United States Patent

Devé

[15] 3,685,165

[45] Aug. 22, 1972

[54] **THERMAL SAND RECLAMATION UNIT**

[72] Inventor: **Vagn Devé**, Pittsburgh, Pa.

[73] Assignee: **Combustion Engineering, Inc.**, Windsor, Conn.

[22] Filed: **Oct. 12, 1970**

[21] Appl. No.: **79,951**

[52] **U.S. Cl.** .....**34/57 A**, 110/18 R, 263/21 A

[51] **Int. Cl.**.....**F26b 17/00**

[58] **Field of Search**.....263/21 A; 34/57 A; 110/18 R

[56] **References Cited**

UNITED STATES PATENTS

2,761,668	9/1956	Sylvest	34/57 A
3,362,083	1/1968	Galev	34/57 A

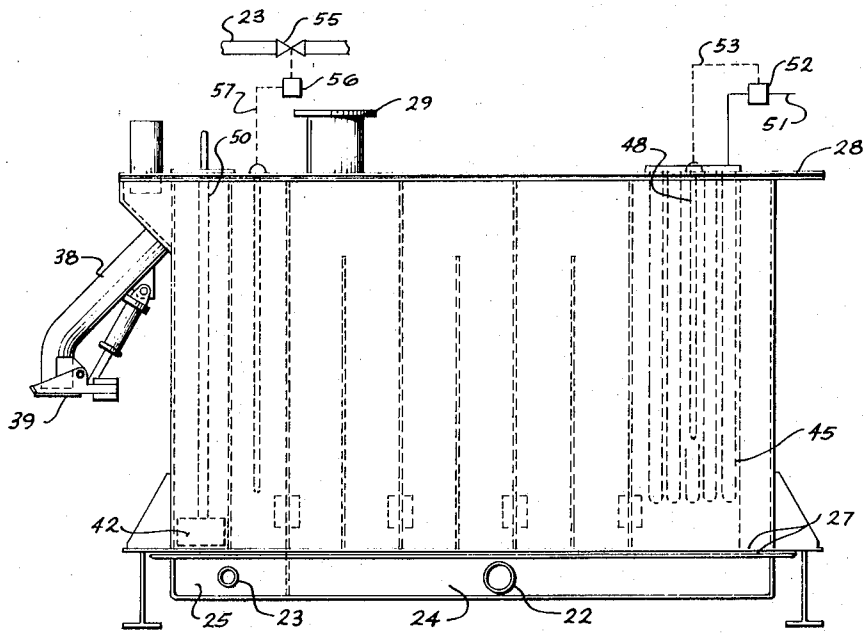
Primary Examiner—John J. Camby

Attorney—Carlton F. Bryant, Eldon H. Luther, Robert L. Olson, John F. Carney, Richard H. Berneike, Edward L. Kochey, Jr. and Lawrence P. Kessler

[57] **ABSTRACT**

Apparatus for thermally reclaiming resin coated sand comprising a plurality of vertical chambers in which the sand is fluidized. The chambers are in series flow relationship proceeding from an inlet chamber to a heating chamber and then to an outlet chamber. The intermediate heating and cooling chambers have a common wall between them so that heat is transferred from the sand to be cooled to the incoming sand. The heat input to the heating chamber is controlled in response to the sand temperature in that chamber. The fluidizing air to the inlet and outlet chambers may be separated from the remainder of the fluidized air and controlled in response to the outlet sand temperature by increasing the activity in the inlet and outlet chambers to reduce sand temperature and by decreasing the activity to reduce the outlet sand temperature. The inlet chamber is segmented to provide for the removal of heavy particles introduced to that chamber on an intermittent basis.

