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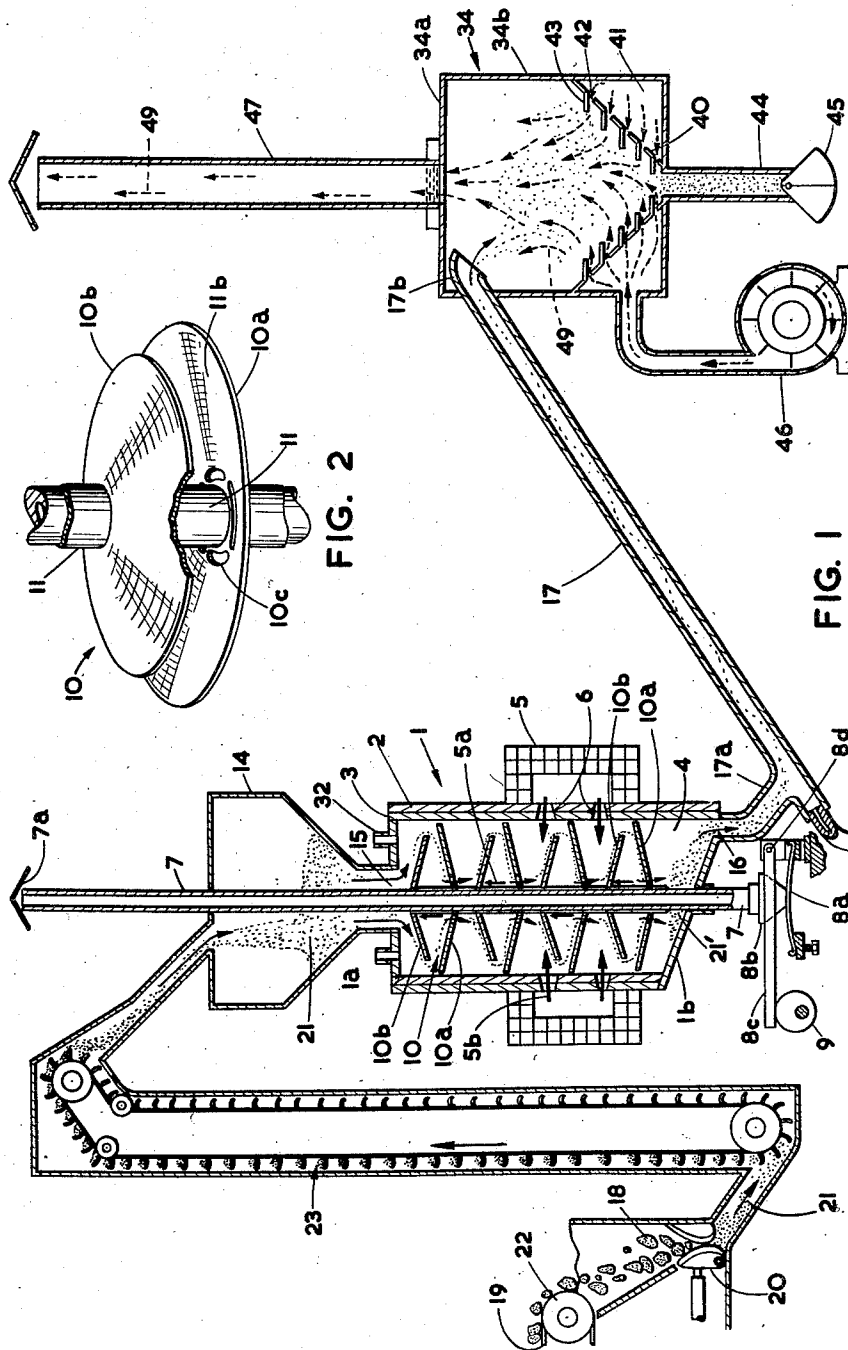
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APPARATUS FOR RECLAIMING FOUNDRY SAND

