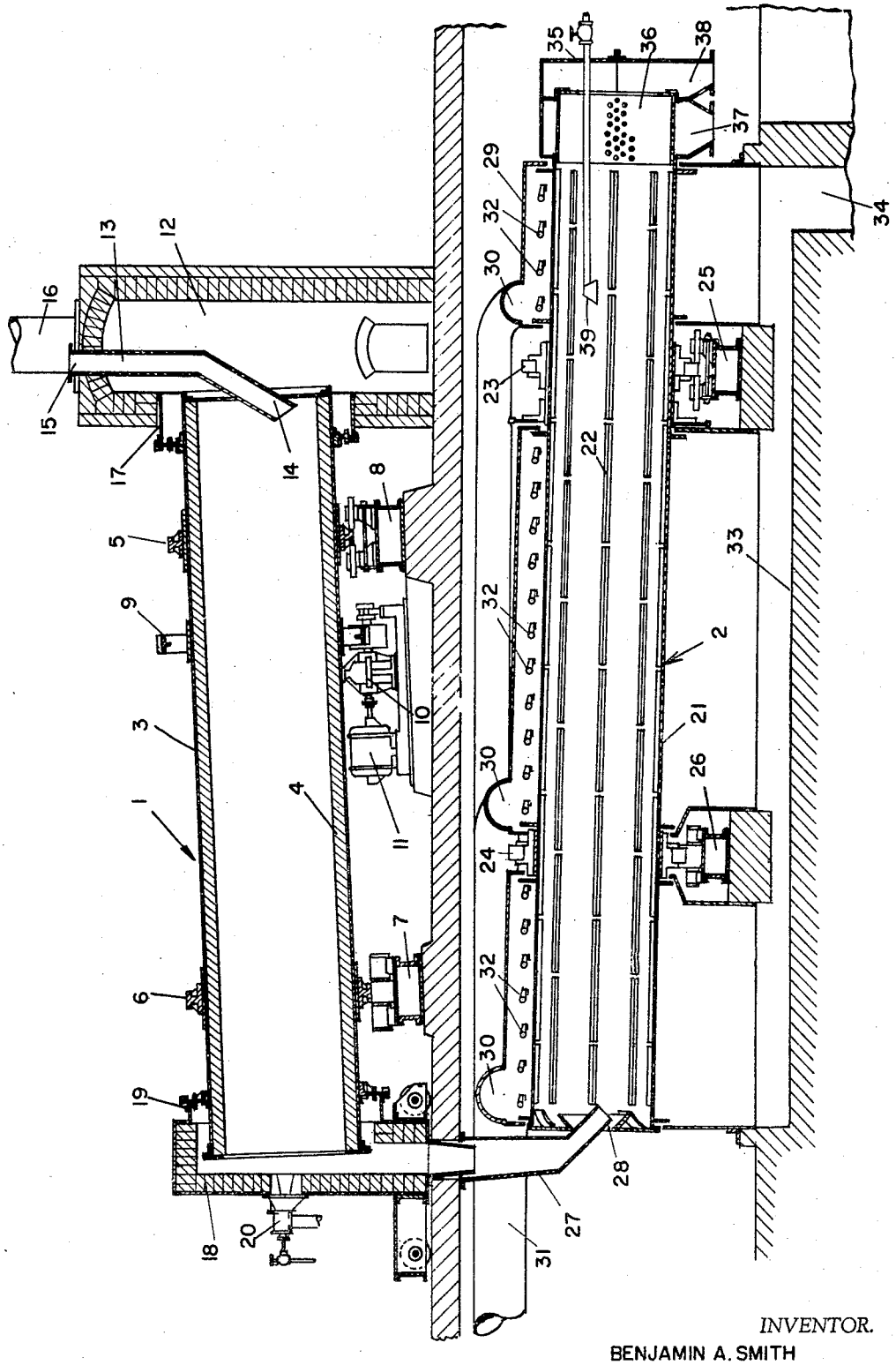
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METHOD OF RECLAIMING MOLDING AND CORE SAND

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METHOD OF RECLAIMING MOLDING AND CORE SAND

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This invention relates as indicated to a method of reclaiming or reconditioning foundry sand such as is used for molds and cores. More specifically, this invention is concerned with a process wherein the sand is heated to substantially a red heat for the purpose of driving off carbonaceous material and the like which may occur as an impurity in the sand, after which the sand is cooled to room temperature in such a way that there is a minimum amount of damage to the sand, and to also provide that the sand, when discharged, will contain substantially the correct amount of moisture necessary to be present for the proper handling of the sand in the molding operation in which it is to be used.

