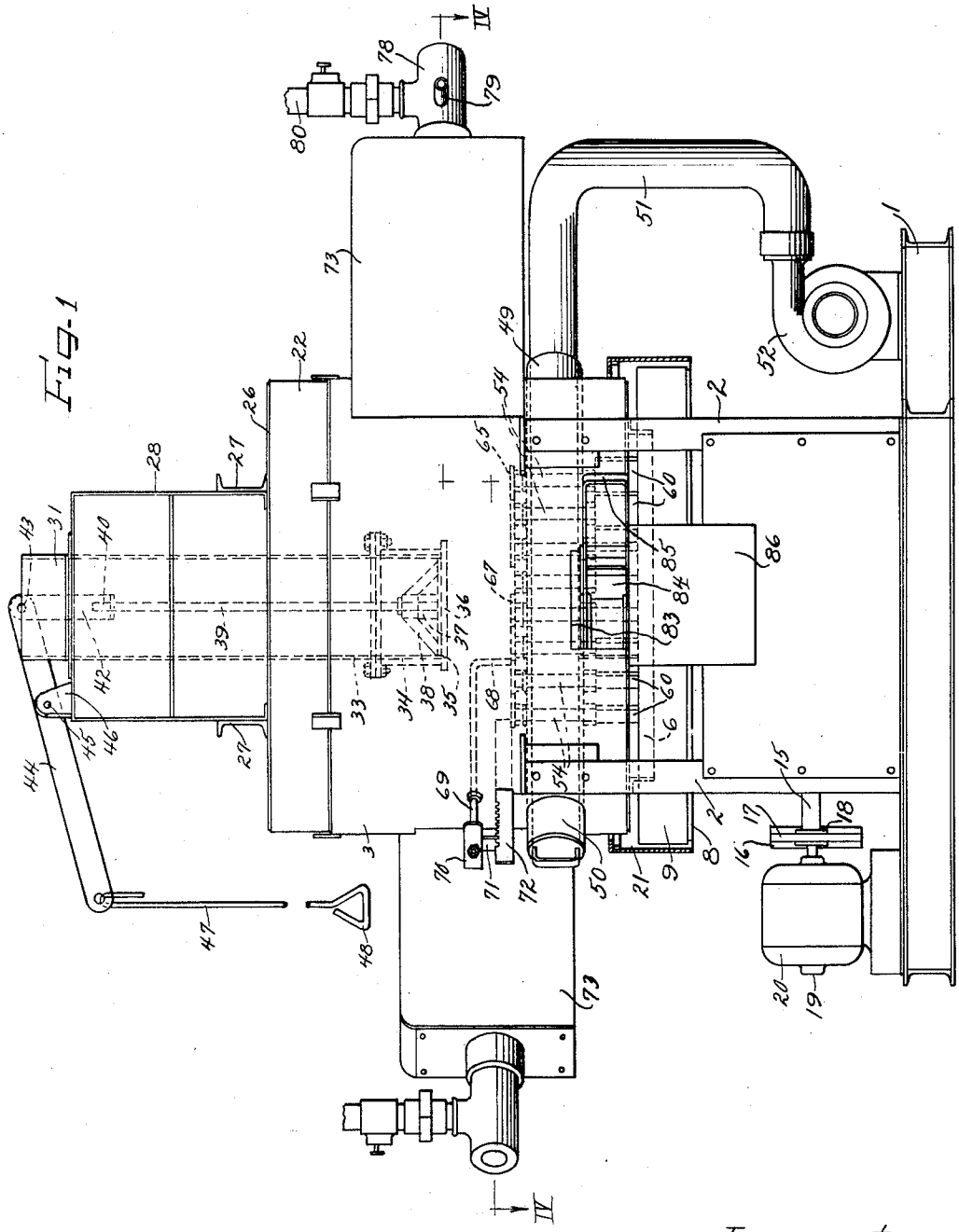
Nov. 21, 1950 A. C. CHRISTENSEN 2,530,651