Filed May 2, 1956

2 Sheets-Sheet 1



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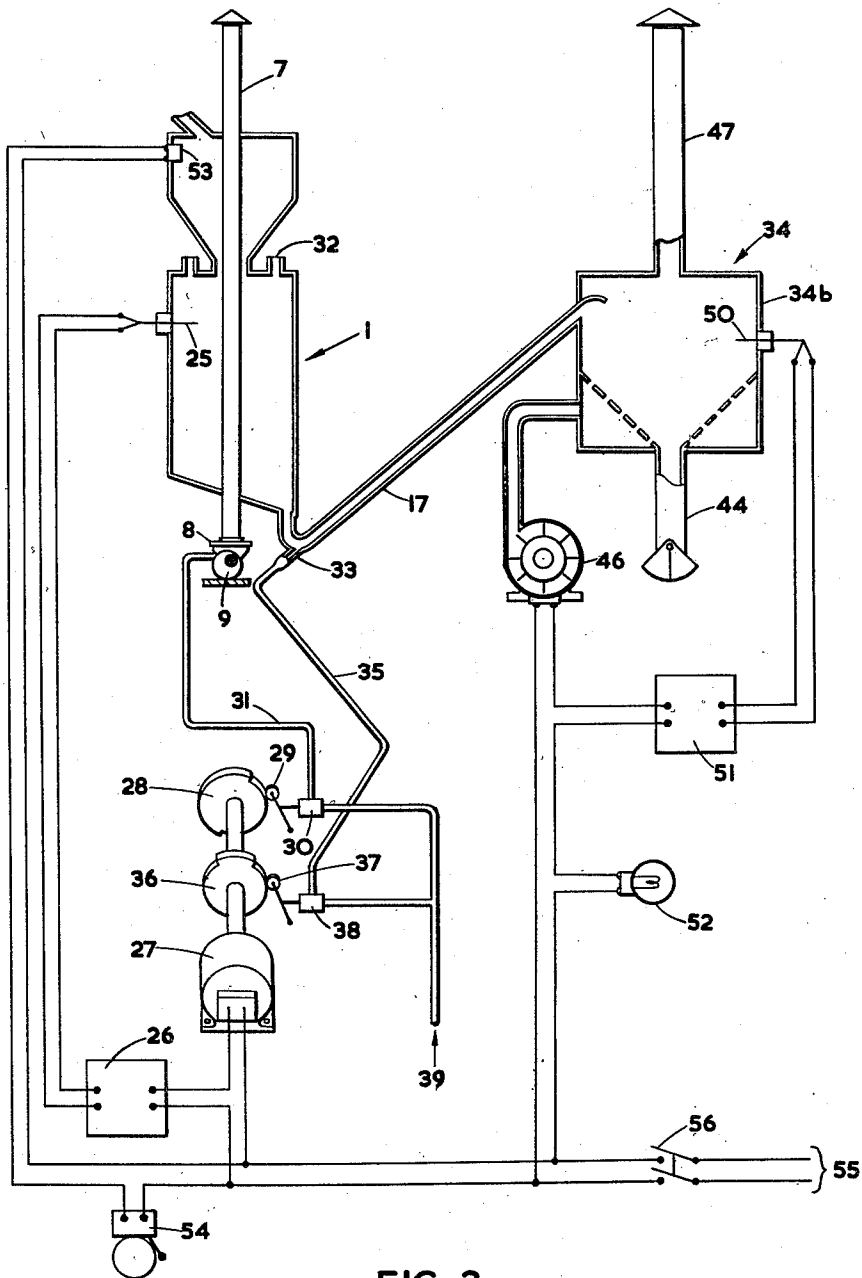


FIG. 3

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APPARATUS FOR RECLAIMING FOUNDRY SAND

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1 Claim. (Cl. 263—26)

This invention relates to an apparatus for processing granulated material and more particularly to a furnace for reclaiming foundry sand after use, particularly after use in shell molding operations.