The process of reconditioning foundry sand involving the step of heating the same to a red heat for the purpose of driving off any impurities, such as carbonaceous material, may be roughly divided into two parts—the heating stage and the cooling stage. The crystalline structure of the sand is such that it may not be subject to very sharp temperature changes since any such changes tend to set up in the sand grains internal stresses which may even proceed to a splitting of the sand grain into small particles. If, however, the proper degree of care is exercised, both in heating and cooling the sand, it may be safely heated to a red heat and then cooled to room temperature without any substantially adverse effects on the sand.

It is a principal object of my invention to provide a process of the character and for the purposes described. Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends said invention then consists of the steps hereinafter fully described and particularly pointed out in the claims.

The annexed drawing shows one form of apparatus capable of performing one form of my improved process, and the following description sets forth in detail one approved mode of carrying out the invention, such illustrated apparatus and disclosed method, however, constituting but one of the various ways in which the principle of my invention may be used.

In said annexed drawing, the single figure is a vertical sectional view through a plant constructed so as to be capable of carrying out the process of my invention.

Before proceeding with a description of the process comprising my invention, it is believed well to refer briefly to the construction and mode of operation of the apparatus illustrated in the drawing and by which such process may be performed.

Referring more specifically to the drawing, the same comprises a heating kiln generally indicated at 1, and a cooling kiln generally indicated at 2.

The heating kiln comprises a tubular metallic shell 3 substantially cylindrical in shape, and internally provided with a refractory lining 4. The shell 1 carries axially spaced annular bearing rings 5 and 6 which revolve on trunnion rolls fitted with shafts journalled in bearing blocks as shown at 7 and 8 for the purpose of rotatably supporting the kiln 1 in an inclined position. Secured to the shell 3 is a bull-ring 9 which cooperates with gearing and speed reduction means, generally indicated at 10 and a motor 11 in rotating the kiln 3 about its longitudinal axis on its trunnion roll and bearing assemblies 7 and 8.

The upper end of the kiln 1 projects into a breeching or smoke box 12 through which projects a feed chute 13, the lower end 14 of which projects into the kiln 1. Material to be fed to the kiln is introduced through the open upper end 15 of the chute 13. A stack 16 is provided for the purpose of carrying off the products of combustion which are produced within the kiln. An air seal shroud 17 is arranged about the upper end of the kiln 1, closing the space between such kiln and the stack, but, at the same time, permitting relative rotation therebetween while avoiding any appreciable infiltration of air.

Mounted adjacent the lower end of the kiln 1 is a firing hood 18 likewise provided with a shroud 19 affecting a substantially fluid-tight seal between the firing hood 18 and the kiln 1 as the latter rotates.

The firing hood 18 carries a conventional burner 20 adapted to utilize any conventional fuel such as gas, oil, or powdered coal. Mounted at a level below the heating kiln 1 is the cooling kiln 2 which comprises a cylindrical metallic shell 21 interiorly provided with longitudinally extending flights 22. The shell 21 is, by means of bearing rings 23 and 24 and trunnion roll assemblies 25 and 26, rotatably supported in a position slightly inclined to the horizontal. Suitable means (similar to those provided for the heating kiln, but for convenience in illustration not shown) will rotate the kiln 2 about its longitudinal axis. A transfer chute 27 is arranged to carry by gravity the sand discharged from the lower end of the heating kiln 1 and to introduce the same through the opening 28 into the upper end of the cooling kiln 2.