8 Claims, 3 Drawing Figures



PATENTED AUG 22 1972

3,685,165

SHEET 1 OF 2

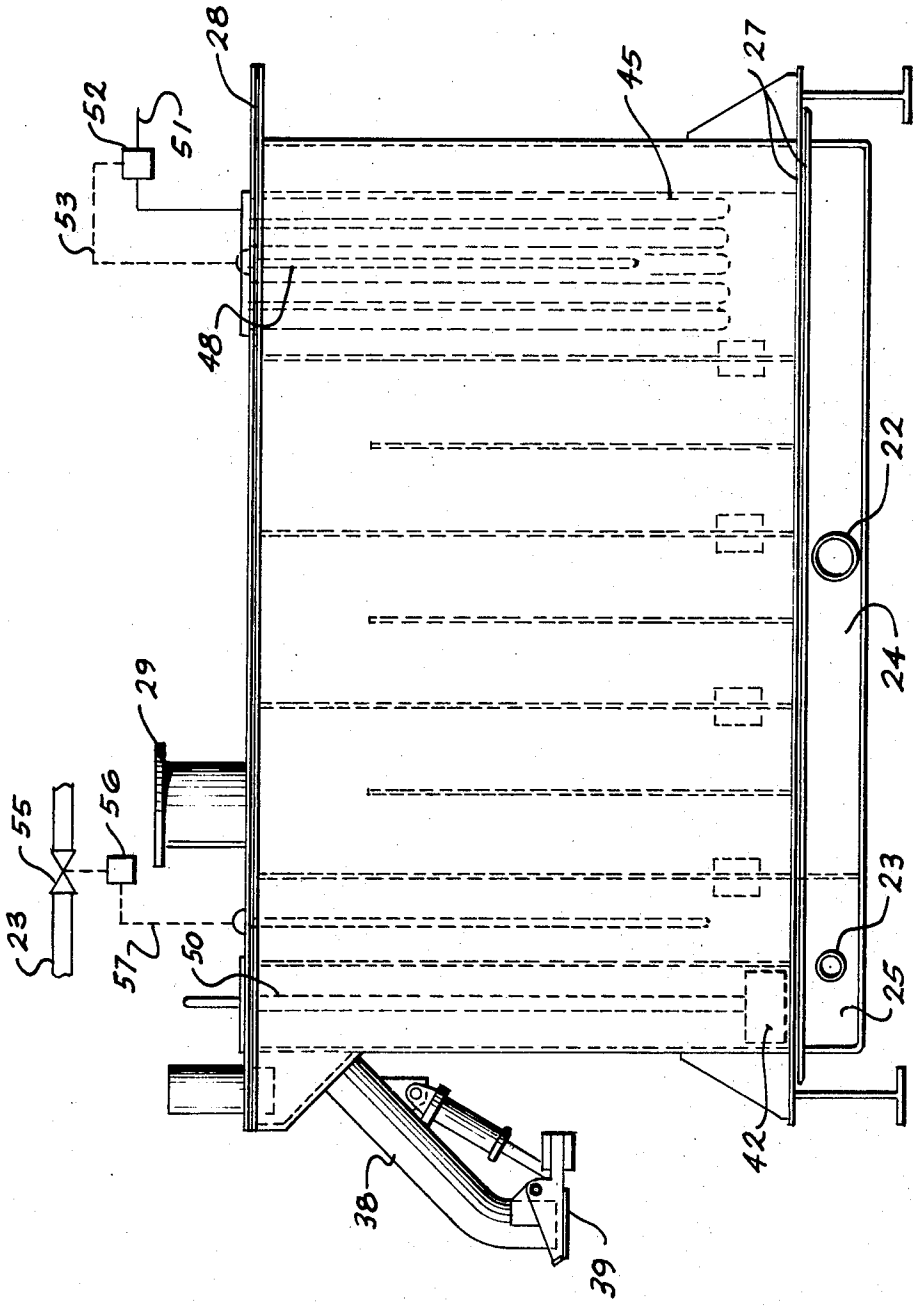


FIG. 1

INVENTOR.
VAGN DEVE'

