

[54] **CONTINUOUS BELT ELEVATOR** 2,424,955 7/1947 Potter..... 51/9
[75] Inventor: **James R. Goff, Mishawaka, Ind.** 3,161,279 12/1964 Petree..... 198/140 X
1,164,934 12/1915 Dull..... 198/140 X
[73] Assignee: **Robert T. Nelson, Oklahoma City, Okla.** 2,584,025 1/1952 Kelsey..... 198/152

[22] Filed: **Dec. 28, 1971**

[21] Appl. No.: **213,064**

Primary Examiner—Donald G. Kelly
Attorney—John W. Behringer et al.

Related U.S. Application Data

[62] Division of Ser. No. 112,543, Feb. 4, 1971, Pat. No. 3,691,689.

[52] U.S. Cl..... **198/140, 51/9, 51/12, 51/174**
[51] Int. Cl. **B24c 7/00, B24c 9/00**
[58] Field of Search..... 51/8, 9, 12, 174-7; 198/140, 152

[56] **References Cited**

UNITED STATES PATENTS

1,437,415 12/1922 Hauter..... 198/140

[57] **ABSTRACT**

A novel, mobile, continuously operable abrasive surface cleaning apparatus utilizing a rotating brush for abrasive recovery is disclosed. Also, a novel continuous belt elevator or conveyor for recirculating the recovered abrasive is disclosed.

1 Claim, 4 Drawing Figures

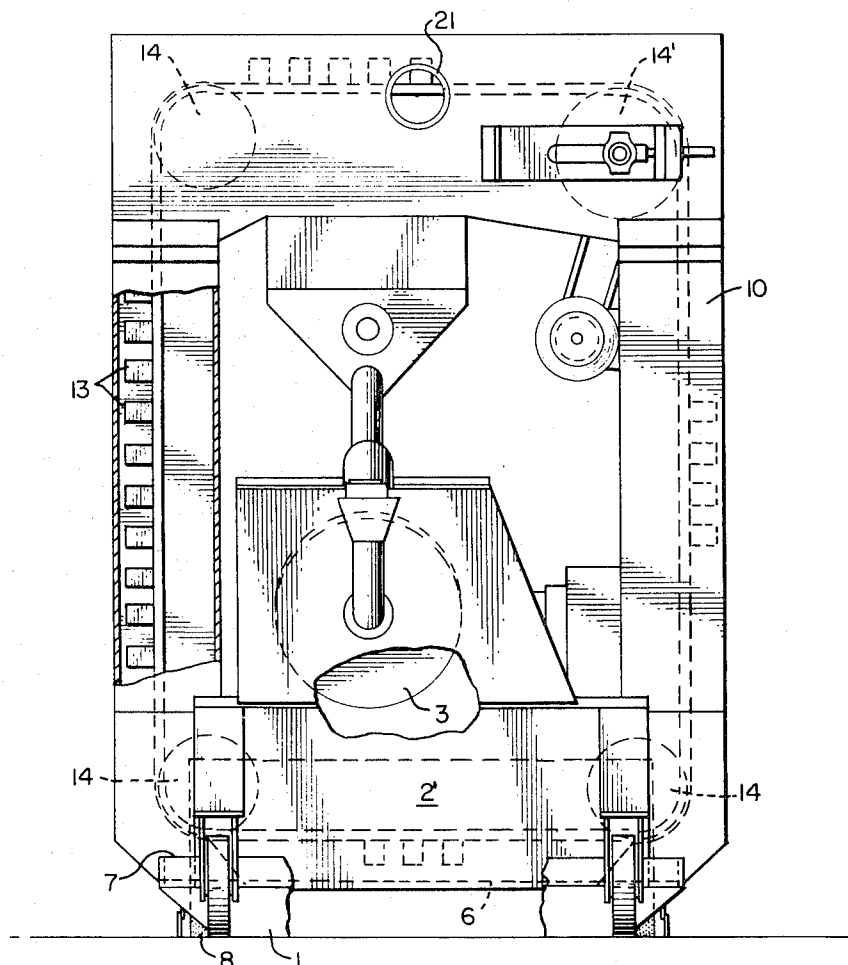


FIG. 1.