By mixing a bonding agent such as phenol, melamine, urea formaldehyde or other such material with foundry sand (silica, alumina or zirconia) the resultant material may be used as a mold in casting metal articles, the bonding agent being used to maintain the sand in a desired configuration. After the casting has set within the mold, the mold is broken away and discarded. It has been found advantageous and economical to reclaim the sand in the broken mold for further use, by cleansing it of its bonding agent.

Several different methods are used for reclaiming the foundry sand from broken shell molds, for example wet scrubbing, dry scrubbing, calcination or combinations thereof. In the method of calcination, the bonding agents are removed by passing the material through a furnace which usually takes the form of a rotary kiln or a multiple hearth. However, both the rotary kiln and the multiple hearth have serious disadvantages. Rotary kilns have very steep temperature gradients and their refractory linings are short-lived due to the severe stresses placed on them in service. Multiple hearths, wherein rotating rabble arms are used to actuate the material to be calcinated, suffer from initial high cost, require a large amount of space, and use a large amount of power during operation. Also, the cooling and lubrication of the moving parts in both the rotary kiln and the multiple hearth present a constant problem of maintenance during service.

The present invention overcomes these disadvantages by providing a reclaiming furnace having no moving parts in the hot zone, while at the same time being adapted for continuous automatic operation. The furnace consists of a vertical series of conical hearths fixed on a vibrating support column. The material to be reclaimed is fed into a hopper positioned at the top of the furnace and feeds downwardly through the furnace over each conical hearth by means of the vibratory motion imparted to the hearths by the column. During the passage of the material downwardly through the furnace, hot gases of combustion are forced upwardly through and over the hearths. The material is calcinated by the action of the hot gases to remove the bonding agent and the remaining sand is collected from the bottom of the furnace and transferred to a cooling bin after which it is ready for re-use.

In the drawings, which illustrate one embodiment of the invention and in which like reference numerals refer to the same parts throughout the several views:

Figure 1 is a schematic view in elevation showing the furnace and complementary apparatus;

Figure 2 is a broken away perspective view of a hearth of the furnace; and

Figure 3 is a schematic diagram showing the electrical circuits and the operative relationships of the various parts of the apparatus.

The device according to the invention consists of a

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furnace 1 which has a cylindrical wall 2 lined with insulating material 3 to provide a combustion chamber 4. The lower portion of the wall 2 is circumscribed by an annular plenum chamber 5 which feeds hot gases of combustion, as indicated by arrows 5a in Figure 1, to the combustion chamber through ports 6 placed circumferentially around the furnace wall 2. Gas or fuel oil may be used to fire the plenum chamber 5 and heat the gases fed to the combustion chamber.

A support column 7 is mounted vertically within the combustion chamber 4 of the furnace 1 and projects both through the top 12 of the furnace and through the base 1b of the furnace, resting on a reciprocating base structure 8. It is arranged to move vertically within the furnace in alignment with the longitudinal cylindrical axis of the furnace. The base structure 8 includes a leaf spring 8a on which a footplate 8b attached to the column rests, and which determines the frequency of vibration of column 7. A lever 8c on a fixed fulcrum 8d is arranged to engage the footplate in upward movement around the fulcrum, and it is raised and lowered rapidly by a mechanical vibrator 9. The vibrator 9 may be of pneumatic, electromagnetic or mechanical apparatus such as a vibrating unit manufactured by the Peterson Company Limited under the trade mark "Vibrolator"; an eccentric throw of 0.125" to 0.062" is suitable, if the vibrator has a 4-1 mechanical advantage on the lever with respect to the point of contact with the footplate, as shown. The support column 7 is hollow to allow for cooling; a current of cool air passes up through the column and out through a vent 7a at the top of the support column 7.

A plurality of conical hearth units 10, as shown in Figure 2 of the drawings, are mounted on the support column 7 within the furnace 1. Each of these hearth units 10 comprises a lower conical or dished disc 10a and an upper conical disc 10b coaxially aligned on column 7 and spaced apart from one another by spacer sleeves 11 on the column 7, with their concave surfaces facing each other. The lower disc 10a is of a larger diameter than the upper disc 10b and has slots 10c in its face adjacent the column 7. The spacers 11 also separate hearth units 10 from one another. Both the discs 11 and 12 and the spacers 11 are preferably cast from chrome-nickel heat resistant iron to extend their useful life.

