

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) ABRASIVE SURFACE CLEANING APPARATUS

(71) I, ROBERT TIVIS NELSON, a Citizen of the United States of America, of 715 East Reno, Oklahoma City, Oklahoma, United States of America, do hereby declare the invention for which I pray that a patent may be granted to me and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention is directed to a mobile, continuously operable surface treating apparatus in which particulate abrasive material is projected at high velocity against a surface to be treated in order to remove rust, dirt, paint or other deposits therefrom. In particular, the apparatus of this invention is a mobile, continuously operable surface treating apparatus provided with an improved means for recovering the particulate abrasive material from the surface for reuse.

Previous surface cleaning apparatus of this type have generally utilized vacuum means, magnetic means or rebounding techniques to remove the particulate abrasive material and the loosened dirt and other deposits from the surface. The following United States patents are considered representative of such prior art devices: 3,034,262 issued May 15, 1962 to Eugene T. Pawlson; 3,380,196 issued April 30, 1968 to Georges Anthony Mabile; and 3,448,544 issued June 10, 1969 to Michael Alexandre Pierre Cardon.

The surface treating apparatus of this invention, however, utilizes a rotating brush as the recovery means for the particulate abrasive material. In a particularly advantageous embodiment of this invention the rotating brush is used in conjunction with elevator means to provide for highly efficient, continuously operable surface treating apparatus. Generally, the apparatus of this invention is economical to manufacture and simply constructed, yet sturdy and durable upon extended use. Moreover, the apparatus of this invention operates with relative freedom from wear and other mechanical difficulties due to the unique recovery

means utilized, particularly when used in conjunction with the unique elevator means for the recirculation of the spent particulate abrasive material. Also the apparatus of this invention operates with almost total elimination of the passage of grit and dust to the atmosphere, and thus provides a highly acceptable reduction in pollution normally attendant the use of many conventional surface treating apparatus.

In its broader sense this invention provides a mobile, continuously operable surface treating apparatus useful for treating relatively flat horizontal surfaces comprising in combination: an enclosure with an open side adapted to contact the surface to be treated, projecting means within the enclosure for directing a stream of abrasive particles through the open side of the enclosure onto the surface to be treated, resilient sealing means around the boundary of the open side of the enclosure to restrain the spent abrasive, rotating brush means located behind the enclosure with open side to recover the spent abrasive collected within the enclosure and passing under the resilient seal upon movement of the apparatus over the surface being treated, and recirculation means to return the spent, recovered abrasive material to the projecting means.

The mobile, continuously operable surface cleaning apparatus of this invention can be self-propelled or propelled by another vehicle or means such as a tractor or truck. Advantageously it is self-propelled, either by an electric motor or gasoline engine of suitable size.

The mobile, continuously operable apparatus of this invention is generally easily adaptable to numerous uses and is thus broadly practical and salable. For instance, the apparatus may be adapted for use in the surface treatment of petroleum storage tank tops and bottoms, ship decks, concrete surfaces such as airport runways and highways, steel plate prior to painting or other treatment, etc. The surfaces to be treated should generally be relatively flat and horizontal.

[Price 25p]

The accompanying drawings will provide a more complete understanding of the nature and objects of the present invention; the drawings are however only exemplary of embodiments of the present invention:

5 Figures I and IA together represent a side view of a self-propelled surface cleaning apparatus of this invention, Figure IA showing the uppermost parts of the apparatus;

10 Figure II represents a frontal view of a self-propelled surface cleaning apparatus of this invention;

Figure III represents a bottom view of a seal means and rotating brush useful in the apparatus of Figures I and II.

15 Figure IV represents a partially-sectioned elevation of a portion of the continuous belt elevator means with attached bucket means used in the apparatus of Figures I and II.

20 The apparatus represented in Figures I and II is a self-propelled surface cleaning apparatus of this invention. More particularly, in Figures I and II seal 1 surrounds the open side of the enclosure 2 adapted to contact the surface being treated. The seal is sufficiently resilient to pass over obstructions present on the surface and to allow the spent abrasive material to pass under the edge thereof when the apparatus moves across the surface being treated. The seal is preferably constructed of an abrasion-resistant polyurethane elastomer having a Durometer value of about 70A to 80A. The seal, however, may be constructed of any suitable material or synthetic resin having sufficient resilience or flexibility to allow the abrasive to pass thereunder as the apparatus moves across the surface being treated. Thus other exemplary resilient elastomeric materials are natural rubbers, synthetic rubbers such as those prepared from butadiene or butadiene and styrene, and other known resilient resins. The enclosure 2 is constructed so that the open side thereof in combination with the seal 1 contacts the surface being treated in such a manner as to prevent the escape of spent abrasive and grit or powder to the atmosphere except for the passage of the spent abrasive under the seal. An auxiliary rubber seal 7 prevents passage of air or abrasive between the enclosure 2 and the main seal 1. The enclosure is normally metal such as steel or aluminum and also advantageously has an abrasive resistant lining on the inside portions thereof coming in contact with rebounding abrasive material. Exemplary abrasion-resistant lining materials are high strength polyolefins such as polyethylene or silicon carbide or other disposable abrasion-resistant materials.

