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Goff

[11] **3,788,010**

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[54] **APPARATUS FOR TREATMENT OF VERTICALLY DISPOSED SURFACES**

[75] Inventor: **James R. Goff,** Oklahoma City, Okla.

[73] Assignee: **Robert T. Nelson,** Oklahoma City, Okla.

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[52] **U.S. Cl.** **51/9,** 51/273

[51] **Int. Cl.** **B24c 3/06,** B24b 55/06

[58] **Field of Search** 51/8, 9, 12, 270, 273

[56] **References Cited**

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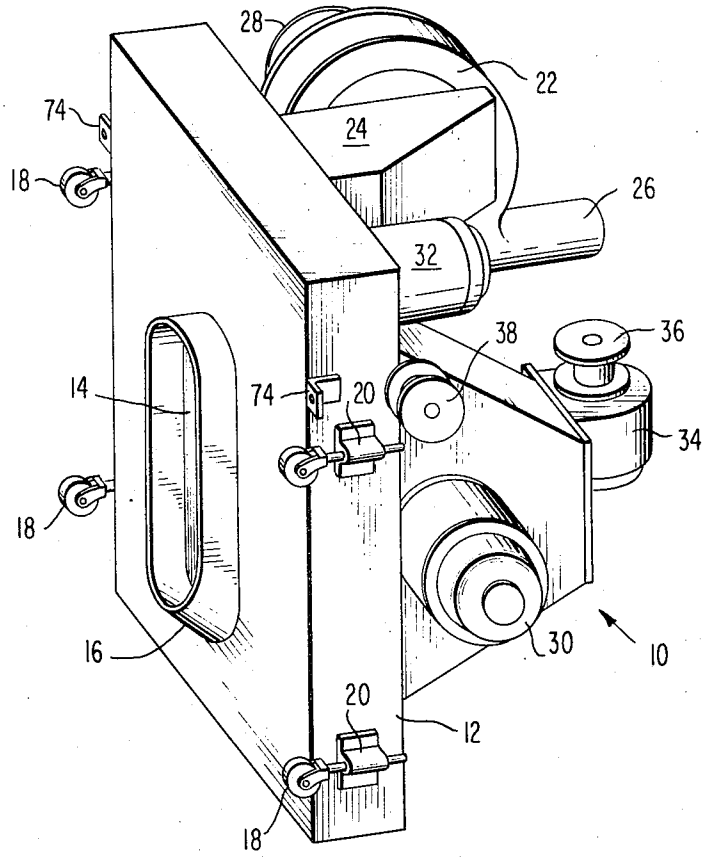
Primary Examiner—Donald G. Kelly
Assistant Examiner—Howard N. Goldberg
Attorney, Agent, or Firm—John W. Behringer et al.

[57] **ABSTRACT**

A portable airless blasting head suitable for treatment of vertically disposed surfaces is described. The blast head comprises in combination an enclosure with an opening in one side adapted to contact the surface to be treated, projecting means within the enclosure for directing a stream of particulate abrasive material through the opening in the enclosure onto the surface to be treated, a resilient sealing means around the boundary of the opening in the opening of the enclosure which contacts the surface to be treated and retains the abrasive material in the apparatus, and a recirculation means to return the particulate abrasive material to the projecting means. Advantageously the apparatus of the present invention is self-propelled.