A hopper 14 is mounted above the furnace 1 and surrounds a part of the column 7 projecting through the top of the furnace. An annular opening 15 in the top 1a of the furnace around the column 7b allows the feed material to be reclaimed to descend from the hopper 14 into the combustion chamber 4 of the furnace 1. The base 1b of the furnace is sloped towards a single outlet 16 which allows the reclaimed material to funnel into a conduit 17.

In the operation of the device, broken pieces 18 of used shell mould are passed by a belt or oscillating material conveyor 19 into a jaw-crusher 20 where they are uniformly crushed into granules 21 of approximately 1/4 of an inch diameter. A magnetic separator pulley 22 at the end of the conveyor belt 19 separates tramp ferrous metals from the pieces 18 in order to protect the jaw-crusher from damage and to protect the reclaimed sand from impurities. The granulated material 21 is fed into a bucket elevator 23 which raises the material 21 to the hopper 14.

From the hopper 14 the granulated material 21 falls through opening 15 onto the apex of the upper disc 10b of the topmost hearth unit 10. When the column 7 is at rest, the granulated material 21 will not feed continuously through opening 15 of hopper 14 into furnace 1 since the material accumulates on the apex of the hearth 10, which backs the material up into the hopper. Therefore in order to start the column 7 vibrating, a thermo-

couple 25 is positioned in the combustion chamber 4 on the refractory winding 3 of the furnace 1, preferably at a point immediately above the lower disc 16a of the third hearth unit 10 from the opening 14a. The thermocouple 25 triggers a motor starting relay 26 immediately the temperature at the thermocouple reaches a predetermined triggering temperature, suitably 1100° F. Relay 26 starts motor 27 which drives a cam 28.

Cam 28, through follower 29, actuates an inner valve 30 in a compressed air line 31 causing vibrator 9 to operate. The column 7, vibrated by the action of vibrator 9, transmits the vibration to the hearth units 10 and causes the material 21 to move outwardly and downwardly over the upper surface of the upper disc 10b and onto the upper surface of the adjacent lower disc 10a whence it moves inwardly and downwardly towards column 7 and through slots 10c onto the upper disc 10b of the next hearth unit 10.

After a predetermined time interval, when the material 21 is spread in a thin layer over all the hearths 10, cam 28 closes air valve 30 and the vibration stops, allowing the material to rest on the hearths and exposed to the hot combustion gases 5a which carbonize the bonding agents in the material. The degree of break-down of the bonding agents is a function of time and temperature, the size and speed of the cam 28 being governed accordingly. A preferred time of travel of the material 21 through furnace 1 is a period of one hour at 1100° F. The hot combustion gases 5a which continuously enter furnace 1 through ports 6 from the plenum chamber 5 pass upwardly through the furnace and circulate about the conical hearth units 10 for the period determined, passing out of the top of the furnace through flues 32.

When the vibrator is started again, the reclaimed sand 21' falls onto base 1b of furnace 1 and is funnelled into conduit 17 through outlet 16. The conduit 17 has an upwardly directed elbow 17a adjacent the base 1b of the furnace 1 and a venturi tube 33, placed in the elbow 17a, at suitable intervals applies compressed air at 100 to 120 pounds per square inch to the reclaimed sand 21', blowing it in a fast moving air stream up conduit 17 whence it strikes a deflection plate 17b and falls into a cooling bin 34. The reclaimed sand may enter the cooling bin 34 at a temperature of about 200° F., having been cooled to that temperature by the air stream from the venturi tube 33. The venturi tube 33 is controlled by a cam 36 acting on a follower 37 which actuates a valve 38 in a compressed air line 35 leading to the venturi tube 33. The cam 36 is also driven by the motor 27 and it is designed to operate venturi tube 33 when column 7 is being vibrated and reclaimed sand 21a is entering conduit 17 from base 1a of furnace 1. The compressed air in both lines 31 and 35 may be drawn from a common source 39.

