Dec. 21, 1948. A. C. CHRISTENSEN ET AL 2,456,769

METHOD OF RECLAIMING FOUNDRY SAND

Filed Feb. 16, 1944 2 Sheets-Sheet 1

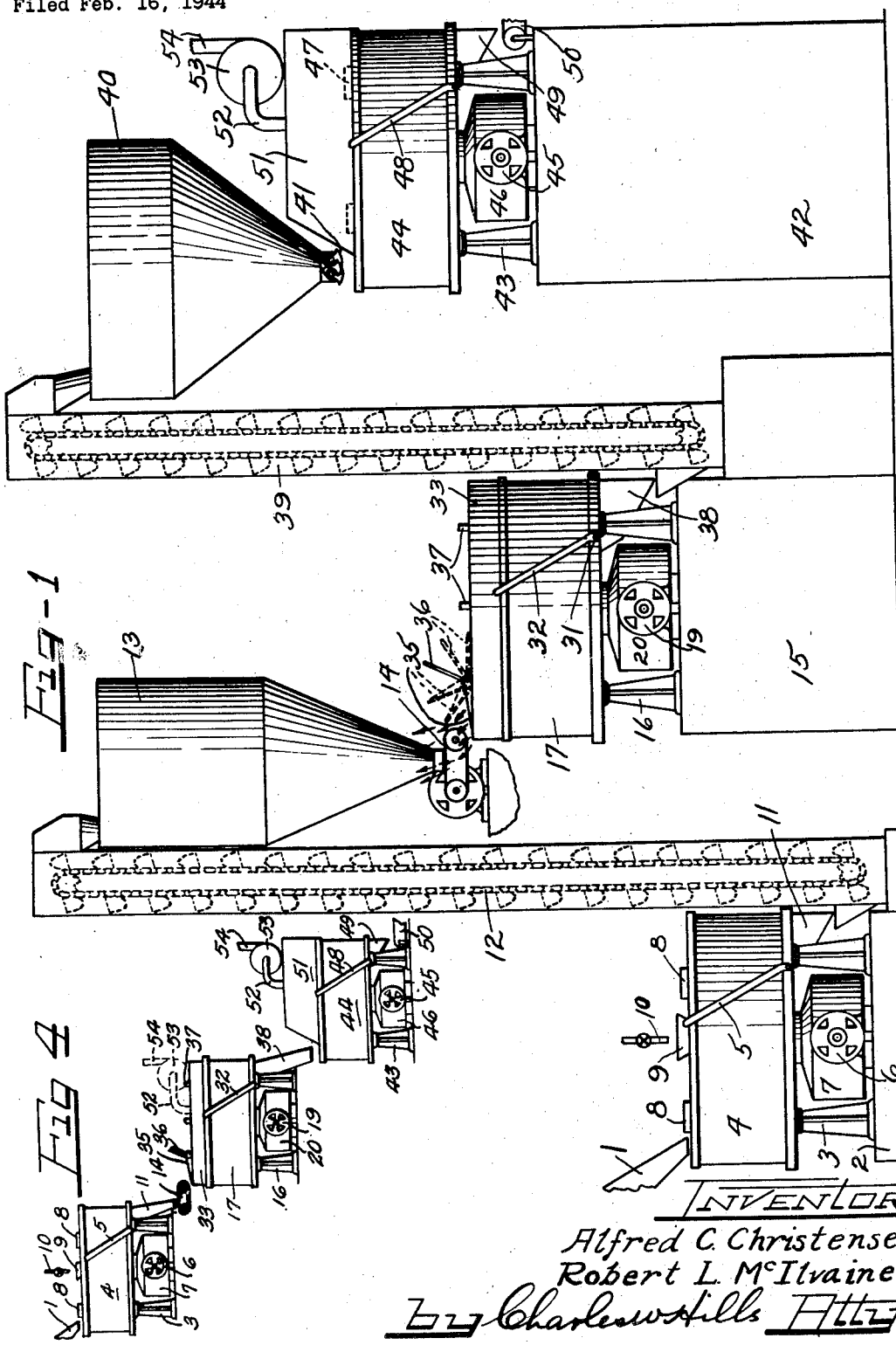


Fig. 1

Fig. 4

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Filed Feb. 16, 1944 2 Sheets-Sheet 2

