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(54) IMPROVED ABRADING MACHINE FOR TREATING HORIZONTAL AND INCLINED SURFACES

(71) We, WORLDWIDE BLAST CLEANING LIMITED, a company organized under the Commonwealth of the Bahamas, of Post Office Box N-7788, Nassau, Bahamas, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to abrading machines, and more particularly, machines having means for blasting a surface to be treated with an abrasive.

Abrading machines are well known in the art. One such machine adapted for use on flat, horizontal surfaces is disclosed in U.S. patent 3,691,689. This machine comprises an enclosure having an opening adapted to contact the surface to be treated. The opening in the enclosure is surrounded by a resilient seal. A centrifugal blast wheel projects abrasive particles onto the surface. Spent abrasive particles accumulate on the surface being treated. As the machine moves forward, the spent abrasive particles lying on the surface pass under the resilient seal, and are picked up by a rotating brush located behind the enclosure. The spent abrasive that is picked up is thrown upward and forward into a collection bin by the rotating brush.

There are several disadvantages associated with the use of this prior machine for cleaning flat surfaces. First of all, one occasionally encounters surfaces that are difficult to clean. In such an instance, it is frequently necessary to reduce the rate of forward movement of the machine or to operate the machine in a stationary position for a period of time. The machine disclosed in U.S. patent 3,691,689, however, cannot be operated in a stationary position for too long a period of time because the spent abrasive accumulates on the surface being treated. The abrasive that falls dead within the blast zone eventually masks the surface to be treated, and very little cleaning is accomplished. The machine must be moved forward in order for the spent abrasive to clear the work area.

Secondly, the rotating brush is generally

operated at a constant speed for a given application. While blasting at a relatively slow rate of forward movement, abrasive is picked up by the rotating brush at the same rate as it is thrown, regardless of the size of the pile of abrasive between the resilient seal and the rotating brush. When the operator increases the rate of forward movement of the machine, a large quantity of abrasive suddenly appears between the seal and the rotating brush. The resulting large quantity of abrasive that must be reclaimed within a very short period of time can jam the material handling system.

Thirdly, in order to blast continuously with the device disclosed in U.S. patent 3,691,689, the device must be capable of carrying a quantity of abrasive sufficient to supply the blast wheel, and at the same time allow for the spent abrasive accumulated on the surface being treated. This spent abrasive lying on the surface performs no useful function, but adds to the overall weight of the cleaning apparatus. This additional weight of the cleaning apparatus might be considerable when metal shot is used as the abrasive. This is especially disadvantageous when the tops of storage tanks are being cleaned, because the tops are not designed to support concentrated static or dynamic forces.

U.S. patent 3,380,196 discloses a mobile surface treating apparatus in which a centrifugal impeller projects a stream of abrasive material against a surface to be treated. Spent abrasive is collected and returned by means of suction to the impeller. Since the device relies entirely on suction and high volume air flow to recycle spent abrasive, the device becomes uneconomical to construct and operate when relatively heavy abrasive material is being used. This is especially true when oil storage tanks are being cleaned since heavy metal shot is generally used as the abrasive.

U.S. patent 3,262,228 discloses a surface treating apparatus wherein an abrasive is projected against a surface to be treated. Spent abrasive is returned to the projecting means by the action of gravity. This device

would not be entirely satisfactory for cleaning the top of a horizontal or inclined surface because gravitational forces could not be relied upon to return spent abrasive to the projecting means.

U.S. patent 3,034,262 discloses a resurfacing and finishing machine having rotary throwing means for projecting abrasive against a surface to be treated. Spent abrasive is returned to the throwing means by gravity, and also by suction forces created by the rotary throwing means. In this device, abrasive particles settle on the surface being treated, which is undesirable as previously pointed out in the discussion of U.S. patent 3,691,689. Furthermore, the suction created by the throwing means would not be adequate to recirculate a large volume of abrasive of large particle size or high density. Additionally, gravitational forces cannot be relied upon to recirculate spent abrasive when the device is used on the top of a horizontal surface.

There is also known an abrasive throwing machine in which spent abrasive particles rebound from the surface being treated, and are propelled by rotatable means back to the throwing means for re-use. The rotatable means is typically a brush or paddle. The rotatable means is subject to wear when large volumes of heavy or large particle size abrasive is being thrown against the surface to be treated. For example, the bristles on the rotating brush can become excessively frayed thereby losing their stiffness, resiliency, and ability to propel the rebounding particles toward the throwing means.

