Oct. 5, 1943. M. OVESTRUD 2,331,135

METHOD OF RECLAIMING USED FOUNDRY SAND

Filed Dec. 16, 1939 3 Sheets-Sheet 1

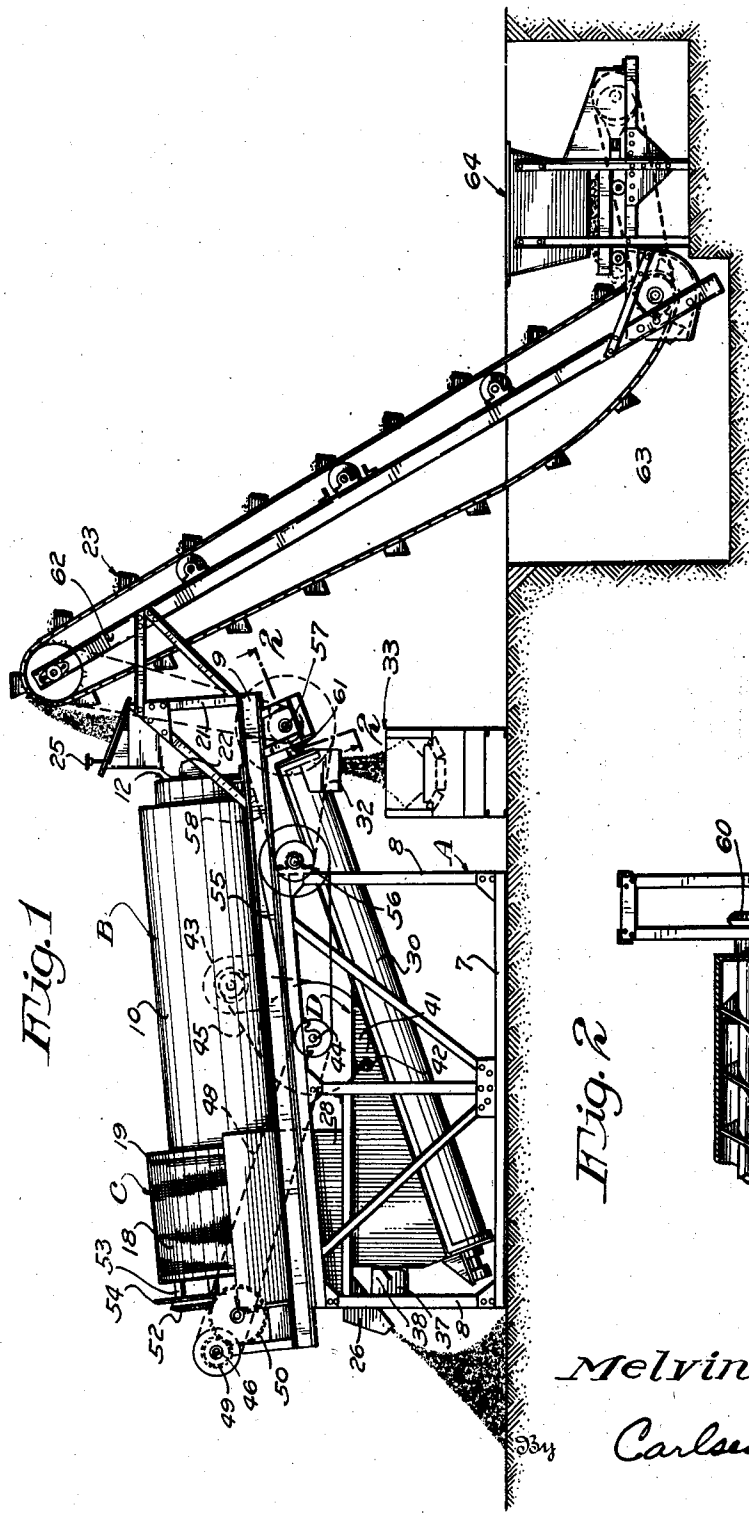

Fig. 1

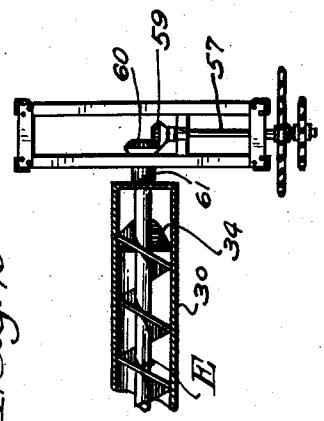

Fig. 2

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Oct. 5, 1943. M. OVESTRUD 2,331,135