BY E R Hockey

ATTORNEY

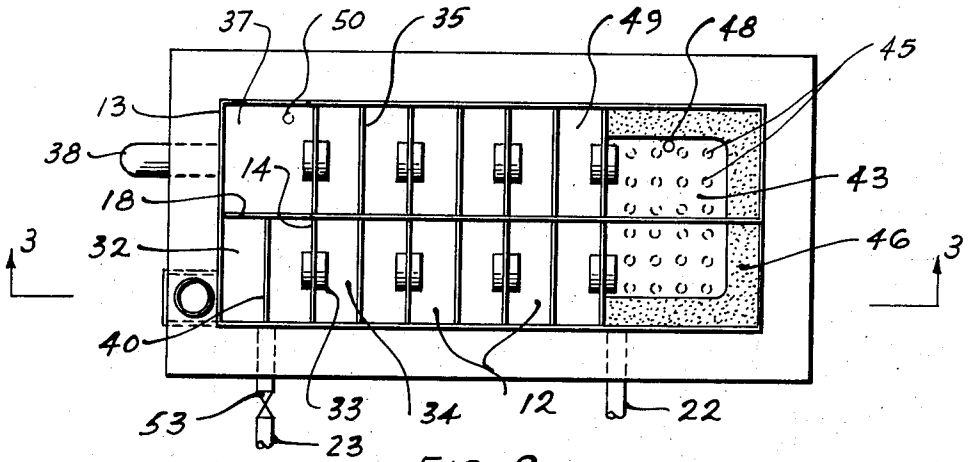


FIG-2

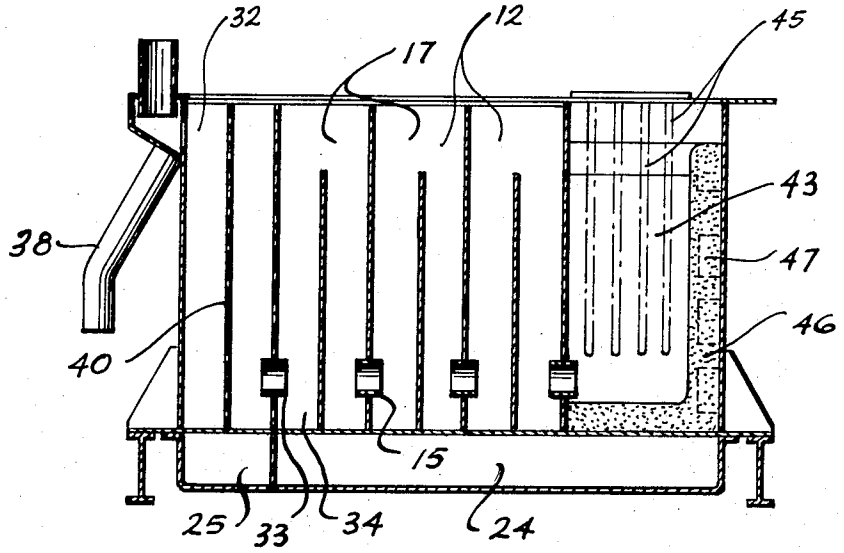


FIG-3

INVENTOR.
VAGN DEVE'

THERMAL SAND RECLAMATION UNIT

BACKGROUND OF THE INVENTION

This invention relates to sand core molding for foundries and in particular to a method and apparatus for reclaiming resin coated sand for reuse.

The cost of operating a foundry can be substantially reduced if the sand used for molding is reclaimed and used again. It has been recognized that it is important to thoroughly remove the resin coating on the recycled sand in order to achieve proper molding characteristics for the formation of cores. One method of achieving this is to burn off the resin by subjecting the sand to heat in rotary kilns and various type furnaces. These methods suffer from various objections including exposure of the sand to the contaminants in flue gases, the use of moving parts in a highly contaminated sand filled atmosphere, and the requirement of considerable heat input and high sand outlet temperatures requiring cooling of the sand for reuse.

SUMMARY OF THE INVENTION

In my invention the sand is fluidized and passes serially through a plurality of vertical chambers. The sand is preheated in the first series of chambers by taking the heat from the sand in the latter series of chambers thereby simultaneously preheating and cooling the sand. A portion of the contaminants is burned off the sand during this period thereby decreasing the high residence time at a high temperature. A common wall separates the preheating and cooling chambers so that the activity of the fluidized sand against this common wall operates to transfer heat from the sand to be cooled to the sand to be preheated.

Heat is introduced into the heating chamber preferably by electrical heating elements. The heat recovery in this apparatus reduces the heat requirement thereby making electrical heating more practical and therefore avoiding problems introduced by the use of combustion gases. Means for sensing the temperature of the sand in the heated chamber operates in conjunction with the electrical heat input to modulate the heating to maintain the desired sand temperature in that chamber.

