United States Patent [19]

Rose et al.

[11] **3,916,568**

[45] **Nov. 4, 1975**

[54] **SANDBLAST MACHINE**

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[73] Assignee: **Enviro-Blast International,** Los Angeles, Calif.

[22] Filed: **Oct. 29, 1974**

[21] Appl. No.: **518,579**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 483,357, June 26, 1974, abandoned, which is a continuation of Ser. No. 360,192, May 14, 1973, abandoned.

[52] **U.S. Cl.** ..... **51/8 R;** 51/9 M; 51/174

[51] **Int. Cl.**[2] **B24C 3/06**

[58] **Field of Search** ..... 51/8 R, 9 M, 14, 15, 174; 15/345, 346

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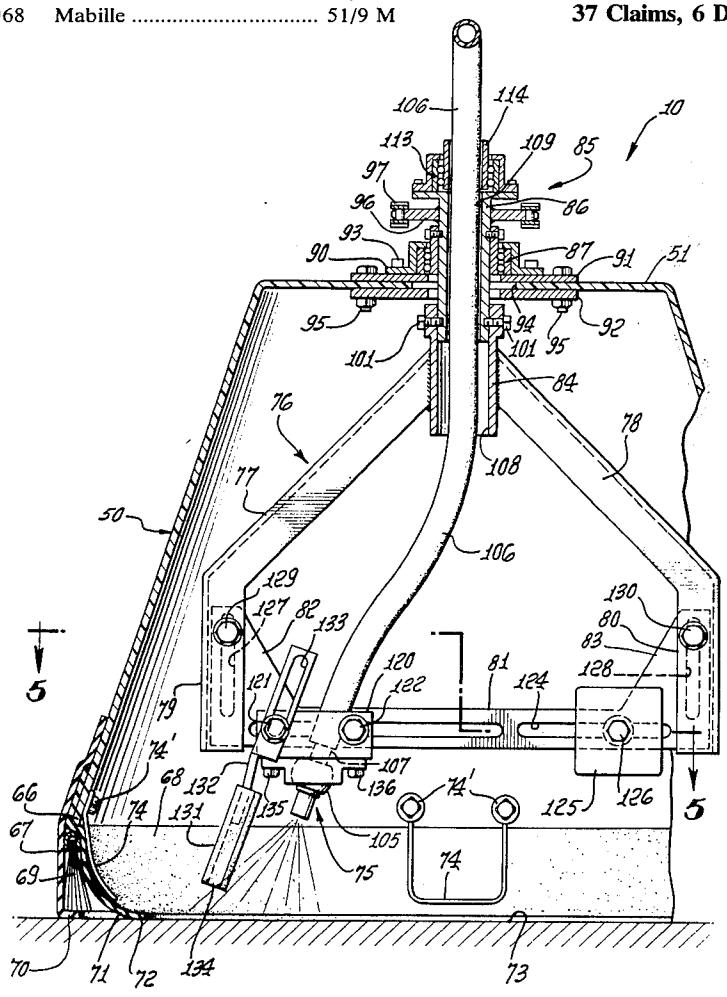
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[57] **ABSTRACT**

To sandblast a floor surface, a hood is mounted on wheels to move over the floor with the open side of the hood facing downward to form a traveling chamber. A sandblast nozzle inside the hood is directed downward and is moved in a circular horizontal orbit by a variable speed motor to traverse the floor as the hood travels. An air jet pump is attached to the hood to maintain a vacuum therein and to withdraw from the hood a high velocity air stream entraining the solid particles that are created by the sandblast operation. The hood is manually steered and is driven by a variable speed motor. Simply cutting off the supply of sand to the blast nozzle enables the device to function as a vacuum cleaner in which clean air discharged by the orbiting blast nozzle agitates particles of debris on the floor and thus enable the air stream created by the jet nozzle to entrain and remove the particles.

