Jan. 11, 1955 Z. H. SMITH 2,698,977

SAND CONDITIONING MACHINE

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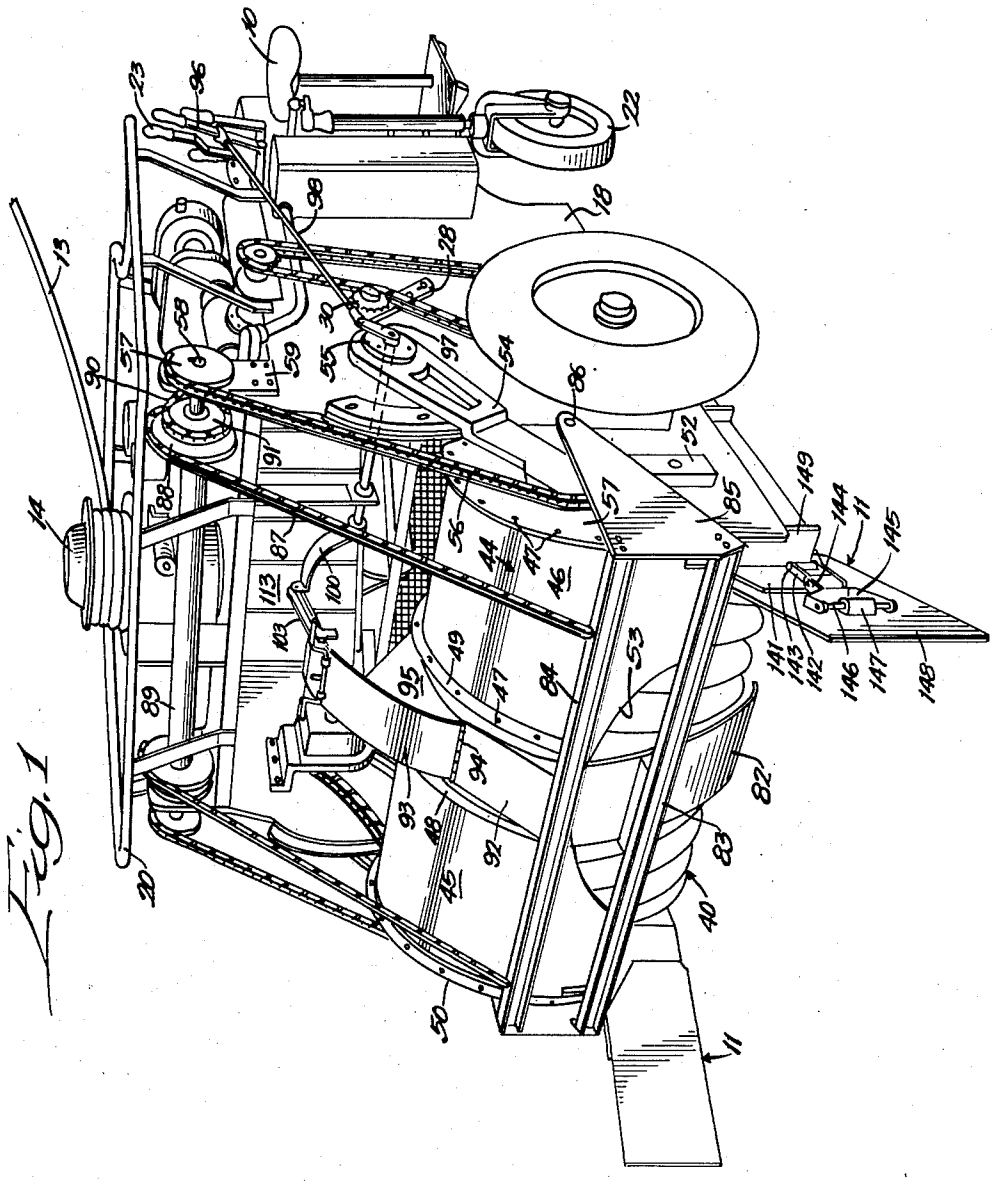


Fig. 1

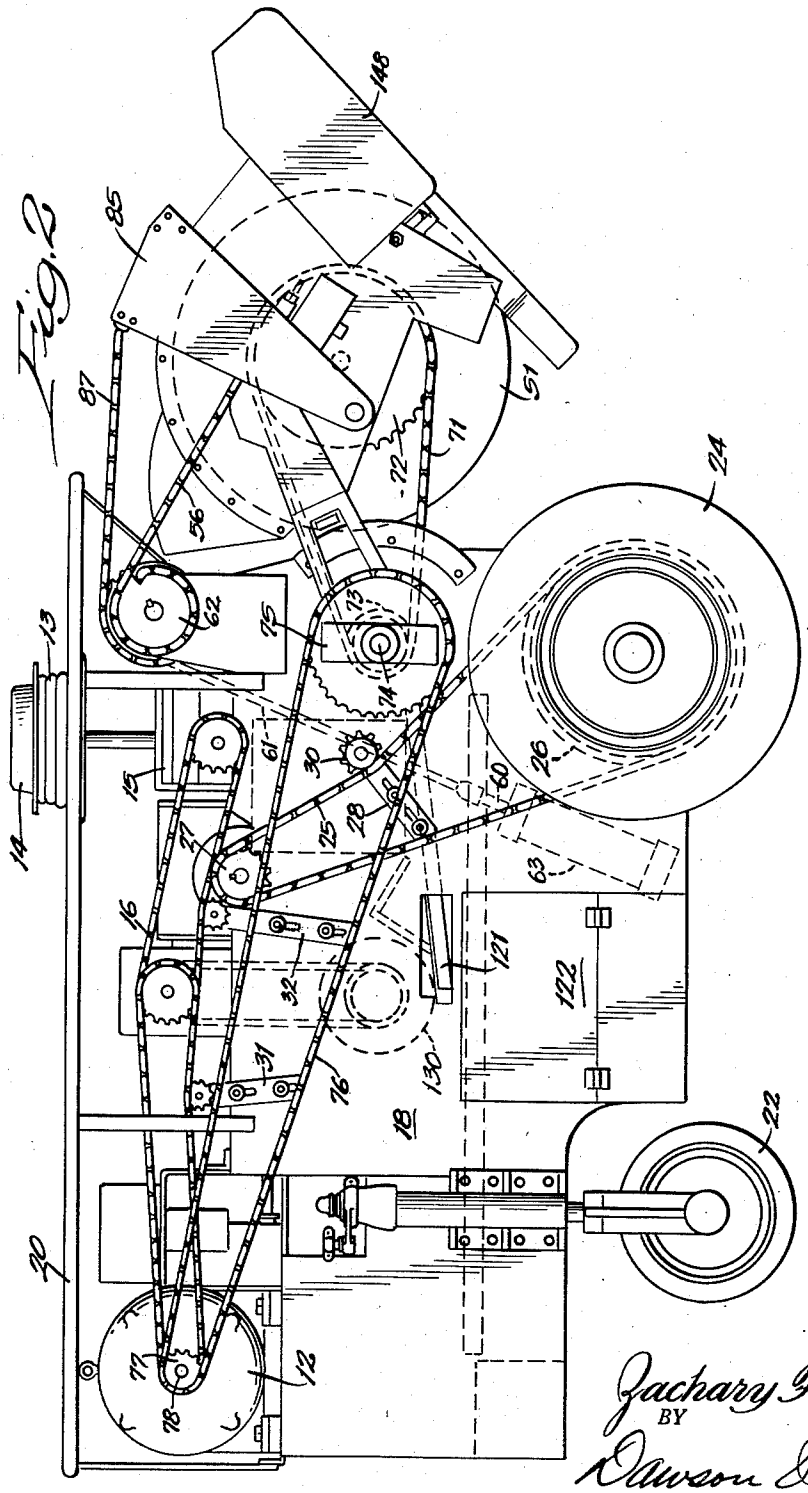
INVENTOR.
Zachary H. Smith,
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SAND CONDITIONING MACHINE