The temperature of the sand in the last cooling chamber is sensed and the fluidizing air to that chamber may be regulated to increase or decrease the activity of the sand in that chamber and thereby regulate the outlet sand temperature to that desired for subsequent sand coating steps.

The series flow chambers are in fluid communication through alternate upper and lower openings to avoid excessive bypassing of any of the chambers by the sand. The inlet chamber is divided with a vertical perforated baffle so that heavy lumps of sand or metal particles and the like will not pass through. These particles may be segregated, collected and removed.

My invention provides a method for thermally removing resin from used sand which minimizes the heat input required and avoids moving parts and the maintenance problems. It is suitable for batch or continuous operation as desired. The maximum temperature to which the sand is to be heated may be readily controlled; the sand is also cooled and temperature to which the sand is cooled may be regulated while simultaneously making use of the heat removed to preheat the incoming sand.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation;

FIG. 2 is a plan view with the cover plate removed; and

FIG. 3 is a sectional side elevation of the thermal sand reclamation unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A series of vertical chambers **12** are formed within the vertical outer wall **13**. A plurality of vertical walls **14** separate the series flow chambers from one another with alternate chambers having a round opening **15** at the lower end and an overflow space **17** at the upper end. A common wall **18** separates the inlet series of chambers from the outlet series.

Fluidizing air is supplied through pipes **22** and **23** to air wind boxes **24** and **25** which are located below the plurality of fluidized sand chambers. A pair of base plates **27** are located above the wind boxes with **150** mesh screening between them. These plates have a multiplicity of small holes with about 1 inch spacing and are provided to introduce the fluidizing air into the chambers. Air being introduced into the wind boxes passes upwardly through these holes and through the chambers, fluidizing the sand contained within the chamber, with the air passing outwardly through the top of the reclamation unit. While the apparatus may be open at the top, it preferably includes a cover plate **28** having an opening **29** which collects any fine residue of resin which may be carried off by the air and any fine particles of sand which may be carried off. The sand passing through the unit is fluidized and behaves generally as water with a definite surface and has free flowing characteristics.

As sand is introduced into the first chamber **32** the fluidized sand level tends to increase and sand passes through opening **33** into the next preheating chamber **34**. This raises the sand level in that chamber with sand passing over baffle plate **35** into the next preheating chamber, and so on with sand alternately passing into the last or outlet chamber **37**. As this chamber is filled with sand it overflows into outlet spout **38** and is retained in this spout by door **39**. The door may be opened as desired to withdraw the reclaimed sand from the unit.

The inlet chamber **32** is divided by a vertical perforated plate **40** with the inlet half of the chamber **32** having basket **42** formed of a plate containing ½-inch holes located at the bottom of it. Lumps of sand which are too heavy to fluidize as well as any piece of metal from the castings will fall into this basket **42** with the sand passing through the vertical perforated plate and continuing through the reclamation unit. This basket **42** may be periodically removed and emptied.

The sand passes through the series of preheating chambers to the heated chambers **43** and **44**. Electrical heating elements **45** are located in this chamber being supported from cover plate **28**, and operate to heat the fluidized sand in that chamber to about 1,200°F. The heat transfer from these elements to the sand is accomplished by direct contact of the fluidized sand and the heating element, while the gas film inherent with heat transfer to air tends to insulate the air so that the air does not reach the temperature of the heated sand.

These chambers are larger than the preheating and cooling chambers so that residence time of the sand is increased in this chamber and the sand is therefore held and the maximum temperature for a longer period of time. They also include a cast ceramic **46** on the outer edges to protect the casing from the high temperature.

The vertical plate separating chambers **43** and **44** has a number of openings **47** throughout the height thereof for the purpose of holding the ceramic material in place. Temperature sensing element **48**, also supported from the cover plate **28**, is located at the upper portion of the chamber and operates to sense the temperature of the sand in the chamber. A resistence type element is used which averages the temperature sensed throughout its length. The heat input into the heating elements **45** is controlled in response to the sensed temperature to maintain the temperature of the sand at about 1,200°F. Power line **51** supplying the heating elements **45** includes a controller **52** which operates to modulate the electrical input to the heating elements. This controller operates in response to a temperature signal passing from the temperature sensing element **48** through control line **53**. This control may be either of the on-off type or of the modulated heat input type.