14 Claims, 3 Drawing Figures



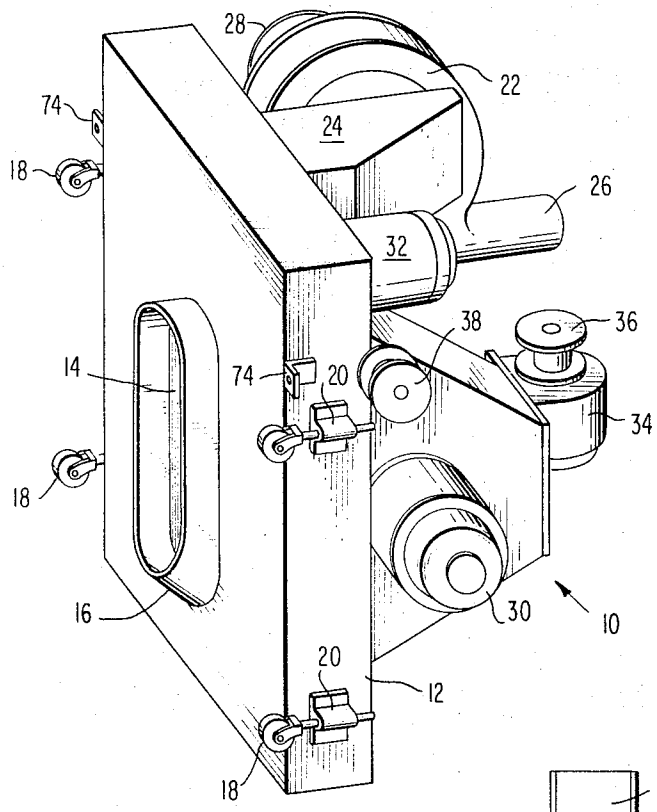

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FIG. 1

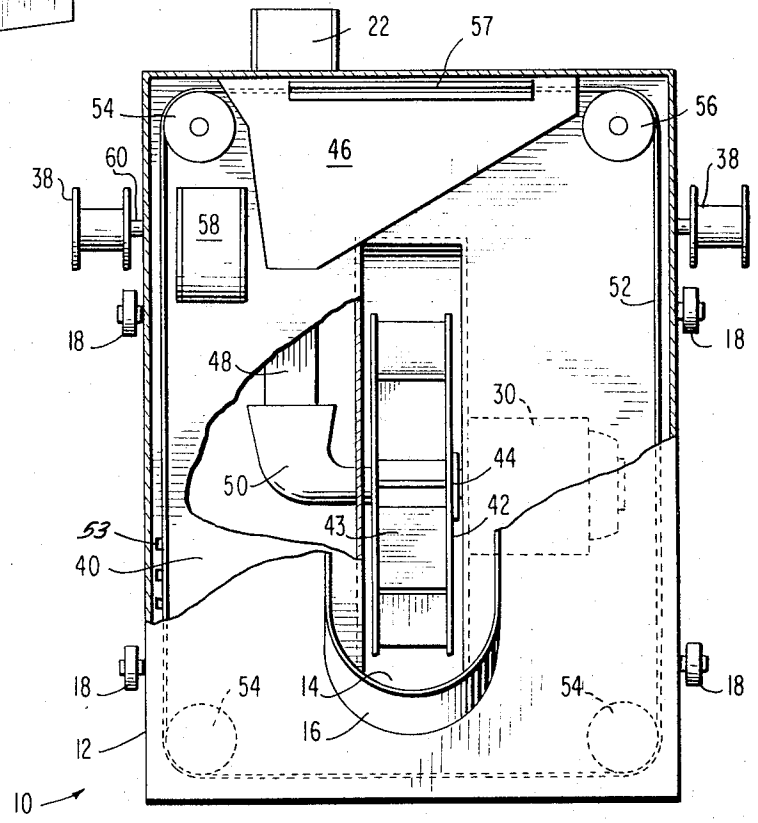
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FIG. 2

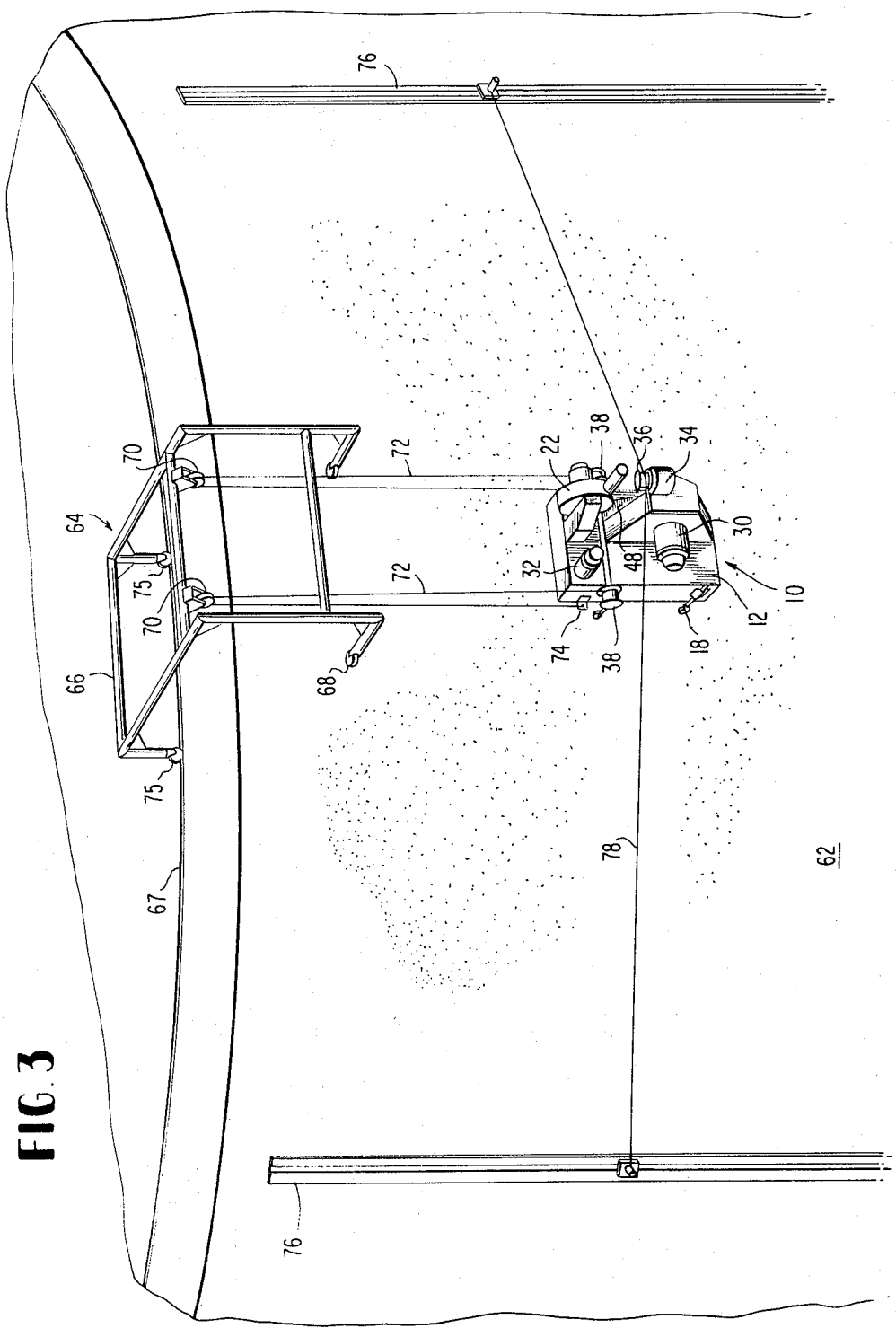
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FIG. 3