Cooling bin 34, in the shape of a hopper, has a conical base 40 surrounded by an air chamber 41. Ports 42 in base 40 of bin 34 allow air from chamber 41 to pass into the bin. Each port 42 has a louver 43 attached adjacent it to prevent the reclaimed sand 21a in bin 34 from entering chamber 41. A chute 44 leads from the lowest point of the conical base 40 and terminates in a closure 45. A blower 46 delivers cooling air to the chamber 41 at a suitable rate, preferably about 300 cubic feet per minute at approximately 20 inches of water gauge (.07226 pound per square inch). The air from blower 46 passes through the ports 42 and out into the atmosphere through a flue 47 in the roof 34a of the bin 34, as indicated by arrows 49 in Figure 1.

The cooling operation is triggered by a thermocouple 50 positioned in the upper part 34b of the bin. The reclaimed sand 21', blown through conduit 17 to cooling bin 34, fills the bin to a level where the sand contacts the thermocouple 50, which operates a relay starter 51, starting blower 46. As the sand in the bin 34 is cooled

to 120 to 130° F., the thermocouple 50 cuts out blower 46 through relay starter 51. A signal light 52 in series in the circuit of the blower 46 may be used to indicate when the reclaimed sand in the bin is ready for withdrawal. The sand is withdrawn from bin 34 through chute by opening closure 45.

If it is found that the granulated material 21 backs into hopper 14 to such an extent that the hopper is filled, a pressure switch 53 may be placed on the upper portion of the inside of hopper 14 which when actuated will cause an alarm 54 to operate.

Motor 27, blower 46, thermocouples 25 and 50, and pressure switch 53 may draw power from a single supply main 55 through a closed main switch 56, as shown in Figure 3.

The apparatus disclosed herein may be used for drying or dehydrating granulated material as well as reclaiming all types of materials normally processed through rotary kilns or multiple hearth furnaces. In the case of foundry sand, the apparatus recovers 95 to 98 percent of the sand without distorting the sand grain distribution and does not increase the amount of phenol resin binder required to make satisfactory shell molds with the reclaimed sand.

It will be understood that the form of the invention herewith shown and described is a preferred example and various modifications may be carried out without departing from the spirit of the invention or the scope of the appended claim.

What I claim as my invention is:

Apparatus for processing used foundry sand containing an organic binder, to recover the sand for re-use, comprising means for granulating the material, a furnace, a hopper above the furnace and opening into the top of the furnace, means for delivering the granulated material to the hopper, a vertical column slidably mounted in the furnace for vertical movement relative to the furnace, a leaf spring under the base of the column and supporting the column, a lever reciprocable in a vertical direction and engaging the column to vibrate the column on the spring, means for reciprocating the lever, a plurality of hearth units secured to the column, each unit comprising an upper and a lower dished disc coaxially aligned with each other on the column and spaced apart from each other with their concave dished surfaces facing each other, the diameter of the lower disc being greater than that of the upper disc and the lower disc having openings in it in a ring around and near the column, a plenum chamber opening into the lower part of the furnace and providing a source of hot gases of combustion for the furnace, an opening in the bottom of the furnace, a conduit connected to the opening, a cooling bin into which the conduit leads, pneumatic means in the conduit for transferring the material from the bottom of the furnace through the conduit to the bin, the bin having apertures in its bottom and means for introducing cooling air under pressure through the said apertures, automatic control means in the furnace responsive to a predetermined operating temperature in the furnace to start the vibrating means, timing control means stopping the vibration after a predetermined time sufficient for the material to become distributed over all the hearth units and starting the vibration after a further predetermined heating time, and control means connected to the said timing control means actuating the said pneumatic means in the conduit during periods when the furnace is being vibrated.

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