Fig-2

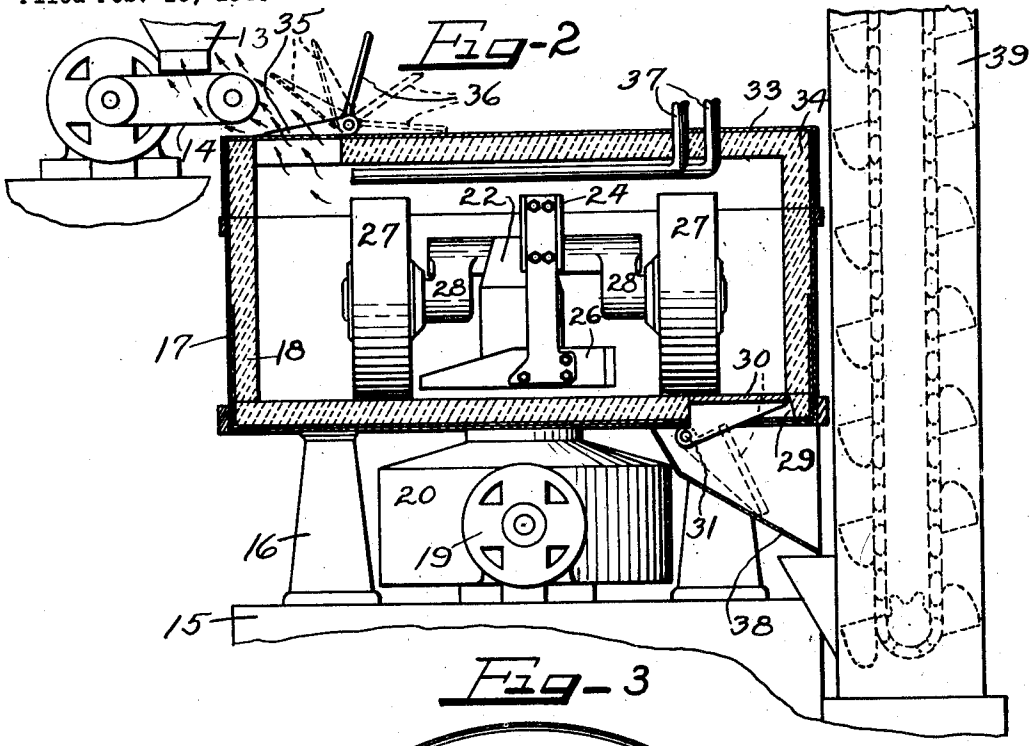
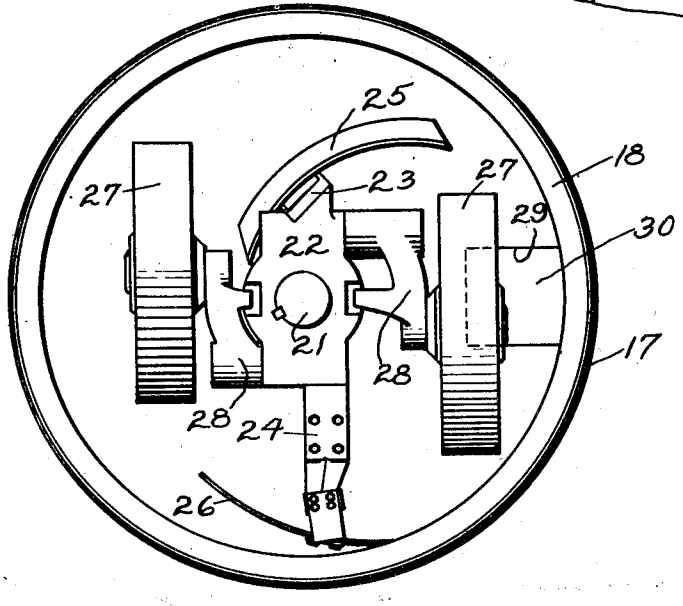


Fig-3



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METHOD OF RECLAIMING FOUNDRY SAND

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4 Claims. (Cl. 22—217)

1

The invention herein disclosed and claimed relates to a method of more efficiently reclaiming spent and inert used material such as bonded foundry sand and the like, by controlling the feed and subjecting batches of the material to wetting, preheating, heating, drying and cooling treatments, successively arranged whereby the material being treated is economically reclaimed for reconditioning and re-use.