37 Claims, 6 Drawing Figures



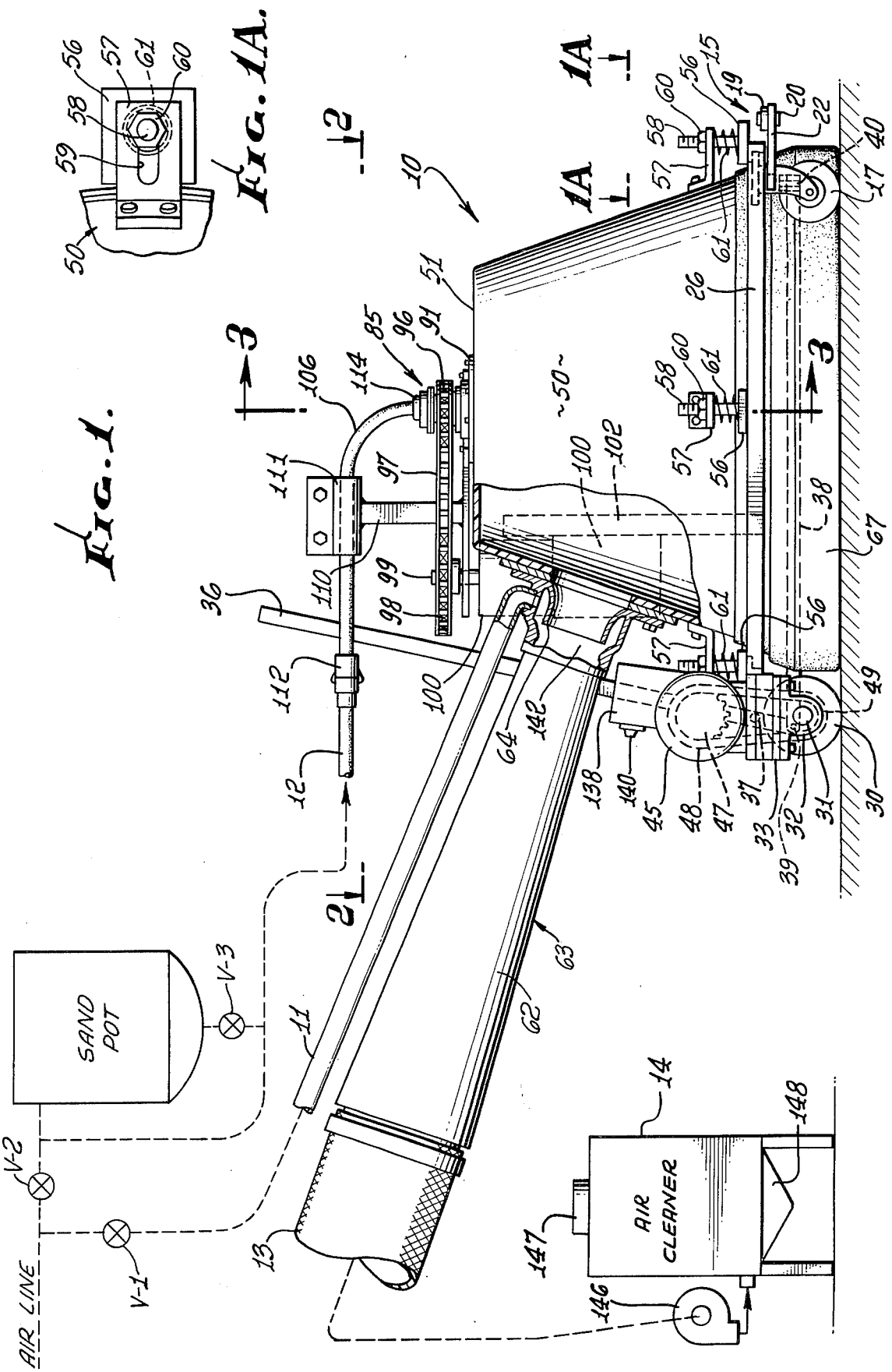

FIG. 1.
FIG. 1A.
SAND POT
AIR LINE
V-1
V-2
V-3
AIR CLEANER
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FIG. 2.