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Fig. 2



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SAND CONDITIONING MACHINE

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Fig. 3

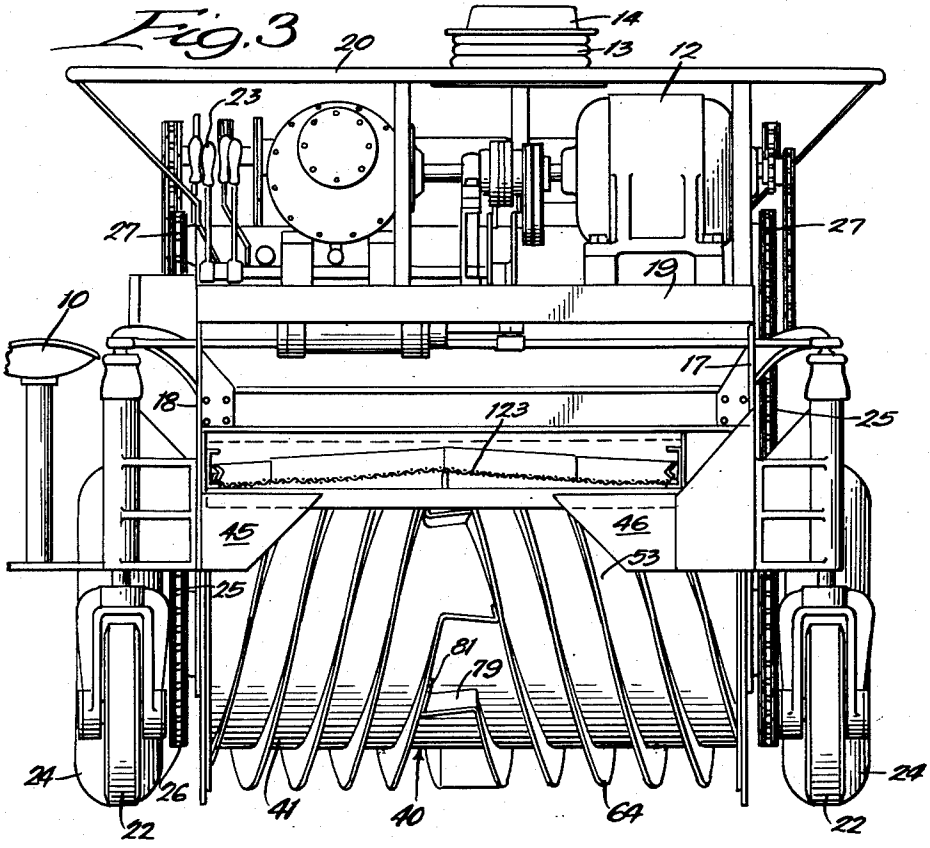
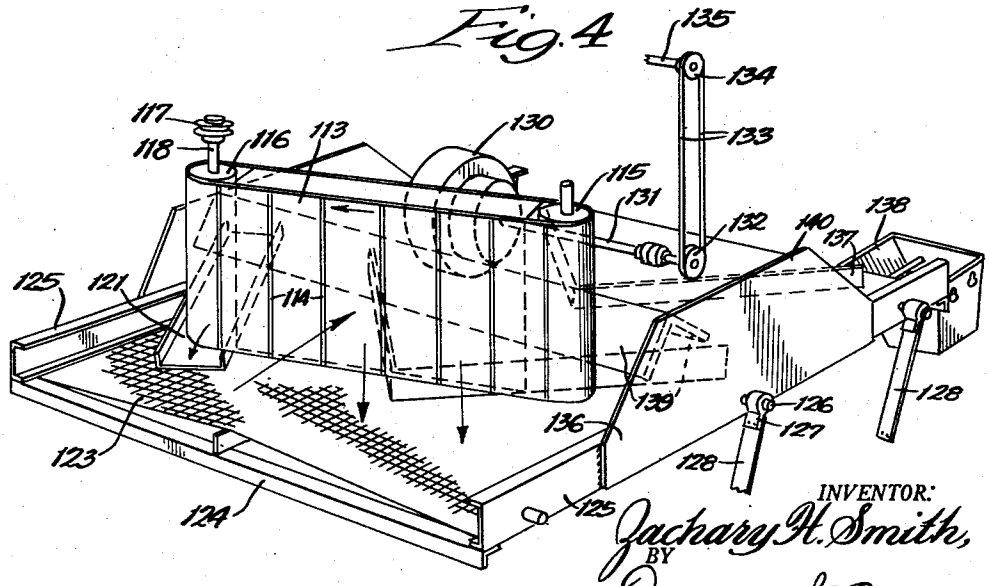


Fig. 4



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SAND CONDITIONING MACHINE

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Fig. 5

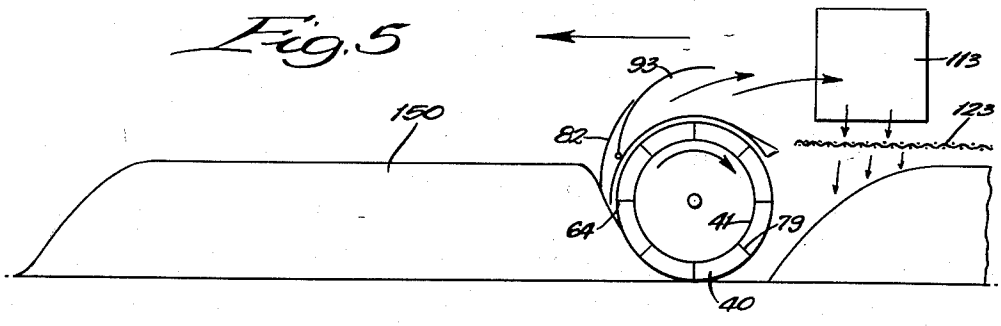


Fig. 6

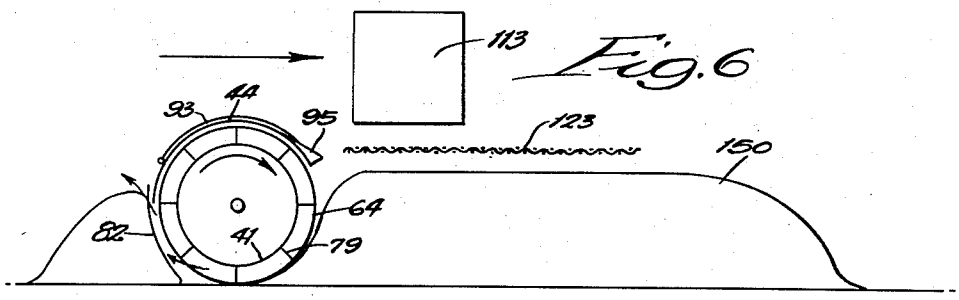


Fig. 7

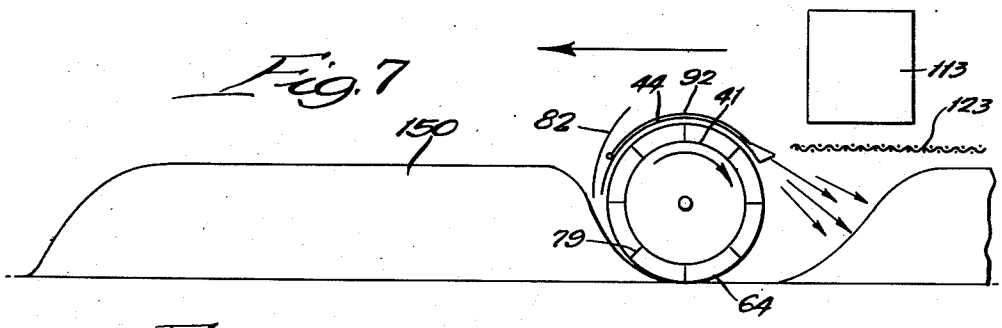
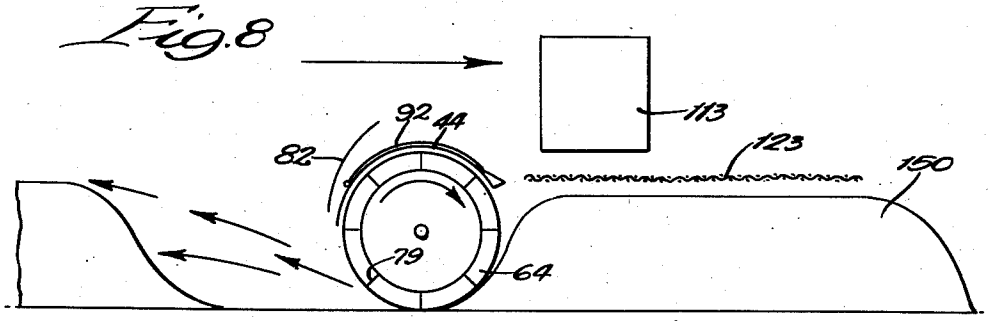