METHOD OF RECLAIMING USED FOUNDRY SAND

Filed Dec. 16, 1939 3 Sheets-Sheet 2

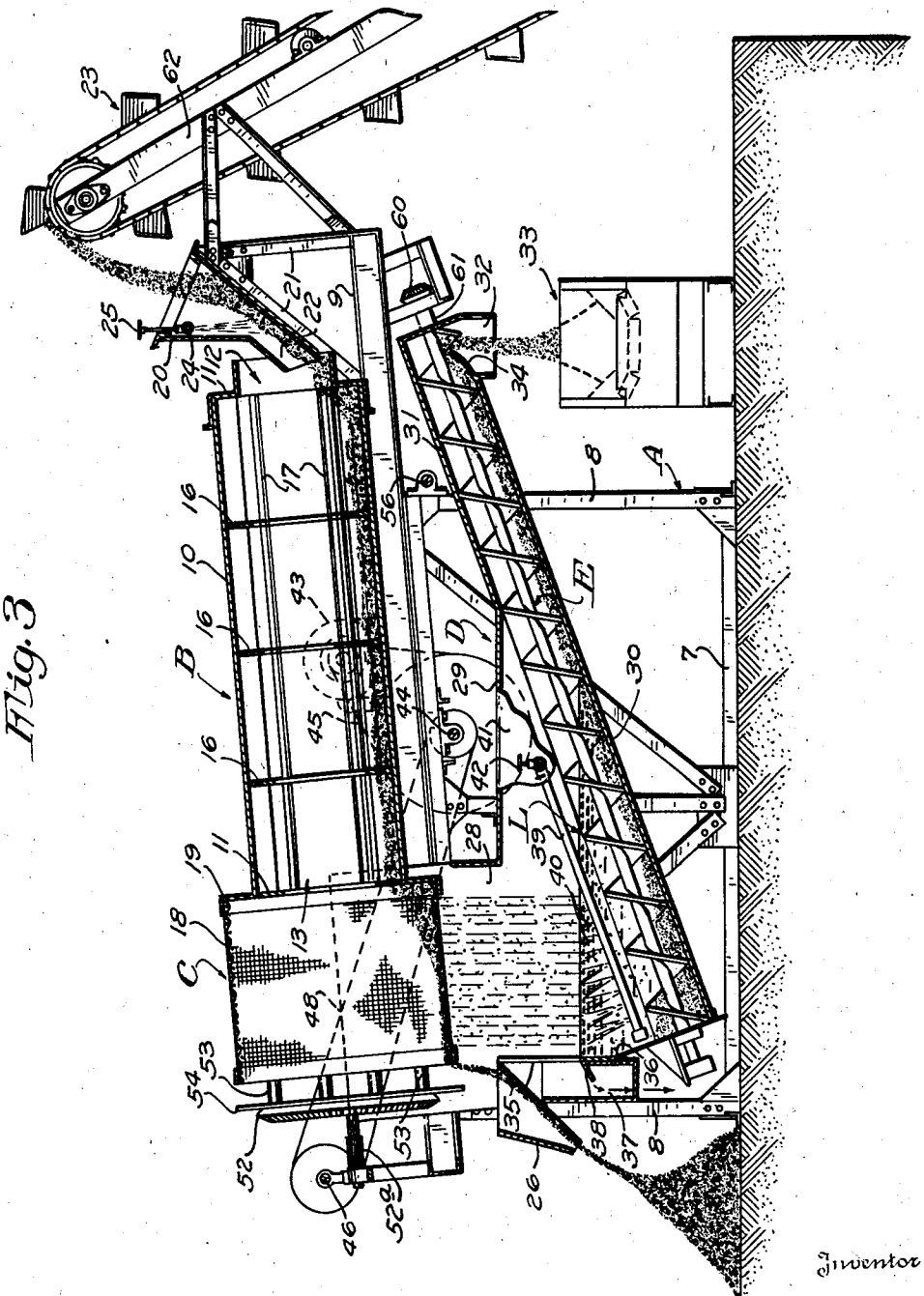

Fig. 3

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Filed Dec. 16, 1939 3 Sheets-Sheet 3