APPARATUS FOR TREATMENT OF VERTICALLY DISPOSED SURFACES

This invention relates to the treatment of vertically disposed surfaces and more particularly it pertains to means for cleaning such vertically disposed surfaces with particulate abrasive material which is projected at high velocity against the surface to be treated in order to remove rust, dirt, paint and other deposits therefrom. This invention is directed to an apparatus which is mobile and is continuously operable for cleaning surfaces such as metal. In addition the novel apparatus is provided with means for recovering the particulate abrasive material for reuse and means for separating the particulate abrasive material from dust and other light particles which result from the cleaning of the surface.

Heretofore vertically disposed surfaces have commonly been air blasted with crushed slag, sand and other abrasives as the abrasive in order to provide the desired cleaning action. The crushed slag abrasives, sand and other abrasives, however, are subject to considerable disintegration and hence no attempts are made for its recovery, and the abrasive is simply disposed of after a single use. Air blasting has several other disadvantages. For instance, the compressed air which is required is relatively expensive and contains significant amounts of moisture, and even condensed water, which tend to enhance reoxidation of treated surfaces before protective coatings can be applied. Additionally, air blasting equipment usually necessitates a crew of three men for the operation of a single head, additional labor and equipment must be used to remove the abrasive and disposal of the large amounts of abrasive that is continuously being spent is an additional consideration. Furthermore, air blasting can be a health hazard due to the excessive amounts of dust created, and thus, protective means must be provided to maintain the safety of personnel in the area surrounding the air blasting operation.

As an alternative, it has been proposed to employ centrifugal blasting wheels to propel the particulate abrasive material. One system having a centrifugal blasting wheel is described in U.S. Pat. No. 3,566,543, issued to Fogel. The patentee discloses a blasting head comprising a housing, a centrifugal blasing wheel, an opening in the housing through which the particulate abrasive is projected onto the surface to be cleaned, and a pair of resilient sealing members extending continuously around the opening in the housing positioned so as to effect a seal between the surface to be treated and the housing. However, several disadvantages exist in the prior art device such as the necessity of replacement of the pair of resilient seals which are subject to wearing due to their contact with the surface undergoing cleaning, the extensive frame required to support and move the blast head which substantially reduces its portability, and the necessity of an operator to be positioned relatively close to the blast head and thus often expensive safety equipment must be incorporated into the blast head.

The present invention provides a portable, continuously operable surface treating apparatus for the cleaning of vertically disposed surfaces. The novel apparatus is economical to manufacture and simply constructed yet sturdy and durable upon extended use and operates with relative freedom from wear. Furthermore, the

operation of the apparatus of this invention requires minimal expense in labor and operating costs. A highly efficient means is provided to prevent loss of particulate abrasive materials and for the isolation of the particulate abrasive materials for recycling. Also, means are provided by the present invention for removal of dust and grit from the surface undergoing cleaning. Hence, this invention can operate with almost complete elimination of the passage of grit and dust to the atmosphere and thus can provide a highly acceptable reduction in pollution normally attendant in the use of conventional surface treating apparatus.

Importantly, the highly portable nature of the present invention allows the apparatus without concern to geographic location of the vertically disposed surface to be treated. The apparatus may be employed over rough terrain, water, oil, etc. without the necessity to provide support for a frame external from the surface being treated. An extensive frame is not required for its operation. Thus, the apparatus of the present invention may be set up for operation quickly and early and its use is not prohibited or restricted by the terrain surrounding the vertically disposed surface to be treated. The apparatus of this invention is adapted for uniform coverage of surfaces of variable or changing contour, e.g., vertical curvature as well as horizontal curvature. The apparatus of the present invention can be operated remotely, adding greater safety to its operation.

This invention provides a mobile, continuously operable surface treating apparatus useful for treating vertically disposed surface to be treated, projecting means within the enclosure for directing a stream of particulate abrasive material through said opening in the enclosure onto the surface to be treated, a resilient sealing means on the side of the enclosure having the opening which contacts the surface to be treated and retains the abrasive material in the enclosure and a recirculation means to return the particulate abrasive material to the projecting means. The apparatus of the present invention is advantageously self-propelled; however, it is also possible to propel the apparatus by other means.