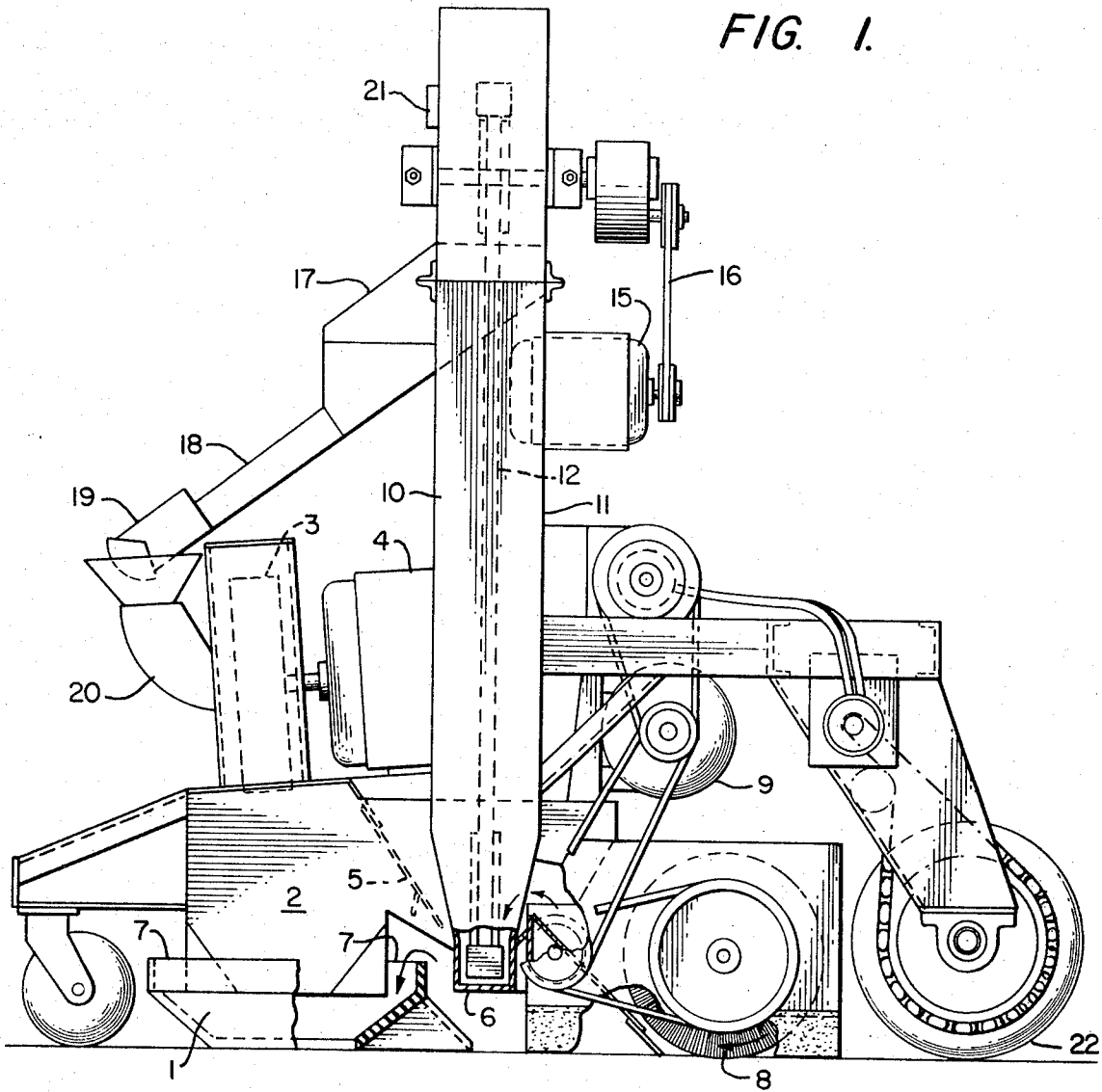


FIG. 3.