Thus there exists a need for a machine for cleaning a horizontal or inclined surface, and capable of operating at variable speeds and even in a stationary position for extended periods of time. The machine should be relatively light in weight so as to render it useful for cleaning surfaces that cannot withstand a heavy load. The machine should be capable of economically and efficiently handling relatively large volumes of heavy abrasive or abrasive of large particle size.

According to this invention an abrasive throwing machine comprises an enclosure having an opening therein, sealing means around the periphery of the opening to contact a surface to be treated and to retard the escape of spent abrasive from the enclosure, means for projecting abrasive particles along an incident path through the opening to a blast zone on the surface and from the blast zone along an upward rebound path, the projecting means being oriented to establish both the incident path and the rebound path at acute angles relative to the surface, and means for returning spent abrasive along a spent abrasive recycle path to the projecting means, the return means comprising a substantially unobstructed, elongate, recirculating chamber means connecting the blast zone

with the projecting means for returning spent abrasive from the blast zone to the projecting means for re-use, the chamber means diminishing in cross-section from the blast zone to the projecting means, and means for providing a stream of fluid into the blast zone, whereby the energy of the rebounding particles and the force exerted on the particles by the fluid are together sufficient to carry the spent abrasive along the recycle path to the projecting means.

Also according to this invention there is provided an abrasive throwing machine for the treatment of substantially horizontal surfaces with particulate abrasive which is projected at high velocity against the surface being treated comprising an enclosure having an opening therein adapted to confront the surface being treated, the enclosure having a delivery section with a projecting means therein for propelling abrasive through the opening to a blast zone on the surface and a chute section adapted to receive spent abrasive rebounding from the surface, the chute section having an upwardly directed concentration zone and an attenuation zone directed to a hopper, and the upwardly directed concentration zone being of diminishing cross-section and having walls adapted to direct rebounding abrasive to the attenuation zone wherein rebounding abrasive strikes a wall of the attenuation zone, thereby decreasing the kinetic energy of the abrasive prior to its passing into the hopper; and means for providing air to the blast zone whereby the energy of the rebounding particles and the air provided to the blast zone carry the spent abrasive to the hopper.

This invention will now be more fully described by way of example, with reference to the drawings, in which:—

Figure 1 is a cross-sectional view of a preferred surface treating machine of this invention;

Figure 2 depicts a type of shot pattern of the machine shown in Figure 1 when viewed from the front of the machine; and

Figure 3 depicts means for obtaining a preferred shot pattern.

Referring to Figure 1, there is depicted an abrasive throwing machine adapted for treating a substantially flat, horizontal surface. The machine comprises an enclosure generally designated as 1. The enclosure has an opening 2 therein adapted to confront a surface 3 to be treated with abrasive material. A centrifugal blast wheel 4 is provided within chamber 5 for projecting a stream 6 of abrasive particles 7 at an inclined angle relative to the surface 3 to be treated. A resilient sealing means 8 is provided around the periphery of the opening 2. The resilient sealing means 8 contacts the surface 3 and substantially prevents the escape of spent abrasive from enclosure 1. Abrasive particles

7 strike surface 3 within a blast zone 9. Spent abrasive particles 10 rebound upwardly along a rebound path generally designated as 11. This rebound path is also inclined at an angle relative to the surface 3.

The rebounding particles 10 enter an elongated, substantially unobstructed chamber 12. A storage hopper 20 is interposed between chamber 12 and blast wheel 4. Chamber 12 connects the blast zone 9 with the blast wheel 4 via hopper 20 making it possible to return to the blast wheel 4 spent abrasive rebounding from the blast zone. Elongated chamber 12 gradually diminishes in cross-section from the blast zone 9 toward the hopper 20, and as shown in Figure 1 has a portion which is curvilinear.