It is an object of this invention to provide an improved method and apparatus for reclaiming spent bonded foundry sand and the like, which method is economical, clean and effective.

It is also an object of this invention to provide an improved method of reclaiming spent or inert used granular materials such as bonded foundry sand by subjecting the materials to wet scrubbing; preheating and partial drying; high temperature heating, oxidation and drying; and finally subjecting the materials to an aerating and cooling treatment and simultaneously removing the fines therefrom to produce a cleaned reclaimed material ready for reconditioning and re-use.

It is another object of the invention to provide a sand reclaiming system wherein a batch of material may be preheated before being gradually fed into a confined area heated to a selected high temperature for burning off spent bonding agents and carbonaceous coatings while the material is being mixed, scoured and mulled to clean and dry the material before cooling and removing the dust and fines from the same.

It is an important object of the invention to provide an improved method for reclaiming spent foundry sand and the like, said method including controlled batch feeding and consecutive subjection of the batches to wet scrubbing, hot scrubbing and cooling and dust and fine removing treatments in open and confined areas while the material batches are being mixed and mulled.

Other objects and features of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

On the drawings:

Figure 1 is a side elevation view of an apparatus constructed and capable of carrying out our method of reclaiming foundry sand and the like.

Figure 2 is a slightly enlarged fragmentary elevational view of the intermediate or middle unit of the machine with the heating and drying unit illustrated in section with parts shown in elevation.

Figure 3 is a top plan view of the intermediate heating and drying unit with the cover removed

2

and illustrating the mixing and mulling mechanisms which are common to all three cleaning units forming part of the apparatus.

Figure 4 is a side elevational view of a modified gravity feed type of apparatus for reclaiming spent materials.

As shown on the drawings:

The improved method of cleaning and reclaiming spent or inert foundry sand and other similar granular materials is adapted to be accomplished by means of a machine assembly or system of the type illustrated in Figure 1 which includes a grouping of various batch treating units with means for the controlled transferring or feeding of the material being treated from one unit to the other. The improved machine assembly includes any suitable material feed mechanism for delivering a batch of material to be treated from a source of supply to the first of a series of mixing and mulling units for consecutively treating the material being reclaimed for selected periods of time by subjecting a batch of the spent material to a wet scrubbing treatment and then control feeding the material into another unit for subjecting the material to hot treatments for cleaning and drying the material grains in a confined heated area from which the escape of the steam and gases is controlled and directed for preheating the entering material, and finally transferring the cleaned and dried hot batch of material into still another treating unit wherein the material is mixed and mulled to aerate, cool and dry scrub the same while being subjected to a suction action to remove the dust and fines therefrom to reclaim the material in a cleaned dry state ready to be again tempered with sufficient moisture and treated with suitable bonding agents to render the sand or material in a moldable condition for the making of foundry molds, cores and the like.

The present invention relates to a system for the reclaiming and cleaning of spent granular materials such as inert foundry sand by subjecting the sand to a series of consecutive treatments by the manual control and timing of a series of mechanisms. The material to be treated may be used oil sand, or spent or inert bonded foundry sand which is obtained from previously used foundry molds or cores which have been broken and crushed and from which the metallic particles have been removed by any suitable mechanisms before the crushed material is fed into the reclaiming system for treatment.

The spent foundry sand or material to be

treated is adapted to be delivered from a feed chute 1. The feed chute 1 is positioned to feed a batch of spent material into a wet scrubbing unit consisting of a mixing and mulling apparatus of a construction comprising a foundation or base 2 and supporting legs 3, said legs having a container or crib 4 supported on the upper ends thereof. The crib 4 is provided with a discharge door in the bottom thereof which is adapted to be manually opened and closed by means of a control lever 5. Supported on the base 2 is a driving motor 6 connected to operate a driving gear mechanism mounted within a gear housing 7 which is connected to the bottom of the container or crib 4 and includes a driving shaft for operating mullers 8 and mixing members and plows similar to those illustrated in Figure 3 which will hereinafter be described. Mounted in the crib 4 is a water distributing mechanism 9 into which water is adapted to be discharged from a water supply pipe 10 provided with a control valve for governing the discharge of water into the wet scrubber unit.