SAND RECOVERY APPARATUS

Filed May 2, 1946 4 Sheets-Sheet 1

Fig-1



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SAND RECOVERY APPARATUS

Filed May 2, 1946 4 Sheets-Sheet 2

Fig. 2

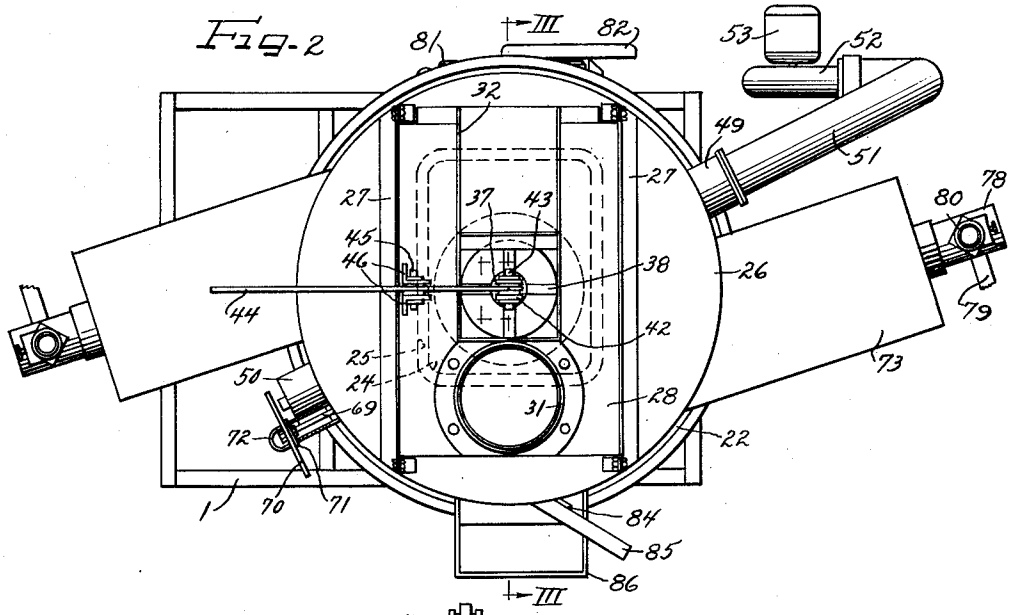
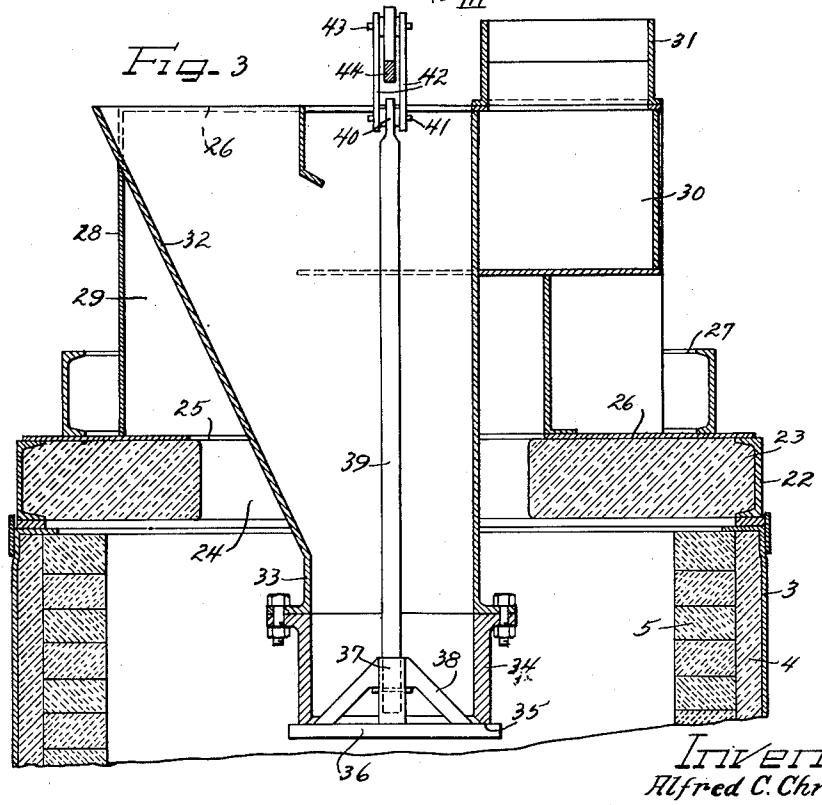


Fig. 3



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SAND RECOVERY APPARATUS

Filed May 2, 1946 4 Sheets-Sheet 3

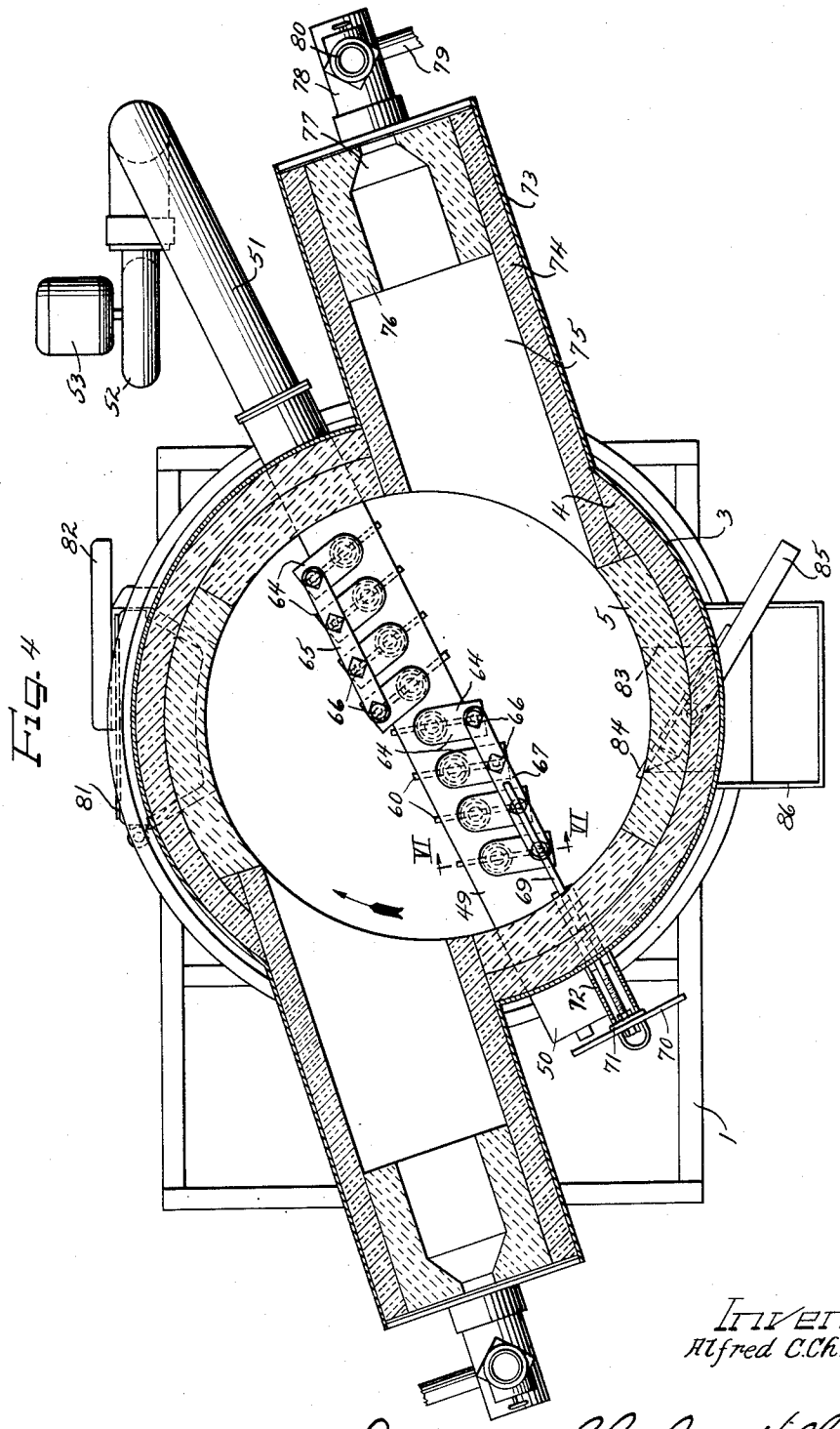


Fig. 4

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SAND RECOVERY APPARATUS

Filed May 2, 1946 4 Sheets-Sheet 4

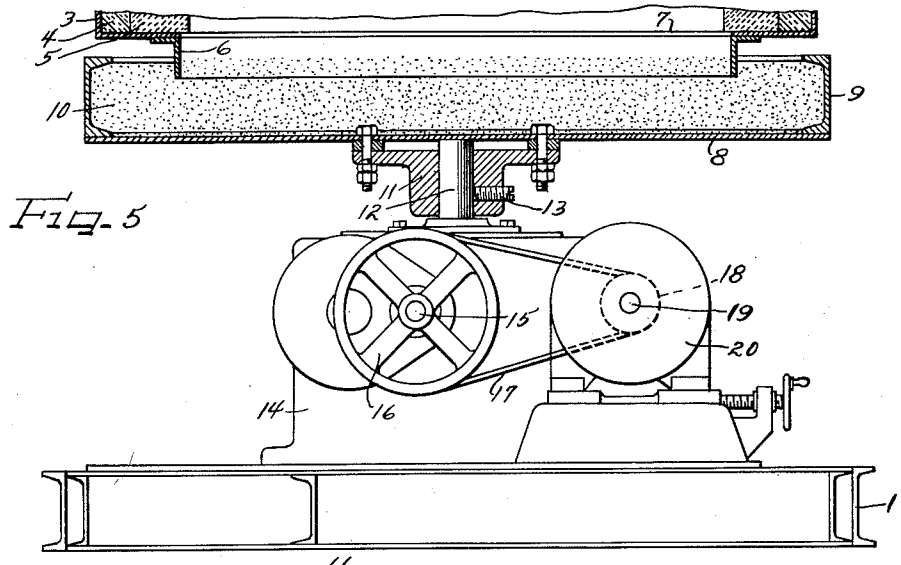


Fig. 5

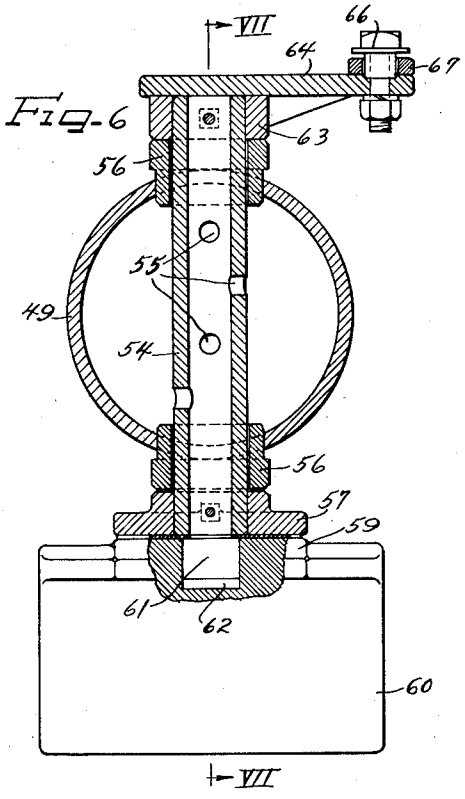


Fig. 6

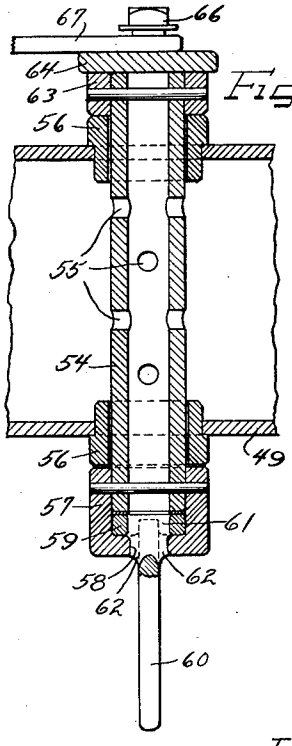


Fig. 7

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Patented Nov. 21, 1950 2,530,651

UNITED STATES PATENT OFFICE

2,530,651

SAND RECOVERY APPARATUS

Alfred C. Christensen, Chicago, Ill., assignor, by mesne assignments, to Herbert S. Simpson, Evanston, Ill., as trustee

Application May 2, 1946, Serial No. 666,756

6 Claims. (Cl. 263—21)

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The invention disclosed and claimed herein relates to an improved apparatus for more efficiently recovering spent and inert granular material such as used foundry sand and the like, by batch feeding of the material into the top of the apparatus and subjecting the material to heat treatment, in a confined area, and to the action of plowing mechanisms adapted while functioning as plows and mixers to simultaneously discharge currents of air over and through the material whereby the material being treated is economically recovered in a cleaned, dry state ready for rebonding and reconditioning for further use.

In foundries and similar establishments using granular materials, such as foundry mold and core sand, such sand usually consists of silica grains combined with clay, oil or cereal bonding agents and 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. Such a condition of course constitutes a considerable waste and the additional expense necessary to purchase new clean sand. It is therefore highly desirable to recover the original sand in an efficiently cleaned state and then recondition the same for further use.

It is an object of this invention to provide an improved machine for recovering inert and spent foundry sand and similar granular materials, by subjecting the materials in a confined area to heat treatments while also being subjected to the action of plows constructed to discharge air currents to cool the plows and serve as a secondary air supply to assist in the burning and oxidation treatments for recovering cleaned silica sand grains.

It is also an object of this invention to provide an apparatus for the batch treatment of spent granular oil or cereal bonded materials in a confined area by subjecting the material to burning treatments while the material is being rotated and carried into the field of operation of stationary and adjustable plows constructed to deliver air currents downwardly between and on opposite sides of the plows to cool the same and also serve as an auxiliary air supply for assisting in the cleaning of the sand by oxidation.

A further object of the invention is to provide an apparatus for the recovery of clay bonded foundry sand and the like which has previously been subjected to a wet scrubbing treatment by subjecting a batch of the partially cleaned sand in a confined area to the further action of whirling flames and simultaneously to the action of stationary and adjustable plows constructed to

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discharge air on the material being treated as the material is conveyed by a rotary support into the field of operation of the plows during the recovery of the material by burning and oxidation treatments to remove carbonaceous matter therefrom and simultaneously cinderize and remove any refractory matter which may still be adhering to the material grains after the initial wet scrubbing treatment.

It is furthermore an object of the invention to provide an improved apparatus for the recovery of inert foundry sand and the like by batch feeding the material downwardly into a confined area and simultaneously subjecting the batch of material to the action of whirling flames and to the action of path changing stationary and adjustable gangs of air discharging plows to which the material is carried by a rotatable support as the products of combustion, hot gases, fines and dust are exhausted from the confined area, prior to the batch discharge of the recovered material.

A still further object of the invention relates to the provision of a method of treating granular material, such as spent foundry sand, including the steps of depositing the material in a moving support in a confined plowing area in which the course of travel of the material is continuously varied contemporaneous with the subjecting of the material to the action of swirling flames in the presence of auxiliary air currents to augment the oxygen supply to establish a more complete combustion and burning off of foreign matter from the material grains laid bare by plowing.

In accordance with the general features of this invention there is provided in a method of treating spent bonded granular material the steps of rotating the material in a confined area and plowing and continuously deviating the course of travel of the material by varying the angle of plowing while simultaneously subjecting the material to the action of swirling flames in the presence of controlled auxiliary air currents to establish a more complete combustion and burning away of foreign matter by oxidation.

An additional and further feature of the invention relates to the discharge of air downwardly between and adjacent opposite sides of a plurality of plows mounted on a stationary air supply support and above a rotatable material-carrying table to bring the material into the field of operation of the air discharging and path diverting plows while said material is being subjected to the action of whirling flames, directed into the treating area from different directions to burn off bonding and carbonaceous coatings from the material particles and permitting the products of combustion, hot gases, fines and the like to escape through an escape stack prior to the discharge of the cleaned recovered material from the treating area.

An additional and further feature of the in-

vention relates to the air cooling of mixing and agitating plows while being subjected in a confined area to the action of whirling flames which act on the material while being plowed and aerated to thoroughly and efficiently remove old bonding and carbonaceous coatings from the material grain to thoroughly recover and clean the material while fines and dust together with hot gases and the like are suctioned from the operating area prior to the discharge of the recovered material ready for rebonding and reconditioning for re-use.

Still another feature of the invention is the provision of a material recovery system in which a batch of material is adapted to be deposited into a controlled treating area to form a variable sealing contact with similar material carried in a recessed portion of a rotatable support whereby the deposited material is adapted to be repeatedly moved into the field of operation of air discharging plow mechanisms which are located in the zone of operation of whirling flames to provide burning and oxidation treatments for the material simultaneous with the diversification of travel, the plowing and the mixing of the material in the presence of the air currents discharged by the plow mechanisms.

It is furthermore an object of this invention to provide a hearth type apparatus for the treatment of oil or cereal bonded core sands and the like, by contemporaneously subjecting a batch of the material in a confined area and on a rotating support to the action of primary air currents and flames, while the material is brought into the field of action of secondary air current discharging plows to clean the material by burning and oxidation as the removed refuse matter, hot gases and fines are withdrawn from the area.

It is an important object of this invention to provide a sand recovery apparatus including a refractory-lined housing having a rotary bottom provided with a seal forming granular bed for receiving a batch of spent material to carry the same in a rotary path into the field of operation of stationary and adjustable air discharging plow mechanisms supported on a stationary air supply member and located in the field of operation of the discharged flames from burners on the housing to simultaneously subject the batch of material to mixing, circuitous plowing actions, aerating, burning and oxidation treatments to efficiently clean the material grains and recover the same prior to discharge from the housing for subsequent rebonding and reconditioning for reuse as foundry mold or core sand.

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

On the drawings:

Figure 1 is a side elevational view of a sand recovery apparatus embodying the principles of this invention, illustrating parts in section and with parts of the interior apparatus shown in dotted lines;

Figure 2 is a slightly reduced top plan view of the apparatus;

Figure 3 is an enlarged fragmentary transverse vertical sectional view of the upper portion of the apparatus taken on line III—III of Figure 2.

Figure 4 is an enlarged horizontal sectional view of the apparatus taken on line IV—IV of Figure 1;

Figure 5 is an enlarged fragmentary sectional view through the lower part of the apparatus housing and the rotatable supporting table, with parts omitted, and showing the table driving mechanisms in elevation;

Figure 6 is an enlarged fragmentary sectional view of the plow mechanism taken on line VI—VI of Figure 4 with the plow blade in elevation and slightly broken away; and

Figure 7 is a vertical detail sectional view taken on line VII—VII of Figure 6 with the major portion of the plow blade in elevation.

As shown on the drawings:

The complete recovery of spent or inert granular materials such as bonded foundry sand and the like is adapted to be accomplished by a machine assembly or apparatus of the type illustrated in Figure 1. The machine is of the batch treating type permitting a batch of spent material to be deposited into a confined area or combustion chamber upon a rotary table which carries the material in a circular path into the field of operation of gangs of stationary and adjustable plow mechanisms which are supported on and communicate with an air supply means for causing air to be discharged on opposite sides of the plows into the material as it is being mixed and plowed while being rotated in the path of whirling flames, whereby burning and oxidation treatments are applied to the material grains assisted by the secondary air supply from the plows to thoroughly clean the material and simultaneously draw off the dust, fines and hot gases and the like, leaving a cleaned batch of the hot material ready for discharge and re-use.

As clearly illustrated in Figure 1, the improved machine assembly is preferably mounted on a foundation or base frame 1, constructed of channel irons or the like and which is adapted to be rigidly secured in place upon a floor. Rigidly secured to the frame 1 are a plurality of upwardly projecting posts or legs 2 on the upper portions of which the lower end of a vertical hearth or furnace housing or casing 3 is secured. The housing 3 is constructed of metal or other suitable material and forms a shell around an insulation lining 4 constructed of "Sair" blocks or blocks of other suitable standard insulating material. An inner lining 5 is built within the housing adjacent the inside of the insulation lining 4, and said inner lining is preferably constricted of a refractory material such as fire blocks. The lower end of the furnace housing 3 extends inwardly beneath the concentric inner linings and has rigidly secured to the bottom thereof a collar or sleeve 6 which registers with an opening 7 in the bottom of the housing 3.

The housing collar 6 projects downwardly into the open top of a rotatable furnace table comprising a bottom plate 8 having rigidly secured upon the top periphery thereof a channel cross-sectioned table rim 9 which forms a recess or chamber in the rotatable table into which the housing collar 6 projects as clearly illustrated in Figure 5. A bed 10 of granular material, such as silica sand, is provided to fill the table chamber, and said bed of material serves as an insulation seal co-acting with the material treated in the furnace housing.

Rigidly bolted or otherwise secured to the bottom of the rotatable table is a hub 11 which is axially passaged to fit over a driving shaft 12 to which the hub is secured by means of a set screw 13 or other suitable means. The shaft 12 is rotated at a desired reduced speed by means of a speed reduction gear unit 14, of any desired

suitable standard type which is mounted on the base frame 1 beneath the furnace housing as shown in Figure 5. A shaft 15 projects from the speed reduction unit 14 and has secured on the outer end thereof a grooved pulley wheel 16 around which a driving belt 17 is engaged. The belt 17 is also trained around a small grooved pulley wheel 18 which is keyed or otherwise secured on the projecting end of a motor shaft 19 of a driving motor 20 which is supported on an extension of the base frame 1.

For the purpose of protecting the rotatable furnace table a circular shield or guard 21 is secured around the lower portion of the furnace housing 3 and extends downwardly around the furnace table as illustrated in Figure 1.

Rigidly secured upon the upper end of the cylindrical furnace housing 3 is a stop or cover comprising a metal channel ring 22 which securely surrounds a top ring 23 of insulation material to provide an outlet opening 24 from the interior combustion chamber of the furnace out through an opening 25 which registers with the opening 24 and which is provided in a top ring plate 26 of the furnace housing.

Secured on top of the furnace housing top plate 26 are a pair of parallel channel cross-sectioned bars 27 between which a turret housing 28 is rigidly mounted which fits over the registering openings 24 and 25 and provides an outlet chamber 29 which communicates with an upper outlet passage or chamber 30 whereby fines, dust, hot gases and other discharged products of combustion are permitted to escape outwardly from the furnace chamber through the passages 24 and 25 and the chambers 29 and 30 to be eventually discharged through a discharge chimney or stack 31, the lower end of which is connected with the top of the turret housing 28.

Formed within the turret housing 28 is a material receiving chute or hopper 32 which has the entrance mouth thereof opening up through an opening in the top plate of the turret housing 28 to permit a quantity of a spent granular material such as foundry sand to be deposited in the hopper 32 and move downwardly therein into a restricted cylindrical neck 33. The lower end of the hopper neck 33 is provided with an apertured flange to which the flanged and apertured end of a hopper throat or sleeve 34 is rigidly bolted or otherwise secured. The lower end of the hopper throat 34 is open and is provided with a valve or gate seat 35 at the lower end thereof to permit a control valve or gate 36 to normally seat thereagainst to serve as a closure for holding a charge of material to be treated in the hopper until it is desired to deposit the charge of material into the material recovery chamber of the furnace.

The upper side of the material batch control gate 36 is provided with an axially positioned sleeve 37 which is reinforced by means of a plurality of radially directed inclined brace bars 38. Rigidly engaged in the gate sleeve 37 is the lower end of an operating gate rod 39 the upper end of which is formed to provide a flat-sided apertured tongue 40 which is pivotally supported on a pin 41 supported in the lower end of a pair of links 42 separated from the tongue 40 by a pair of washers. The upper ends of the links 42 are pivotally supported on a pin 43 which is carried by the upper end of a gate operating lever 44. The upper end of the lever 44 is separated from the upper ends of the links 42 by means of washers. The gate operating lever 44 is fulcrumed intermediate its ends on a pin 45. The fulcrum pin 45 is supported in a pair of lugs or brackets 46 which are located in spaced relation with respect to one another on opposite sides of the fulcrum bar and are welded or otherwise rigidly secured to the top plate 26 of the turret housing.

The lower end of the fulcrum lever 44 is provided with an aperture through which the upper end of a gate actuating rod 47 is hooked. The lower end of the rod 47 is formed in the shape of a handle 48 (Figure 1) to provide a convenient arrangement whereby the lever 44 may be pivotally operated about its fulcrum pin to cause opening of the gate 36 to permit a charge of material to be dropped into the treating chamber of the furnace. The lever 44 may also be actuated to be moved into the position illustrated in Figure 1 in which the control gate is moved into closed position against the seat 35 on the lower end of the hopper throat 34. The batch of material which is discharged from the batch measuring hopper 32 passes through the throat 34 when the gate 35 is open, and is permitted to drop upon the rotatable table to rest upon the bed 10 of granular material and co-act therewith to provide a self-seal between the housing sleeve 6 and the rotatable furnace table. The batch of material is thus dropped on the rotatable table so that when the table is rotated the material to be treated is carried through a circular path into the field of operation of a combination plowing and air supply unit disposed within the treating chamber of the furnace housing.

The combination air supply and plow unit is disposed diametrically within the furnace treating chamber, and said mechanism comprises an air distributing and plow supporting pipe 49 the ends of which project through the furnace lining walls and the outer furnace housing or casing 3. One projecting end of the pipe 49 is closed by means of a cap 50. The other projecting end of the pipe 49 is rigidly connected with a secondary air supply pipe 51 the second end of which connects up with an air pump 52 which is supported on the base frame 1. The air supply pump or blower 52 is operated by means of a motor 53.

The air supply pipe 49 serves the double purpose of supplying air from the blower or pump 52 and at the same time serves as a support for a plurality of plow or rake mechanisms. The plow mechanisms are provided in two groups or banks disposed within the burner chamber of the furnace and mounted on the pipe 49 on opposite sides of the center of the burner chamber and on diagonally opposite sides of the pipe 49 as clearly illustrated in Figure 4. Each group of plows consists of four units and the supporting air supply pipe 49 is provided with bottom and top openings arranged in a line and with said openings in the top line registering with the lower openings.

Each plow or rake unit comprises a hollow plow shaft 54 having a plurality of air apertures or openings 55 provided therein and in communication with the interior of the pipe 49 as illustrated in Figures 6 and 7. Each plow shaft 54 projects diametrically through the pipe 49 and through bushings 56 engaged in the pipe openings. Pinned or otherwise rigidly secured to the lower projecting end of each plow shaft 54 and below the lower bushing 56 is a plow holder 57 which is longitudinally grooved and is provided with a bottom slot 58. Slidably engaged in each of the grooved plow holders 57 is the head 59 of

a plow blade or rake plate 60. Each plow head 59 is provided with an opening 61 which communicates with the lower end of the plow shaft 54, and said opening 61 has two oppositely directed discharge slots 62 leading therefrom for directing air currents from the pipe 49 through the plow shaft 54 and the opening 61 in the plow head and then outwardly and downwardly adjacent opposite sides of the plow blade 60 for the purpose of cooling the plow blade and for the further purpose of supplying a secondary source of air to the material while being treated in the combustion and plowing chamber of the furnace or hearth.

The upper end of each of the plow shafts 54 projects through the upper bushing 56 and has the upper end thereof exposed to receive the collar 63 of a plow operating lever 64 pinned or otherwise rigidly secured to the plow shaft. The upper end of each of the plow shafts 54 is thus closed by means of its operating lever 64 as shown in Figures 6 and 7.

Four of the plow units form a stationary group and are connected by means of a connecting bar 65. Bolts 66 connect the plow levers in the stationary group of plows to the bar 65.

The second group of plows are adjustable and are connected by means of bolts 66 to a shiftable connecting bar 67 to the center of which a downwardly directed arm 68 is rigidly secured. The arm 68 forms an integral part of a plow adjusting or operating rod 69 which projects outwardly through a sleeve extending through the furnace walls. The outer end of the plow adjusting rod 69 is provided with a handle 70 having bolted or rigidly secured adjacent one side thereof a locking plate 71. The locking plate 71 projects downwardly so that the lower edge thereof is adapted to be removably engaged between the teeth of a U-shaped locking rack 72 for the purpose of holding the adjustable plows 60 in the adjustable group in a set position of adjustment. To change the adjustment of the adjustable plows the handle is merely lifted and the locking plate is shifted to move the connecting bar 67 and thereby simultaneously adjust the plows 60 associated therewith. When the desired position of adjustment of the plows is reached the locking plates 71 is merely set down between the teeth of the rack 72 to hold the adjusted plows locked in position.

The two groups or gangs of plows 60 are arranged so that one group is stationary while the other group is adapted to be adjusted with respect to the stationary set so that material carried by the rotatable furnace table is passed towards the center of the furnace by one group of plows while the other group acts to divert the material outwardly toward the periphery of the table. The cushion or bed 10 of silica sand which fills the recess in the table serves as an insulator as well as a seal between the stationary furnace collar 6 and the revolving bottom or table 8.

The material out of which the air supply and plow mechanisms positioned within the furnace chamber is constructed, is all of a heat resisting composition to resist the high temperatures to which the parts are subjected within the hearth or furnace housing. The air which is discharged from the pipe 49 through the distributing slots 62 of the plow blades is directed against opposite sides of the blades and serves as a means for cooling the same. The secondary supply of air coming from the plow blades also serves as an aid to thorough combustion of the carbonaceous and foreign material coatings on the sand grains which the being treated in the furnace.

The hearth or furnace is equipped with two burner equipped ovens supported by the furnace housing. Said ovens are arranged in substantially parallel relation and project in opposite directions on opposite sides of the plow mechanisms as clearly illustrated in Figure 4. The two ovens communicate with the interior of the furnace and project outwardly through the furnace walls in a substantially tangential position with respect to the interior of the furnace.

Each of the oven units comprises an oven housing or shell 73 constructed of metal and rigidly secured to the furnace housing 3. The oven shell 73 is provided with an inner insulation lining 74 constructed of blocks or bricks of any standard insulation material. The inner end of the oven chambers 75 opens into the furnace chamber. The outer closed end of the oven shell 73 has disposed therein a firebrick sleeve 76 constructed of a refractory material and shaped to receive a flame throwing nozzle 77 which forms a part of a standard oil burner unit 78, such as the "Hauck" oil burner. Each of the oil burners is equipped with an oil supply pipe 79 connected with a suitable source of oil supply, and with a primary air supply pipe 80 to provide a primary supply of air for mixing with the oil to provide the necessary fuel whereby heating flames are adapted to be directed through each oven into the mixing and burning chamber of the furnace to produce the high temperatures necessary for burning off the oil and other carbonaceous bonding materials and foreign matter from the sand grains while the batch of material is being thoroughly plowed and aerated from the secondary source of air supply.

By providing the two burner and oven units for the furnace, the combustion flames are directed into the interior of the furnace from opposite directions so that a whirling action of the flames is created to act on the material while it is being plowed and rotated to thoroughly clean the material grains by the plowing and oxidation treatments in the presence of the secondary aeration treatment furnished by the plows. Since the oil burner units are of a standard construction and type the details of the burners have been omitted.

For the purpose of making inspections on the interior of the hearth or furnace and for the purpose of hand loading the furnace, one side of the furnace housing is provided with an inspection opening which is closed by means of a hingedly supported inspection door 81 operable by means of a handle 82. Formed in the wall of the treating furnace, opposite the inspection door 81 is a discharge door opening 83 in which a discharge door 84 is pivotally supported between the sides thereof to permit the discharge door 84 to be positioned in an inclined direction projecting through the opening 83, when in closed position, to contact the inner surface of the furnace wall and the exterior shell thereof as clearly illustrated in Figure 4. The discharge door 84 is provided with an operating handle 85. Rigidly supported on one side of the furnace housing beneath the discharge door 84 is a discharge hopper 86.

The improved sand recovery system of this invention embraces an ignition furnace unit which is adaptable for the further refining and cleaning of clay-bonded sands which have previously been treated by scouring by wet methods. If desired

the furnace unit may be used for the direct treatment and recovery of oil or cereal bonded sands which do not require an initial wet cleaning and desilting treatment. If spent or inert oil bonded sands are to be recovered, such sands merely require a standard preliminary preparation such as the removal of metallic refuse and the crushing of lumps. After this has been done the oil bonded sand may then be fed in measured batches, by means of a bucket loader or the like, whereby a measured batch of spent foundry sand or the like is dropped into the open mouth of the receiving hopper **32** and rests upon the closed valve or gate **36**. The batch of used or spent granular foundry sand or similar material which is deposited in the receiving or feed hopper **32**, is adapted to be discharged from said hopper into the treating chamber of the hearth or furnace by pushing upwardly on the operating rod **47** to pivotally swing the fulcrumed lever **44** to cause the material control gate **36** to be moved into an open position thereby permitting the batch of material to drop through the hopper throat **34** into the treating chamber of the furnace. The charge of material is permitted to drop onto the insulation bed **10** of silica sand or the like carried by the furnace table as an insulation medium and to serve as a seal between the table and furnace housing.

When a charge of material is dropped into the furnace the inspection door **81** as well as the discharge door **84** are both closed. By starting the driving motor **20** the furnace table is rotated through the speed reduction gear unit **14** so that the material on the table is carried through a circular path within the stationary furnace housing and into the field of operation of both the stationary and adjustable groups or gangs of plows **69**. When the oil burning units are lighted the fuel mixture consisting of oil and a primary supply of air is discharged into the furnace oven and ignited to cause hot flames to be directed into the interior treating chamber of the furnace from opposite directions thereby causing the flames to rotate in a whirling fashion against and between the sand particles as said sand is agitated and plowed by means of the plow blades. The batch of material is thus subjected to high temperatures in a confined area in the presence of secondary air currents which are discharged from opposite sides of the heads of each of the plows. The secondary air currents discharged from the plows not only act to aerate the material while it is being plowed and subjected to high temperatures but also serves as a medium for supplying additional oxygen to assist in the burning and oxidation treatments so that the coatings of oil bonding materials and foreign matter are burned from the sand grains leaving the same thoroughly cleaned and in a hot condition ready to be discharged.

During the treatment of the batch of sand the hot gases, dust, fines and the cinderized particles of any refractory coating matter, are suctioned off through the turret chambers **29** and **30** and out through the escape stack or flue **31** the upper end of which leads upwardly out of the building or room in which the sand recovery system is mounted or such stack may be connected with a fine and dust collector or the like.

The material while being treated in the enclosed high temperature area within the furnace, is thoroughly mixed and plowed by the gangs of stationary and adjustable plow units, one set of plows serving to direct the material from the center outwardly toward the periphery of the chamber while the other gang of plows acts to direct the material from the outer portion of the chamber inwardly towards the center thereby diversifying the path of travel of the material while being plowed. In case it becomes necessary to require any adjustments of the plows or cleaning of the interior of the furnace or hearth, the inspection door **81** may be opened to permit access to the interior.

After a batch of material has been thoroughly cleaned by burning and oxidation treatments and by the contemporaneous plowing and aerating operations, the burners are turned off and while the table is still rotating the discharge door **84** is opened permitting the material to be discharged out of the discharge opening **83** into the receiving hopper **86** from which the cleaned hot material grains which have been recovered are adapted to be removed and cooled. The recovered material may now be transferred to reconditioning units wherein the cleaned 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 for the recovery of spent granular materials, may be employed for the purpose of reclaiming spent clay-bonded granular materials which have already undergone a washing, mixing and mulling treatment in a suitable machine for the purpose. It is, of course, understood that when a batch of material which has undergone a wet mulling treatment is to be subjected to further cleaning by burning and oxidation treatments in the furnace that the material should preferably first be desilted and should not be too cold or wet when it is deposited in the furnace for further treatment.

When spent or used oil bonded foundry sand and the like requires cleaning by burning and oxidation, such material need not undergo the wet cleaning treatment but may be deposited in batches directly into the furnace unit after the material has undergone the preliminary standard treatments such as the removal of metallic refuse and lumps. The various steps in the recovery of spent granular material by means of the apparatus herein described, may be separately and independently timed, by an attendant, by a manual operation of the feed grate, the setting of the adjustable plows, the starting and stopping of the rotatable table, the starting and turning off of the oil burners in the ovens, and by the operation of the discharge door after the completion of a sand recovery treatment in the controlled heated area of the furnace.

Attention is directed to the novel arrangement and operation of the plow mechanism which as a unit is stationary and is disposed diametrically within the furnace and includes two groups or gangs of plows one gang having the plow blades stationary while the other gang of plow blades are adapted to be manually adjusted simultaneously to permit the path of travel of the material to the other gang of plows to be varied. A further novel feature of the plow mechanisms is the fact that they are supported on a secondary air supply pipe which directs air into the plow shafts and permits the air to pass downwardly from opposite sides of the plow heads against the sides of the plow blades to cool the same while operating in the high temperatures caused by the whirling burner flames. The air thus delivered

by the plow units also serves as a secondary air supply for augmenting the oxygen supply in the treating chamber to assist in a thorough burning and oxidation treatment of the sand as it is being aerated and plowed and simultaneously treated to the whirling flames directed into the confined treating area from opposite sides of the furnace.

While a selected machine assembly has been illustrated and described for practicing an improved method or process of recovering spent or inert foundry sand and other similar granular 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 units and 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. In a material recovery apparatus, including a material processing furnace having a housing enclosing a combustion chamber, means for depositing a batch of material into the housing, a rotatable supporting table forming the bottom of the housing and receiving the materials to support the same and carry the same through a circular path, an air supply pipe supported in the walls of the housing and projecting through the combustion chamber, groups of stationary and adjustable plows supported on the pipe within the housing, said plows having passages therein communicating with the air supply pipe to permit air to be discharged from the plows on opposite sides thereof onto the material to be treated in the housing, means for rotating the table to carry the material into the field of operation of the stationary and the adjustable groups of plows to aerate said material while it is mixed and plowed, and burner means for directing flames into the housing to subject the material to burning and oxidation treatments while undergoing the mixing, plowing and aerating treatments.

2. In a material recovery apparatus, including a furnace having a housing with a rotatable bottom, means for rotating the bottom, a batch delivery mechanism on the housing for delivering a batch of material into the housing and onto the rotatable bottom, burner means on the housing for directing treating flames into the housing from opposite directions against the material as it is being rotated by the rotatable bottom to burn off the foreign matter from the material, an air supply conduit supported in the housing and extending through the furnace combustion chamber, and air discharging stationary plow mechanisms connected to said conduit within the housing positioned across the paths of movement of the material to mix and plow the material and discharge air against the plows and onto the material while it is being subjected to the action of the burner flames and while being rotated by the bottom to cause the material to be thoroughly cleaned by oxidation to remove bonding and foreign matter coatings from the material grains to dry clean the same.

3. A spent foundry sand recovery apparatus comprising a closed furnace having a self-sealing rotatable bottom for receiving a batch of sand and carrying the same through circuitous paths, flame throwers on the furnace for directing flames into the furnace in a whirling direction, a row of plows in the furnace directed in different directions, and means for discharging air currents from the plows to act to cool the same and furnish an additional oxygen supply to the flames to assist in the burning and oxidation treatments contemporaneous with the rotating and plowing treatments of the sand to dry clean the same for reuse.

4. In an apparatus for treating granular material such for example as spent foundry sand, a substantially closed chamber having a bottom on which a batch of material is adapted to rest, plow means supported in said chamber directly over said bottom and in said material, means for directing a flame into said material on said bottom, and means for relatively rotating said bottom and said plow means to agitate said material and to expose progressively the grains of said material to said flame for burning away foreign matter from said grains, said means for directing the flame being connected to said chamber so as to tangentially deliver the flame in a whirling form into the chamber over the bottom of the same.

5. In a method of treating granular materials such for example as spent foundry sand, the steps of depositing the material on a given support in a substantially confined plowing area, rotating the material through said area to agitate and plow the same, directing a stream of flame tangentially into said area as the material is rotated and directing auxiliary air into the agitated mass of material in said area for coaction with said flame to establish a more complete combustion and burning away of foreign matter from the grains of said material as they are progressively laid bare by plowing and to loosen and separate particles.

6. In a material treating apparatus including a rotary furnace, a plow mechanism comprising an air supply pipe secured across the combustion chamber of the furnace, a plurality of hollow plow arms pivotally secured in said supply pipe and extending at either end beyond said pipe, each arm having air inlet holes in that portion of the arm which is inside the supply pipe, a control lever secured at one end of each arm for pivoting the same and a plow blade slidably disposed at the other end of said arms having air discharge passages in communication with the hollow core of said arms whereby air in said air supply pipe enters each plow arm and is discharged through the air discharge passages in said blade.

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