The opening 2 in the enclosure 1 has a front area generally designated as 13 in Figure 1 and a rear area generally designated as 14. The front area 13 and the rear area 14 are outside the blast zone 9, but within the area bounded by seal 8. During operation of the device depicted in Figure 1, there is a tendency for a small amount of spent abrasive to collect in the rear area 14. It is advantageous to recirculate this spent abrasive even though the quantity might be quite small. This can be accomplished by providing means for forcing spent abrasive in the rear area 14 back into the blast zone 9 in order that fresh abrasive 7 will strike the spent abrasive lying on surface 3, and blast it from the surface along the rebound path 11. For example this can be carried out by applying suction in the hopper 20 and providing for the entry of a fluid, such as a gas, preferably air, in the rear area 14. The portion of the resilient seal 8 adjacent rear area 14 can be provided with at least one passage to permit the entry of the air from outside enclosure 1. Preferably, this portion of the resilient seal comprises a resilient brush means 15 adjacent to the rear area 14. Brush means 15 permits the flow of air along the path generally indicated as 16 in Figure 1. This flow of air passes over the blast zone 9 and through the enclosure along the rebound path 11 and recycle path defined by 17, 18 and 19.

This flow of gas through the blast zone and along the recycle path makes a significant contribution toward returning spent abrasive to the blast wheel 4. The energy of the rebounding particles and the force on these particles by the flowing gas are together sufficient to carry the spent abrasive particles 10 along the recycle path to the hopper 20. This result is enhanced by the diminishing cross-section of elongated chamber 12. As the gas travels through chamber 12, its velocity increases because of the diminishing cross-section of the chamber. Thus, as the rebounding spent abrasive particles gradually lose their kinetic energy while moving up-

wardly, this energy loss is at least partially compensated for by the gradually increasing velocity of gas. The diminishing cross-section of the chamber 12 also converts the uncontrolled stream of rebounding particles 10 into a controlled stream that can be guided and directed to the storage hopper 20. Abrasive particles are then fed to the blast wheel 4 through an inlet port 24¹ having means 22 therein for controlling the rate of flow of the particles.

It will be apparent from this description that abrasive particles are continuously impacted on the surface to be cleaned, and continuously removed from the surface to prevent substantial accumulation of spent abrasive particles thereon. This permits the operator to vary the speed of the machine, and even operate the machine in a stationary position while efficiently and effectively treating the surface. Since substantially all of the abrasive material remains within the enclosure and is continuously recycled, the overall weight of the machine is less than a machine in which abrasive passes under the resilient seal and accumulates on the surface until it is picked up by mechanical means. The kinetic energy of the rebounding particles carries the particles free of the surface being treated. Thus, it will also be observed that the device of this invention effectively utilizes the kinetic energy of the rebounding particles in recovering the particles and returning them along the recycle path to the storage hopper.

Any of the well-known means for projecting abrasive particles against a surface to be treated can be employed in the device of this invention. A preferred abrasive throwing means is the centrifugal blast wheel described in U.S. patent 3,867,791. A preferred centrifugal blast wheel has a diameter of about 13 $\frac{1}{2}$ inches and operates at about 3200 rpm.

The abrasive material is projected onto the blast zone of the surface being treated at an angle of about 10° to about 60°, preferably about 15° to about 45°, relative to the surface. An angle of about 30° is particularly preferred. These angles assure that the abrasive material will rebound in an angular direction. Most of the abrasive particles will rebound at substantially the same angle as they strike the surface. Other particles, however, will rebound at a different angle giving rise to the uncontrolled stream of rebounding abrasive.

Any type of conventional abrasive material can be employed in the device of this invention. For example, one can use metal shot, slag, sand, volcanic ash, glass beads, metal oxide particles, zircon, garnet, carborundum, stone, etc. The abrasive material must be capable of rebounding a substantial distance after impacting on the surface being treated. Since smaller or lighter particles do not rebound as well as larger particles, the total mass of this material per unit of time will

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generally be less than when larger, heavier abrasive is thrown by a centrifugal blast wheel. Rebound characteristics can be compensated for by adjusting the speed at which abrasive particles are projected toward the surface. For example, one or more high pressure blast nozzles can be employed in place of a blast wheel. Economics and effectiveness will frequently dictate the use of relatively large abrasive, such as large metal shot. Metal shot of substantially spherical shape is preferred because of its durability and its effects on the surface being treated. Spherically shaped abrasive gives a good blast pattern and profile on the treated surface. While angular-shaped particles can also be employed, the profile of the treated surface is frequently characterized by peaks and valleys. When the treated surface is to be painted, a peak can penetrate the paint film, later serving as a locus for the formation of rust and deterioration.