The inert or spent foundry sand which is to be reclaimed for re-use is deposited in batches or measured quantities in the wet scrubber crib 4 after which a measured quantity of water is sprinkled over the material to wet the same. The quantity of water added to the material may be determined and controlled by an attendant and is dependent upon the condition of the material being treated. The wetted material is then subjected to a mulling and a mixing treatment by the mulling and mixing mechanisms within the crib 4 to cause the materials to be suitably scoured and wet scrubbed. After the material has been sufficiently wet scrubbed, the attendant operates the door control lever 5 permitting the scrubbed batch of material to be discharged from the crib 4 through the outlet chute 11 for delivery to a bucket-type conveyor 12 which is positioned adjacent the wet scrubber unit and carries measured quantities of the wet scrubbed material upwardly, allowing the small quantities of the material to partially dry before the material is discharged into a receiving hopper 13. The hopper 13 is large enough to receive several batches of the material to permit the same to be preheated before being discharged and advanced for further treatment.

The lower portion of the hopper 13 is tapered and is provided with control doors arranged to discharge selected quantities of the contents of the hopper onto a motor operated horizontally disposed feed control conveyor 14 adapted to transfer small quantities of the wet scrubbed spent material from the hopper 13 and gradually deliver the material into a material heating or burning, oxidizing and drying unit forming part of the system.

The controlled feeding of the wet scrubbed material into the hot unit of the system obviates the danger of injury to the hot refractory lining or walls of the unit, which would occur if large quantities or batches of the cold wet scrubbed material were suddenly deposited into the hot interior of the unit.

The heating and drying unit is provided to accomplish the main cleaning and drying steps in the method, and said unit is the intermediate unit in the system as shown in Figure 1. The details of the heating and drying intermediate unit are clearly illustrated in Figures 2 and 3. Said unit is supported on a foundation or base 15 on the top of which supporting pedestals or

legs 16 are mounted. Supported on the legs or pedestals 16 is a container or crib 17 provided with an insulation lining 18 of a refractory material which covers the bottom and inner faces of the side walls of the crib. Positioned on the top of the supporting base 15 is a driving motor 19 which is coupled with suitable driving gears disposed within a gear housing 20 which is supported on the bottom of the crib 17. The gear mechanisms within the gear housing 20 are arranged to drive a vertical driving shaft 21. The shaft 21 projects upwardly into the crib 17 and has keyed or otherwise secured on the upper end thereof a head or spider 22 including projecting arms or supports 23 and 24. The arm 23 carries a plow 25 while the arm 24 is equipped with a combination plow and scraper 26. The plow 25 and the scraper 26 are adapted to cause the material deposited within the crib 17 to be plowed, mixed and distributed into the path of travel of a pair of wheels or mullers 27 which are carried by brackets or arms 28 which are pivotally supported on the head or spider 22. The wheel or drum mullers 27 are positioned different distances on opposite sides of the driving shaft 21 as illustrated in Figure 3.

The bottom of the container or crib 17 is provided with a discharge opening 29 which is normally closed by means of a trap door 30 which is mounted on a shaft 31 on one end of which a manually operable control lever 32 is secured. When the motor 19 is in operation the plow 25 and the scraper 26 serve to engage the wet scrubbed material being treated within the crib 17 to mix and plow the same and move the material into the path of travel of the rotating wheels or mullers 27 which act to thoroughly squeeze, mull and further mix the material so that the grains are brought into scouring or moving contact with one another to cause the bonding material and any carbonaceous coatings on the sand grains to be loosened or partly removed thereby assisting in the cleaning of the sand grains.