60 The projecting means 3 is represented as a centrifugal wheel driven by a high speed electric motor 4. Normally the centrifugal wheel operates at about 1,000 to 4,000 rpm. Other projecting means such as those utilizing compressed gas streams rather than centrifugal force might also be used; however, the centri-

fugal wheel is more efficient and thus preferred. The centrifugal wheel is a conventional, commercially-available device such as that sold under the Registered Trade Mark "Wheelabrator." Normally controlled gravity fed abrasive is funneled into the centre of the rapidly rotating wheel. The abrasive is then propelled by centrifugal force along the blades of the wheel until it leaves the wheel in a controlled stream at a predesignated opening in a housing surrounding the wheel. Preferably, the abrasive is directed to the surface being treated at a slight angle from the perpendicular. In Figures I and II, for instance, an angle of about 3° to 7° from the perpendicular is shown. The impacting of the abrasive at a slight angle from the perpendicular improves the cleaning and assists recovery of the abrasive as some of the rebounding abrasive passes directly through passage 5 to the collection bin 6.

As previously indicated recovery of the abrasive is primarily achieved by the use of a rotating brush. A predominant amount, normally more than 75% or even 95% or more of the spent abrasive material is collected and retained within the seal. Small amounts may as indicated pass directly to the collection bin 6 through passage 5. The predominant portion, however, passes under the seal upon movement of the apparatus across the treated surface. The rotating brush 8 is positioned directly behind the seal 1. For most efficient recovery the brush should be slightly wider than the opening of the seal 1. The brush rotates at a controlled speed in a clockwise direction. Note the arrow in Figure I. The speed of rotation is controlled such that the spent abrasive collected behind the seal is picked up and thrown upwards and forward into collection bin 6. In Figure I the rotating brush is depicted as being driven by an electric motor 9 by a pulley and belt drive system. Electric motor 9 also is shown as driving the self-propelled apparatus through a hydrostatic transmission; however, separate drive motors for each might be provided.

Under normal operating conditions the rotating brush is operated within the range of about 200 to 600 rpm, preferably about 350 to 450 rpm. The rotating brush is cylindrical in shape and normally has dimensions of about 30 to 75 inches in width and 10 to 25 inches in diameter. The bristles may be of any strong friction resistant materials, such as nylon, polyolefins as polypropylene, steel or even natural bristle fibers. Particularly useful rotating brushes available commercially are the Radax[®] and Paralax[®] brushes available from the Wayne Manufacturing Company.

As indicated the recovered abrasive material is directed by the brush into the collection bin 6. The collection bin 6 is the bottom portion of elevator means 10. The particular elevator means 10 illustrated is the subject of applica-

tion No. 30944/72 (Serial No. 1,317,416), which was divided from the present application, and comprises an outer housing 11 surrounding a continuous belt 12. The continuous belt has attached thereto at intervals scoop or bucket means 13, described in more detail hereinafter with reference to Figure IV. The continuous belt is mounted on four pulleys 14, one of which 14, is the drive pulley. An electric motor 15 and pulley and belt system 16 are shown as the means used to drive pulley 14'. When the elevator means is operating the belt travels in a continuous path in a clockwise direction. A particular scoop or bucket means 13 is empty on the vertical downpath of the continuous loop. As it passes horizontally through the collection bin 6, the scoop itself is in a vertical collecting position. Continuing its course on the vertical uppath the scoop or bucket is full of abrasive material. Upon reaching the top of the vertical uppath the scoop or bucket passes horizontally across the top, itself in a vertical dumping position. The abrasive material is dumped into a hopper 17 for collection and controlled return to the projecting means, e.g. a centrifugal wheel. The scoop or bucket means are so constructed that normally more than 95% of the abrasive falls into the hopper. The elevator means is thus provided with a lower horizontal pick up flight in which the bucket means are below the belt, an elevator flight, an upper horizontal delivery flight in which the bucket means are above the belt and a descending return flight. The scoops or buckets do not contact the inner surface of the housing 11 nor do they contact the bottom of the collection bin 6 when passing therethrough. The elevator means is therefore substantially free of friction-caused wear during operation. The continuous belt is normally a V-belt made of sturdy, flexible material such as synthetic resins or natural rubber. Optionally a chain and sprocket (4 sprockets replacing the 4 pulleys) might be used in place of the V-belt. Also any other suitable elevator means might be used. Exemplary of other such means are pneumatic lift devices and other conventional mechanical elevators. The use of the endless belt elevator, however, improves efficiency, reduces operating costs and eliminates the need for auger feed devices to provide horizontal movement of the abrasive material.