The abrasive is projected toward the surface being treated at the rate of about 100 pounds to about 800 pounds per minute for a machine having a blast zone about 18 inches wide. The rotational speed of the blast wheel and the quantity of abrasive required for blast zones of other dimensions can be readily determined with a minimum of experimentation. A particularly preferred centrifugal wheel for use in the apparatus of this invention has a diameter of about 13½ inches, a rotational speed of about 3200 rpm and an abrasive flow rate of about 600 pounds per minute for a blast zone about 18 inches wide, wherein the abrasive is steel shot having a diameter of about 0.030—0.035 inch.

Since the smooth, continuous operation of the device of this invention depends in large measure on the abrasive particles rebounding from the surface being treated, the number and size of particles being projected must be considered. Thus, when a steel shot having a diameter of about 0.017 inch is employed, either the amount of shot thrown is reduced, or the rpm of the blast wheel is increased, or both, when compared with a steel shot having a diameter of about 0.030—0.035 inch. Conversely, a greater volume of a larger shot could be thrown, provided that the number of particles is not so great as to interfere with each other when rebounding from the treated surface. The apparatus of this invention is especially well suited for abrasive particles having an average diameter of at least about 0.017 inch.

While the blast wheel 4 can be centrally located in chamber 5, it will be advantageous to offset the wheel in the chamber when the abrasive has an average particle size of about 0.017 inch or less. Referring to Figure 2, there is depicted a blast wheel 4 in chamber 5 as viewed from the front of the machine. Blast wheel 4 has a clockwise rotation and

projects shot onto blast zone BC. The area ABCD represents the shot pattern. The shot does not strike the blast zone BC in a uniform pattern, and it has been found that this adversely affects the rebound characteristics in the region of the blast zone near point C. Abrasive can even collect on the surface 3 in this region, and eventually mask the surface with spent abrasive. This makes it necessary to shut down the machine, collect spent abrasive remaining on surface 3, return it to the storage hopper 20, and then begin normal operation again.

This problem can be corrected by locating the blast wheel 4 to one side of the centerline of the chamber 5 as shown in Figure 3. As shown in Figure 3, the right hand edge of blast wheel 4 is coincident with the centerline of chamber 5. The pattern of abrasive on blast zone B'C' in Figure 3 is more uniform than on BC in Figure 2, and the rebound characteristics are thereby improved. This embodiment of the invention is particularly advantageous when the smaller abrasive is being used, such as abrasive having an average diameter of about 0.017 inch or less. The embodiment shown in Figure 2 can generally be employed with larger abrasive because large abrasive particles generally have sufficient kinetic energy to carry them free of surface 3 even when the abrasive pattern on blast zone BC is not entirely uniform.

The diminishing cross-section of recirculating chamber 12 is an essential feature of the device of this invention. The diminished cross-section increases the velocity of gas flow through the chamber 12 thereby aiding in the flow of solid material through the chamber. Also, diminishing cross-section converts an uncontrolled stream of abrasive to a controlled stream. This makes it possible to direct the rebounding particles along the recycle path to the blast wheel.

The recirculating chamber 12 is at least as wide as the blast zone 9. In the preferred embodiment of this invention, the discharge of chamber 12 is about 36 inches above the surface being treated, the largest cross-sectional dimensions of the chamber are about 10 inches by 18 inches and the smallest cross-sectional dimensions are about 2 inches by 18 inches. As shown in Figure 1, the discharge of the chamber 12 is higher above the surface 3 than is inlet port 24.

The gas flow 16 is especially advantageous when the machine is operated at low speeds or in a stationary position, since it prevents large quantities of spent abrasive from collecting in the rear area 14 of the opening 2. It will be understood that a gas flow can be provided in the front area 13 if the collection of spent abrasive particles in this area becomes a problem. This might occur, for example, when the device is operated in a stationary

position. When the device is mobilized and used for cleaning horizontal surfaces, any spent abrasive that collects in the front area 13 will enter the blast zone 9 as the machine moves forward. In this instance, it generally will not be necessary to include auxiliary air in the front area 13.

Brush means 15 not only permits the passage of gas into the rear area 14 of the opening 2, but also restrains spent abrasive from escaping from the opening.