Mounted upon the top of the insulated crib 17 is a cover 33 provided with a refractory or fire brick lining 34. The cover 33 is provided with an entrance opening which is adapted to be closed by means of a door 35 provided with an operating lever or handle 36 for opening the same. As shown in Figure 2, the cover opening is positioned substantially beneath one end of the material transfer conveyor 14 to receive wet scrubbed material therefrom. The conveyor 14 acts to deposit the wet scrubbed material in controlled quantities through the cover opening for deposit into the heated area of the cleaning, scouring and drying unit of the system.

As clearly illustrated in Figure 2, the crib or container cover 33 has a heating or burning mechanism mounted therein in the form of heat distributing pipes or burners 37 which may be connected with any suitable source of heat such as steam, hot air, gas or fuel oil which is adapted to be used in the heating members or burners to cause the interior of the crib 17 to be heated to high temperatures by the heating mediums or flames to cause the material being treated within the crib 17 to be subjected to high temperatures within a range of substantially 900° to 1200° F. The wet scrubbed sand or material which is deposited in small measured quantities in the crib 17 is thus adapted to be turned, plowed, mixed and mulled by the plow, the scraper and the mulling units while being subjected to the heat treatment, for a period of approximately fifteen

minutes, so that the burnt and spent binders and other foreign matter still adhering to the material grains are removed by oxidation and by the scouring action of the grains on one another due to the mulling and mixing treatment, thereby rendering the material thoroughly cleaned and dried but still heated due to the heat treatment.

Referring to Figure 2 it will be noted that the door **35** may be manually opened its full amount to permit a batch of the wet scrubbed material to be gradually fed into the crib **17**. The door **35** may then be completely closed for a short period determined by the operator of the machine. The high temperatures to which the material batch in the crib **17** is subjected, creates steam and gases which are permitted to escape through the opening in the cover **33**. By opening the door **35** a desired amount, as illustrated in dotted lines in Figure 2, the gases and steam escape from the crib **17**, as indicated by the directional arrows, and flow into contact with the conveyor **14** and the hopper **13** to cause preheating and partial drying of the wet scrubbed material before the same is delivered to the crib **17** for a hot scrubbing treatment.

The cleaned, hot, dry sand or material resulting from the timed hot scrubbing treatment, is discharged from the crib **17** by opening the door **30** by means of the door actuating lever **32** thereby allowing the cleaned dry sand batch to flow out through a discharge chute **38** into a vertical bucket type conveyor **39** positioned adjacent the cleaning, heating and drying unit of the system.

The conveyor **39** may be driven by any suitable driving mechanism such as a motor, and carries the cleaned hot sand or material upwardly in controlled bucket quantities for discharge into a hopper **40**, the lower end of which is provided with manually operable and controlled discharge doors **41** which control the discharge of the cleaned hot sand or material from the hopper **40** into an aerating, cooling and dry scrubbing unit of the system.

The aerating, cooling and dry scrubber unit is mounted beneath the hopper **40**, as illustrated in Figure 1, on a foundation or base **42**. The dry scrubber unit comprises supports or legs **43** on the upper ends of which a container or crib **44** is supported. Also mounted on the base **42** is a driving motor **45** the shaft of which projects into a gear housing **46** secured to the bottom of the container or crib **44**. The gearing within the gear housing **46** drives a vertical shaft which projects into the crib **44** to operate a head or spider on which a plow, a scraper and mullers **47** are carried similar to the arrangement illustrated in Figure **3**. With the rotation of the head or spider within the crib **44** the hot cleaned material deposited in the crib **44** is adapted to be aerated by the plow and scraper and is also mulled by the action of the wheel drum mullers **47** to cause the hot cleaned sand or material to be dry scrubbed and cooled off.

The fines and dust resulting from the dry scrubbing and cooling treatments in the crib **44**, are drawn off through a cover or hood **51** engaged on the crib. Connected to the hood **51** is a suction pipe **52** which connects with a suction fan unit **53** and discharge pipe **54** permitting the escape of the dust and fines from the crib **44**.

