaft of a motor (not shown) has a shot path which is disposed crosswise with respect to the flow of material. In this case, the hottest area of the wheel stream is aimed downwardly toward the middle of the trough **11** and adjacent the discharge end **21** of the upper surface **19.** By providing a trough **11** with sufficiently high side walls, abrasive particles from the head stream and tail stream ricochet off the side walls and downwardly into the lumps to increase the effectiveness of the wheel stream at points remote from the hottest area. It is contemplated that a plurality of abrasive throwing wheels **49** can be mounted together to increase the width of the blast pattern.

The upper and lower surfaces **19** and **25,** respectively, are oscillated back and forth rapidly in a horizontal direction. As illustrated in FIG. **1,** the oscillation of the trough **11** is accomplished by a power device **53** connected at one end to the frame **15** and at the other end to the trough **11.** The power device **53** is in the form of a hydraulic cylinder and piston rod with the piston rod connected to a member **55** rigidly secured to the bottom of the trough **11.** At the extended position of the piston rod, there is provided a stop **57** attached to the frame and having a yieldable member secured thereto for limiting the forward stroke of the power device **53.** Another stop **59** having a yieldable member is also provided for limiting the backward stroke. Preferably the oscillating motion is such that the trough **11** moves backwardly more rapidly than it moves forwardly. At the forward end of the stroke there is preferably a sudden reversal which allows the sand lumps to continue moving forward due to their momentum while at the backward end of the stroke there is preferably a decelerating backward motion followed by an accelerating forward motion. Any suitable control **61,** such as a four-way hydraulic control can be used to regulate the motion of the power device **53.**

Any suitable power device **53** such as a mechanical, electrical, pneumatic or hydraulic means can be used to oscillate the trough **11.** The conventional mechanical oscillators generally use positive eccentric drives while the electrical operating systems operate on a release cycle or push-pull cycle using electro and/or permanent magnets. It is contemplated that any suitable type of power device or oscillating means **53** known in the prior art can be used to produce the oscillating motion.

A preferred embodiment of the present invention, as illustrated in FIG. **4,** includes side wall **63** which is adjacent the conveyor **23** and spaced from the side wall of the trough **11** so as to form a passage **65** communicating with the bottom of the trough **11.** The upper portion **67** of the side wall **63** is perforated so as to permit the passage of granulated sand and shot therethrough. As illustrated in FIG. **2,** the upper portion **67** is a screen comprising wear-resistant material. The screen is beneficial in that the drainage of abrasive and sand from the blast area is increased and the tendency for abrasive and sand to build up at the sides and corners is reduced.

It is contemplated that the lower and upper surfaces **19** and **25** can be gently sloped downwardly so as to permit an increased flow of material. In the interest of efficiency, minimized wear throughout the system, and proper flow of sand lumps, it is preferable to maintain a steady flow of lumps in a maximum capacity. Therefore, it is preferable to use a hopper or other suitable means at the entrance end of the conveyor for providing a reservoir of lumps to insure a steady influx of feed material.

Preferred embodiments of the present invention having been described herein, it is to be recognized that modifications, variations and changes therein will be apparent to one of ordinary skill in the art. It is contemplated that the claims appended herewith will cover such modifications, variations and changes therewith in the broad spirit and scope of the present invention.

What is claimed is:

1. Apparatus for granulating lumps of molded sand comprising: (a) a first surface having an end for discharging lumps of sand; (b) an endless conveyor positioned below said first surface for receiving lumps of sand discharged therefrom; (c) means for projecting abrasive particles in a path toward said endless conveyor for granulating lumps of molded sand; (d) a second surface for receiving granulated lumps of molded sand discharged from said endless conveyor; and (e) means for oscillating said first and second surfaces for transporting lumps of sand to and away from said endless conveyor.

2. Apparatus according to claim **1** wherein said first surface comprises a plurality of serrations, each serration having an inclined support surface.

3. Apparatus according to claim **1** wherein said second surface includes a plurality of apertures to permit granulated sand to pass therethrough.

4. Apparatus according to claim **1** wherein said pro-

jecting means comprises a centrifugal throwing wheel.

5. Apparatus according to claim **1** wherein said oscillating means comprises means for moving said first and second surfaces back and forth rapidly in a horizontal direction.

6. Apparatus according to claim **5** wherein said oscillating means is adapted to move said first and second surfaces backwardly more rapidly than said first and second surfaces are moved forwardly.

7. Apparatus according to claim **1** wherein said endless conveyor comprises a plurality of rollers mounted for rotation, an endless belt trained around said rollers, and means for driving said belt so as to move lumps of molded sand into the path of projected abrasive particles.

8. Apparatus according to claim **7** wherein said belt includes a plurality of projections for holding the lumps while being blasted.

9. Apparatus according to claim **8** wherein said belt includes an upper section and a lower return section, said apparatus including a surface spaced from said lower return section.

10. Apparatus according to claim **1** including a trough supported for oscillating movement, said first and second surfaces being supported by said trough, and said oscillating means being operably associated with said trough.

11. Apparatus according to claim **10** wherein said second surface includes a plurality of apertures for passage of granulated sand and abrasive particles, and the bottom of the trough being adapted to receive the granulated sand and abrasive particles, said bottom having an opening for the passage of granulated sand and abrasive particles.

12. Apparatus according to claim **11** wherein said endless conveyor comprises a pair of rollers, each roller mounted at either end thereof to respective sides of said trough for rotation.

13. Apparatus according to claim **12** including a wall adjacent the side of said conveyor and spaced from the side of said trough to form a channel extending to the bottom of said trough, said wall including a plurality of apertures for the passage of granulated sand and abrasive particles therethrough.

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