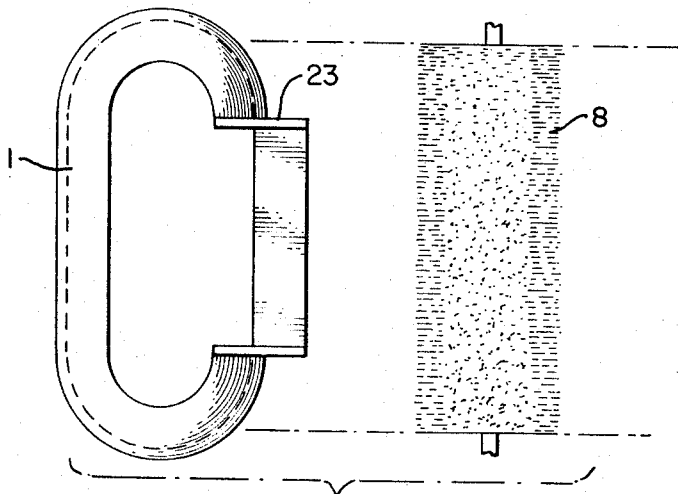


FIG. 2.

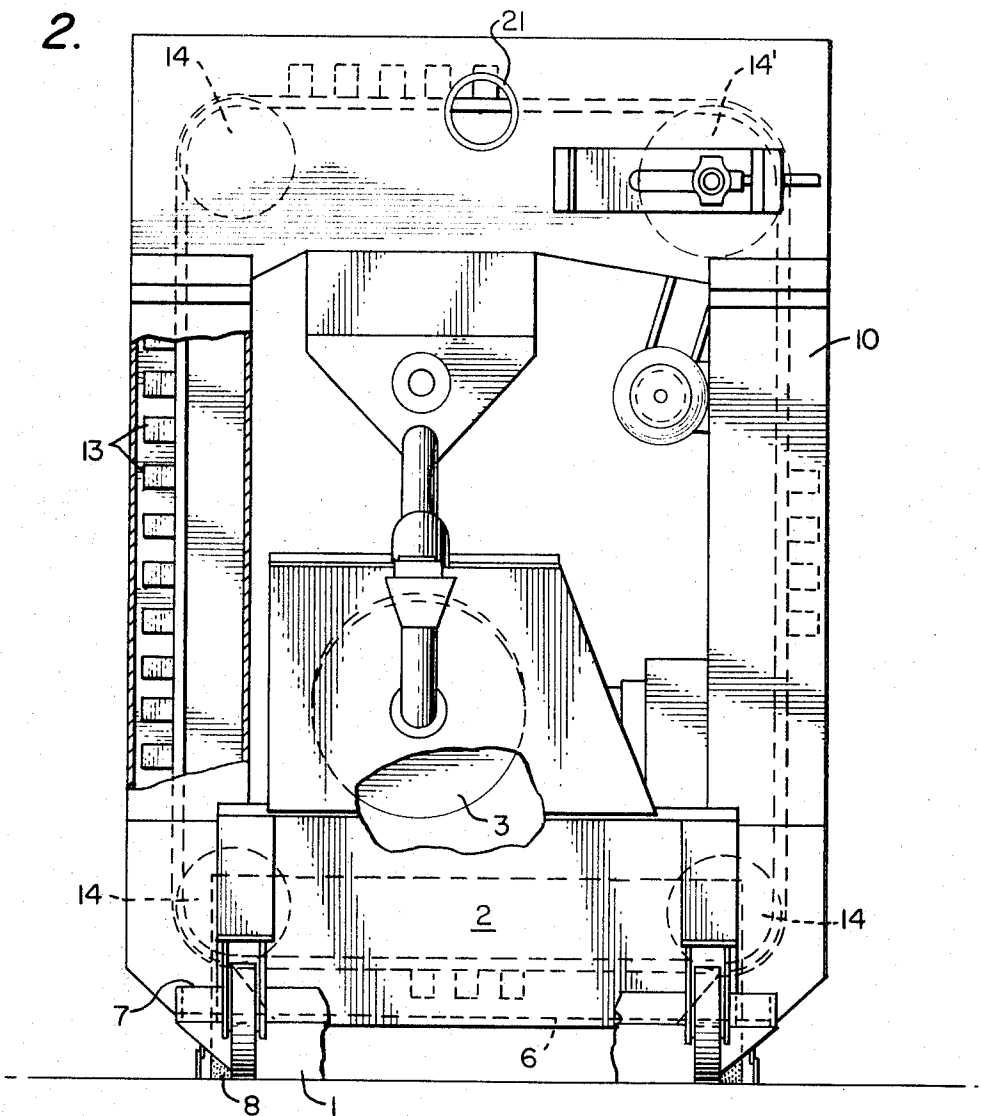
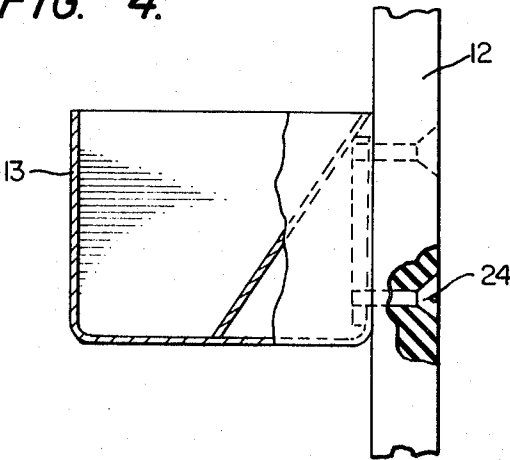


