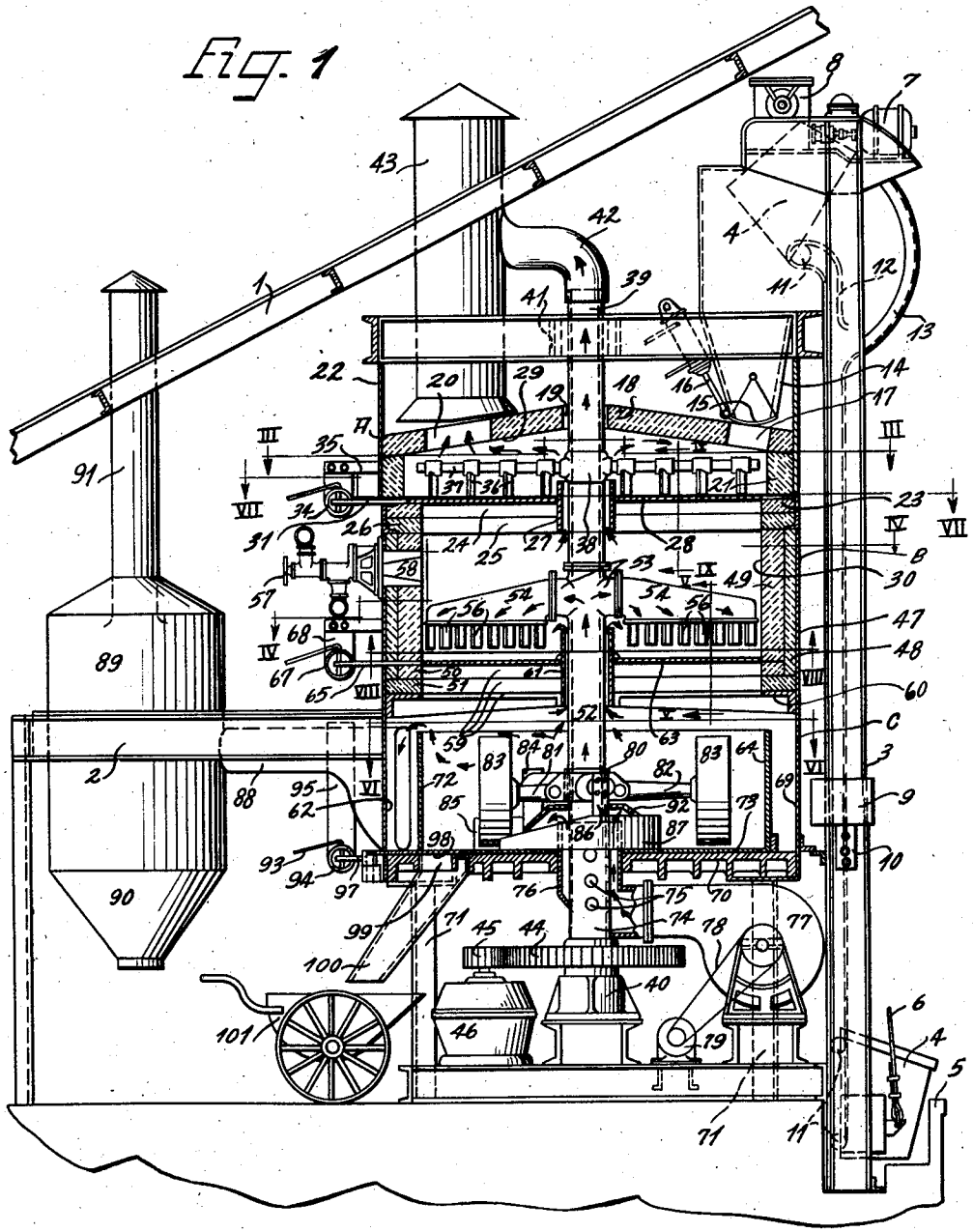
Oct. 28, 1947. A. C. CHRISTENSEN 2,429,667