Fig. 8



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SAND CONDITIONING MACHINE

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Fig. 9

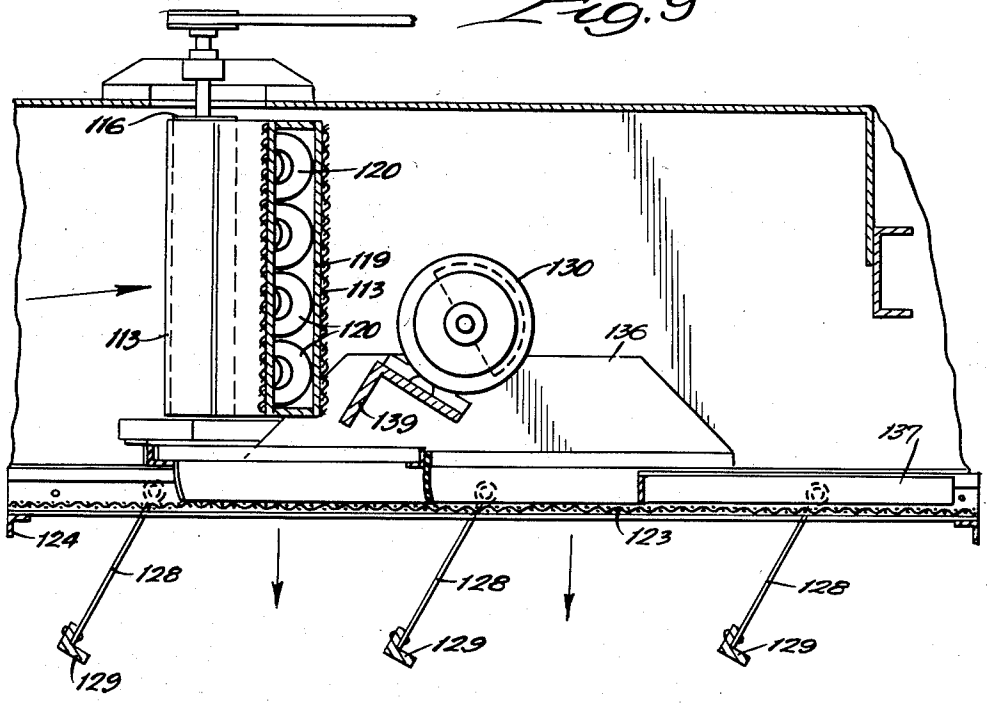
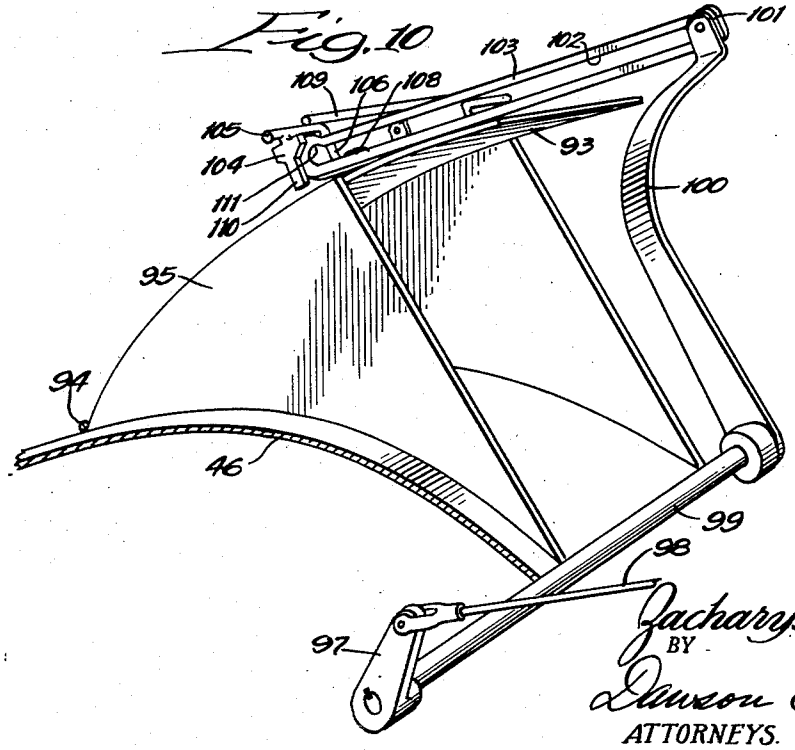


Fig. 10



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Fig. 11

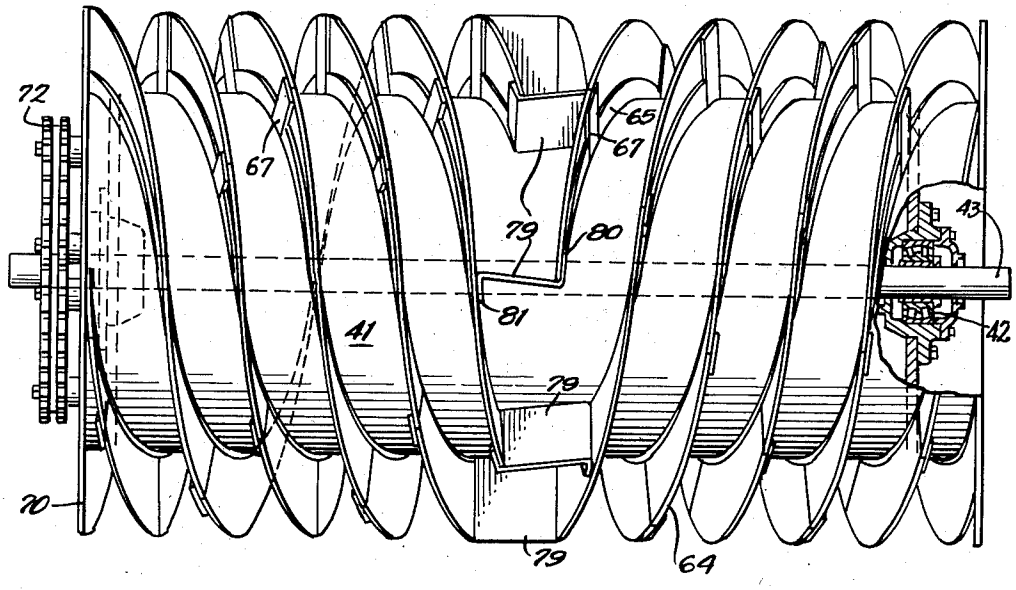
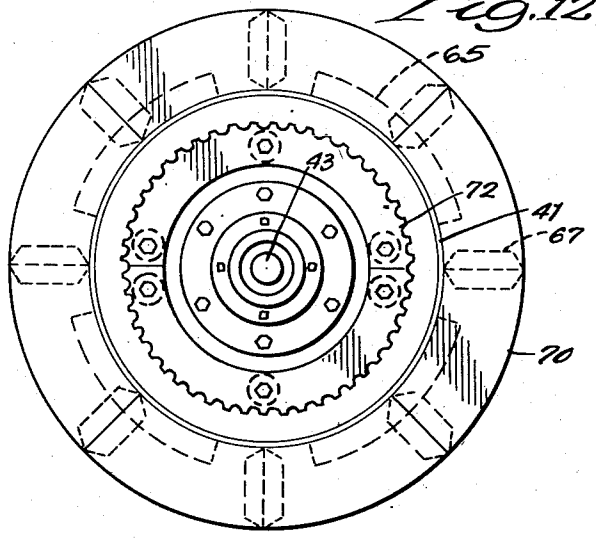


Fig. 12



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Fig. 13

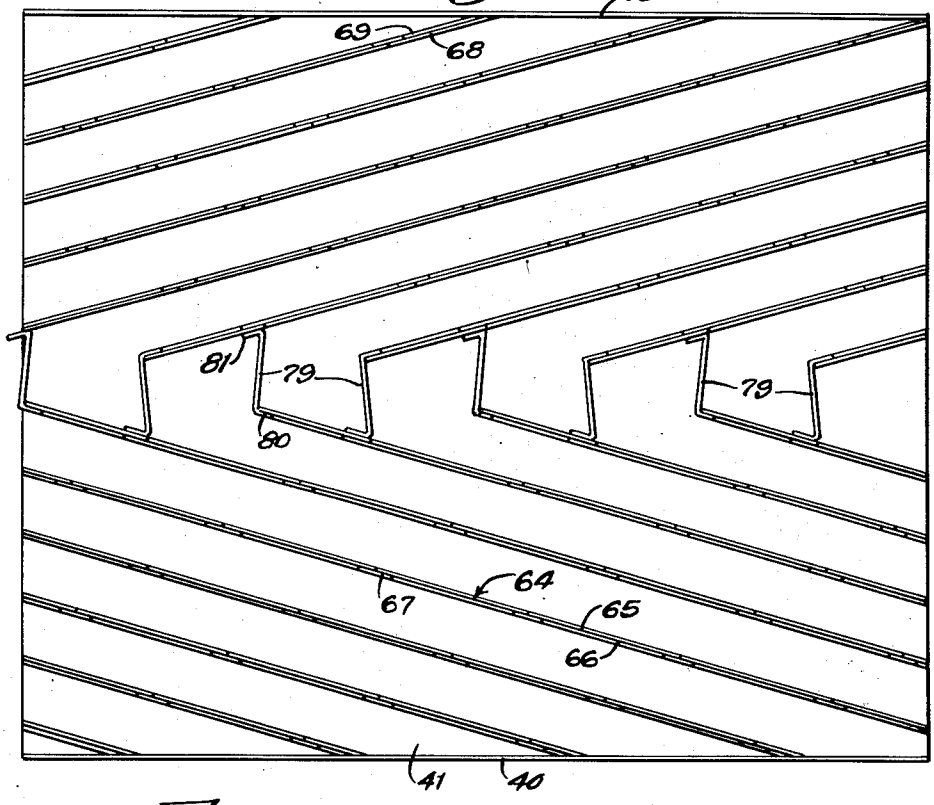
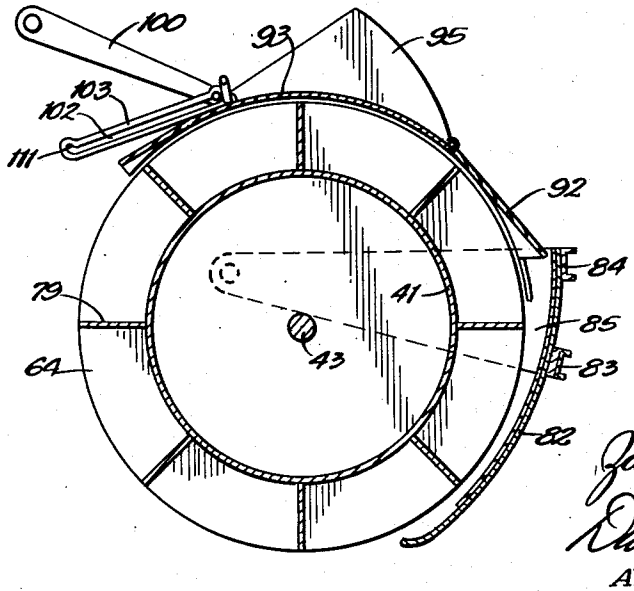


Fig. 14



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United States Patent Office 2,698,977 Patented Jan. 11, 1955

2,698,977

SAND CONDITIONING MACHINE

Zachary H. Smith, Mishawaka, Ind., assignor to American Wheelabrator & Equipment Corporation, Mishawaka, Ind., a corporation of Delaware

Application November 24, 1950, Serial No. 197,242

9 Claims. (Cl. 22—89)

This invention relates to a machine for conditioning foundry sand used in the manufacture of molds for metal casting and the like. The operating characteristics desired to be embodied in a suitable machine are manifold and in most instances they are not met by any machine on the current market.

It is the usual foundry practice to unload the molds onto the floor of the foundry after the castings have solidified. The castings, sprues and gates are removed for separation and for further processing while the sand is left on the foundry floor for reconditioning to be used again. As left, the sand is full of gas and very often a hard crust forms over the top even after it is piled in windrows so that the gases and steam that exists becomes entrapped in the pile. Gaseous inclusions of this type are harmful and dissipation into the atmosphere is desirable. The sand naturally collects a large amount of metallic powders and particles, such as iron rust and scale, and very often large metallic parts such as castings, gates and sprues are inadvertently allowed to remain in the sand pile. These metallic parts and particles are objectionable because they cause the formation of imperfect castings, particularly when such particles become lodged in the mold adjacent or in close vicinity to the metal casting. The casting so produced becomes waste because it is unfit for the purpose for which it was intended.

The sand dumped from the molds usually contains a large number of hard lumps of substantial size and these should be broken up or else removed, otherwise an imperfect casting might be produced. The previous molding operation has caused some moisture evaporation and that which remains has been inequitably distributed during the molding cycle and it is necessary to incorporate additional water and uniformly to distribute the moisture in order to impart the desired cohesive characteristics to the sand for molding. It is also necessary periodically to add and distribute clay or bond which, in combination with the water, imparts cohesive strength to the molded mass. Besides all of these requirements, it is desirable to combine a mixing or mulling action with a masticating action in order to impart the desired consistency to the sand and then it is desired to collect the sand in windrows or in a neat pile for subsequent use in mold manufacture.

Machines of various types have been introduced to overcome the more inefficient technique of reconditioning molding sand by shoveling. To the present, the machines have been unable to provide more than a few of the above requirements and even those have been accomplished to a limited extent. For example, machines of the type commonly used in present sand cutting operations make use of a number of rotating paddles or mixer blades carried about the periphery of a rotating wheel. The blades merely operate to bat the sand about and its mixing and integrating action is very inefficient. It requires a number of passes up and down the windrow and even then the uniform distribution of moisture and bond is not secured, metal particles are not removed and lumps are allowed to fall down through the blades so that substantial amounts of relatively large size remain in the reconditioned sand. The machine is incapable of removing foreign matter, such as wood, paper and the like, and when these remain in the molding sand they complicate and endanger the casting process because of by-product formation upon thermal decomposition.

It is an object of this invention to produce a machine which meets most all of the requirements outlined for

sand conditioning and reconditioning in a simple and expedient manner.