The hopper 17 is of sufficient size to contain the total abrasive material used during operation. Normally a hopper containing about 1 to 4 cubic feet is sufficient. The size of the hopper in Figures I and II is about 2 cubic feet, sufficient to hold about 600 pounds of abrasive steel shot. Other abrasive materials such as glass beads, aluminum oxide particles, silica, etc., may be useful but steel shot is preferred.

The hopper 17 is directly connected through passage 18, valve 19 and funnel-shaped passage 20 to the centrifugal wheel 3. The valve

19 may be opened and set to provide a continuous flow of abrasive from the hopper to the centrifugal wheel. The rate of flow is determined by numerous factors such as the type of surface being treated and the desired effect thereon. A normal rate of flow is, however, generally between 300 and 600 pounds per minute.

The abrasive cleaning apparatus is essentially a closed system allowing very little grit or powder to reach the atmosphere. Normally a vent 21 or vents are present for grit and dust collection. The vent or vents form a passage or passages to a dust collection system such as a fan and dust bag collector. The enclosed or closed system thus is normally operated under a vacuum created by the fan or other collection means. The vacuum is sufficient to remove selectively the grit and dust particles formed during the operation as these are sufficiently lighter than the abrasive.

Also the self-propelled apparatus of this invention will normally contain an electric motor or gasoline engine as a drive or propelling means. Note again electric motor 9 driving the brush and the apparatus through wheel 22. As noted previously, however, the self-propelling devices of this invention are preferred only.

The abrasive surface cleaning apparatus of this invention normally operate, whether self-propelled or extraneously propelled, at speeds in the range of 0 to about 400 feet per minute. At the lower speeds, self propelled devices are more useful. Preferred operating speeds are about 20 to 200 feet per minute and are generally determined by the type of surface being treated and the desired effect thereon.

Figure III represents a bottom view of the seal means 1 and rotating brush 8 useful in the apparatus of this invention. The seal means is constructed from suitable resilient or flexible materials as discussed previously. Advantageously a flange or flap 23 is attached to the backside of the seal to direct or conduct a stream of the abrasive material passing under the seal towards the rotating brush for recovery.

Figure IV represents a side view of a portion of the continuous belt elevator means 12 with attached bucket or scoop means 13. The bucket is attached snugly to the belt, preferably by counter-sunk attachment means 24 such as rivets or bolts. The bucket or scoop itself is shaped on the inside so as to direct the abrasive into the hopper when in dumping position.

WHAT I CLAIM IS:—

1. A mobile, continuously operable surface treating apparatus comprising in combination: an enclosure with an open side adapted to contact the surface to be treated, projecting means within the enclosure for directing a stream of abrasive particles through the open side of the enclosure onto the surface to be treated, resilient sealing means around the boundary of the open side of the enclosure to restrain the

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5 spent abrasive, rotating brush means located behind the enclosure with open side to recover the spent abrasive collected within the enclosure and passing under the resilient seal upon movement of the apparatus across the surface being treated, and recirculation means to return the spent, recovered abrasive material to the projecting means.

10 2. The apparatus of claim 1 wherein the projecting means is a centrifugal wheel.

3. The apparatus of claim 2 wherein the recirculation means comprises continuous belt elevator means in conjunction with a storage hopper for the spent, recovered abrasive.

15 4. The apparatus of claim 3 wherein the continuous belt elevator means comprises in combination an outer housing, a continuous flexible belt located within the outer housing and having attached thereto a plurality of
20 bucket means, said bucket means not being in contact with the housing during operation and being adapted to recover and transport particulate matter from the bottom of the housing to the top of the housing for dumping into
25 a storage hopper, drive means to drive the belt and maintain the belt in a four-sided shape

providing a lower horizontal pick-up flight in which the bucket means are below the belt, an elevator flight, an upper horizontal delivery flight in which the bucket means are above the belt, and a descending return flight, and a storage hopper beneath the delivery flight at the top of the housing to collect particulate matter dumped from the plurality of bucket means during operation.

35 5. The apparatus of claim 1 further containing a drive means to provide a self-propelled apparatus.

6. The apparatus of claim 1 further containing a dust collection means to remove powdered grit and dust from the recirculating abrasive material.

40 7. A mobile, continuously operable, surface treating apparatus, substantially as herein described with reference to the accompanying
45 drawings.

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