METHOD OF RECLAIMING SPENT MATERIAL

Original Filed April 6, 1944 3 Sheets-Sheet 1

Fig. 1



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Fig. 3

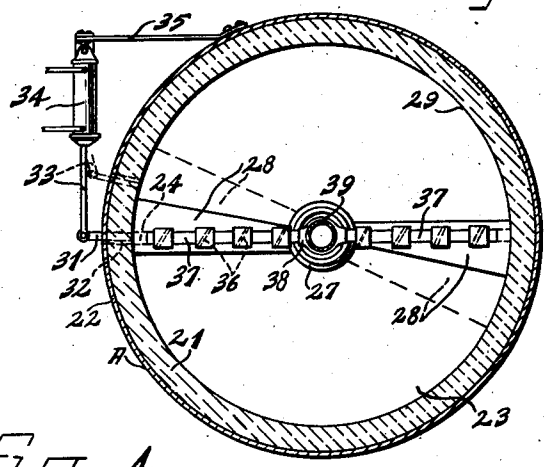


Fig. 4

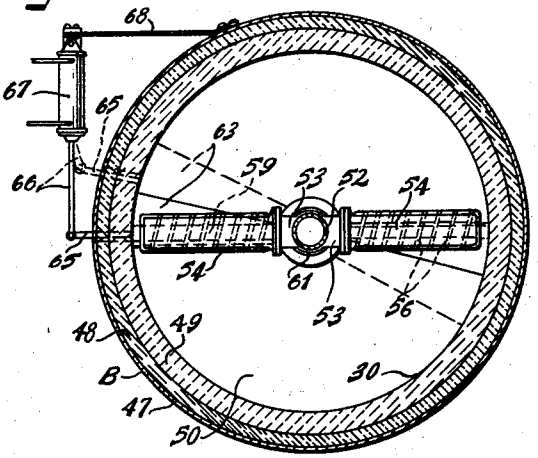


Fig. 5

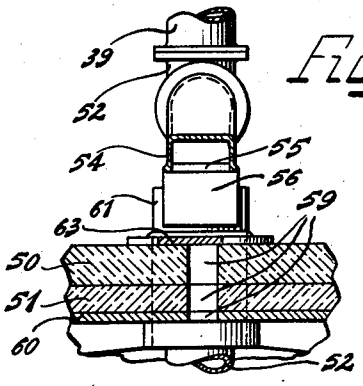
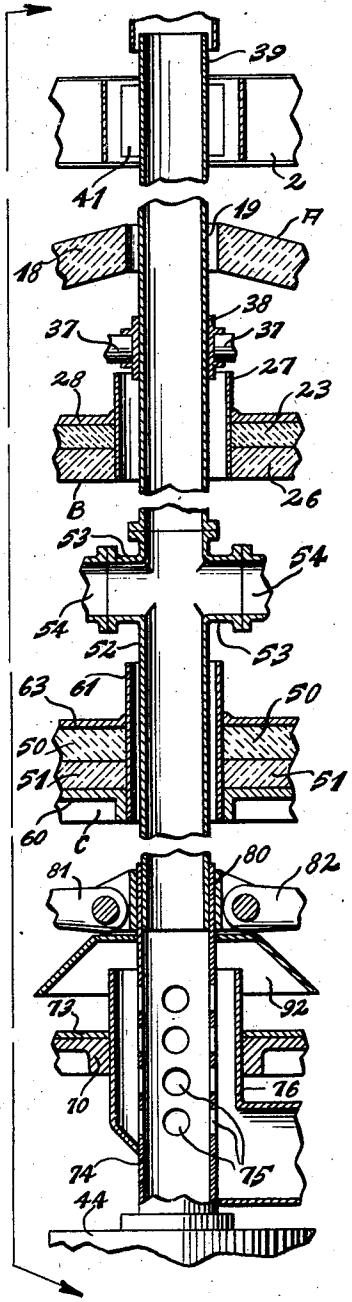


Fig. 2



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METHOD OF RECLAIMING SPENT MATERIAL

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Fig. 6.

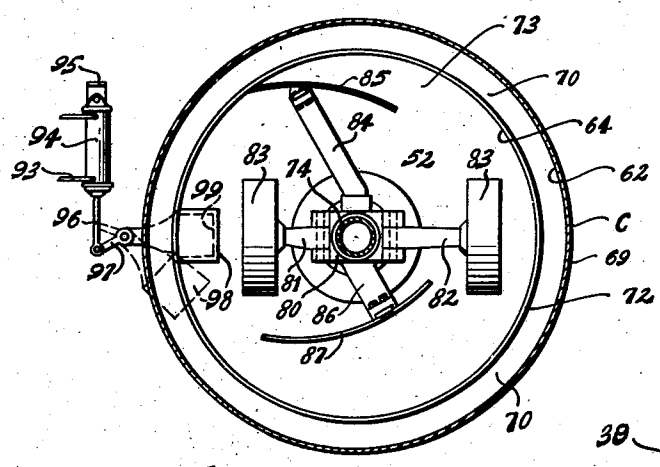


Fig. 7

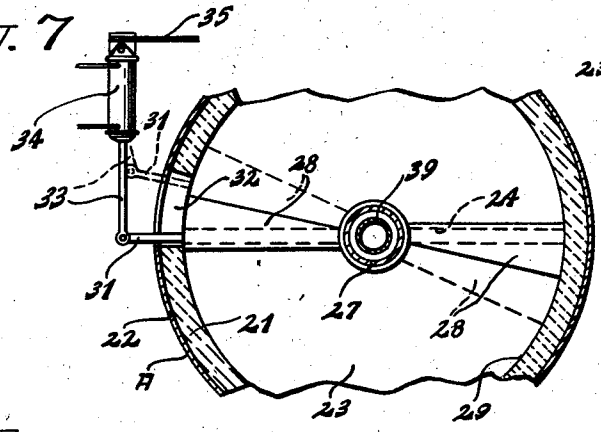


Fig. 8

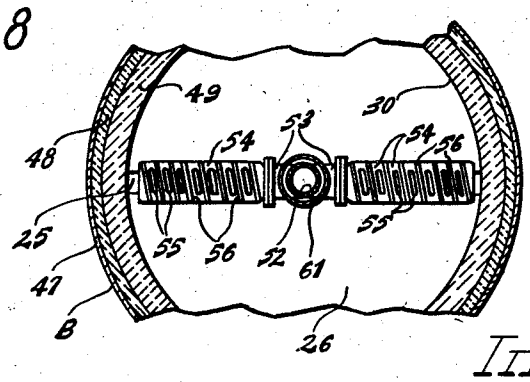
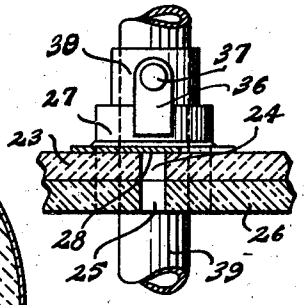


Fig. 9



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Patented Oct. 28, 1947 2,429,667

UNITED STATES PATENT OFFICE

2,429,667

METHOD OF RECLAIMING SPENT MATERIAL

Alfred C. Christensen, Chicago, Ill., assignor to Herbert S. Simpson, Evanston, Ill.

Original application April 6, 1944, Serial No. 529,770. Divided and this application March 2, 1945, Serial No. 580,583

9 Claims. (Cl. 22—217)

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The present invention disclosed and claimed herein pertains to a method for more efficiently reclaiming spent and inert materials such as used foundry sand and the like, by batch feeding of the material and subjecting the material in batches to successive preheating, burning and cooling treatments as the batches are fed downwardly by gravity through superimposed levels whereby the material being treated is economically reclaimed for reconditioning and reuse.

The present subject-matter has been divided from my copending application, Serial No. 529,770, filed April 6, 1944.

In establishments using granular materials, such as a foundry using mold and core sand, said sand usually consists of silica grains combined with bonding agents tempered with sufficient moisture to develop the strength of the binders and to render the sand moldable. After such sand has been used for making molds, cores, and the like, it becomes spent or inert and due to the heat to which the sand is subjected, it becomes coated with unburned bonding material and carbon to such an extent that the sand is no longer fit for further use and must consequently be discarded. This constitutes a considerable waste and the additional expenditures necessary to purchase new clean sand are such that it is highly desirable to reclaim the original sand and then recondition the same for further use.

It is an object of this invention to provide an improved method for reclaiming inert and spent foundry sand and similar granular materials, which method is economical, clean and effective.

It is also an object of this invention to provide an improved method for reclaiming spent and inert used granular materials by conducting the materials downwardly through a vertical path or course and subjecting the materials to preheating and agitating treatments, burning and rabbling treatments, and then subjecting the materials to mixing, mulling and aerating treatments and simultaneously removing the fines therefrom to produce a cleaned reclaimed material ready for reconditioning and reuse.

A further object of the invention is to provide for reclaiming and reconditioning previously bonded granular materials such as foundry sand and the like, by subjecting a plurality of batches of the material in different superimposed units to selectively controlled timed treatments consisting of first agitating and preheating the material, then subjecting the same to sufficient heat to burn off and remove the bonding and carbonaceous coatings from the material grains and then aerating and cooling the material and simultaneously dry scrubbing the same and removing the fines therefrom to produce a resultant cleaned and cooled material suitable for rebonding, retempering and reuse.

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It is furthermore an object of this invention to provide an improved method for reclaiming inert foundry sand and the like by batch feeding the material downwardly through successive areas and subjecting a batch during its passage to agitating, burning and oxidating, and to mixing and mulling treatments in the presence of air currents to serve as a cooling medium, in a cooling area, as an oxygen supply in the burning area, and as a preheating medium in the material receiving area whereby the material batch is successively treated in the respective areas and is finally subjected to a fine removing suction action before being batch discharged in a cooled and cleaned condition ready to be stored or subjected to retempering and rebonding treatments to recondition the material for further use.

Another object of the invention is to provide a sand reclaiming system wherein a batch of material is agitated and preheated before being batch fed into a confined area heated to a selected temperature for burning off spent bonding agents and carbonaceous coatings while the material is being mixed and air treated before being batch fed into a confined area to be mulled, mixed and air cooled while the fines and dust are suctioned from the cleaned cooled batch of material prior to discharge for storage or reconditioning treatments.

An important object of the invention is to provide an improved method for reclaiming spent foundry sand and the like, said method including controlled batch feeding with the aid of gravity, said method also including the consecutive subjection of the batches to agitating and preheating treatments, to burning and oxidation treatments in the presence of circulating air currents, and then to cooling, mixing, mulling and dust and fine removing treatments in a confined area in the presence of cool air circulating currents which are subsequently utilized for circulation through the burning and oxidating area and then through the preheating area in a direction opposite to the movement of the material batches through the various material reclaiming stages of the method.

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

It is believed that my novel method will be best understood from the following description of an apparatus for practicing the same.

On the drawings:

Figure 1 is an elevational and sectional view of an apparatus or machine constructed in accordance with the principles of this invention and capable of expeditiously and economically carrying out the methods of reclaiming spent granular materials such as foundry sand and the like.

Figure 2 is an enlarged fragmentary vertical sectional view, with parts shown in elevation, and taken through the common driving mechanism and the air supply and circulating means for the three superimposed material feeding units of the improved apparatus.

Figure 3 is a horizontal sectional view taken on line III—III of Figure 1 through the mixing and preheating top unit of the apparatus.

Figure 4 is a transverse sectional view taken on line IV—IV of Figure 1 looking downwardly in the burning and oxidation or intermediate unit of the apparatus.

Figure 5 is an enlarged vertical detail sectional view taken on line V—V of Figure 1 and transversely across one arm of the material mixing and air distributing rabble mechanism within the confined area of the burning and oxidizing intermediate unit.

Figure 6 is a transverse sectional view taken on line VI—VI of Figure 1 and looking downwardly into the cooling, mixing and mulling unit of the apparatus.

Figure 7 is a transverse sectional view taken on line VII—VII of Figure 1 through the lower part of the upper preheating unit to show the diametrically disposed material discharge control doors or plates in closed position over the diametrical discharge slot in the bottom of the upper unit and also indicating the dotted line open positions of the discharge doors.

Figure 8 is a transverse detail section taken on line VIII—VIII of Figure 1 looking upwardly in the intermediate high temperature unit of the apparatus to show the air supply openings in the bottom of the rabble arms of the rotatable rabble blade mechanism.

Figure 9 is an enlarged fragmentary vertical detail section taken on the line IX—IX of Figure 1 through the preheating unit rabble blade mechanism and showing the registering discharge slots or openings between the top unit and the intermediate unit of the machine.

As shown on the drawings:

The improved method of cleaning and reclaiming spent or inert granular materials such as foundry sand and the like is adapted to be accomplished by means of a vertical machine assembly or system of the type illustrated in Figure 1 and which includes a superimposed grouping of various batch treating units permitting batch feeding of the material with the aid of gravity from one unit into the next lower unit. The improved machine assembly includes a common drive mechanism combined with an air supply and circulating means whereby a plurality of batches in different units may be simultaneously treated and subjected to the action of air currents while being treated or actuated by rabble mechanisms in the two upper units, and while the batch in the lowermost unit is being cooled and subjected to mulling and mixing treatments while the fines and dust are removed prior to the discharge of a cleaned cooled batch ready for storage or reconditioning for reuse.

As clearly illustrated in Figure 1, the improved machine assembly is preferably disposed within a building, which has been omitted except for the roof section 1. Disposed within the building is a supporting framework 2 including a vertical frame 3 upon which a controlled material bucket type feeder is supported for batch feeding the material to be reclaimed by discharging the batches, in timed order, into the upper end of the machine.

The batch type bucket feeder comprises a batch bucket 4 which when in its normal position, as indicated in full lines in Figure 1, is positioned adjacent a loading platform 5 from which the spent or inert sand or other material, which is to be reclaimed, is adapted to be deposited into the bucket when in a receiving position. The batch feed bucket 4 is adapted to be alternately raised and lowered by means of a cable 6 adapted to be wound and unwound by means of a drum mounted on the upper portion of the machine framework and operable by means of a motor 7 acting through a speed reducer drive 8. The operation of the bucket 4 is accomplished by means of a reversing switch 9 supported in a convenient position on the feeder frame 3. The switch 9 is connected with a combination start, stop and reverse push button control 10 also mounted on the feeder frame 3. The batch feed bucket 4 is provided with upper and lower rollers 11 which track in guide tracks 12 and auxiliary guide tracks 13 supported on the frame 3. The auxiliary guide tracks 13 are located near the upper portion of the frame 3 and are adapted to serve as guides for the lower rollers 11 of the loading bucket 4, when the upper rollers reach the upper closed ends of the main guide tracks 12 to cause the loading bucket at the upper limit of its movement to be upset or reversed to tilt the same to cause discharge of a batch of the material into a receiving hopper 14. The material receiving hopper 14 is provided with a discharge door 15 the operation of which is controlled by means of an air operated plunger rod mechanism 16.

A batch of spent sand or material, which is to be reclaimed, is adapted to be discharged from the feed hopper 14 into an end opening 17 provided in a roof or top 18, which forms the top of the material reclaiming machine or apparatus. The machine is of the vertical type and has the various material treating units thereof mounted in superimposed relationship upon the framework 2.

The material reclaiming machine or apparatus consists of three superimposed units namely a top or material preheating unit A, an intermediate or burning unit B upon which the preheating unit A is supported, and a lower cooling, stirring and mulling unit C upon which the middle or burning unit is supported.

The top or preheating unit A includes the roof or top 18 which is constructed of fire bricks or other suitable refractory material and in addition to the entrance opening 17, is provided with a central opening 19 and an outlet or escape opening 20. The top or preheating unit A of the machine in addition to the refractory top 18 includes a refractory cylindrical body or lining 21 which is disposed within a cylindrical metal housing 22. The preheating unit also includes a refractory bottom 23 which is formed with a diametric discharge slot or opening 24 through which a batch of material after being preheated and treated in the preheating unit A is adapted to be discharged downwardly with the aid of gravity through a diametric material inlet slot of opening

25 formed in a heat insulation top wall 26 disposed directly beneath the refractory bottom or floor 23 of the top unit A.

The middle of the refractory bottom or floor 23 of the top unit A and the middle of the insulation top wall 26 of the burning unit B are each provided with a central opening. A door supporting and air circulating sleeve or hub 27 is rotatably engaged through the central openings to form a communication between the interiors of the top and middle units A and B. Rigidly secured to or integrally formed on the sleeve or hub 27 are segment-shaped shutters or blades 28 which form a control door over the registering slots 24 and 25 to govern the discharge of a batch of material from the upper preheating chamber 29 of the unit A into the burning chamber 30 of the intermediate unit B. The control door, formed by the diametric blades 28, is adapted to be shifted into open and closed positions with respect to the discharge slot 24, by means of a radially projecting arm 31 which projects outwardly through a slot 32 formed in the lower portion of the top unit refractory body wall or lining 21 and the outer housing wall 22. Pivotally connected to the outer end of the door operating arm 31 is a piston rod 33 which slidably projects into an air controlled cylinder 34 supported in place by means of a bracket 35 secured to the housing 22 of the top or preheating unit A.

A batch of material delivered from the hopper 14 through the entrance opening 17, when the hopper door 15 is opened, is discharged into the chamber 29 of the preheating unit A and is adapted to be agitated or stirred up by means of a plurality of rabble blades 36 which are mounted in spaced relation on a pair of radially opposite or diametric rabble arms 37. The inner ends of the two rabble arms 37 are rigidly secured in a collar 38 which in turn is rigidly fastened around a centrally disposed upper hollow driving and air circulating shaft section 39 which forms a part of a main operating shaft centrally disposed in and common to all three of the superimposed units A, B and C as clearly illustrated in Figure 1.

The main air supply and driving shaft is formed in sections and has the lower end thereof supported in a lower bearing 40. The main shaft projects upwardly and centrally through the three treating units A, B and C and has the upper shaft section 39 projecting out through the central opening 19 of the top unit A. The upper end of the shaft section 39 engages in an upper bearing 41 mounted on upper horizontal frame members of the framework 2. The upper end of the air circulating and operating shaft section 39 projects upwardly into an elbow pipe 42 which connects up with one side of a collector 43. The collector 43 is supported on the framework 2 and has the lower end thereof devised to form a hood which is disposed over the outlet or escape opening 20 in the roof or top 18 of the top unit A. The upper end of the collector 43 projects upwardly through the roof 1 of the building to permit escape of the air passing upwardly through the shaft section 39 and the heated air from the chamber 29 of the top unit A. Any dust or fines from the top chamber 29 are carried off into the collector 43 by the escaping heated air leaving the top unit A. Keyed or otherwise rigidly secured on the lower section of the main shaft above the lower bearing 40, is a large driven gear 44 which is in mesh with and receives a drive from a small driving gear 45. The gear 45 is secured on the shaft of a driving motor 46 which is mounted on horizontal frame members near the bottom of the framework 2 as shown in Figure 1.

A batch of material after having been agitated and stirred by the rabble blades 36 in the upper preheating unit A and having been sufficiently preheated, is adapted to be batch discharged from the top chamber 29 by opening the door blades 28 allowing the partly treated and preheated batch of material to drop downwardly by the aid of gravity through the registering openings 24 and 25 into the burning chamber 30 of the intermediate unit B of the machine. The burning or middle unit B comprises a cylindrical metal housing 47 which forms a casing for enclosing an inner housing consisting of the insulation top wall 26, a cylindrical insulation wall 48 adjacent the inner surface of the metal housing 47 and surrounding a refractory inner wall or lining 49. The burning unit B also includes a refractory bottom or floor 50 disposed about an insulation bottom 51. The inner wall 49 and the inner bottom floor 50 are constructed of refractory material such as fire brick or the like. The refractory walls are surrounded by the top wall 26, the side wall 48 and the floor bottom 51 all of which are constructed of an insulation material whereby the high temperatures required for the treatment of the material, are adapted to be maintained in the burning chamber 30 of the intermediate unit B.

The hollow main shaft also includes an intermediate hollow shaft section 52 which is disposed axially in the intermediate unit B and is provided with a top flange which is rigidly secured to a bottom flange of the top or upper shaft section 39. Integrally formed on the intermediate shaft section 52, within the chamber 30, are a pair of diagonally opposite supporting arms 53 the outer ends of which are provided with flanges. Rigidly secured to the flanges on the ends of the supporting arms 53 are a pair of radially disposed diametric hollow rabble arms 54 the bottom wall of each of which is provided with a plurality of spaced diagonally positioned air distributing slots or apertures 55 clearly illustrated in Figure 8. Rigidly secured or integrally formed on the bottom of each of the hollow rabble arms 54 are a plurality of spaced diagonally positioned rabble blades 56. Rotation of the main shaft causes rotation of the rabble blade carrying air supply arms 54 to cause the batch of preheated material, received from the upper preheating unit A, to be mixed and agitated in the chamber 30 of the intermediate burning unit B. The slots or apertures 55 in the arms 54 are adapted to discharge air at ordinary temperature into the chamber 30 to supply a sufficient amount of oxygen whereby oxidation may take place within the chamber 30 during the treating of the particles of the material being treated.

For the purpose of subjecting the material in the chamber 30 of the intermediate unit B to substantially high temperatures ranging from approximately 900° to 1200° F. a gas or oil burner 57 is mounted on the exterior of the intermediate housing 47 and includes a flame throwing nozzle 58 which projects through registering openings in the housing 47 and in the inner walls 48 and 49 whereby heating flames may be directed into the chamber 30 to produce the required temperatures, thus the granular particles of the batch of material being dry scoured in the chamber 30 are adapted to be further cleaned by having the coatings of the old bonding materials and foreign

matter burned off of the grains by an oxidation treatment to complete the cleaning of the batch of material.

The superimposed bottoms 50 and 51 of the intermediate unit B are provided with diametric registering discharge slots or openings 59 which register with a third diametrical discharge slot or opening 59 formed in a top wall 60 formed of metal or other suitable material. The top wall 60 forms the top of the lower cooling and mulling unit C of the machine. The two superimposed bottoms 50, 51 and the top wall 60 are provided with registering central openings intersected by the discharge slots 59. Projecting through the central openings of the bottoms 50 and 51, and the top wall 60 is an air circulating collar or sleeve 61 through which the lower arm of the intermediate driven shaft section 52 projects to extend into a cooling chamber 62 of the lower unit C. To retain the batch of material within the burning chamber 30 a diametric control door 63 is provided within the intermediate unit B and said door consists of a pair of diametrically opposite or radial shutters or blades having their inner ends thereof rigidly secured to a collar which is rotatably engaged on the air circulating sleeve or collar 61 to permit the door to be rotated to cause opening of the discharge opening in the bottom of the intermediate unit B to permit a cleaned hot batch of material from the chamber 30 to be dropped by the aid of gravity into a mixing and mulling chamber 64 provided within the lower cooking chamber 62 of the bottom unit C. A radially directed door operating arm 65 is rigidly connected to the door 63 and projects out through a slot in the walls of the intermediate unit B to permit the outer end thereof to be pivotally connected to a piston rod 66 which forms a part of an air control cylinder 67 mounted on a bracket 68 secured to the exterior of the cylindrical metal housing 47 of the middle unit.

The batch of material after being hot treated or cleaned by the burning process within the chamber 30 is permitted to be discharged through the registering discharge openings 59 in the bottom of the unit B into the lower or cooling unit C. The lower unit C is a combination cooling, mixing and mulling unit including the metal top wall 60 which is supported on a metal outer cylindrical casing or housing 69 closed by means of a bottom 70 which is rigidly supported by legs or standards 71 which form a part of the framework of the machine. Securely mounted within the casing or housing 69 is an inner cylindrical casing wall 72 which is spaced from the outer wall 69 providing a circular space between the two walls 69 and 72 as illustrated in Figure 1. The inner wall 72 forms the material receiving chamber 64 into which the hot cleaned material from the intermediate unit B is discharged after being cleaned by being subjected to the rabbling and oxidation treatments. The inner cylindrical casing 72 is provided with a replaceable wear plate 73 which serves as the bottom of the inner casing 72 and rests upon the top surface of the bottom 70 of the lower unit C, as clearly illustrated in Figure 1.

The common hollow main driven shaft for the machine in addition to the upper section 39 and the intermediate section 52, consists of a slightly enlarged lower tubular shaft section 74 the lower end of which is engaged in the bearing 40 and has the driven gear 44 secured thereon. The upper end of the lower shaft section 74 projects upwardly through an opening in the bottom of the lower cooling unit C and has the lower end of the shaft section 52 rigidly secured therein. The lower shaft section 74 is provided with a series of air intakes or apertures 75.

Air is supplied to the lower apertured shaft section 74 from an air supply elbow 76. The vertical portion of the air supply elbow 76 projects upwardly through an opening in the bottom of the lower cooling unit C and is spaced circumferentially around the lower driven shaft section 74 as clearly illustrated in Figures 1 and 2 to permit air to be admitted into the lower mulling and mixing chamber 64 of the lower unit C as well as into the air receiving apertures 75 of the common driven shaft of the machine. The lower shaft section 74 projects axially upwardly into the elbow 76 so that the apertures 75 of the lower shaft section are disposed within the elbow. The horizontal portion of the air supply elbow 76 has the outer end thereof rigidly connected to the outlet of an air blower 77 operated by means of a belt 78 from a driving motor 79 mounted beneath the lower cooling unit C on lower members of the machine framework 2.

It will thus be noted that cool air from the blower 77 is adapted to enter the apertures 75 in the lower section of the driving shaft permitting the air to pass upwardly through the shaft to the various superimposed material treating units and acting to serve as a cooling medium for the upper shaft bearing 41 before the air is discharged into the elbow 42 to pass into the collector 43 and escape through the upper end of the collector from beneath the cover or hood thereof. Air from the blower 77 also passes upwardly through the elbow 76 and enters the lower inner chamber 64 and the outer chamber 62, of the lowermost cooling unit C from which the air is permitted to pass upwardly through the collar or sleeve 61 into the burning chamber 30 of the intermediate or burning unit B to be heated to high temperatures by the flames from the burner 57.

The highly heated air from the chamber 30 is then permitted to pass upwardly through the sleeve or collar 27 into the upper chamber 29 of the top unit A to serve as a means for preheating the material as it is being agitated and stirred to dry scour the same by the action of the rabble blades 36 when the rabble blade carrying arms 37 are rotated by the action of the rotating common driven and air circulating shaft. The preheated air from the preheating chamber 29 is permitted to escape through the outlet opening 20 in the roof or top 18 of the top unit and is permitted to enter through the lower end of the collector 43 carrying with it any light dust or fines resulting from the treatment of the material batch in the chamber 29.

Air passing upwardly through the hollow main driven shaft is also adapted to pass transversely through the arms 53 into the hollow rabble arms 54 to be discharged or fed downwardly through the rabble arm outlet or air feed slots or apertures 55 to enter into the burning chamber 30 of the intermediate unit B to be discharged against the material while being rabbled. This arrangement permits sufficient oxygen to be supplied to the burning chamber to coact with the combustion gases from the heater to cause oxidation and a cleaning off of the old bonding and foreign matter coatings from the grains of the batch of material being agitated and mixed by the rabble blades 56 when the rabble arms 54 are rotated with the rotation of the hollow driven shaft.

For the purpose of treating a clean batch of hot material received from the intermediate heating unit B, the lower unit C is equipped with a mulling and mixing mechanism consisting of a supporting collar or head 80 which is rigidly secured around the upper end of the lower shaft section 74 within the inner housing 72. Pivotally supported on opposite sides of the collar or head 80 are a pair of radially directed muller supporting arms 81 and 82 with the arm 81 being shorter than the arm 82. Rotatably mounted on the outer ends of the arms 81 and 82 are mullers 83. Also rigidly secured to the collar 80 is an arm 84 on the lower end of a vertical extension of which a scraping blade 85 is supported. The scraping blade 85 is positioned to have the outer end thereof engaged adjacent the inner face of the inner casing wall 72 to serve as a scraper while the lower end of the scraper 85 is adapted to pass over the top surface of the replaceable liner wear plate 73. Also rigidly secured to the collar 80 is a shorter arm 86 the outer end of which is directed downwardly or is provided with a vertical extension on the lower end of which a plow blade 87 is secured to pass over the wear plate 73 for plowing the material being treated and for moving the material into the plate of travel of the mullers 83.

The batch of material, having been deposited in the inner chamber 64 of the inner casing 72 of the lower unit C, is adapted with the rotation of the main driven shaft to be mixed and mulled in the presence of air currents circulating and passing through the inner chamber 64 and then passing upwardly through the collar or sleeve 61 into the burning chamber 30 of the intermediate unit B. While the material is being mixed, mulled and cooled in the chamber 64 of the lower cooling unit C, part of the air entering the chamber 64 of the lower cooling unit C passes over the top of the inner housing wall 72 into the space between the circular wall 72 and the outer casing wall 69 carrying with it any fines and dust still remaining in the material while undergoing its final treatment so that the fines and dust may be carried out through an outlet flue 88 having one end thereof connected around an outlet opening in the lower casing 69 while the other end thereof is connected to project into one side of a fine and dust collector 89 in which the fines and dust are permitted to settle and be drawn off through the lower hopper end 90 formed on the bottom end of the collector 89 while the air is permitted to escape outwardly through the top of the collector through a discharge stack or flue 91 which projects upwardly through the roof 1 of the building in which the machine is installed.

In order to prevent the hot material discharged from the burning chamber 30 into the cooling chamber 64 of the muller unit B from entering the vertical section or arm of the air inlet elbow 76 within said chamber 64, a material deflecting shield 92 is mounted around the lower shaft section 74 above the open upper end of the vertical part of the air inlet elbow 76 as clearly illustrated in Figure 2.

After the material in the lower cooling unit C has been mixed, mulled and cooled for a timed period the duration of which may be governed by the attendant of the machine, the attendant merely operates an air control which governs the operation of the air control cylinder 94 carried by a bracket 95 supported on the machine framework. The air control cylinder 94 and the other air control cylinders of the machine have air intake and outlet pipes 93 connected therewith. An air operated plunger rod 96 projects from the cylinder 94 and has the outer end thereof pivotally connected to a door operating lever or handle 97 which is integrally formed at an angle at the outer tapered end of a discharge door 98. The discharge door 98 is pivotally supported on a suitable bracket exterior of the outer housing or casing 69, of the lower unit C, and has the main portion of the door disposed in a suitable slot in the side of the lower unit C so that normally the door 98 is engaged in the full line position illustrated in Figure 6 to cover a discharge opening 99 provided in the bottom or floor members 73 and 70 of said lowermost unit.

The discharge opening 99 registers with the upper end of a material discharge chute 100 which projects downwardly beneath the machine into a position to permit a material receiving cart or wheelbarrow 101 to be moved into position beneath the discharge end of the chute to receive the batch of cleaned dry and cooled reclaimed sand or other material to permit the batch to be carted away for storage until needed or to a station containing suitable apparatus to permit the cleaned, reclaimed cool material to be retempered and rebonded to completely recondition the same so that the reclaimed material may again be used for making foundry molds, cores and the like.

The apparatus or machine assembly 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 superimposed treating units each of which is equipped with material actuating mechanisms all of which are adapted to be simultaneously operated from a common combination drive and air circulating shaft. The machine permits a series of batch treatments to be conducted simultaneously in the various units in which the respective batches may be subjected to the successive timed treatments of the improved reclaiming method or process.

The improved method or process adapted to be practiced by means of the improved machine assembly or apparatus such as illustrated in Figure 1, consists of batch feeding the material to be reclaimed, such as previously used foundry sand obtained from old foundry molds or cores which are first crushed and then treated by any standard means whereby the metallic particles and the excessive dust and fines are first removed. The resultant used or spent granular foundry sand or similar material is then delivered in batches through the top of the machine into the uppermost unit where the material is subjected to a rabble agitating treatment while being subjected to hot air currents to preheat the material batch for a manually controlled period of time after which the preheated batch is discharged by gravity into a lower highly heated area of zone which supplies hot air to the upper preheated area and simultaneously subjects the material batch in the second area to high temperatures in the presence of air currents to cause the batch to have the coatings of old bonding materials and foreign matter burned therefrom by oxidation assisted by the projection of cool air drafts from a rabbling means which dry scours the batch leaving the same in a cleaned hot condition ready to be discharged. The hot cleaned batch after a time treatment is next discharged into a cooling area where the batch is subjected to mixing, plowing and mulling actions in the presence of

moving cool air currents to cause cooling of the cleaned material by the air currents which partially travel into the burning area while the remaining air currents are discharged for drawing off the remaining dust and fines allowing the thoroughly dry reclaimed material batch to be batch discharged for storage or for transfer to reconditioning means wherein the batch may be retempered with the required quantities of water and mixed with selected bonding agents to prepare the material so that it may again be used for making foundry molds, cores and the like.

It is to be understood that the machine herein described and the method or process adapted to be practiced may be employed for the purpose of reclaiming spent oil sand or the like instead of inert bonded foundry sand. The various steps in the reclaiming of spent granular material by means of the machine herein described, may be separately and independently timed, by an attendant, by a manual operation of the air pressure control mechanisms connected with the various discharge doors of the three superimposed treating units of the machine thereby permitting a treated batch to be discharged from one of the units before a new batch is admitted from another unit or from the batch supply feed hopper. The supply of material in batches to the machine is also manually controlled by means of the push button control 10 connected with the reversing or control switch 9 of the batch feed mechanism.

While a selected machine assembly or system has been illustrated and described for practicing the improved method or process of reclaiming spent or inert foundry sand and other similar materials, it is to be understood that the machine is one exemplification of the principles involved, and the right is accordingly reserved to make such changes in the construction and in the arrangement and combination of the unit and the parts 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.

I claim as my invention:

1. The method or process of reclaiming spent granular material including subjecting a batch of the spent material to consecutively arranged rabbling and preheating treatments, next to rabbling, burning and oxidizing treatments and then to mixing and mulling treatments in different areas in the presence of air currents consecutively traversing the areas in a direction reverse from that of the travel of the batch of the material.

2. A method of reclaiming spent granular material in different areas, including manually timing and consecutively subjecting a batch of material to rabbling and preheating treatments in one area, then to rabbling and high temperature treatments in another area, then to cooling, mixing, mulling and fine removing treatments in still another area, and subjecting the material during the various treatments to air currents continuing from one area into another through the system.

3. A method of reclaiming spent granular material including timing and consecutively subjecting a batch of material to rabbling in the presence of heated air in a primary area to preheat the batch, then transferring the preheated batch to a second area and subjecting the batch to rabbling and burning treatments to clean the batch by oxidation, next transferring the cleaned hot batch to a cooling area and subjecting the batch to mixing and mulling treatments, said method including the forcing of cool air currents through the cooling area to cool the cleaned batch, said air currents continuing through the second area wherein the temperature of the air currents is raised to a high degree to produce oxidation and cleaning of the batch while being rabbled, said heated air currents then continuing upwardly into the primary area to preheat a material batch.

4. The method of reclaiming spent granular material, including first preheating and rabbling a batch of the material, then rabbling the batch and subjecting the same to burning and oxidation treatments to remove the coatings of bonding and foreign matter from the material grains to clean the same, then mixing and mulling the cleaned material batch, and then simultaneously aerating contemporaneous batches of the material by a continuous flow of air currents successively through the mulling treatment, the oxidation treatment and the preheating treatment.

5. The method of reclaiming spent granular material, including first rabbling a batch of the material and subjecting the same to heated air currents to preheat the batch, then subjecting the batch to further rabbling and to burning treatments to clean the batch in the presence of circulating air currents which are heated to high temperatures and subsequently used for preheating a subsequent batch of the material, then contemporaneously subjecting the hot cleaned material batch to mixing, plowing and mulling treatments in the presence of cool air currents and removing the dust and fines from the material batch to reclaim the same, said air currents continuing and being utilized in the burning, rabbling and preheating treatments of subsequent batches of the material.

6. The method of reclaiming used spent foundry sand and the like for reuse, which includes subjecting a batch of the material to different steps of a series of selectively timed rabbling, mixing and mulling treatments in confined areas in which the material is first rabbled and preheated in one area, then transferred to another confined area and subjected to a burning treatment while the material is rabbled in the presence of air currents to remove the bonding and carbonaceous coatings from the material grains by oxidation and utilizing the heated air currents in the first area for preheating purposes, and finally transferring the hot cleaned material into still another area and subjecting the material to mixing and mulling treatments and withdrawing the fines therefrom by the circulation of cool air currents partly continuing along one course to withdraw the fines and partly continuing into the burning area leaving a reclaimed cooled material for storage or reconditioning.

7. The dry treatment method of reclaiming inert and spent granular materials, said method comprising batch feeding the material into an air circulating heated area and subjecting the batch to rabbling treatments for preheating the batch and withdrawing released dust and fines therefrom with the escaping heated air, gravity feeding the preheated batch into a burning area and rabbling the batch and dry scouring the same in the presence of air currents and burning off the bonding and foreign matter coatings from the grains by oxidation to dry clean the batch, and then gravity feeding the hot cleaned batch to still another area and subjecting the batch to mixing, mulling and aerating treatments and si-

multaneously withdrawing the remaining dust and fines therefrom leaving a cooled reclaimed material ready for storage or retempering and rebonding for reuse, said aerating treatment including a continuous flow of cool air successively through the mulling stage, the oxidation stage and the preheating stage of the treatment.

8. The method of reclaiming foundry sand from inert foundry shake-out material, said method comprising the advancing of batched material through a gravity feed line including a series of timed treatments consisting of first rabbling the batch in an area in the presence of preheated air currents to preheat the batch and remove dust and fines therefrom, then dropping the preheated batch into another area in the presence of air currents and rabbling the batch while blowing additional cool air thereon and subjecting the batch to burning actions to remove the bonding and foreign matter coatings from the batch grains to clean the same by oxidation, then dropping the hot cleaned batch into an area and subjecting the batch to mulling treatments in the presence of forced cool air currents acting to withdraw the remaining dust and fines therefrom leaving a resultant cooled reclaimed material batch for storage or for reconditioning, said forced cool air currents being repeatedly reused successively in the various treating areas.

9. The method of reclaiming foundry sand from inert foundry shake-out material, said method comprising the advancing of a batch of the material through a gravity feed line including a series of manually timed treatments consisting of rabbling the material in the path of preheated air currents to preheat the material and withdraw dust and fines therefrom, then again rabbling the preheated material and subjecting the same to cool air currents and to burning treatments to heat the air currents to high temperatures to remove the coatings of foreign matter from the material grains to clean the same by oxidation, then subjecting the hot cleaned material to plowing, mixing and mulling treatments in the presence of traveling cool air currents allowing part of the cool air to escape to withdraw dust and fines from the cooled cleaned material and permitting the balance of the traveling cool air currents to be utilized in an oxidation treatment and subsequently in a preheating treatment of subsequent batches of the material all contemporaneously undergoing different stages of the reclaiming treatments.

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