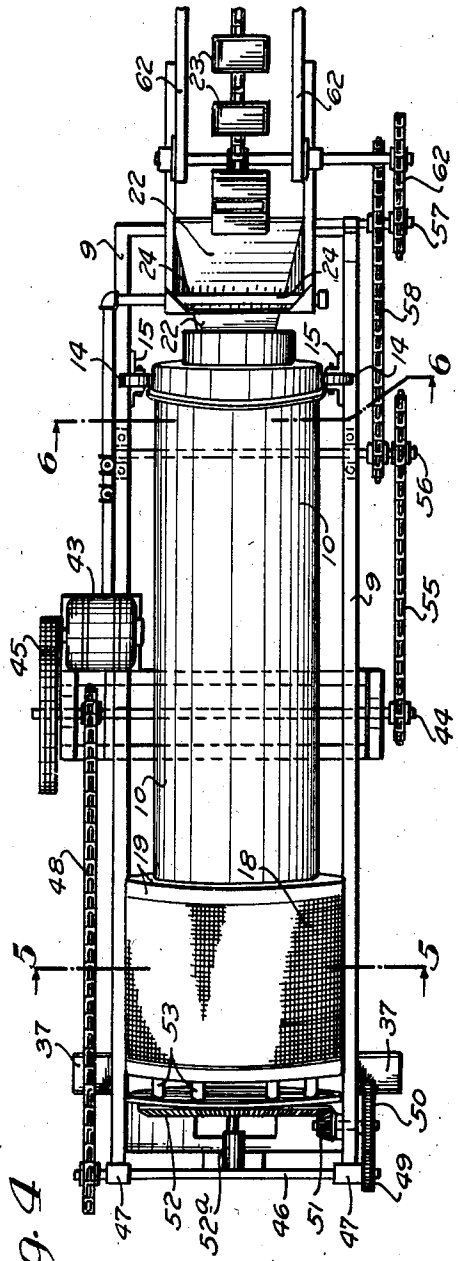

Fig. 4

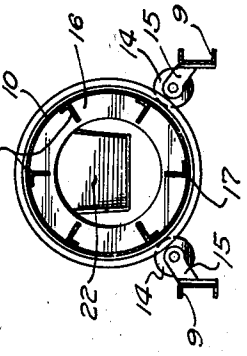

Fig. 6

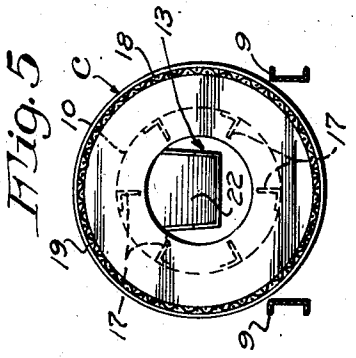

Fig. 5

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METHOD OF RECLAIMING USED FOUNDRY SAND

Melvin Ovestrud, Minneapolis, Minn., assignor, by mesne assignments, to The Jeffrey Manufacturing Company, a corporation of Ohio

Application December 16, 1939, Serial No. 309,616

5 Claims. (Cl. 22—217)

This invention relates to an improved method of washing and screening sand used in foundries in the formation of steel castings.

In the manufacture of steel castings, impressions of the objects to be cast are made in specially prepared silica sand to form molds into which the molten steel is poured to form the castings of desired shape. It has been found that it is necessary that the silica sand, even though it must be packed solidly so as to withstand the hydraulic pressure of the molten metal, as well as the washing effect of the flowing metal while pouring, still must be porous enough to permit the escape of gases from the surface of the molten metal. If the silica sand is not porous enough to permit the escape of the gases, these gases will enter into the surface of the molten steel and produce unsound steel castings characterized by gas bubbles in the surface.