FIG. 4.



CONTINUOUS BELT ELEVATOR

This is a division, of application Ser. No. 112,543, filed Feb. 4, 1971 now U.S. Pat. No. 3,691,689.

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 failure 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: U.S. Pat. No. 3,034,262 issued May 15, 1962 to Eugene T. Pawlson; U.S. Pat. No. 3,380,196 issued Apr. 30, 1968 to Georges Anthony Mabilie; and U.S. Pat. No. 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 brush is used in conjunction with a novel elevator means to provide for highly efficient, continuously operable surface treating apparatus. Generally, the 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 a coin position and being 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.

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:

FIG. 1 represents a side view of a self-propelled surface cleaning apparatus of this invention;

FIG. 2 represents a frontal view of a self-propelled the line cleaning apparatus of this invention;

FIG. 3 represents a bottom view of a seal means and rotating brush useful in the apparatus of FIGS. 1 and 2.

FIG. 4 represents a partially-sectioned view of a portion of the continuous belt elevator means with attached bucket means used in the apparatus of FIGS. 1 and 2.

The apparatus represented in FIGS. 1 and 2 is a self-propelled surface cleaning apparatus of this invention. More particularly, in FIGS. 1 and 2 seal 1 surrounds the open side of the enclosure 2 adapted a piston having 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.

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. rotates dowel Other projecting means such as those utilizing compressed gas streams rather than centrifugal force might also be used; however, the centrifugal wheel is more efficient and thus preferred. The centrifugal wheel is a conventional, commercially-available device such as a Wheelabrator type wheel. Normally controlled gravity fed abrasive is funneled into the center of a 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 FIGS. 1 and 2, 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.

As previously indicated recovery of the abrasive is primarily achieved by the use of a rotating brush. A predominant amount, normally more than 75 percent or even 95 percent 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 depress 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 FIG. 1. The speed of rotation is controlled such that contacts spent abrasive collected behind the seal is picked up and thrown towards and forward into collection bin 6. In FIG. 1 reaches the rotating brush is depicted as being driven by an electric motor 9 by a pulley and belt the 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 the 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 the elevator means 10. The particular novel elevator means 10 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 FIG. 4. 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 percent of the abrasive falls into the hopper. The novel elevator means of this invention 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 (four sprockets replacing the four pulleys) might be used in place of the V-belt. Also any other suitable not means might be used. Exemplary of other such means are pneumatic lift devices and other conventional mechanical elevators. The use of the novel endless belt elevator, however, improves efficiency, reduces operating costs and eliminates the need for auger feed devices to the 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 FIGS. 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 of this invention 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 smaller being but 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. which 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.