The air 16 can be provided by means of a vacuum or a forced air system. For example, the enclosure could be connected to means for providing a vacuum within the enclosure, such as by connection to a dust collector system. Air could then enter the brush means 15 in the lower portion of the enclosure. When the vacuum system is employed, it is preferable to connect the storage hopper 20 to the blast wheel 4 by means of a substantially air-tight seal in order to prevent short-circuiting of the air flow. The air flow 16 can also be provided by means capable of supplying air at a positive pressure near the brush 15. In this instance, it is not as important that the seal between the storage hopper 20 and blast wheel 4 be air-tight, since air is being forced into the rear area 14; air drawn into the blast wheel 4 at the seal between the blast wheel 4 and hopper 20 will, therefore, not prevent the air flow 16 from performing its intended function.

It has been found that the air flow 16 should be of substantially high volume and low pressure or vacuum. In the preferred device previously described, an air flow of about 800 cfm at about 2—7 inches water column and ambient temperature has been found to be adequate. Other flow rates and pressures can be employed provided that the flow is sufficient to force spent abrasive in the rear area 14 into the blast zone 9, and adequate to assist in recycling the rebounding spent abrasive. It will be understood that the air flow 16 should not interfere with the abrasive particles 7 along their inclined path 6. Since the air flow need not alone be sufficient to recycle spent abrasive (i.e., the energy of rebounding particles also being relied upon), very high pressures and air flow rates can be avoided.

The air supply proceeds along the path 17, 18, 19. When the spent abrasive particles fall into the hopper 20, the air continues along the path designated as 23. It will be apparent that air sweeps through the descending particles 24 along the path designated 23. This results in an air washing of the spent abrasive particles. Foreign material removed from the surface being treated can effectively be separated from the spent abrasive particles in this manner.

As the air proceeds along the path 23, it carries with it a small quantity of spent

abrasive designated as 25 in Figure 1. The air is permitted to pass through an expanded area generally designated as 26. This results in a decrease in the flow rate of the air. Abrasive particles 25 then fall by the action of gravity into the trough 27. Trough 27 is provided with an adjustable gate 28, preferably constructed of a resilient material such as rubber. Abrasive particles collect above the adjustable gate 28, and eventually trickle back into the storage hopper 20. The air proceeds along the path designated as 29 in Figure 1. The air can then be passed through a dust collector (not shown) to remove foreign material picked up from the surface being treated.

The apparatus can also be provided with a steering handle, such as 30 in Figure 1. The apparatus can be self-propelled by providing one or more drive wheels 31 near the rear of the machine. A caster wheel assembly 32 can be provided in the front of the machine. Controls for regulating the speed and direction of the machine and the speed of the throwing device can be mounted on steering handle 30. It will be apparent that the rate of travel of the machine can be adapted to suit a particular application. Preferably, variable speed controls are provided.

The device depicted in Figure 1 is designed to travel close to the surface being treated in the direction indicated by the arrow 33. The central portion of the machine can hang-up on obstructions or irregularities on the surface. This can be avoided by placing drive wheels 31 in an area adjacent to the blast zone 9, but still outside the enclosure 1. The device can then ride over obstructions and irregularities on the surface.

The enclosure employed in the apparatus of this invention is generally made of a lightweight material, such as thin gauge steel or aluminium. Portions of the enclosure can be lined with a replaceable, abrasion-resistant material. For example, with reference to Figure 1, the housing 5 in which the blast wheel 4 is installed can be lined with manganese steel, cast alloys or hardened plate. This is conveniently accomplished by using replaceable liners of the type well known in the art. Similarly, other surfaces of the enclosure subjected to wear can be lined with an abrasion-resistant material.

The resilient sealing means around the periphery of the opening in the enclosure substantially impedes the escape of spent abrasive particles from the enclosure. The seal should be comprised of a material that is sufficiently resilient to pass over or around obstructions on the surface being treated, yet confine spent abrasive within the enclosure. Elastomeric materials for this purpose are well known in the art. The rear portion of the seal adjacent 14 is preferably a rectangular

brush having its bristles substantially normal to the horizontal surface.

The surface treating machine can be powered by conventional means. For example, hydraulic, electric, pneumatic or manual drive means can be employed. Hydraulic drive means are preferred when the weight of the machine is an important consideration.