The silica sand when new admirably meets the above requirements, but after a short period of use, even one or two times, the sand becomes relatively impervious and the continued use of such sand results in the formation of imperfect castings. This is due first to the breaking down of the sand particles exposed to the hot steel and, secondly, to the filler or binding matter used in the sand while preparing the mold. As a result it has been the custom heretofore to continually add new sand to the molding sand after each exposure to the hot steel and to discard the replaced sand. The replacement has usually been on the order of fifty to one hundred percent new sand, and it will be readily appreciated that there has thus been a continued expense for new sand, as well as for hauling away the "spent" sand.

In the effort to avoid this constant buying of new sand and the expense of hauling away the old sand there have been attempts made to reclaim and recondition the old sand for use. Such operation is entirely feasible since the removal of the fine, broken down particles of the sand, the dust-like binder material, and all lumps and similar particles will restore the sand to good condition with the required permeability. However, all such attempts heretofore made, with which I am familiar, have employed a screening system in connection with a pneumatic cleaning apparatus. In other words, the sand has been handled dry and in the removal of the very fine dust particles a dust condition has been set up which, in actual practice, has required either a very elaborate and expensive dust collecting system in the plant or has exposed the workers to the occupational ills arising from such dust conditions. Of even more importance, however, it has been found that such pneumatic cleaning processes do not in fact produce a sand having all characteristics of the new sand, and it has been necessary to continue the addition of new sand even if in smaller quantities.

Having in mind the foregoing it is the primary object of my invention to provide a method whereby spent foundry sand may be reconditioned and made ready for use again with as good results as would obtain in the use of new sand.

Another and important object is to provide a method for thus reclaiming spent foundry sand which operates with water as the cleaning medium, thus eliminating in one stroke all difficulties with dust in the operation.

A further object is to provide a method for this purpose which will operate at least semi-automatically with only occasional attention and at little expense so that the reclaiming of the spent sand will be far less expensive than the continued buying of new sand.

These and other more detailed and specified objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a side elevation of an apparatus constructed in accordance with my invention and showing the same in operative condition.

Fig. 2 is a fragmentary detail sectional view along the line 2—2 in Fig. 1, showing the drive means for the dehydrator and conveyor.

Fig. 3 is an enlarged vertical and longitudinal section through my apparatus, a portion of the feeder conveyor being broken away.

Fig. 4 is a top plan view of the structure shown in Fig. 3.

Fig. 5 is a cross sectional detail view along the line 5—5 in Fig. 4, showing the screen and outlet opening in the end of the scrubber.

Fig. 6 is a cross sectional detail view through the washer and associated frame parts, taken along the line 6—6 in Fig. 4.

Referring now with more particularity to the drawings, in my improved method there is used apparatus which comprises as its main units a frame A, a scrubber and washer B, screen C, elutriation tank D, and dewatering or dehydrating conveyor E, all of which are assembled in compact and cooperative arrangement as shown. Units D and E together constitute a liquid or hydraulic separator and dehydrator.

The said frame A is made up of suitable structural beams including a base 7, upstanding post

8 and upper parallel channels or members 9 all rigidly secured together in accordance with usual practise in such constructions.

The scrubber B and screen C are assembled and operate as a unit and will be first described in detail. Said scrubber takes the form of an elongated imperforate drum or cylinder 10 having inwardly turned end flanges 11 which form large inlet and outlet openings 12 and 13. This drum is supported in an endwise inclined position in the frame A upon rollers 14 attached by bearings 15 to the upper parallel frame members 9 so that said drum may rotate freely about its longitudinal axes above said frame. The inclination of the drum is such that it slopes downwardly from the inlet end toward the outlet end. Intermediate these ends the drum carries a series of spaced inwardly turned, annular partition flanges or rims 16, the inner edges of which form large center openings as shown, and between the end flanges 11 and these partition flanges are provided a series of inwardly and radially turned, longitudinally extended scrubbing blades or flights 17.