The space about the cooling kiln 2 is laterally

confined by means of a housing 29 at intervals provided with vents 30 leading to an exhaust duct 31. Mounted in the upper portion of the casing 29 are a plurality of water feed devices 32, connected to a common inflow manifold not shown, and effective to cascade cooling water over the outer surface of the shell 21 as the latter rotates. The steam and water vapor generated in the housing 29 pass out through the stack 31 and the water in liquid form flows along the inclined surface of the floor 33 to be discharged to the sump 34.

A stationary housing 35 encloses the lower end of the kiln 2, and into such housing projects a screen extension 36 which is fastened to and rotates with the shell 21. The fines passing through the screen 36 are discharged through the hopper 37 and the coarse material passing over the screen is discharged through the chute 38.

In carrying out the process of my invention, the sand to be conditioned, which is usually at a room temperature of about 60° F., will be introduced through the charging chute 13 into the heating kiln 1. The rate of fuel consumption, together with the rate of feed and those other factors which it may be necessary to adjust, such as the speed of rotation of the kiln, will all be so coordinated that the sand will pass through the kiln in a period of about 30 minutes and will be discharged from the heating kiln at a temperature from 1400° F. to about 1600° F.

At this point it may be desirable to indicate that a convenient size of apparatus for commercial use comprises a heating kiln, the metallic shell of which is about five feet in diameter and about twenty five feet long, having a six-inch thick refractory lining, making the net diameter of the heating kiln about four feet. When the kiln is supported at a slope of about one-half inch per foot and rotated at a speed on the order of about .6 to about 1.5 and at preferably about 1.0 R. P. M., approximately five tons of sand per hour will pass through the kiln.

After the sand, at a temperature of about 1400° F. to about 1600° F., is discharged from the heating kiln 1, it is carried by means of the transfer chute 27 to the upper end of the cooling kiln. In order to economically match the heating kiln previously described, the cooling kiln should desirably have an inside diameter of about four feet and a length of about thirty two feet, with a slope to the horizontal of about one-fourth inch per foot and driven at a speed of about one to three and preferably at about two R. P. M. Under such circumstances, and when the exterior of the cooling kiln is flooded with water in the manner hereinafter more particularly explained, the time of travel through the cooler will be on the order of about 30 to 50 minutes, averaging about 40 minutes.

The flights 22 are shallow, solid, angle projections which extend radially inwardly of the shell 21 for a distance just sufficient so as to insure that the mass of sand in the cooler will roll and tumble within the revolving shell, rather than slide as a body over the inner periphery of the shell 21 as the latter is rotated. Lifting flights so constructed and arranged will result in a gentle agitation and mixing of the sand as it passes through the cooler, thus avoiding violent cascading which might be destructive of the individual sand particles.

The outer surface of the shell 21 is flooded with water through the devices 32 which may be either spray nozzles or preferably individual boxes into which a supply of water is continuously fed, and from which the water flows over a weir onto the outer surface of the shell. The water used for cooling the shell exteriorly is recirculated, i. e., that collected in the sump 34 being pumped back to the distributing means at the hotter portions of the cylinder 21, there to evaporate. The cool water supply fed in to replace evaporation losses is first fed through the distributors 32 at the lower or cooler end of the cylinder 21. Depending upon the temperature of the water, it may be necessary to make adjustments in the rate at which it is fed to the outer surface of the shell.

At this point it should be noted that for best results the rate of flow of water over the shell 21 should be such that the outer surface of the shell at the hot end will have a temperature of about 500° F. to about 600° F., and the temperature of the cold or lower end will be about 80° F. to 100° F. When conditions are maintained as above indicated, the sand will be discharged from the lower end of the cooler at a temperature of about 125° F. to about 150° F.

Heating the sand to the temperatures indicated may cause some agglomeration due to various causes so that it becomes necessary to screen these agglomerated masses from the fines, and to this end the screen 36 is provided.