More specifically, it is an object of this invention to produce a machine and to provide a method for conditioning foundry sand in a minimum amount of time and with a minimum number of passes of the machine up and down the windrow, which provides an effective mixing and masticating action that breaks up and reduces the lumps and intimately mixes and uniformly distributes moisture and clay or bond, which aerates and degases the sand, which removes metal objects and metal particles from the sand as an incidence to the reconditioning operation, which separates out and removes large particles, lumps and foreign material that remain in the sand after the mixing and masticating action has taken place, which operates effectively to recondition the sand during movement of the machine in either the forward or backward direction, which piles the sand in neat windrows or in a large pile up against the wall following reconditioning operations, which can be operated with a minimum amount of skilled labor and which is a self-contained unit capable of continuous operation.

It has been found that the more efficient mixing and masticating action which characterizes the operation of the machine that is the subject of this invention permits the use of less water and less clay or bond in the sand mixture. This not only reduces the current costs of the material but indirectly it results in higher yield of acceptable castings since the amount of volatiles released during casting is reduced.

These and other objects and advantages of this invention will hereinafter appear, and for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which—

Figure 1 is a perspective view of the machine embodying features of this invention;

Figure 2 is a side elevational view of the machine shown in Figure 1 with the cutting cylinder in raised position;

Figure 3 is an elevational view from the rearward end of the machine shown in Figure 1;

Figure 4 is a perspective view showing the magnetic separator and vibrating screen arrangement which forms a part of the machine shown in Figure 1;

Figure 5 is a schematic drawing illustrating a possible operation of the machine while traveling in a backward direction;

Figure 6 is a schematic drawing similar to that of Figure 5 illustrating a possible operation of the machine while traveling in a forward direction;

Figure 7 is another schematic drawing which illustrates another possible operation of the machine while traveling in the rearward direction;

Figure 8 is a schematic drawing similar to that of Figures 5, 6 and 7, illustrating a further possible operation of the machine while traveling in a forward direction;

Figure 9 is a sectional elevational view of the elements shown in Figure 4;

Figure 10 is an enlarged elevational view partially in section of the door operating and rocking device which forms a part of the machine shown in Figure 1;

Figure 11 is an elevational view partially in section of the cutting cylinder which forms a part of the machine;

Figure 12 is an end elevational view of the cylinder shown in Figure 11;

Figure 13 is a development of the cylinder shown in Figure 11, and

Figure 14 is a sectional elevational view of the cylinder shown in Figure 11 and parts associated therewith.

As illustrated, the front of the machine is in the direction to the right in Figure 1 where the driver's seat **10** is located and the rear of the machine is to the left, where the scraper blades **11** ride along the ground or foundry floor when in the assembled relation. The machine illustrated is powered with a single electric motor **12** that derives its power through a cable **13** wound upon a reel **14** which is constantly urged in the direction for winding up by means within a housing **15** driven by a chain **16** operated from the power source **12**. It will be understood that power sources other than an electric motor, such for example as an internal combustion engine

or the like, may be used as the power source or that each of the operating parts of the machine might be separately driven by a motor or engine, if desired.

The machine includes a pair of side wall members 17 and 18 interconnected by a number of cross bars, some of which support a floor 19 in the upper forward portion of the machine which is surrounded by a railing 20. The frame 21 is supported at its forward end portion by a pair of laterally spaced steering wheels 22 operatively connected for turning movement through suitable shaft and link members to a hand operated lever 23 manipulated by the driver to effect steering operations. The rearward portion of the frame is supported on a pair of laterally spaced driving wheels 24 actuated by chains 25 that operate about sprockets 26 on the wheels 24 and sprockets 27 rotated through a reduction gear assembly from chain 16 connected to the power source. The driving chain 25 is adjustably tensioned by a link member 28 mounted on the frame 21 for endwise movement and having a sprocket 30 on the end thereof that operatively engages the chain at a point intermediate sprockets 26 and 27. Chain 16 is similarly tensioned by corresponding members 31 and 32 adjustably fixed to the frame 21.

Mounted on the rearward portion of the machine is the horizontally disposed cutting cylinder 40 formed on a shaft or axle member 43 rotatably carried in self aligning bearings 42 or other type bearing members such as spherical roller bearings. A cutting cylinder shield or housing 44 is arranged in closely spaced relation about the upper and rearward portion of the cutting cylinder to provide a confining space therebetween. The housing consists of a pair of curvilinear plates 45 and 46 which correspond to the contour of the cutting cylinder and are secured, as by bolts or rivets 47, at their inner ends to curvilinear laterally spaced channel members 48 and 49 respectively and at their outer ends to vertically disposed laterally spaced side plate members 50 and 51 respectively. Bearings 42 are journalled in a vertically disposed end portion 52 of swingable side arm members 54 which will hereinafter be described and which is rigid with the side plate members 50 and 51. The rearward inner end portion of each of the curvilinear plates 45 and 46 are cut away as at 53 to permit more desirable access of the cutting cylinder to the sand pile, as will hereinafter be pointed out.

The housing 44 and the cutting cylinder 40 constitute a unitary cutting cylinder assembly that is adapted to be rocked in the direction toward and away from the floor or ground by supporting side arm members 54, each of which is pivoted at the forward end upon a stub 55 rigid with the side wall frame 21. The outer or rearward end portion of the supporting and pivoting arms 54 are rigidly secured to the side wall plates 50 and 51 of the cutting cylinder housing assembly. The cutting cylinder and the housing is rocked about its pivot in response to actuation controlled by chains 56 having their free ends secured to the end portion of the arm 54 while the other ends are partially wound about and anchored to disc members 57 keyed to a shaft 58 rotatably mounted on supports 59 extending upwardly from the side wall frame members 21. Rotational movement of the shaft 58 is controlled by a hydraulic ram 60 connected to the shaft by chain 61 having one end secured to the end of the ram 60 while the other end is partially wound and anchored upon the periphery of a separate drum or disc member 62 fixed to the shaft 58. As the ram 60 is caused to move outwardly in cylinder 63 thereby to pay out chain 61, the weight of the cutting cylinder assembly causes shaft 58 to rotate in the direction to let out chain 56 and permit the housing and cylinder to rock in the direction towards the floor. When the piston or ram 60 is retracted within the cylinder 63, the shaft 58 is caused to rotate in the opposite direction and wind up chain 56 so that the cutting cylinder housing is rocked about its pivot.

As shown in Figures 3 and 11 and as developed in Figure 13, the cutting cylinder 40 is provided with a plurality of screw blade members 64 pitched toward the center of the cylinder and which extend substantially vertically from the periphery of the drum 41 to operate as a screw conveyor for the sand by reaction during rotation on the floor. The blade members are formed of a plurality of sectional spirally shaped plates 65 secured in end to end relation to form a continuous spiral about the drum by fastening the base portion of each section to blade retainer members 66 fixed, as by riveting, to the peripheral surface of the drum. The blades 64 are reinforced intermittently at positions corresponding to the juncture between sections 65 by vertically disposed reinforcing strips 67 that are disposed between the retainer members 66 for intermediate blades. The end blades 68 are provided with end blade retainer members 69 both of which are fixed to circular end plates 70 which form outside blade sections.

As shown in the drawing, there are four leads from each end and in such construction eight cuts are made into the sand pile upon each rotation of the drum. It will be understood that the number of leads and spiral blades may be increased or decreased from the amount employed in the illustrated embodiment of this invention without departing from the spirit of the invention. The drum is rotated in a direction whereby the spiral blades are caused to operate as a conveyor which positively conducts sand and other material between the blades towards the center of the cylinder.

The cutting cylinder is adapted to be rotated in a clockwise direction by a chain 71 which connects a double sprocket 72 fixed to one side of the outside plate 70 to a sprocket 73 fixed onto a shaft 74 having a larger sprocket 75 which is driven by another chain 76. Chain 76 operates about sprocket 77 fixed to shaft 78 operated by the power source 12. The shaft 74 is in substantial alignment with the stub 55 about which the cutting cylinder assembly is rotated. As a result, it will be apparent that the desired operating connection can be established between the power source and the double sprocket on the cutting cylinder to effect its rotational movement notwithstanding the position of the cutting cylinder assembly during any portion of its rocking movement or position in which it might be disposed relative to the floor.