The opening 2 in enclosure 1 is generally of a rectangular or square shape, although other shapes can be employed. For example, an oval or oblong opening can also be employed. A rectangular or square opening permits the operator to move the blast zone closer to obstructions on the surface being treated. Thus, for example, the operator will be able to move the machine close to columns projecting through the floating roofs of storage tanks.

The particularly preferred device of this invention has been described as having an 18 inch wide blast zone. It will be understood that blast zones of other dimensions are contemplated, and can be provided by proper selection of the abrasive projecting means. For example, where a wide blast zone is desired, two or more centrifugal blast wheels can be arranged side-by-side. A wide blast zone is frequently advantageous because it permits the treatment of a larger surface area per hour of operator time than a narrow blast zone.

It will be understood that the device of this invention can be mobilized or operated in a stationary position. While the device has been described as being mobile and especially adapted for use in cleaning substantially flat, horizontal or inclined surfaces, it will be understood that the device can be operated in a stationary position, and the surface being treated moved past the opening in the enclosure.

The device of this invention possesses several advantages. The device of this invention is compact, making it relatively maneuverable. It can be operated in a stationary position or it can be mobilized. In either case, spent abrasive particles are prevented from accumulating in large quantities on the surface being treated. The blast zone is of a substantially constant size because abrasive particles are continuously removed from the surface being treated. Furthermore, since the abrasive material is continuously removed from the surface and recycled to the throwing means, the amount of abrasive is small relative to that required in some prior art devices. This reduces the overall cost of operation and the weight of the machine, making the machine especially suitable for cleaning the tops of storage tanks. Additionally, the energy of the rebounding particles is not wasted. This is accomplished by preventing most of the rebounding particles from returning to the surface being

treated. As the machine moves forward, abrasive is continuously blasted at the surface being treated, and is continuously recycled. The forward speed of the machine can be changed without surges of spent abrasive particles clogging the recycle mechanism. The apparatus of this invention includes a substantially unobstructed recirculating chamber free of moving parts that could be worn by rebounding spent abrasive particles. The device of this invention is capable of projecting and recycling large volumes of large or heavy abrasive particles.

The device of this invention is especially useful for cleaning decks of naval vessels, roadways, aiseways and the tops of storage tanks.

WHAT WE CLAIM IS:—

1. An abrasive throwing machine comprising an enclosure having an opening therein, sealing means around the periphery of the opening to contact a surface to be treated and to retard the escape of spent abrasive from the enclosure, means for projecting abrasive particles along an incident path through the opening to a blast zone on the surface and from the blast zone along an upward rebound path, the projecting means being oriented to establish both the incident path and the rebound path at acute angles relative to the surface, and means for returning spent abrasive along a spent abrasive recycle path to the projecting means, the return means comprising a substantially unobstructed, elongate, recirculating chamber means connecting the blast zone with the projecting means for returning spent abrasive from the blast zone to the projecting means for re-use, the chamber means diminishing in cross-section from the blast zone to the projecting means, and means for providing a stream of fluid into the blast zone, whereby the energy of the rebounding particles and the force exerted on the particles by the fluid are together sufficient to carry the spent abrasive along the recycle path to the projecting means.

2. A machine according to claim 1 which is mobile.

3. A machine according to claim 1 or claim 2 wherein the opening has a front area and a rear area outside the blast zone, but within an area bounded by the sealing means, the front area being toward the direction of movement, and the means for providing a stream of fluid being sufficient to force spent abrasive from the rear area into the blast zone.

4. A machine according to claim 3 wherein the fluid is air and the portion of the resilient seal adjacent the rear area includes at least one passage to permit entry of the air into the rear area to force spent abrasive from the rear area into the blast zone.



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The surface treating machine can be powered by conventional means. For example, hydraulic, electric, pneumatic or manual drive means can be employed. Hydraulic drive means are preferred when the weight of the machine is an important consideration.

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The particularly preferred device of this invention has been described as having an 18 inch wide blast zone. It will be understood that blast zones of other dimensions are contemplated, and can be provided by proper selection of the abrasive projecting means. For example, where a wide blast zone is desired, two or more centrifugal blast wheels can be arranged side-by-side. A wide blast zone is frequently advantageous because it permits the treatment of a larger surface area per hour of operator time than a narrow blast zone.