The screen C is also cylindrical but of larger diameter than the washer B and the perforate cylindrical wall 18 is secured coaxially and endwise on the lower delivery end of the drum 10 by an outwardly turned circumferential rim 19 which joins the parts and prevents the escape of water or sand at the junction. The drum thus opens directly into one end of the screen and the opposite, lower delivery end of the screen is left entirely open as shown.

A feed or receiving hopper 20 is mounted by frame members 21 on the end of the frame A in an inclined position so that its spout 22 will enter the inlet opening 12 of the scrubber B. The spent sand is fed to the open upper end of this hopper by any suitable means such as a conventional bucket type conveyor 23, and the sand may of course flow by gravity into the scrubber. A spray pipe 24 is arranged in the hopper 20 to spray the sand with water as it enters and a control valve 25 is provided for controlling the spray.

A delivery spout 26 for the oversize material is supported in the frame outwardly of, and beneath, the open lower end of the screen C in position to receive material ejected from said screen and deposit the same either upon the ground as shown, or upon a conveyor or other means for carrying it away.

Supported in the frame immediately below the screen and scrubber elements is the elutriation tank D having a large opening 28 in its top 29 to receive material passed directly downward through the screen C. The bottom 30 of the tank 27 inclines upwardly from the receiving end to a point beneath the receiving end of the scrubber B and this bottom is of semi-circular cross section to fit the spiral screw-type dewatering or dehydrating conveyor E which is mounted along said bottom. The tank in fact has a cylindrical or tubular extension 31 enclosing the upper end portion of the conveyor E and this extension terminates in a downwardly opening delivery spout 32 disposed over a hopper and conveyor mechanism 33 for carrying off the cleaned and dehydrated material. The spout opening or discharge point of the conveyor E is constricted by an upwardly inclined wing or vane 34, for a purpose which will appear.

The deeper end of the tank D immediately beneath the screen C has an overflow opening 35 in its end wall 36 which opens into a side delivery conduit 37 for carrying away waste water, and the water level in the tank may be controlled by a vertically adjustable weir or gate 38 movable over said opening 35. A water spray pipe 39 is arranged in the tank in an inclined position over the conveyor E and has jet openings 40 for discharging water upwardly below the normal water level L and against the downward fall of sand from the screen C, the pipe entering laterally through the side wall 41 of the tank and being provided exteriorly with a control valve 42. These water jets 40 are located immediately inward of the weir 38 and extend along the pipe the full width of the sheet or stream of sand falling from the screen C, being thus extended approximately the full length of the screen itself and in the same vertical plane, as shown in Fig. 3.

The various working parts are driven by a suitable prime mover, as for example the electric motor 43 which rotates a main countershaft 44 through the belt and pulley mechanism 45. A scrubber drive shaft 46 is journaled transversely in the frame in bearings 47 in spaced relation to the discharge end of the screen C and is rotated by sprocket chain assembly 48. A pinion 49 on this shaft 46 drives a gear 50 on the shaft of which is a beveled pinion 51 meshed with a large beveled ring gear 52 supported as by brackets 53 in coaxial relation but in axially spaced position with respect to the screen C. A large guard disk 54 backing up this gear 52 prevents material ejected from the screen from coming in contact with the gears and at the same time guides said material downwardly to the spout 26. The aforesaid drive mechanism will of course rotate the entire scrubber and screen mechanism upon its axis and upon the rollers 14. The ring gear 52 has its shaft journaled in a bearing 52a on the frame to support the lower end of the screen and scrubber unit.

Also driven from the main countershaft 44, by sprocket chain mechanism 55, is a second countershaft 56 which in turn drives a conveyor drive shaft 57 through chain mechanism 58, these chains and drives serving to reduce the speed of rotation to the shaft 57. Said shaft 57 at its end carries a bevel pinion 59 meshing with a similar pinion 60 in the upper end of the shaft 61 of conveyor E to thereby rotate said conveyor in a direction causing its spiral blade to carry material upwardly along the tank bottom 30 toward the spout 32.