After the dry cleaned material has been properly cooled off in the crib **44** a discharge door in the bottom of the crib **44** is opened by means of an actuating lever **48** permitting the cleaned cooled material to be discharged from the crib

through a discharge chute **49** upon a suitable motor driven conveyor **50** which may be arranged to conduct the reclaimed sand to a sand conditioning mixer and muller to again be tempered and conditioned by the addition of required amounts of water to the dry mixture plus the addition of the required selected bonding agents, so that the reclaimed sand may be properly reconditioned and ready for the making of foundry molds, cores and the like.

If desired, the reclaimed cool dry sand or material in the crib **44**, after the dust and fines have been removed, may be tempered in said crib by the addition of water and selected bonding agents which may be thoroughly mixed with the clean dry sand particles to properly recondition and rebond the cleaned sand before the same is discharged from the crib **44** onto the conveyor **50** to be conveyed to a foundry for re-use in the making of molds, cores and the like.

The machine assembly or system whereby the improved method of reclaiming foundry sand and similar materials is adapted to be accomplished, is illustrated in Figure 1 and consists of a plurality of spaced treating units of the mixing and mulling type between which suitable conveying mechanisms are positioned for the controlled transferring and timed feeding of the material, to be reconditioned, through the different stages and treatments of the improved reclaiming method or process.

While the arrangement illustrated in Figure 1 shows the three mixing and mulling units positioned at different elevations with vertical type conveyors disposed therebetween for transferring the material from one treating unit to another, it is to be understood that the first or wet scrubbing unit may be at a higher elevation than the second or heating and drying unit so that the material from the crib **4** may be deposited directly onto the control feed conveyor **14** and then gradually fed into the open top of the crib **17**. From the crib **17** the cleaned dry material after treatment may be discharged into the third or cooling crib **44** which may be arranged at a level beneath the level of the first two cribs so that the crib **17** may discharge its contents through the chute **38** directly into the cooling crib **44**. This arrangement will do away with the necessity of having the conveyors positioned between the treating units and would cover a system requiring less floor space than the system illustrated in Figure 1. The modified arrangement of the treating unit with the crib **4** at a higher elevation than the cribs **17** and **44** is illustrated in Fig. 4.

The improved method adapted to be practiced by means of a machine assembly such as illustrated in Figure 1, or by a modified arrangement of the mechanisms, consists of first crushing previously used foundry molds or cores and removing therefrom, by any standard means, any metallic particles and the dust and fines. The resultant used granular foundry sand or other material to be reclaimed, is then delivered by means of the feed chute **1**, in predetermined quantities or batches, to the crib **4** of the first unit.

The spent foundry sand in the crib **4** is then sprinkled or mixed with water from the water distributing mechanism **9**. The motor **6** is then started to cause operation of the plow, the scraper and the mullers within the crib **4** to cause the wet spent sand particles to be subjected to a wet scrubbing action, by the mechanisms within the crib **4**, for a period of two or three minutes.

The material accordingly assumes a paste-like form, the grains of which are brought into coacting scouring relationship with one another to be wet scrubbed so that the spent material is partly cleaned or loosened by the wet scrubbing treatment. After the spent material has been wet scrubbed as described the discharge door of the crib 4 is opened, by means of the lever 5, and the wet scrubbed material batch is discharged into the conveyor 12 for delivery, in bucket quantities, into the hopper 13.

Since the length of treatment of the material in the crib 4 is only two or three minutes, while the hot scrubbing treatment in the crib 17 is about fifteen minutes, a number of batches of the material may be wet scrubbed and delivered and stored in the hopper 13 to be preheated and partially dried and then gradually delivered as required to the hot scrubbing unit by the conveyor 14 to be delivered gradually or at a desired controlled rate through the opening in the cover 33 into the crib 17 ready to be subjected to the heat or oxidation treatment.

While the wet scrubbed material is gradually fed into the crib 17, so as not to cause damage to the refractory lining of the crib, the motor 19 is set in operation thereby causing the plow, the scraper and the mullers within the crib 17 to agitate, mix and mull the partly cleaned material in the closed area of the unit. The material while thus being treated is subjected to heat, from the pipes or burners 37, to temperatures from 900° to 1200° F. for a period of substantially fifteen minutes or for any other selected period which may be determined by the experienced operator of the machine. As the material is being treated in crib 17, the resultant steam and gases are permitted to escape through an opening in the cover 33 to cause heating of the conveyor 14 and the hopper 13 to preheat the wet scrubbed material before it is delivered into the crib 17.