It will be understood that the device of this invention can be mobilized or operated in a stationary position. While the device has been described as being mobile and especially adapted for use in cleaning substantially flat, horizontal or inclined surfaces, it will be understood that the device can be operated in a stationary position, and the surface being treated moved past the opening in the enclosure.

The device of this invention possesses several advantages. The device of this invention is compact, making it relatively maneuverable. It can be operated in a stationary position or it can be mobilized. In either case, spent abrasive particles are prevented from accumulating in large quantities on the surface being treated. The blast zone is of a substantially constant size because abrasive particles are continuously removed from the surface being treated. Furthermore, since the abrasive material is continuously removed from the surface and recycled to the throwing means, the amount of abrasive is small relative to that required in some prior art devices. This reduces the overall cost of operation and the weight of the machine, making the machine especially suitable for cleaning the tops of storage tanks. Additionally, the energy of the rebounding particles is not wasted. This is accomplished by preventing most of the rebounding particles from returning to the surface being

treated. As the machine moves forward, abrasive is continuously blasted at the surface being treated, and is continuously recycled. The forward speed of the machine can be changed without surges of spent abrasive particles clogging the recycle mechanism. The apparatus of this invention includes a substantially unobstructed recirculating chamber free of moving parts that could be worn by rebounding spent abrasive particles. The device of this invention is capable of projecting and recycling large volumes of large or heavy abrasive particles.

The device of this invention is especially useful for cleaning decks of naval vessels, roadways, aiseways and the tops of storage tanks.

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2. A machine according to claim 1 which is mobile.

3. A machine according to claim 1 or claim 2 wherein the opening has a front area and a rear area outside the blast zone, but within an area bounded by the sealing means, the front area being toward the direction of movement, and the means for providing a stream of fluid being sufficient to force spent abrasive from the rear area into the blast zone.

4. A machine according to claim 3 wherein the fluid is air and the portion of the resilient seal adjacent the rear area includes at least one passage to permit entry of the air into the rear area to force spent abrasive from the rear area into the blast zone.



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5. A machine according to claim 4 wherein the portion of the resilient seal having the at least one passage is a brush means.
6. A machine according to claim 5 wherein the means for projecting abrasive particles is a centrifugal blast wheel.
7. A machine according to any preceding claim wherein a storage hopper is interposed between the recirculating chamber means and the projecting means.
8. A machine according to any preceding claim wherein a portion of the recirculating chamber means is curvilinear.
9. A machine according to any preceding claim wherein the projecting means is located in a first chamber means in communication with the blast zone, the first chamber means is defined by walls, the first chamber means has a centreline substantially parallel to the walls, the projecting means has a centreline substantially parallel to the walls and to the incident path, and wherein the centreline of the first chamber means is not coincident with the centreline of the projecting means.
10. A machine according to any preceding claim including means for inducing an air flow in said recirculating chamber means.
11. A machine according to claim 7 wherein the recirculating chamber means extends continuously to a level above the hopper.
12. A machine according to any preceding claim wherein the recirculating chamber means extends continuously to a level above the projecting means for returning

spent abrasive from the blast zone to the projecting means for re-use.

13. An abrasive throwing machine for the treatment of substantially horizontal surfaces with particulate abrasive which is projected at high velocity against the surface being treated comprising an enclosure having an opening therein adapted to confront the surface being treated, the enclosure having a delivery section with a projecting means therein for propelling abrasive through the opening to a blast zone on the surface and a chute section adapted to receive spent abrasive rebounding from the surface, the chute section having an upwardly directed concentration zone and an attenuation zone directed to a hopper, and the upwardly directed concentration zone being of diminishing cross-section and having walls adapted to direct rebounding abrasive to the attenuation zone wherein rebounding abrasive strikes a wall of the attenuation zone, thereby decreasing the kinetic energy of the abrasive prior to its passing into the hopper; and means for providing air to the blast zone whereby the energy of the rebounding particles and the air provided to the blast zone carry the spent abrasive to the hopper.
14. An abrasive throwing machine constructed and arranged substantially as herein described and shown in the drawings.
- WITHERS & ROGERS,
Chartered Patent Agents,
4, Dyer's Buildings, Holborn,
London, EC1N 2JT.
Agents for the Applicant.