The blades 64 each terminate before the center portion of the drum and provide a circumferential space occupied by kicker plates 79. The kicker plates are paddle-like members having an end portion 80 turning in one direction and anchored to the end of a spiral blade while the opposite end portion 81 is turned in the opposite direction and anchored to a spiral blade converging towards the first but from the opposite end of the cylinder. A kicker plate 79 is provided for each spiral blade and is anchored to opposite blades in the manner described. In their assembled relation, the kicker plates alternate at angles selected to be from 3 to 15 degrees from the horizontal and preferably about 7 degrees, to impart an improved mastication and throwing action, as will hereinafter be described.

A sand control plate 82 in the form of an elongate curvilinear plate is dimensioned to extend beyond the edges of the kicker plates 79 and to cooperate therewith, when in a lowered position of adjustment, and impart a confining space wherein mastication and working of the sand conducted therein by the spiral blades 64 occurs by reaction of the angularly disposed kicker plates. In this manner uniform mixing is achieved and the lumps are further broken down. Because of the inability of the sand to escape outside the confining space when the sand control plate is lowered, or when the opening is otherwise closed by the sand pile, the sand conducted therein is carried further around the cutting cylinder to be thrown therefrom at the next exit.

The sand control plate 82 is fixed onto the inner walls of vertically spaced horizontally disposed cross channel members 83 and 84 fixed at their outer ends to the end portions of rearwardly extending segments 85 pivoted at their inner ends upon stubs 86 extending outwardly from the side walls 50 and 51 of the housing 44. Rocking movement of the sand plate between raised and lowered positions of adjustment is controlled by chains 87 secured at one end to the top channel member 84 while the other end of each chain is partially wound and secured upon a disc 88 fixed to a drum 89 which is concentrically mounted for relative rotational movement upon shaft 58. Rotational movement of the drum 89 is effected by chain 90 operating between a sprocket 91 fixed to the drum 89 and a sprocket (not shown) connected to the power source.

A shield plate 92 fixed between rim members 43 and 49 covers the space between the sand control gate 82 and a sand control door 93 hinged, as at 94, to one end of the plate 92. Sand control door 93 is an elongate

curvilinear plate that swings between vertically disposed and laterally spaced guide plates **95** to open and closed positions of adjustment. The upright guide plates **95** are also secured to the rim members **48** and **49**. The sand control door **93** is adjusted to open and closed positions by any suitable means or even by a handle for manual adjustment but it is best to provide means for effecting opening and closing movements of the door and for locking the door in closed position by manipulations from the operator's position, otherwise the force of the sand propelled by the kicker plates may force the door open.

A preferred operating system, shown in Figures 1 and 10, includes a door operating handle **96** operatively connected to a crank lever **97** by an elongate rod **98** pivoted at one end to the lever **97** and at the other end to an intermediate portion of the handle **96**. Lever **97** operates a cross shaft **99** having a curvilinear arm **100** swingably mounted on the inner end thereof. A stud **101** on the end of the arm **100** is slidable in an elongate slot **102** formed in a rectangular arm **103** rigid with a forwardly extending portion of the sand control door **93** and extending forwardly thereof.

Locking means are provided for securing the door in the closed position. Said locking means are rendered effective and ineffective responsive to operation of the door to the open and closed positions of adjustment. A suitable locking means comprises a T-shaped member **104** depending integrally from the outer end of one of a pair of laterally extending horizontally disposed rods **105** having an inner downwardly extending portion **106** and a crosswise connecting portion **107** which is rotatably secured in sleeve members **108** fixed to the outer wall of the door **93**. A cross arm **109** joins the laterally extending horizontally disposed rods **105** to insure their conjunct movement.

A stem **110** of the T-shaped member normally projects within the path of the stud **101** when actuated to completely closing position whereby the stem **110** will be rocked in the clockwise direction and bring the cross arm **109** into latching engagement with a hook member (not shown) rigid with the rims **48** and **49** or the shield members **45** or **46**. An upwardly extending notch **111** is formed contiguous with the rearward end of slot **102** to enable the stud **101** to rise therein during initial opening movement to engage the sloping wall **112** on the under side of the T-shaped member to cam the member in a counter-clockwise direction for the purpose of unlatching the locked elements. Subsequent movement of the stud forwardly in the slot **102** causes the door to swing to open position between the side plates **95** which function in open position as sand guards.

Disposed forwardly of the cutting cylinder and directly ahead of the open sand control door **93** is an upright endless belt **113** having a number of cross ribs **114** in the surface thereof to facilitate its operation as a conveyor. The belt which operates between idler gear roller **115** and the driving roller **116**, is driven in lateral movement by sheave **117** fixed to shaft **118** and connected to the power source by a chain or belt (not shown). The conveyor belt **113** travels over a smooth walled rigid housing **119** formed of metal or the like within which a series of vertically and laterally arranged permanent magnet members **120** are mounted so as to provide magnetic attraction to that portion of the conveyor belt surface disposed between the roller **115** and **116**. A trough **121** is provided underneath the drive roller **116**, where magnetic attraction no longer exists, to collect the metal particles which separate out on the face of the belt and fall into the trough, which then conveys the particles forwardly and outwardly to a removable bucket **122** mounted on the side of the machine.

The drive roller **116** is positioned rearwardly of the idler roller **115** thereby to dispose the conveyor belt **113** at an angle leading in the direction of travel to compensate for the effect which the travel of the belt might have upon the sand particles thrown against it, otherwise the sand particles would be deflected or carried in the direction of travel of the belt so that a large portion of the sand would be thrown into the collecting trough **121** or deposited substantially off center. The angle of travel of the belt is not critical but it should depend upon the rate of travel and the velocity of the particles thrown against it. In normal operation, an angle of about 15 degrees from a line crosswise of the machine is suitable but it may be varied as much as plus or minus 10 degrees.

Disposed rearwardly of the cutting cylinder and directly below the magnetic separating belt is a horizontally disposed vibratory screen **123** supported between a frame work of angle irons **124** and side channel members **125**. The side channel members have a number of outwardly extending studs **126** each of which is gripped between a rubber bushing **127** fixed within a bore on the upper end of resilient vertically disposed hanger straps **128** which are fastened at their lower ends to cross base members **129** fixed to the machine frame. In this manner, the screen is suspended for forward and rearward vibratory movement that is effected by an eccentric driving motor **130** driven by a shaft **131** having a sheave **132** on the end thereof. The sheave is driven by a belt **133** operating over another sheave **134** on shaft **135** that is rotated from the power source.

A number of V-shaped metal members **136** and **137** rigid with the upper face of the screen **123** and with their apexes extending rearwardly guide the rearward travel of the tailings and the like which do not immediately sift through the screen member thereby to make certain that particles of a size capable of passing through the screen will have an opportunity to do so before the larger tailings reach the forward edge of the screen and are guided by the forward V-shaped member **137** to fall in end buckets **138** mounted on the machine. The channel members **136** and **137** support a cross angle member **139** upon which the eccentric motor is mounted. Vertically extending guard plates **140** are secured to intermediate portions of the side channel members **125** to minimize the passage of sand beyond the side walls of the machine and out of the path of intended movement. The screen member **123** should be located at a level just above the end of the the sand control door **93** when the door is in closed position in order to prevent sand being thrown thereon during certain operations, as will hereinafter be pointed out.

Mounted on the rearward ends of the side frame members and in surface contact with the floor or ground over which the machine travels are a pair of scraper assemblies **11** adapted automatically to adjust themselves responsive to the direction of movement of the machine to deflect sand on the floor which is beyond the spread of the cutting cylinder into the path of the cutting cylinder and out of the path of the driving wheels when traveling in one direction, and deflect the edge portions of the windrow into the main part of the sand pile when traveling in the other direction. Each scraper assembly comprises a vertically disposed outwardly inclined and rearwardly extending plate **141** secured to the side frame member. A bracket consisting of a pair of connected vertically spaced bars **142** are hinged by pins **143** and **144** respectively to a pair of laterally spaced hinge members secured to the side wall of the plate **141**. Pivoted onto the rearward hinge of the bracket is a rearwardly extending yoke **145** having a hinge pin **146** extending through the end thereof and through sleeve **147** fixed to a scraper blade **148** at a point offset from its longitudinal center.

Because of the offset pivotal mounting of the plate **148** it is caused to swing in one direction or the other to assume the positions described responsive to the direction of travel of the machine. For example, when moving in the rearward direction into the windrow, the frictional force operating as the plate scrapes over the floor will cause the plate to swing inwardly and seat against the inner wall of the supporting plate **141**, as shown in Figure 1. When in this position, the effective range of the machine will extend beyond the wheels **22** since the plate will scrape the sand in advance thereof and deflect it inwardly into the operating range of the cutting cylinder. When traveling in the opposite direction, the plate **148** will swing outwardly until the shorter section, as measured from the pivot, bears against a laterally extending stop **149** on the rearward edge of the frame. In this position, the plate will slant inwardly and rearwardly to deflect outlying portions of the sand into the windrow.

After pin **144** is removed, the entire scraper unit may be pivoted about hinged pin **143** to enable the scraper blade assembly to be swung entirely out of position. If the pin **143** is also removed, the entire scraper blade assembly may be disconnected from the sand conditioning machine.

OPERATION OF THE MACHINE

(a) Vehicular movement without sand conditioning

During driving of the machine about the foundry floor to align the machine with a windrow for sand reconditioning, the plug at the end of cord **13** is inserted into a suitable electric socket for the purpose of energizing the electric motor **12**. The sand control door **93** should be closed and the entire cutting wheel assembly raised off the floor to its upper position of adjustment, shown in Figure 2, during such positioning movements. The driving wheels may be selectively operated in the forward direction or in the rearward direction and the vehicle turned to effect the desired steering operation until proper alignment is obtained.

(b) Sand reconditioning with magnetic separation and sifting

After the desired amount of bond has been distributed on the surface of the sand which may be prearranged into a partial windrow and after the estimated quantity of water has been sprinkled onto the surface, the machine is readied for passage into the windrow to mix and masticate the sand, remove iron particles and separate out foreign material and lumps that resist breaking. For this purpose, the cutting wheel assembly is lowered to floor position, the sand door is raised to open position, the magnetic separator belt is operated in the crosswise direction indicated by the arrow in Figure 4 and eccentric motor **130** is operated to cause vibration of the screen **123**. The cutting cylinder **40** is rotated in the clockwise direction, which is the only direction it turns during any operation, and the sand control plate or gate **82** is lowered until its bottom edge is in position just above the top level of the sand. The machine is then caused to travel in the rearward direction into the windrow.

As shown in Figure 5, the operations which take place are as follows:

The sand **150** is deflected inwardly into the path of the cutting cylinder **40** by the scraper blade **148** and the spiral blades **64**, pitched towards the center, cut into the sand on the floor to break up the lumps thereof and positively convey the sand towards the center where the kicker plates **79** pick it up and by reaction with the sand control gate and shield masticates the sand further to break up the lumps and effect a mixing action.

As the level of the sand pile rises, the sand control gate **82** is correspondingly raised because the level of the sand pile eliminates the need for the gate to close the rearward exit and the kicker plates remain in more efficient contact with the sand pile. Since the rearward exit is closed either by the gate or by the sand, the kicker plates continue to convey the sand about the cutting cylinder so that it is forcibly thrown through the next exit which is that left open by the sand control door **93**.

The sand is thrown forwardly through the exit and against the front wall of the laterally traveling magnetic separating belt. Metal particles are retained on the surface of the belt and carried therewith until the belt passes over the driving roller **116** where magnetic attraction ceases and the iron particles are dropped into the trough **121** to be carried forwardly therein by vibration and deposited in bucket **122**. It is necessary to empty the bucket periodically as it becomes filled.

The sand drops from the separator belt onto the vibrating screen **123**. That which is fine enough to pass through the screen is allowed to fall onto the foundry floor over which the cutting cylinder has already passed. The tailings are caused to pass forwardly and outwardly over the surface of the screen, as guided by members **136** and **137**, and drop into buckets **138**, which are also periodically emptied. The sand passing through the screen has the bond and water uniformly distributed therein and is in such condition as to be immediately suitable for mold making in the event that the amount of moisture is sufficient.

The machine can thus be operated in continuous fashion until it passes through the entire windrow. Towards the end of the windrow, the sand control gate is again lowered to conform with the level of the sand pile in order to maintain a closed exit at the rearward portion of the cutting cylinder. In the event that an obstacle is encountered that resists cutting or resists conveyance to the center of the cutting cylinder and lifting by the kicker plates, it is pushed rearwardly in front of the cylinder and

when sufficient notice is given, the machine may be stopped and the cutting cylinder assembly raised to permit probing immediately in advance of the cutting cylinder to dislodge the obstacle and permit its removal before damage can be effected.

(c) Return operation out of the windrow

When the machine is operated in the forward direction out of the windrow, as shown in Figure 6, it matters not whether the sand control door is open or closed. The cutting cylinder assembly is lowered to floor position and the cylinder rotated. The sand control gate **82** is initially lowered to regulate the height of the windrow and, as the machine advances, it is gradually raised out of the closing position. During movement of the machine, the sand is conducted inwardly by the screw plates and picked up by the kicker plates. Mixing action takes place during such conveyance and during lifting by the kicker plates which then tosses the sand rearwardly out of the rearward exit onto the windrow that forms behind the machine.

It is during this type of operation that the angular position of the kicker plates are of substantial importance. If the kicker plates **82** had an angle less than 2 degrees, the sand would merely be moved rearwardly as by a shovel and little, if any, mixing action would have been achieved. If the angular relation were greater than 12 or 15 degrees in alternating plates, then the sand would be tossed to one side and then to the other and spread beyond the area desired. While the exit is closed and the sand is carried about the cylinder to the exit through the sand control door or therebelow, the angular relation of the kicker plates is not critical but it is best to maintain it within the range described.

During forward movement out of the windrow no iron separation or sifting takes place. Additional water may be sprayed onto the windrow in advance of the machine in the event that more is indicated. Sand thrown back onto the windrow is kept from spreading sidewise by the scraper plates **148** which automatically assume the offset position.

(d) Rearward movement without magnetic separation and sifting

This operation is diagrammatically illustrated in Figure 7. Neither the conveyor belt nor the vibratory screen are operated. The sand control door is closed so that the first exit for the sand occurs at a point below the vibratory screen. The sand is conveyed inwardly by the spiral blades and carried around the cutting cylinder by the kicker plates and thrown forwardly from the cutting cylinder at a point below the vibratory screen. The entire quantity of sand which passes through the machine is thus thrown directly onto the floor space just passed over by the cutting cylinder.

Figure 8 schematically shows the operation of the machine for moving the sand back into a pile against a foundry wall. The relationship and adjustment of parts is the same as that existing in the operation of the machine as described under heading *(c)* except that the sand control gate is kept raised so that the sand will be thrown forcibly rearward during alternating rearward and backward movement of the machine with a steady advance in the forward direction.

It has been found that a single rearward and forward passage of the machine through the windrow is sufficient to reduce the sand to condition for immediate use. The reconditioned sand is of such fine character that it can be used for face sand or other similar material in the preparation of molds thereby to enable the elimination of such costly face materials and to simplify mold making. Iron and lumps are substantially eliminated and the resulting sand has molding characteristics comparable to other sands embodying increased proportions of bond and moisture.

It will be understood that numerous changes may be made in the details of construction, arrangement and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In a sand conditioning machine, a horizontally disposed cutting cylinder shiftable between raised and floor positions of adjustment having means thereon for conveying sand inwardly towards the center when rotated over the floor, means for rocking the cylinder between

raised position and floor position, a housing about the upper portion of the cutting cylinder to provide a confining space therebetween, means arranged about the central portion of the cutting cylinder for receiving sand conveyed thereto and for mixing and carrying the sand at high speed over the cylinder from the rearward end toward the forward end, a first exit opening in the rearward portion of the housing in substantial alignment with said carrying means, a second exit opening in the forward portion of the housing in substantial alignment with said carrying means on the cutting cylinder, a sand control plate adjustable relative to the housing between positions of adjustment for opening and closing said first exit opening, a sand control door shiftable between positions of adjustment for opening and closing said second exit opening, and means for rotating the cylinder whereby sand is conveyed towards the center and carried about the cylinder to be thrown outwardly through the first open exit.

2. In a sand conditioning machine, a horizontally disposed cutting cylinder, screw blades on the cutting cylinder pitched towards the center for conveying sand towards the center when the cutting cylinder is lowered to floor position, means about the central portion of the cutting cylinder for carrying the sand about the cutting cylinder from the rearward portion towards the forward portion thereof at such speed that the sand tends to be thrown from the cylinder by centrifugal force, a housing located about the upper portion of the cylinder to provide a confining space therebetween, a first exit in the rearward portion of the housing in alignment with throwing means on the cylinder, a second exit in the forward portion of the housing in alignment with the central portion of the cylinder, sand control doors adjustable relative to the housing between positions for opening and closing said exits, magnetic separating means including a vertically disposed, laterally travelling belt located in the path of the sand when thrown through said forward exit for separating the metallic particles capable of magnetic attraction from the sand and conveying same laterally from the sand, screening means located below the separator, the sand being thrown from said first exit when the sand control panel associated therewith is in open position, said sand being carried past said exit when said sand control panel is in closed position to be thrown from the next exit, the sand being thrown from said forward exit against the magnetic separator from which it falls onto the screening member and then deposited on the floor when the associated sand control door is in open position of adjustment and below the magnetic separating means and screening member when the sand control door is in closed position.

3. In a sand conditioning machine, a horizontally disposed rotatable cutting cylinder mounted for shifting movement between raised and floor positions of adjustment, means for adjusting the cylinder between operative floor position and inoperative raised position of adjustment, spiral actuators on the peripheral surfaces of the cutting cylinder for cutting into the sand and conveying the sand inwardly towards the center when rotated in floor position of adjustment, kicker means in the central portion of the cylinder thereof for carrying the sand which has been conveyed thereto about the cylinder and throwing the sand radially therefrom and deflector plates swingably mounted alongside of the cutting cylinder for deflecting the sand on the floor inwardly into the path of the cutting cylinder when traveling in one direction and for changing its operation to direct the sand inwardly into the windrow when traveling in the opposite direction in which the means for deflecting the sand comprises an elongate scraper blade pivoted from the machine at a point offset from its longitudinal center so that movement thereof to a desired position of adjustment occurs automatically responsive to frictional force as the blade scrapes over the floor.

4. A sand conditioning machine as claimed in claim 3 in which an arm is pivotally hinged at one end onto the machine and is removably connected at its spaced apart portion onto an adjacent portion of the machine for fixing the arm onto the machine to prevent pivotal movement, and means pivotally connecting the scraper blade to the other end of the arm in an offset portion of the blade for pivotal movement in the manner described whereby the arm is held to position the scraper blade in position of use when the removable connection is effective and the scraper blade and the arm is pivoted out of position of use when the latter connection is ineffective.

5. In a wheeled sand conditioning machine, a horizontally disposed cutting cylinder having screw blades about the outer wall thereof pitched towards the center for conveying sand inwardly towards the center when rotated over the floor, a housing extending substantially about the upper half of the cylinder to provide a confining space therebetween and having exit openings in the forward and rearward portion of the housing in radial alignment with the central portion of the cylinder, kicker plates arranged about the central portion of the cutting cylinder, blocking means adjustable relative the housing between positions of adjustment for opening and closing said exit openings, and means for rotating the cylinder in a direction to convey the sand over the floor inwardly toward the center and to rotate the kicker plates for carrying the sand about the cylinder with such speed as to throw the sand radially outwardly from the cylinder through the first open exit.

6. In a wheeled sand conditioning machine, a horizontally disposed cutting cylinder having means thereon for conveying sand inwardly towards the center when rotated over the floor, means for rocking the cylinder between raised and floor positions, a housing about the upper portion of the cylinder to provide a confining space therebetween and having forward and rearward exit openings in radial alignment with the central portion of the cutting cylinder, means arranged about the central portion of the cutting cylinder for receiving sand conveyed thereto and for carrying sand at high speed about the cylinder from the rearward end towards the forward end, blocking means adjustable between positions for opening and closing said exit openings, a horizontally disposed screening member arranged adjacent the forward edge of the housing at a level slightly above the lower edge of the housing, and means for rotating the cylinder to convey the sand towards the center and to carry the sand about the cylinder to be thrown through the forward exit opening onto the screen when the exit opening is free of said blocking means and to carry the sand beyond the screen to the underside thereof when the exit opening is closed by said blocking means.

7. In a wheeled sand conditioning machine, a rotatable cutting cylinder which operates over the floor to convey sand inwardly towards the center and throws the sand radially therefrom in a horizontal direction, a horizontally disposed vibrating screen arranged adjacent the cutting cylinder, a semi-cylindrical housing disposed substantially about the upper half of the cylinder to provide a confining space therebetween terminating at a level below the screen, said housing having an opening in the portion adjacent the screen and means on said housing for adjustment between positions for movement into and out of position for obstructing said opening, means forming a part of said cylinder for carrying the sand about the cylinder and throwing the sand through said opening onto the screen when free of obstruction and for carrying the sand to the underside of the screen when the opening is obstructed to carry the sand beyond the screen to the underside thereof when thrown from the cylinder, and channel members arranged over the surface of the vibrating screen inclined in the direction of the cutting cylinder to increase the length of travel of sand over the screen and to guide tailings onto collecting means, and collecting means for receiving the tailings incapable of being sifted through the vibrating screen.

8. In a wheeled sand conditioning machine, a horizontally disposed cutting cylinder having means on the periphery thereof for conveying sand inwardly towards the center when rotated over the floor, means for raising and lowering the cutting cylinder to raised and floor position, a housing about the upper portion of the cylinder to provide a confining space therebetween and having exit openings in the forward and rearward portion thereof in radial alignment with the central portion of the cutting cylinder, means arranged about the central portion of the cutting cylinder for receiving sand conveyed thereto and for carrying the sand at high speed over the cylinder from the rearward end toward the forward end, blocking means adjustable between positions for opening and closing said exit openings, a vertically disposed laterally traveling magnetic conveyor means arranged to confront the path of the sand when

thrown through one of the exit openings to separate the iron particles from the sand, and a horizontally disposed screening member located below the magnetic conveyor and which receives the sand falling therefrom for separating the large particles from the fines which pass therethrough and deposit on the floor.

9. In a wheeled sand conditioning machine, a horizontally disposed drum having screw blades on the periphery thereof leading from each end towards the center, a housing about the upper portion of the drum having an opening in the forward central portion and another opening in the rearward central portion, means for opening and closing each opening in the housing, means for raising and lowering the drum with its housing in the direction toward and away from floor position, means for rotating the drum in a direction which turns the screw blades for operation as a screw conveyor to conduct sand disposed therebetween towards the center of the drum, radially extending kicker plates disposed as a continuation from the inner ends of each screw blade and alternately disposed at opposite angles of 3–15 degrees with the horizontal axis of the drum, said kicker plates receiving sand conveyed thereto by the screws from opposite directions and providing a mixing action as they throw the sand centrifugally radially from the drum through the first open exit in the housing.

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