The portable, continuously operable apparatus of the present invention is generally easily adaptable to numerous uses and is thus broadly practical and salable. For instance, the apparatus may be used to clean the outer side walls of a ship's hull, large conservation tanks for water, gas petroleum or other fluids or solids, walls, exteriors of buildings and the like. The material may be metal, concrete or other material where abrasive cleaning may be desired.

For a fuller understanding of the invention, reference should be made to the following detailed description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of an apparatus of the present invention;

FIG. 2 is a front elevational view with a break away section of the apparatus; and

FIG. 3 is a schematic view of the apparatus in a suitable rigging for operation to treat a vertically disposed surface.

With reference to FIG. 1, the apparatus, or blast head, is generally indicated at 10. The blast head 10 comprises an enclosure of housing 12 which defines a blast chamber having opening 14 through which particulate abrasive material is passed to contact the surface to be treated. Opening 14 also receives rebounding par-

ticles from the surface being treated and the scale, deposits or other material being removed from the surface. The shape of the opening may be of various configurations. Preferably, the opening is oblong and in an oval or rectangular shape with the major axis of the opening parallel to the projecting means, for example a centrifugal throwing wheel, located in the housing and is more preferably at or near perpendicular to the desired direction of travel of the blast head. When, for example, the apparatus is traveling in a horizontal direction, the major axis of the opening is vertical.

Means are provided to effect a sealing relationship between the surface being treated and the housing. The sealing means is advantageously designed to abate the release of dust, scale or other deposits to the atmosphere at the point of contact with the surface and the loss of the particulate abrasive material from the housing. The sealing means is preferably sufficiently resilient to pass over obstructions present on the surface being treated and to allow sealing over a moderately curved surface which is sufficient to prevent release of dust or other material through gaps which would otherwise be formed. The sealing means can be constructed out of any suitable material such as natural rubbers, synthetic rubbers and other elastomeric materials. For instance, polyurethane elastomerics, butadiene rubbers and the like may be advantageously employed. The sealing means **16** is depicted as extending from boundary of opening **14**, although it may be located in any manner on the housing which would enable result to be obtained. The sealing means can advantageously be of a design which enables easy replacement of the sealing means on the housing. Beneficially, at least the lower portion of the sealing means, that is, the section of the sealing means which is positioned at the bottom of opening **14** during normal operation of the blasting head, projects angularly, outwardly from the housing in a direction toward the axis perpendicularly extending from the center of the plane of the opening. The angular projection of the sealing means facilitates the passage to any material deposited thereon to the housing. Suitable sealing has been observed using a single resilient member for the sealing means.

The movement of the blast head over the surface to be treated is facilitated by casters **18** which are mounted on the housing. The casters are rotatably mounted and are affixed to the housing by clamps **20.** Clamps **20** permit the casters to be positioned either a greater or lesser distance from the housing, and the positioning of the casters can be done manually or remotely. Thus, the working compress upon sealing means **16** can easily be adjusted to provide a seal which is sufficient for the nature of the surface being treated. For example, a greater working compress will be necessary when treating a rough, irregular surface in order to abate the escape of dust and the like, whereas a relatively smooth surface may require a substantially lesser working compress on the sealing means. Additionally, the casters can be positioned to control the attitude of the apparatus. It is readily seen that by the use of casters, the use of a complex support frame means to position to apparatus with respect to the surface being treated may not be required. Nor is continual readjustment of the casters necessary to provide a sufficient seal with the surface. The casters are shown as being laterally positioned on the housing. Other placements of the casters can be made; for instance, a set of three casters may be employed which are placed on the housing in a triangular configuration.

As shown in FIG. **1** is fan housing **22.** While the fan means is depicted as being directly attached to the housing, the fan means may also be located more distant from the apparatus and employed with, for example, a flexible line, to provide the desired effect. The fan in fan housing **22** is designed to draw air in from the chamber formed by housing **12** via vacuum air line **24.** The fan draws in air from the chamber which is laden with dust and fine particles resulting from the cleaning operation. The air and materials in association therewith are expelled from the fan to air exhaust duct **26.** The fan is powered by a fan motor which is contained in fan motor housing **28** which is shown as attached to fan housing **22.** The air fed to the chamber in housing **12** is desirably provided in association with the particulate abrasive material and is circulated in the chamber by the projecting means. Desirably, the projecting means forces air toward the surface being treated and is drawn upward under the influence of the fan means. The air serves to separate fines created by the treatment of the surface from heavier particles such as the particulate abrasive material and larger pieces of scale or deposit which is removed from the surface. Also, the circulation of air and its exhaust from the blast head prevents heat buildup in the abrasive and in the various components of the blast head assembly. The importance of this feature is readily understood when it is realized that large amounts of head are generated by the impact of the abrasive against the surface to be treated. Thus, by the circulation of air it becomes possible to operate the apparatus of the present invention continously over relatively long periods of time with little, if any, heat buildup in the particulate abrasive material.

If desired, the air exhausted from the blast head via exhaust duct **26** can be transmitted to a conventional dust collector (not shown) for removal of the particulate contaminants in the air. The dust collector can be separate from the blast head, in which case, the communication means between exhaust duct **26** and the dust collector is preferably flexible and allows movement of the blast head over the surface being treated. On the other hand, the dust collector may be affixed securely to the housing of the blast head. The release of dust and the like from between the sealing means and the surface being treated can, in part, be abated by operating the apparatus so as to maintain subatmosphere pressure, i.e., a pressure lower than ambient, in the chamber. Therefore, if any gap occurs between the sealing means and the surface being treated by reason of, for example, an irregularity on the surface being treated, the atmospheric air, being at the higher pressure, will be drawn into the chamber at the point of the gap and carrying with it material which might otherwise escape to the surroundings.

Projection means motor housing **30** is affixed to housing **12.** Also shown in FIG. **1** is elevator motor housing **32.** The elevator motor therein powers a conveyor means which returns the discharged particulate abrasive material to the projecting means to be reused. A motor to propel the blast head in a horizontal direction is provided in drive motor housing **34.** The motor is used to drive horizontal track engaging means **36.** The slippage between the horizontal track engaging means and a horizontal track means which is engaged, is avoided through design to provide friction contact or

other essentially non-slipping contact. The horizontal track means can be, for example, a cable, rigid or flexible track, chain or other suitable device. One particularly advantageous means of providing frictional contact of the engaging means **36** to, for example, a cable is to provide a freely rotable pulley on the opposing side of the cable from the engaging means. The freely rotably pulley can then be drawn towards the engaging means by, for example, a tension spring, pneumatic or hydraulic means, or other suitable means to force the cable into contact with the engaging means to provide the desired, frictional contact. Desirably, the horizontal tract means is relatively flexible and positioned such that the track means is bowed with an apex at the engaging means or adjacent to the engaging means. When, for instance, a cable is employed as the track means, friction suitable for traction can be achieved be providing a pulley means which can be activated in a direction essentially perpendicular to the surface being cleaned to engage the cable and increase the tension in the cable. Suitable activation means are, for instance, a pneumatic or hydraulic cylinder. Beneficially, the pulley and the engaging means can be cable sheaves, each with three grooves. The cable can be threaded on the side furthest from the surface being treated of one sheave, across to and around the second sheave and back to and around the first sheave and across over the last groove of the second sheave. By increasing the distance, in any desirable direction, between the pulley and engaging means, the tension in the cable can be increased.

Winch means **38** are provided on both sides of the housing **12** and preferably extend perpendicularly therefrom. The winch means are adapted for engaging a vertical support means, which can be, for example, a flexible cable, whereby the vertical support means can be wound on the winch means to elevate the blast head. The winch means are preferably interconnected by a rigid shaft means and is powered by a hoist drive means. Desirably, a hoist drive means employed to activate the winch means is provided with a self-braking gear drive. The vertically disposed cable can be supported by a frame means having pulley means thereon with the cable being attached to housing **12**, passed over the pulley means on the frame and back to winch means **38**.

FIG. **2** depicts the apparatus of FIG. **1** in a front-elevational view with a break away section to permit viewing of chamber **40** which is enclosed by housing **12** and a further break away to permit viewing of the supply means to supply particulate abrasive material to the projecting means. Projecting means **42** is represented as a centrifugal throwing wheel driven by a centrifugal throwing wheel motor in housing **30**. A drive means **44** can be employed to transmit the power from the motor to projecting means **42**. Projection means **42** can be a conventional centrifugal throwing wheel which can be commercially obtained such as the type manufactured and sold by The Wheelabrator Corporation and described in U.S. Pat. Nos. 2,708,814 and 2,819,562 or as the type manufactured and sold by the Pangborn Corporation, a division of the Carborundum Company. In general, the Wheelabrator type wheels comprise a plurality of radially extending blades **43** arranged in circumferentially spaced apart relation between confining disc plates. The particulate abrasive material, which can be metallic particles, for example, steel shot, steel grit, crushed iron, chilled iron grit, glass beads, aluminum oxide particles, silica or the like, can be fed into the inner ends of the blades, and the particulate abrasive material is thrown centrifugally at high velocity from the outer ends of the blades since the wheel is rotated at high speed about its axis, typically at about 1,000 to 4,000 rpm. The particulate abrasive material is thrown forward by and through opening **14** into engagement with the surface being treated. The abrasive may contact the surface at a slight angle to perpendicular in order to improve the cleaning action.

The particulate abrasive material is stored in storage means **46.** Storage means **46** is provided with abrasive material transfer means **48** to supply the abrasive material to projecting means **42.** As depicted, the abrasive material transfer means is located outside of the housing and communicates with the storage means **46** which is depicted as in the interior of the housing. The abrasive particles flow by gravity through abrasive material transfer means, shown as a conduit, to a charging means **50** which is shown as a funnel having the large opeining at the top and which is curved in a manner to provide release of the particulate abrasive material to the center of, for example, the centrifugal throwing wheel. Desirably, the top of the funnel surrounds the lower end abrasive material transfer means **48** and provides a gap sufficient to allow passage of air into the funnel, but yet is preferably designed such that the particulate abrasive material does not escape. The centrifugal throwing wheel can simultaneously perform as a centrifugal air fan. Thus, during operation, the low pressure area which exists to the center of the throwing wheel can be employed as a motivational force to draw in air through the gap formed at the top of the funnel. Additionally, the presence of air being drawn into the center of the throwing wheel assists the flow of particulate abrasive materials into the throwing wheel. The air exhausted by the centrifugal throwing wheel can circulate within the chamber of the housing and desirably flow through the particulate abrasive material after impinging upon the surface being treated so as to wash the abrasive material and remove fine particles such as dust and the like. The abrasive material supply means may be provided with a valve means or motive means to control or facilitate flow of the particulate abrasive material to the projecting means.

The particulate abrasive material, after impinging upon the surface being treated, falls by the force of gravity to the bottom of the chamber formed by housing **12.** The spent abrasive material is picked up by particulate abrasive conveyor means **52** to be recycled to the projecting means **42.** Conveyor means **52** is depicted as an endless belt running in a clockwise direction on the loop around the inside of housing **12**; however, other elevator means might be used such as pneumatic lift devices and other conventional mechanical elevators. The endless belt may employ scoops or bucket means attached thereto at various intervals. The drawing depicts several representative scoops **53**; however, it is realized that the scoops are spaced at regular intervals on the entire endless belt. When operating the scoop or bucket means is empty on the vertical downpath of the continuous loop. As the belt passes horizontally through the lower portion of the housing, the scoop itself can be in a vertical collecting position. Continuing its course on the vertical up path, the scoop or bucket means contains the abrasive material. Upon

reaching the top of the vertical up path which is preferably located in the upper portion of the housing, the scoop or bucket passes horizontally across the top, itself in a vertical dumping position. The conveyor means, in this delivery zone, releases the particulate abrasive material to the storage means. The scoops or bucket means are preferably below the belt during the lower horizontal pick up flight, and hence, are above the belt during the upper horizontal dumping flight. The scoop or bucket means is essentially free from contact which may result in friction caused by wear. Additionally, by employing a conveyor belt having the scoop or bucket means, less power is required for its operation then, for example, a pneumatic elevator. The scoop or bucket means can be designed so that a high percentage of the particulate abrasive material, often in the neighborhood of 95 percent or more falls into storage means **46.**

The continuous belt can be a V-belt made of sturdy, flexible material such as synthetic resins or natural rubber. The continuous belt can contact pulleys **54** at three corners of housing **12** and power pully **56** in the remaining corner and thus form the configuration, of the continuous loop. Rather than a V-belt and pulley system, the conveyor means may comprise, for example, a chain and sprocket system wherein the pulleys are replaced by sprockets. Power pulley **56** is depicted as engaging with conveyor means **52** in order to move the conveyor means in a clockwise direction. Power pulley **56** is driven by elevator motor in housing **32.** The elevator motor may be attached to suitable drive means to transmit the power to power pulley **56.** An abrasive collector means may optionally be provided in the lower portion of housing **12** to assist the recovery of the particulate abrasive material. The abrasive collector means may be, for instance, a hopper which is adapted to localize the particulate abrasive material to facilitage its pick up by the conveyor means.

The particulate abrasive material drops from conveyor means into storage means **46.** Desirably, air which is drawn from chamber **40** to the fan means in fan housing **22** exits the chamber by a vacuum port means which is in communication with the fan by means of vacuum air line **24** and which is preferably located on housing **12** behind the upper horizontal path of conveyor means **52.** The air circulation in chamber **40** can be approximately diagrammed as follows. Air enters centrifugal throwing wheel **42** and is circulated in a direction towards the surface being treated. The air can serve to wash the particulate abrasive material of fine particulate matter generated due to the action of the abrasive material on the surface. Also, the forced air may serve to dislodge particles on the surface that are not removed by the impact of the particulate abrasive material. The air is then swept upward towards the inlet means carrying with it dust and other fine particulate materials generated in the course of the treatment of the surface. Due to the location of the inlet means to the fan, the air passes around the conveyor means. The proximity of the inlet means to the horizontal path of conveyor means allows the maintenance of relatively high air velocities past the conveyor means. These higher air velocities can beneficially be employed to separate particles of a lower specific gravity which are transported by the conveyor from the particulate abrasive material. For instance, when steel shot or the like is used as the particulate abrasive material, relatively large particles, such as rust or paint, which are not washed from the particulate abrasive material by the air circulated by the centrifugal wheel, may be carried by conveyor means **52** with the steel shot to be returned to storage means **46.** The velocity of air entering the inlet means may, however, be sufficient to remove the relatively large particles of lower specific gravity before they enter storage means **46** and essentially vacuum the lower density particles from chamber **40.** The laden air can be exhausted from the system via the fan and exhaust port **26.** Particles which may not be removed from the steel shot are normally sufficiently fragile that upon being propelled by centrifugal throwing wheel **42** and impacting upon the surface being treated, they disintegrate to a particle size which can be readily removed from the system.

Advantageously, storage means **46** can be provided with port **57** through which air in the chamber is drawn and thus the air can be further directed to pass around the conveyor means to insure that the low density particles are swept from the particulate abrasive material. A valve means can be provided in connection with the port means for vacuum line **24** to adjust the rate of air withdrawal from chamber **40,** and hence, the velocity of air over conveyor means **52.** An additional vacuum line may communicate from the fan means to the housing and be adapted to sweep air from other portions of the enclosure.

Motor housing **58** contains a hoist motor to actuate winch means **38** to provide a means of vertical movement of the blast head. The motor is preferably attached to a drive means to power shaft **60** which is connected to winch means **38.** As stated previously, the drive means for winch means **38** is desirably self-braking.

FIG. **3** illustrates the apparatus to the present invention in connection with a suitable rigging means for transporting the apparatus over the surface being treated. In particular, the surface being treated is indicated as **62** and has thereon a deposit or scale represented by the shaded area. The blast head **10** is positioned upon surface **62** in such a manner that the sealing means contacts the surface to provide a relatively air tight seal. In actual operation, the seal of the sealing means with the surface will be broken by, for example, abrupt protusions or indentations on the surface and thus surrounding air will be drawn into the chamber. Casters **18** contact surface **62** and serve to position the blast head a desired distance away from the surface so as to enable the sealing means to properly contact the surface.

The apparatus is vertically supported by vertical support frame means **64.** Frame means **64** is depicted as comprising a plurality of support members **66** adapted to support themselves and the blast head when positioned at the upper edge of the surface. The frame means can preferably run along track means **67** which is located adjacent to the upper edge of the surface. Desirably, the track means provides support for the frame means for vertical forces, e.g., to counteract gravity, and for a lateral force in a direction perpendicular and away from the surface. Caster means **68** are provided on the frame means and contact the front of the surface and reduce friction of movement of the frame means over the surface. Thus, the frame means will be in equilibrium by its contact with the track means and the front of the surface and is adapted to

move freely along the edge of the surface. Pulley means **70** are shown as affixed to the upper lateral support members of frame means **64** and are adapted to receive vertical support means **72.** The vertical support means attach to housing **12** at attachment means **74** pass over pulley means **70** and attach to winch means **38.** By drawing more of vertical support means **72** onto winch means **38,** the blast head can move in an upwardly direction, and by releasing a length of vertical support means **72,** the blast head can be lowered. Preferably frame supports means **64** is designed to enable passage of the blast head at least partially into its interior. By locating pulley means **70** to the interior of frame means **64,** it is possible to raise the blast head to a position to enable the sealing means to reach or surpass the upper edge of the surface.

The track means which frame means **64** rides upon may be a rail or groove in which wheel means **75,** or the like, affixed to frame means can engage. If a rail is employed, the wheel means are preferably designed such that vertical forces and lateral forces developed by the frame means are conteracted by contact of the wheel means and the track means. The rail can be rigid or somewhat flexible. The track means may be permanently secured or may be detachable. Affixing means operable are, for example, vacuum cups, magnets, clamps, or other fastening devices.

Attached to the surface being treated on opposing sides of the blast head are horizontal track securing means **76.** The securing means may be permanently attached to the surface being treated or it may be detachable. Attachment means include vacuum cups, magnets, clamps and the like. Securing means **76** can be in the form of a grooved track wherein the point of attachment of horizontal track means can be quickly adjusted to the desired height, either manually or remotely, and even automatically. Since the blast head traverses horizontal track means, **78,** it is often advantageous to maintain about an equal the distance from the top edge of the surface to the point at which the track means is secured to each securing means **76.** Thus, for a given vertical position of the blast head, a horizontal pass may be made, and minimal, if any, concurrent readjustment of the vertical position need be made. The blast head pulls itself along the horizontal track means by engaging means **36** which is driven by a horizontal drive motor contained in housing **34.** Normally, to affect engagement of engaging means **36** with the track means to provide the necessary frictional contacts, a tensioning means is provided on the blast head. However, the tension of the track means against the engaging means may be increased by shortening the length of track means between the securing means. This can be done by providing, for instance, a winch means on one of the securing means. The track means may also be provided with a turnbuckle means for decreasing its length.

In the operation of an apparatus of the type depicted in the drawings, the frame means **66** is at the upper edge of the surface to be treated and above the blast head. The vertical support means **72** is attached to the blast head housing, passed over pulley means **70** and attached to winch means **38.** The winch means is activated and the blast head is elevated to the desired position. Horizontal track means is then affixed to securing means **76** so that it is equidistant from the top edge of the surface and contacts engaging means **36.** The horizontal drive motor can be activated to move the blasting head horizontally across the surface. Upon starting the projection means and conveyor means, the treatment of the surface commences. The control of the apparatus of the present invention can be operated remotely, thus the operator need not be closely positioned to the blast head. After a horizontal pass, the horizontal track means can be released from engaging means **36,** and the blast head can be raised or lowered to place it in position for additional passes over the surface. The horizontal track means can be repositioned to engage with the blast head and operation can continue.

While the description of the apparatus has been in terms of travel in a horizontal direction, it is apparent that the novel apparatus is not limited to such horizontal operation. For example, the opening in one side of the enclosure may have its major axis essentially horizontal. Vertical drive can be effected by actuating the winch means. The horizontal drive track can be replaced by a vertical tension line passing from a point above the apparatus to a point below the apparatus. The vertical tension line contacts a freely rotable pulley located on the housing in a manner which enables the tension line to force the apparatus into contact the surface being treated.

It is claimed:

1. An apparatus for the treatment of surfaces with particulate abrasive material which is projected at high velocity against the surface comprising;

a. an enclosure in the form of a housing having an opening in one wall;

b. a projecting means within the enclosure for propelling a stream of particulate abrasive material through the opening in the enclosure;

c. a resilient sealing means located on the wall of the enclosure having the opening and being adapted to contact the surface to establish a sealing relationship between the surface and the enclosure;

d. a storage means for the particulate abrasive material which is adapted to supply the projecting means with the particulate abrasive material, said storage means defining an upper opening within said enclosure;

e. a member defining a port in the upper portion of the enclosure for drawing air from the enclosure, said member being located such that the air from the enclosure is drawn across the opening defined by the storage hopper to the port; and

f. a recirculation means adapted to collect the propelled particulate abrasive material from a lower portion of the enclosure, to convey the collected particulate abrasive material to the upper portion of the enclosure, and to deliver the particulate abrasive material at a delivery zone into the storage means, wherein the delivery zone is located such that the air from the enclosure which is drawn across the opening defined by storage hopper, is drawn across the delivery zone.

2. The apparatus of claim **1** wherein the projecting means is a centrifugal throwing wheel and wherein the centrifugal throwing wheel is adapted to force circulation of air through the opening in the enclosure and toward the surface.

3. The apparatus in claim **1** which is self-propelled and includes therein a hoisting means to propel the apparatus in a vertical direction.

4. The apparatus of claim 3 which includes a horizontal drive means to propel the apparatus in a horizontal direction.

5. The apparatus of claim 1 wherein the opening in the enclosure in oblong and has a major axis which extends vertically and wherein the apparatus moves in a horizontal direction during treatment of the surface.

6. The apparatus of claim 5 wherein the resilient sealing means in a single resilient member extending outwardly from the enclosure.

7. The apparatus of claim 1 wherein the vacuum port on the enclosure is in communication with a fan means wherein the fan means is located on the enclosure.

8. The apparatus of claim 7 wherein the fan means is a centrifugal fan.

9. The apparatus of claim 1 wherein the recirculation means is a conveyor means comprising an endless belt having attached thereon at intervals scoop or bucket means which are adapted to collect the particulate abrasive material and deliver the particulate abrasive material to the storage means.

10. An apparatus for the treatment of surfaces with particulate abrasive material which is projected at high velocity against the surface comprising:

a. an enclosure in the form of a housing having an opening in one wall;

b. a projecting means within the enclosure for propelling a stream of particulate abrasive material through the opening in the enclosure;

c. a resilient sealing means located on the wall of the enclosure having the opening and being adapted to contact the surface to establish a sealing relationship between the surface and the enclosure;

d. a storage means for the particulate abrasive material which is adapted to supply the projecting means with the particulate abrasive material, said storage means defining an upper opening within said enclosure, said upper opening having a portion which is coterminous with a wall of the enclosure;

e. a member defining a port above the storage hopper in the wall of the enclosure which is coterminous with the upper opening of the storage hopper for drawing air from the enclosure;

f. a recirculation means adapted to collect the propelled particulate abrasive material from a lower portion of the enclosure, to convey the collected particulate abrasive material to the upper portion of the enclosure, and to deliver the particulate abrasive material at a delivery zone into the storage means, wherein the delivery zone is located such that the air from the enclosure which is drawn across the opening defined by storage hopper, is drawn across the delivery zone.

11. The apparatus of claim 10 wherein the projecting means is a centrifugal throwing wheel and wherein the centrifugal throwing wheel is adapted to force circulation of air through the opening in the enclosure and toward the surface.

12. The apparatus of claim 10 which is self-propelled and includes therein a hoisting means and a horizontal drive means to propel the apparatus in a vertical and a horizontal direction.

13. The apparatus of claim 10 wherein the resilient sealing means is a single resilient member extending outwardly from the enclosure.

14. The apparatus of claim 10 wherein the recirculation means is a conveyor means comprising an endless belt having attached thereon at intervals scoop or bucket means which are adapted to collect the particulate abrasive material and deliver the particulate abrasive material to the storage means.

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