The conveyor 23 may also be conveniently driven from the shaft 57 by sprockets and chain 62 as clearly shown. In Fig. 1 this conveyor is shown, for example, as directed into a pit 63 wherein is located a feed hopper 64 of conventional form.

In operation the spent or used sand is dumped into the feed hopper 64 from which it is fed to conveyor 23 and then dumped into the hopper 20. The pipe or spray means 24 then sprays the dirty sand and washes it through spout 22 into the scrubber B at the same time filling the scrubber with water, and the sand, to the level of the lower edge of the delivery opening 13. As the drum 10 rotates, this mass of water and sand is carried upwardly by the baffles 17 and given a thorough mixing and scrubbing action thereby, while at the same time being moved gradually toward the delivery end of the drum. This thorough mixing and scrubbing action is effective to remove all adhering foreign matter from the sand grains such as spent binder material.

Most lumps are thus disintegrated, and as the material flows onto the screen C the material of proper size will drop straight through down into the tank D. The larger particles such as lumps and trash will be screened out and discharged from the open end of the screen into spout 26 for disposal.

The material falling into the tank D is thus all of desired size and smaller, and the "fines" such as broken down sand particles, binder and like material, will be put in suspension and may flow off through the conduit 37, the elutriation process being facilitated, and the sand further cleaned, by admission of clean rinsing water by pipe 39.

In such operation the water jets 40 thoroughly agitate the full sheet or body of sand as it falls into the tank and these jets, being located near the weir 38 and directly in the strata of water flowing over the same, will obviously aid also in carrying the "fines" over said weir.

The heavier particles of sand falling to the bottom of the tank D are picked up by conveyor E and are carried thereby up along said bottom and finally discharged at spout 32 onto conveyor 33 for transmission thereby to storage pile or bin. As the sand reaches the spout 32 it is squeezed by the wing 34 so that the water is forced out and allowed to flow back to the tank while the dehydrated sand is carried on out.

As heretofore stated, permeability is the most important characteristic of sand used for molding purposes. It has been found that after the sand has been exposed to the hot steel, it has to be remixed with a certain proportion of new unused sand in order to maintain a required minimum permeability. This is partly due to the breaking down of the sand particles when in contact with the molten steel, but is chiefly on account of a tendency of the binding ingredients used in the sand to fill up the voids between the component sand particles, with the result that the sand will not permit the gases to escape and will cause the appearance of gas pockets as well as rough blemishes on the castings.

It is evident that by the removal of these fine particles of broken down sand and binder material, as well as larger lumps and trash, that the residue of the sand, constituting by far the greater part of its bulk, may be made completely fit for use again, and this process is carried out admirably by my apparatus and method disclosed herein. In fact due to the thoroughness in which the sand is washed and the fines removed, the reclaimed sand is found to have even a higher degree of permeability than the new sand.

My method is seen to be simple and capable of inexpensive continuous operation so that the cost of reclaiming the sand may in fact be less than the disposal of the sand at some remote dump might be.

The reviving of the used sand in the apparatus is accomplished by what I believe is an entirely new method. This involves initially spraying of the sand and scrubbing and tumbling the mixture of sand and water so that the binder and fine materials in the sand are put in suspension, screening the sand to remove all lumps and large particles, rinsing the sand and floating off all binder materials and fines, and finally dehydrating and delivering the completely washed and revived sand for further use.

The superiority of this method over previous ones using air for removing the fines are apparent and should need no further delineation herein.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings in a liquid gravity separator to produce products of usable sand and foreign matter, and directing the separated products along different paths.

2. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings in a hydraulic separator to produce products of usable sand and foreign matter, directing the separated products along different paths, and dehydrating the usable sand.

3. The method of treating used foundry sand which comprises recovering used sand, disintegrating pieces of adhering sand particles, scrubbing the sand particles in a liquid bath to remove foreign matter adhering thereto, separating the cleaned sand and foreign matter by hydraulic gravity separation, and dehydrating and recovering the cleaned sand.

4. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from adhering foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings in a hydraulic separator to produce products of usable sand and foreign matter, and directing the separate products along different paths.

5. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings in a separator to produce products of usable sand and foreign matter, and directing the separate products along different paths.

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