The heated sand at full temperature passes from the heated chamber **44** through the first cooling chamber **49** and serially through the other cooling chambers to the last chamber **37**. In all of these chambers the sand is fluidized with the agitation of the sand operating to transfer heat through the central wall **18** to the sand in the preheating chambers, thereby simultaneously cooling the heated sand and preheating the incoming sand. The surface of this central wall may be varied as desired to increase the heating surface and increase the efficiency of heat transfer between the incoming sand and the outgoing sand.

The sand being cooled finally reaches the outlet chamber **37** which contains a second temperature sensing element **50**. In order to continue the sand molding process and recoat the sand with resin, it is desired that the outlet temperature of this unit be between 300° and 340°F for phenolic resin. The temperature of the sand in the outlet chamber **37** is sensed by temperature sensing element **50**. The heat transfer between this hot sand and the cold incoming sand may be decreased by decreasing the amount of fluidizing air passing through wind box **25** thereby decreasing the sand activity in the first and last chambers. The air inlet line **23** is illustrated schematically at the upper end of FIG. **1** where it includes a control valve **55**. Controller **56** modulates that valve so as to control the air input to wind box **25** in response to a temperature signal passing through control line **57** from the temperature sensing element **50**.

This air may be stopped entirely and introduced only for purposes of fluidizing the bed in order to obtain the desired discharge through spout **38**. The openings **33** through the vertical walls separating adjacent chambers should be relatively restricted to avoid excessive air bypassing during this type of operation. Alternately the first chamber could be reversed so that the sand overflows the baffle wall, in which case air bypass would not be a problem.

An apparatus of the type illustrated to process 4 tons of sand per hour would be about 8 feet long and 4 feet wide. At any one time the apparatus holds about 10,000 pounds of sand even though it only processes 8,000 pounds per hour. The sand, therefore, remains within the unit for an average of 1¼ hours. The sand may be fed continuously or intermittently dumped into the sand chamber in 5 to 10 minute intervals. This sand must be crushed before introduction sufficiently fine to allow it to fluidize. Adding sand to this first chamber **32** causes a flow of fluidized sand to cascade through the remaining chambers passing alternately through the openings at the bottom of the separating walls and over the alternate walls.

Most of the heat transfer occurs between the sand and the wall or the heated elements by direct contact with the inherent gas film tending to influence the air from the heat transfer medium. It has been found that only 6 percent of the heat is carried away by the fluidizing air.

While I have illustrated and described a preferred embodiment of my invention it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I, therefore, do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

What is claimed is:

1. An apparatus for thermally recovering resin coated sand comprising: a plurality of vertical walls defining a plurality of chambers connected in series flow relation, said chambers including first, intermediate preheating, heated, intermediate cooling and last chambers; said first and intermediate preheating chambers having an imperforate wall common with said intermediate cooling and last chambers; means for introducing heat to said heated chamber; means for introducing sand to be treated into said first chamber; means for removing treated sand from said last chamber; and means for introducing fluidizing air into each of said chambers including means for regulating the fluidizing air introduced to said first and last chambers independent of that introduced to the other chambers.

2. An apparatus as in claim **1** wherein said intermediate preheating and intermediate cooling chambers are arranged in counter flow heat flow relationship.

3. An apparatus as in claim **1** wherein said chambers are in fluid flow relationship through alternately upper and lower openings in the wall between adjacent chambers.

4. An apparatus as in claim **1** having also first temperature sensing means for sensing the temperature of the sand located in said heated chamber; said means for introducing heat into said heated chamber being responsive to said first temperature sensing means.

5. An apparatus as in claim **1** having also second temperature sensing means for sensing the temperature of said last chamber; means responsive to said second temperature sensing means for varying the flow of said second fluidizing air.

6. An apparatus as in claim **1** wherein the means for removing sand from said last chamber comprises an overflow spout in fluid flow relationship with the upper end of said last chamber.

7. An apparatus as in claim 1 wherein said first chamber has also a vertical perforated plate dividing said first chamber into inlet and outlet portions; means for removing settled heavy solids from the bottom of said inlet portion.

8. An apparatus as in claim 7 wherein said means for removing heavy solids comprises a removable basket.

* * * * *