FIG. 3 represents a bottom view of the seal means 1 and rotating brush 8 useful in the apparatus of this in-

vention. The seal means is constructed from suitable resilient or flexible materials as discussed previously. Advantageously a flange or flap 23 is attached to the back-side of the seal to direct or conduct a stream of the abrasive material passing under the seal towards the rotating brush for recovery. position,

FIG. 4 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.

It is claimed:

1. A continuous belt elevator for particulate matter comprising in combination: an outer housing; a continuous flexible belt within said outer housing; a drive means to drive the continuous flexible belt and maintain the continuous flexible belt in a four-sided shape providing a lower horizontal switching an elevator flight, an upper horizontal flight, and a descending return flight; a storage hopper beneath the upper horizontal flight; a collection bin within said outer housing and below the lower horizontal flight; and a plurality of

bucket means attached to said continuous flexible belt such that said bucket means are below the continuous flexible belt in the lower horizontal flight and adapted to pick-up particulate matter in the collection bin and are above the continuous flexible belt in the upper horizontal flight and adapted to deliver particulate matter to the storage hopper, wherein said bucket means are not in contact with the outer housing during operation, said bucket means being comprised of an outside enclosure defining an opening adapted to receive the particulate matter in the lower horizontal flight and deliver the particulate matter in the upper horizontal flight and having a portion immediately adjacent to the continuous flexible belt and a portion away from the continuous flexible belt, a bottom on said enclosure opposite said opening, and a fixed member within said enclosure extending from the bottom intermediate the portion adjacent to and the portion away from the continuous flexible belt to the portion adjacent to the continuous flexible belt at the opening such that said member directs the particulate matter in to the storage hopper in the upper horizontal flight.

* * * * *

25

30

35

40

45

50

55

60

65

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,756,377 Dated September 4, 1973

Inventor(s) James R. Goff

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 14, delete the first word "failure" and insert therefor --generally--

Column 1, line 30, after "the" insert --apparatus--

Column 1, line 61, delete the first five words of the line "a coin position and being"

Column 2, line 15, delete first two words "the line" and insert therefor --surface--

Column 2, line 18, delete "view" and insert therefor --elevation--

Column 2, line 25, after "adapted" delete "a piston having" and insert therefor --to--

Column 2, line 46, correct the spelling of "auxiliary"

Column 2, line 58, after "4,000 rpm." delete "rotates dowel"

Column 3, line 18 & 19, after "rotating" delete "depress", and insert therefor --brush--

Column 3, line 24, after "that" delete "contacts" and insert therefor --the--

Column 3, line 25, after "thrown" delete "towards" and insert therefor --upwards--

Column 3, line 26, after "FIG." insert "1," then delete "reaches"

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,756,377 Dated September 4, 1973

Inventor(s) James R. Goff

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 28, after "belt" delete "the" and insert therefor --drive--

Column 3, line 38, after "materials" delete "the" and insert therefor --such--

Column 3, line 41, after the words "RADAX" and "PARALAX" insert a capital R in the superscript position

Column 4, line 16, after "suitable" delete "not" and insert therefor --elevator--

Column 4, line 21, after "to" delete the word "the"

Column 4, line 26, change the Roman numerals "I" and "II" to Arabic numerals "1" and "2"

Column 4, line 53, delete the first three words "smaller being but"

Column 4, line 61, after "minute." delete "which" and insert --At--

Column 5, line 6, after "recovery." delete "position,"

Column 5, line 20, after "horizontal" insert --flight,-- then delete "switching"

Signed and Sealed this

sixteenth Day of September 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks