

April 30, 1963

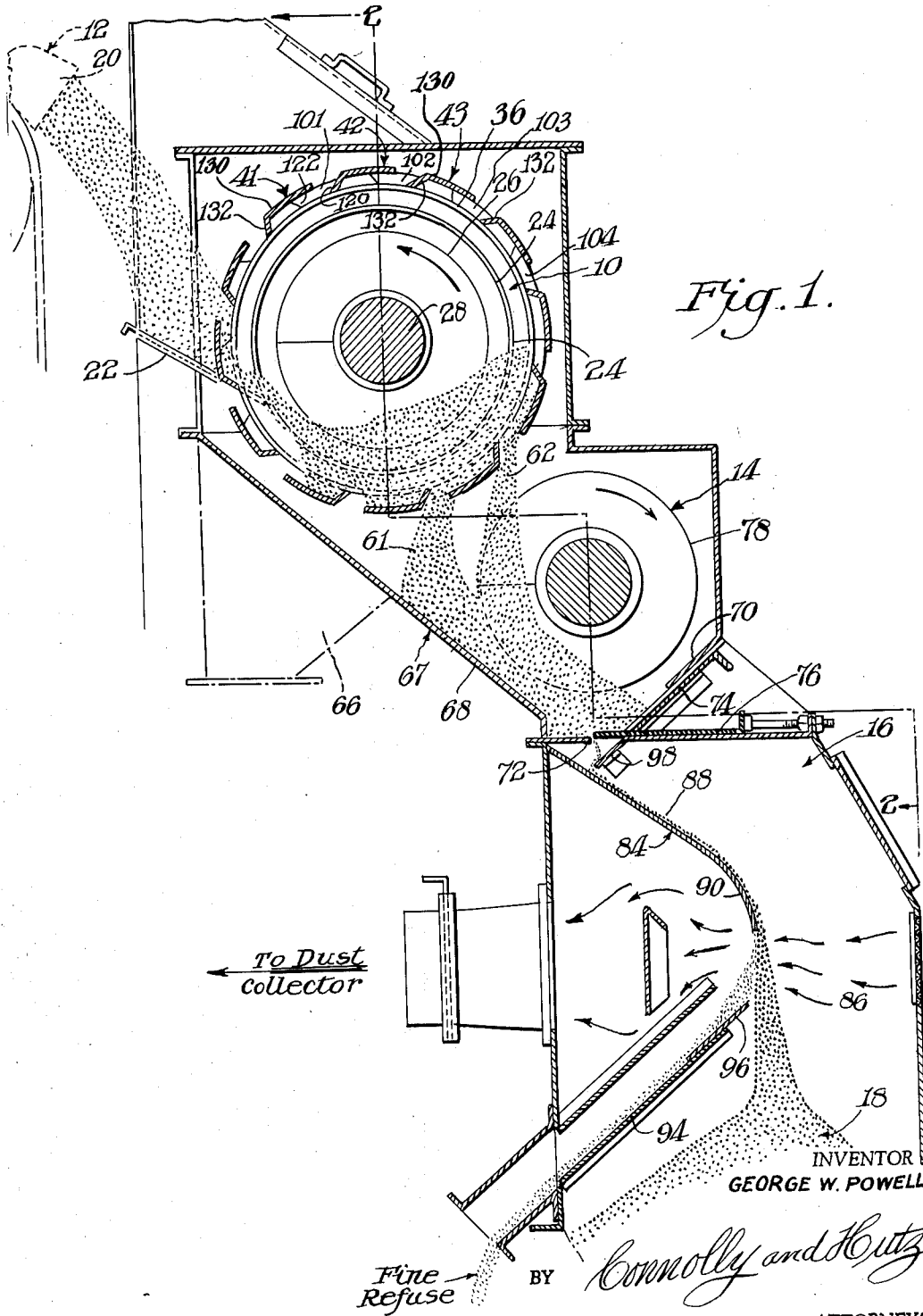
G. W. POWELL

3,087,615

AIR SEPARATOR

Filed April 15, 1960

2 Sheets-Sheet 1



1

3,087,615

AIR SEPARATOR

George W. Powell, Hagerstown, Md., assignor to Pangborn Corporation, Hagerstown, Md., a corporation of Maryland

Filed Apr. 15, 1960, Ser. No. 22,588
3 Claims. (Cl. 209—134)

This invention relates to the treatment of particle mixtures for the purpose of separating out or classifying a portion of the particles. Such treatment is especially valuable in connection with particles of blastant abrasive used to project against work pieces to effect a cleaning, abrading or peening action.

The blasting of work pieces in the above manner conventionally uses particles of metal such as steel, cast iron, aluminum or the like. Such particles have a much more effective action on work pieces than sand particles, and have substantially displaced sand for these purposes. One of the very significant factors in such displacement is that metal particles can be effectively propelled in a blasting stream by means of centrifugal throwing wheels with very little erosive action on the wheel structure, as compared with sand. By way of example a wheel that will stand up for as much as 100 hours of operation with steel abrasive, will need replacement after only about 6 to 10 hours of similar blasting action with sand.

Because the above throwing wheels can inexpensively project many tons of particles per hour, they are enjoying considerable commercial use particularly to clean metal castings. Such castings before this cleaning contain appreciable quantities of sand. Some sand adheres to their surfaces from the sand molds in which the castings are formed, and in most cases the castings have openings or pockets that are filled with the molding sand inasmuch as it is generally impossible to remove the sand from these openings and pockets when the casting is withdrawn from the mold. In addition the sand in such openings and pockets is frequently supported by wires or rods that are buried in them and used to structurally support those sand bodies as well as to more securely hold those bodies in place on the main section of the sand mold.

The above sand, wire, rods and other articles are blasted loose from the castings by the impingement of the projected metal particles and are collected along with those particles so that the metal particles can be recycled through the throwing wheel. Without such reuse of the metal particles, the blasting operation would be uneconomical, and in actual practice these particles are recycled a great many times and are only discarded after repeated blasting causes them to break into smaller and smaller particles too fine for the desired operation.

In the prior art there has been considerable difficulty removing all the sand from the recycling particles. Air separators such as described in U.S. Patent No. 2,771,189 granted November 20, 1956, do not give consistently sharp separation. The removal of the mold wires and rods has also necessitated the use of relatively large separators called scalping drums, typical constructions for which are shown in the above U.S. patent.

Among the objects of the present invention is the provision of improved and more efficient and reliable separators of the above types.

The above as well as additional advantages of the present invention will be more completely understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein:

FIG. 1 is a partly diagrammatic vertical sectional view of an improved metal blastant recirculation system that

2

includes two separators representative of the present invention;

FIG. 2 is a vertical sectional view taken generally along line 2—2 of FIG. 1, showing more details of the construction of FIG. 1; and

FIG. 3 is a fragmentary view similar to FIG. 2 of a modification of that construction in accordance with the present invention.

According to the present invention an air separator has an inclined guide plate along which a stream of mixed particles is guided to drop at a fluctuating rate through a stream of air to cause the air to deflect the lighter of the dropping particles away from the heavier particles, and the guide plate is curved to approximate the free dropping of the particles when they are supplied at the maximum rate. For blasting with metal particles an effective arrangement is for the guide plate to be inclined at an angle of about 30 to 40° from the horizontal with its lowermost length curved about a radius of about 6 to 10 inches for a length of about 5 to 10 inches, and the lowest guide portion of the plate is brought by the curve to an inclination of about 5 to 10° from the vertical.

The scalping drum of the present invention with its usual cylindrical screen across which the particles are moved and through which they fall, and its set of imperforate louvers surrounding the screen, each louver having at least most of its area spaced from the screen to prevent articles longer than this spacing from escaping through the screen, can have these louvers fixed in non-adjustable position so that time-consuming spacing adjustments are not needed, the particles being arranged to substantially completely discharge from the scalping drum after moving no more than about two feet along the length of the screen, with screen diameters of about 15 to 30 inches. Louver spacing adjustments in the prior art have been directed primarily at the spacing of the discharge edges of the louvers inasmuch as by bringing that discharge edge closer to or further away from the screen periphery, the discharge rate of particles from the louvers can be controlled to cause the particles to move a greater or lesser distance along the drum before they completely discharge. The remainder of the louvers are generally affected very little by prior art spacing adjustments in order to keep from unduly changing the maximum wire length capable of discharging through the louvers. This critical distance is generally about $\frac{5}{8}$ to $\frac{3}{4}$ of an inch.

Referring more particularly to the drawings, the apparatus of FIG. 1 includes a scalping drum 10 fed with recycling blastant particles by a bucket elevator 12 and discharging the particles into a spreader 14 which spreads a stream of discharged particles over a relatively long dropping path so that they are dropped through a series of air separators 15, 16 and 17 from which they are collected in individual hoppers 18 for direct return to individual throwing wheels.

The bucket elevator 12 lifts the particles from a hopper or the like in the lower portion of or below the blasting chamber where the work pieces are exposed to the stream of violently projected particles thrown by the wheel. As the individual buckets 20 of the bucket elevator move around the curved path at the uppermost part of the elevator, they flip their contents onto a receiving apron 22 of a fixed trough 24 in which is located an advancing screw 26. The advancing screw is mounted on a shaft 28 which by means of spiders 30 and 32 carries the scalping drum proper, and is rotated in suitable bearings as by means of a sprocket or pulley 34.

The scalping drum proper is principally a cylindrically shaped perforated plate 36 secured to the spiders 30, 32 as by welding, and having perforations dimensioned to permit the desired particles to fall through them. The

perforated wall 36 is encircled by a set of louvers 41, 42, 43, etc. Each louver is fixed in place at each end against rings 51, 52 that encircle and stiffen the perforated wall.

On the internal surface of the perforated wall there is affixed as by welding, an advancing spiral 54 extending over a relatively short distance adjacent the trough 24. The successive bucketfuls dropped on the trough are pushed into the scalping drum by the advancing screw 26, and when they reach the end of the trough they drop on the inner surface of the perforated drum wall 36. At this point the advancing spiral 54 causes the particles to move along the inner surface of the drum wall and keeps the particles from building up to the point where they can roll off the drum wall under the trough 24.

As the particles are thus moved along the inner surface of the drum wall they fall through the perforations in the wall fairly rapidly and collect in the louvers as they arrive at the lower portion of their rotational path. Mold wires thin enough to also pass through the wall perforations only start through but are kept by the louvers from completely escaping through these perforations. As the drum continues to rotate in the manner shown in FIG. 1, the louvers move to an inclined position that causes the particles in them to drop out from their open edges, as shown by the streams 61, 62 in FIG. 1. Wires or other objects longer than the spacing between louvers and wall remain trapped by the louvers until these louvers reach the uppermost portion of their rotational path. At this point such objects drop back into the drum. All such objects continue to work their way along the interior of the drum and eventually drop off the wall edge 64 into a discharge hopper 66.

The streams 61, 62 of the recycling particles drop into a second trough 67 defined by a sloping rear wall 68, a sloping front wall 70, both of which walls are impermeable, and a perforated or slotted floor 72. A removable access plate 74 can be included as part of the front wall 70, if desired. The trough floor 72 has an adjustable slide 76 arranged to adjustably cover portions of the floor and thereby effectively narrow the gap through which the particles in the trough drop down from the floor. A spreading mechanism such as a second advancing screw 78 is arranged to distribute the particles in the lower trough 67 and can be driven as by a sprocket or pulley 80 in synchronism or simultaneously with the scalping drum. The advancing screw 78 is arranged to propel the particles along the lower trough in a direction away from the scalping drum or to the left, as seen in FIG. 2. At the extreme end of the advancing direction, beyond the perforated floor 72, an overflow spout 82 can be provided to receive excess particles and return them as by way of the bottom of the elevator 12 to the recirculation system. The return path from the spout 82 is preferably arranged to be observable as by providing a gap through which the movement of particles can be observed visually, or by providing an electric switch with an operating arm against which the overflowing particles drop to keep the arm in switch-opening position. A light connected to the switch will then go on as a warning to indicate that particles are not overflowing and therefore that the spreading of the particles may not be taking place along the entire length of the floor trough 72.

The individual air separators 15, 16 and 17 are shown as adjacent each other under floor 72. Each separator can be identical, with a guide plate 84 that receives the particles as they drop through the floor 72 and guides them into a path along which they drop across a moving air stream represented by the arrows 86 in FIG. 1. The guide plate has an upper portion 88 which is generally flat and inclined at an angle of between about 30 to 40° from the horizontal. The lower portion of the guide plate is curved as shown at 90, so that the particles as they drop along the plate move in a path

corresponding to that which they would normally move through when the particles are supplied to the separators at the maximum rate.

A skimmer plate 94 with a slidably adjustable lip 96 projects partially into the path of the particles as they drop through the air stream 86, and the lighter particles such as sand, which are more readily deflected by the transverse movement of the air stream, are caused to drop onto the skimmer plate, whereas the heavier particles are less deflected and drop beyond the edge of the skimmer plate into the recirculation hopper 18.

Fluctuation of the rate of supply of particles to the guide plate 84 takes place when the blasting operation with which the above recirculation apparatus is used, operates batchwise on castings. At the commencement of such a batch blasting the sand is blasted free of the casting at a very rapid rate, and accumulates and recirculates along with the recirculated blastant particles. Near the end of such a batch treatment substantially all the sand and other foreign particles have already been removed from the casting and the recirculation is then substantially entirely blastant particles. As a result the volume of the recirculation stream at the beginning of the batch blasting can be several times as high as the volume near the end of the batch blasting. Furthermore, the added volume is attributable to such things as the sand which comes through the scalping drum 10 and the trough floor 72 with the blastant particles. The surge of flow over prior art guide plates causes the particles to drop off the end of prior art guide plates through a higher and wider trajectory as compared with the dropping path when there is no surge. In accordance with the present invention, however, by guiding the particles along the guide plate so that they move through the highest and widest path that they would otherwise only take at surge time, essentially the same dropping path is followed even in the absence of a surge. As a result the air separation effects more uniform removal of the sand and other lighter particles so that the equipment can be readily set for any desired type of operation, and no adjustments are needed to take care of surges.

For most blasting operations using ferrous metal shot the guide plate works exceedingly reliably if the lowermost 5 to 10 inches length of the plate is curved about a radius of from 6 to 10 inches, so that at the bottom of the curve the plate is brought to about 5 to 10° from the vertical. One particularly effective construction has the flat portion of the guide plate inclined at an angle of 33° from the horizontal, with the curved portion about 7 inches long and curved about an 8 inch radius.

To help protect the guide plate from excessive erosion by the particles dropping on it, a wear deflector 98 of simple flat bar shape, for instance, can be positioned under the portion of the perforated floor 72 from which there is the maximum dropping fall to the guide plate. The wear deflector can also be made readily removable if desired, and by inclining it in the illustrated direction, it effectively shortens the drop and therefore reduces the erosion of the guide plate by the particles.

The scalping drum louvers 41, 42, 43, etc. are also preferably held in such a manner that they can be mounted in opposite senses for simplifying the production of the apparatus. As shown in a broken away portion of FIG. 1, the rings 51, 52 upon which the louvers are supported, have a series of teeth 101, 102, etc. and each tooth has an undercut toe 120 as well as an undercut heel 122. Each louver has a principal section 130 which can be flat or curved so as to be concentric with the drum wall, and this portion 130 rests on the outer edge of one tooth of each ring. The louvers also have a bent portion 132 which is relatively short and which is dimensioned so as to bring its longitudinal edge directly against the outer surface of the perforated wall 36. This louver portion 132 is held against the undercut toe 120 of a tooth adjacent the one upon which louver portion 130 is fastened.

For scalping drums that rotate in a direction opposite to that shown in FIG. 1, the louvers are assembled during manufacture so that the bent portion 132 is on the opposite side of the louver and engages under the heel of a tooth on the opposite side.

The direction in which the scalping drum rotates depends primarily on the location of the scalping drum with respect to the bucket elevator 12. This rotation is such that the portion of the drum adjacent the elevator moves downwardly, so that whereas the scalping drum is in front of the elevator as seen in FIG. 2 it can alternatively be placed behind the elevator in which event its rotation is reversed. Because of the relatively large size of the entire blasting apparatus, practically each installation must be tailored to the user's space requirements so that it is essential to be able to rotate the scalping drum in either direction.

Similarly, whereas the scalping drum is arranged to the left of the elevator as seen in FIG. 2, it can also be arranged on the right hand side of the elevator by inverting the combination of scalping drum, advancing screw, spreader, and air separators. The number and location of air separators can also be subject to wide variation. Instead of having three separators immediately adjacent each other and all very close to the scalping drum, there can be any other number of air separators, for example, two, and they can be spaced far apart from each other as well as far from the scalping drum. The lower trough 67 in such event can have its floor perforated or slotted only at those locations where there are air separators. The advancing screw 73 can also be replaced by other spreader mechanism such as a moving or vibrating conveyor arranged to carry the particles dropping from streams 61, 62, and provided with deflectors that engage the top of the conveyor and cause the particles carried by the conveyor to be deflected over the conveyor's edge and thereby drop into an air separator at any desired location.

For best results the distribution of the particles as they are fed into the air separator should be sufficient to assure that particles are dropping down over the entire width of each guide plate 84. An appreciable gap where the guide plate does not drop particles into the air stream leaves a low resistance path through which the air stream tends to be diverted, thereby reducing the efficiency of the deflection at the remaining widths of the guide plate. It is for this reason that the overflow monitoring of the discharge through spout 82 is important. So long as there is a steady overflow here, the spreading action of the spreader and trough 67 can be relied on as sufficiently uniform. Insufficient or absence of overflow should be counteracted by an adjustment of the slide 76 to narrow the passageway through floor 72 and thereby cause the advancing particles to drop into the separator more slowly as they advance along trough 67 so that there will be an overflow excess. Each air separator can have its own adjusting slide 76 and if desired and convenient a single slide will do to operate all aligned air separators.

The portions of the illustrated apparatus that are not described in detail above are unchanged details of prior art constructions and should be obvious as represented by the above-identified U.S. patent,

A feature of the present invention is that by having the scalping louvers fixed, they need no longer be relied on to effect any spreading of the recirculating particles. Accordingly they can be fixed with their discharge spacing at the widest position so that the louvers bring minimum interference to the discharge of the particles through the perforated scalping drum wall. The entire travel of the particles along the length of the scalping drum can therefore be held down to about 2 ft. or even less, and the overall length of the scalping drum can be correspondingly abbreviated, thus reducing manufacturing costs.

As shown in FIG. 3 the scalping drum can also have an advancing screw 200 surrounding its louvers instead of using a separate spreading device. The perforated or slotted spreading trough is accordingly brought up to cooperate with the advancing screw 200, as shown at 202, and the air separators can then be directly below trough 202. This spreading action is sufficient for supplying one or two air separators.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An air separator for separating finer contamination particles from a supply of heavier metal particles comprising an open bottom walled chamber, a particle feed opening in the top of the chamber, a curved guide plate supported by the chamber walls for receiving the particles from said top opening and along which said particles travel to drop off the free end thereof, said guide plate being inclined at an angle of about 30 to 40° from the horizontal and its lowermost length curved about a radius of about 6 to 10 inches for a length of about 5 to 10 inches, the lowest guiding portion of the plate being brought by the curve to about 5 to 10° from the vertical, and openings in opposite walls of the chamber positioned so as to direct a stream of air through the particles falling from the guide plate for removing the finer particles from the heavier particles.

2. The air separator according to claim 1 wherein means are affixed to the top of the chamber for adjusting the size of said feed opening in the chamber top wall.

3. The air separator according to claim 1 wherein wear deflector means extend from the top wall of the chamber to lie in the path of the particles being fed into the chamber through the top wall opening to deflect the particles from their normal path before they strike the guide plate.

References Cited in the file of this patent

UNITED STATES PATENTS

1,031,144	Murray	July 2, 1912
2,601,924	Gonder	July 1, 1952
2,771,189	Kriz	Nov. 20, 1956
2,850,162	Widmer	Sept. 2, 1958
2,870,909	Wynne	Jan. 27, 1959

FOREIGN PATENTS

867,089	France	June 30, 1941
---------	--------	---------------