When sand has been thus heated to the temperatures indicated above it will be freed of substantially all moisture. However, a certain amount of moisture is necessary and desirable in molding sand, and this fact may be utilized to advantage in a refinement of my process as above explained. It has been found that sand particles, after they have been cooled to approximately 500° F., may have water introduced thereto without very substantial degradation of the sand particles. It is, therefore, within the contemplation of my invention to introduce water by means of a spray, 39, into the cooler 2 at the point where the sand in its longitudinal travel through the cooler reaches a temperature of about 500° F. A portion of the water thus introduced will, of course, be vaporized and the amount of water vaporized will have a substantial cooling effect on the sand and water which remains. The amount of water thus introduced to the sand may accordingly be adjusted for best results. However, the end point which determines the amount of water to be thus introduced is the amount of water which the sand may contain and which it will preferably contain for the molding operation in which it is to be used.

It is an important feature of my invention that the sand, during the interval while it is cooling from a red heat to about 500° F., is secluded from the atmosphere and substantially all of the heat abstracted from the sand flows by conduction outwardly through the shell 21 to be absorbed by the water which is flowed over the outer surface of the shell.

Of course the entire process of cooling the sand and the transfer of heat ultimately to the water which carries it away is not simply conduction, but a very complex heat transfer process involving radiation, conduction and convection, all to a degree and in different parts of the transfer.

For example, the heat in the center of the sand grain flows to the exterior of that grain purely by conduction. The temperature of the exterior surface of the sand grain is lowered and heat flows from it by radiation to the cool wall of the enclosing cooler cylinder. The heat flows from this wall surface by conduction through

the metal wall of the cooler cylinder to the opposite side, where it is removed by convection of the flowing water past this surface or by evaporation of the water which tended to wet the surface, the action here being combined evaporation and vapor convection. Some radiation of heat does take place from the exterior wall of the cooler cylinder to the water, and to the water vapor forming as a result of the evaporation of some of the water, but this effect is small.

It is also true that a minor portion of the heat of the sand particle is conducted through the interface between the sand particle and its contact with the interior of the cylinder wall, but the area of such interface is generally so small (i. e. the point of contact is almost infinitesimal) that only a small proportion of the total heat exchange takes place in this manner. It will be observed, however, that substantially all of the heat abstracted from the sand is at one stage forced to pass by conduction through the wall of the cylinder 21. The wall of the cylinder hence acts as a sort of thermal barrier against too rapid a rate of heat transfer away from the sand. Thus the sand grains are cooled so slowly and evenly throughout their individual mass that no substantial portion of the sand is subjected to shock chilling. In this way the generation of destructive contractive forces in the sand particles is avoided, thereby resulting in very minimum degradation of the sand particle size.

The atmosphere is excluded from the cooler, i. e. no drafts of atmospheric air are permitted to strike the sand since even such drafts would have the effect of causing a degradation of the sand particles on the surface of the mass with which such drafts come in contact.

While the drawing is illustrative of one form of apparatus which may be used in carrying out my process, other types of apparatus may be used for the same purpose so long as the fundamentals of the process as above recited are observed and maintained.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. The method of conditioning foundry sand and the like which comprises gradually heating the same to a red heat, and then simultaneously agitating and slowly cooling the same in a chamber, from which the major portion of the heat is abstracted by conduction, and then applying water to the sand in an amount such that the residue in the sand after cooling to room temperature provides substantially the required moisture content for its desired use.

2. The method of conditioning foundry sand and the like which comprises gradually heating the same to a temperature of about 1400° F. to 1600° F. and then simultaneously agitating and slowly cooling the same to a temperature of about 500° F. in a chamber from which the major portion of the heat is abstracted by conduction, and then applying water to the sand in an amount such that the residue in the sand after further cooling to room temperature provides substantially the required moisture content for its desired use.

3. The method of conditioning foundry sand and the like which comprises gradually heating the same during a period of about 30 minutes to a temperature of about 1400° F. to 1600° F., and then simultaneously agitating and slowly cooling the same to a temperature of about 500° F. in a chamber substantially closed to the atmosphere and from which the heat is abstracted by conduction through its wall, to the exterior surface of which water is applied, and then applying water to the same in an amount such that the residue in the sand after further cooling provides substantially the required moisture content for its desired use.

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