After the material has been given the heat treatment in the crib 17 in which the action of the heat removes the spent bonding materials, as well as any carbonaceous coatings and foreign matter from the sand grains, assisted by the rubbing action of the sand grains on one another due to the plowing and mulling treatment by the operating mechanisms within the crib 17, said material becomes thoroughly cleaned and dried and is ready to be discharged. The crib door 30 is next opened, permitting the hot treated sand or material to be discharged through the chute 38 into the conveyor 39 and then into the hopper 40.

The third stage of the method is now started and consists of delivering the hot dry material into the crib 44 which forms a part of the aerating, cooling and dry scrubbing unit of the system. The hot cleaned reclaimed sand in the crib 44 is subjected to the action of the plow, the scraper and the mullers, thereby causing the hot material to be thoroughly dry scrubbed, aerated and cooled for a period of approximately ten minutes, thereby rendering the cleaned material grains cooled and dry ready for storage. During the dry scrubbing treatment the resulting fines and dust are suctioned off through the hood 51 and the escape pipes or flues 52 and 54.

The cooled dry reclaimed material is next discharged from the crib 44, through the discharge chute 49, onto the conveyor 50 to be carried to a storage station from which it may be taken as required. The reclaimed cleaned cooled sand delivered to the storage station is now ready to be

reconditioned for foundry use by tempering the same with required quantities of water and mixing selected bonding agents therewith to prepare the sand ready to again be used for making foundry molds, cores and the like.

In case it is desired to reclaim spent oil sand or the like, instead of inert bonded foundry sand, the wet scrubbing unit and the first conveyor and hopper may be omitted. Only the second and third treating units and the material transfer mechanisms therebetween are therefore necessary to subject the spent oil sand to the mixing, mulling and heat treatments and to the dry scrubbing treatment to reclaim the sand for storage and re-use.

In case sufficient cooling areas are available, and the reclaimed material is not urgently needed, the third or dry scrubbing and cooling unit may be omitted, using only the first two units and discharging the hot cleaned material from the crib 17 for delivery to a cooling space in which the reclaimed hot material may be allowed to gradually cool off. When the third unit is omitted the cover 33 of the second unit may be equipped with a fine and dust suction attachment similar to that supported on the hood 51.

It is to be understood that if conditions permit and it is desired, the cleaned cool sand after treatment, in the crib 44 of the cooling unit, may be retained in said crib and may then be subjected to the further action of the plowing, scraping and mulling mechanisms after a required amount of water and selected bonding agents have been deposited in the crib 44 for the final reconditioning treatment of the reclaimed sand to again recondition the same for foundry use.

While only one form of a selected machine assembly or system has been illustrated for practicing the improved method or process of reclaiming and reconditioning spent foundry sand and the like, it is to be understood that this is merely one exemplification of the principles involved, and the right is accordingly reserved to make such changes in the above construction and in the arrangement and combination of the units of the system as will widen the field of utility and increase the adaptability of the system without departing from the principles of this invention. It is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

We claim as our invention:

1. In a method of conditioning used bonded foundry sand for re-use, the steps of first wet scrubbing and mulling the sand to break up the sand and to moisten the particles thereof so that the sand is thoroughly mulled in a paste-like form and thereafter while the sand is in said divided form with the grains thereof in a substantially free state transferring the sand to a heating station, and at said station contemporaneously heating and mulling the sand to loosen and substantially remove carbonaceous and combustible foreign material from the grains of sand.

2. The method of claim 1 further characterized by the heat applied to the sand being of a temperature of from substantially 900° to 1200° F. so that the carbonaceous or foreign material is burned off the sand grains.

3. The method of claim 1 further characterized by directing liberated steam from the heated sand material against an incoming fresh batch of previously wet-scrubbed sand to preheat the same.

4. The method of claim 1 further characterized by the additional step of, subsequent to the heat-

ing step, aerating the heat treated sand to drive off the fines liberated during the previous mulling steps.

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