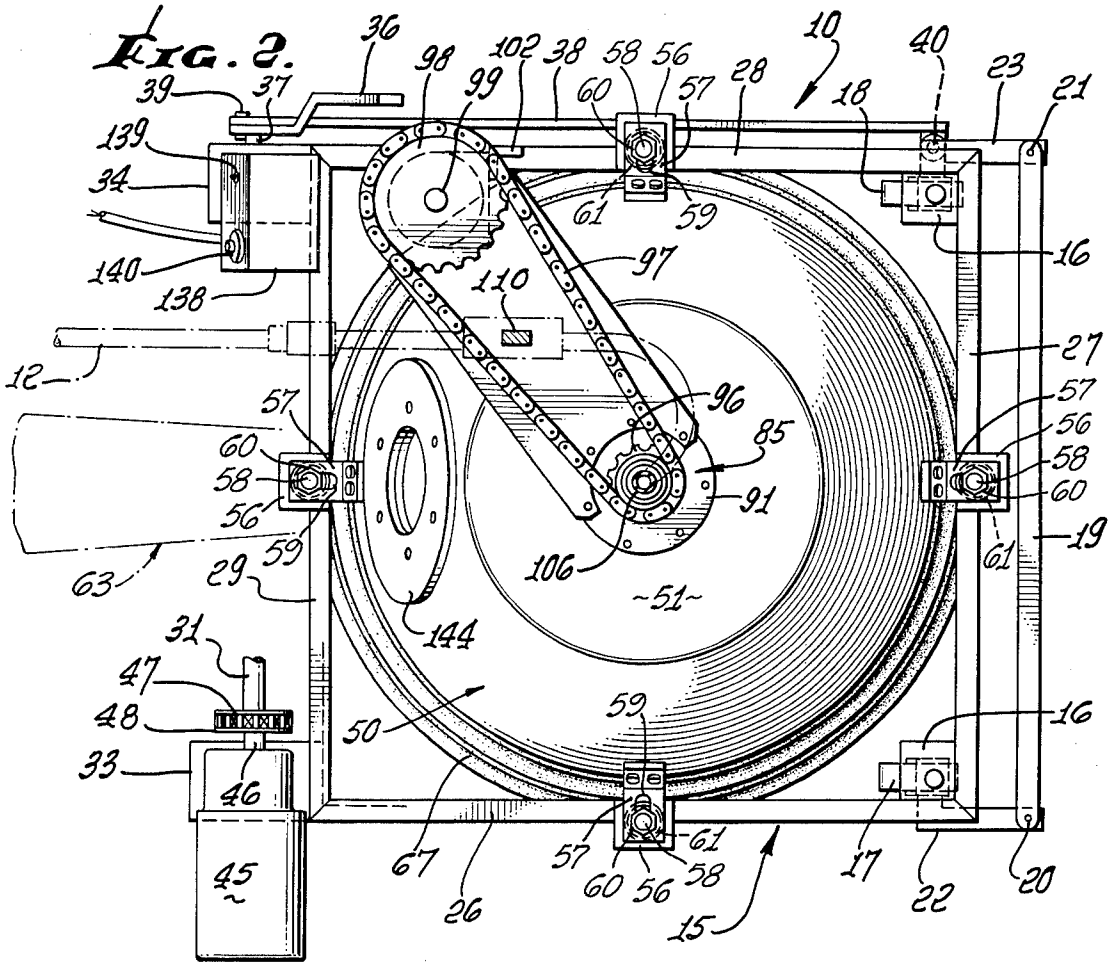

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FIG. 5.

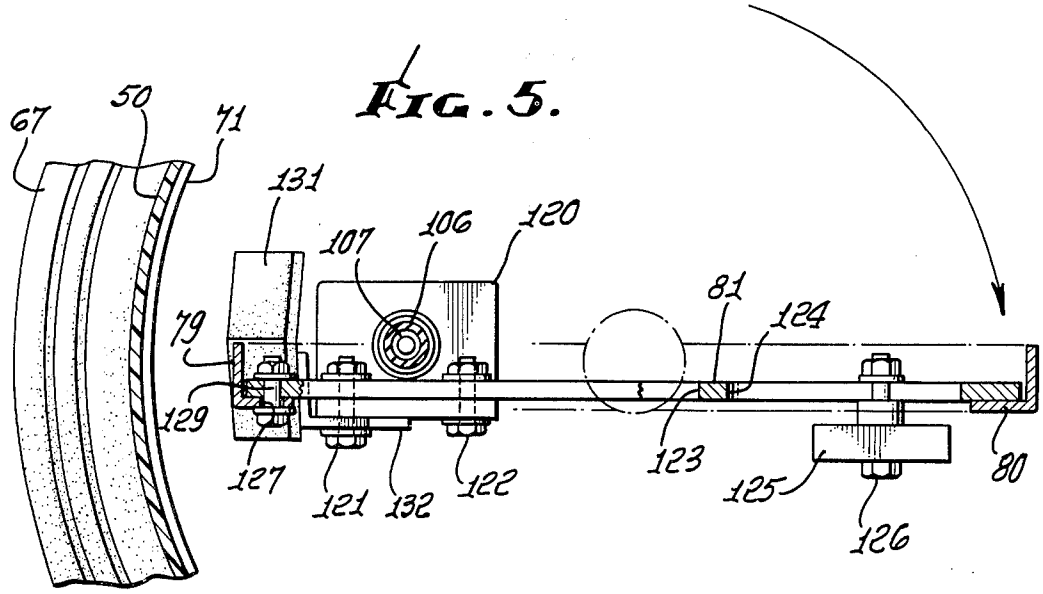

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FIG. 4.

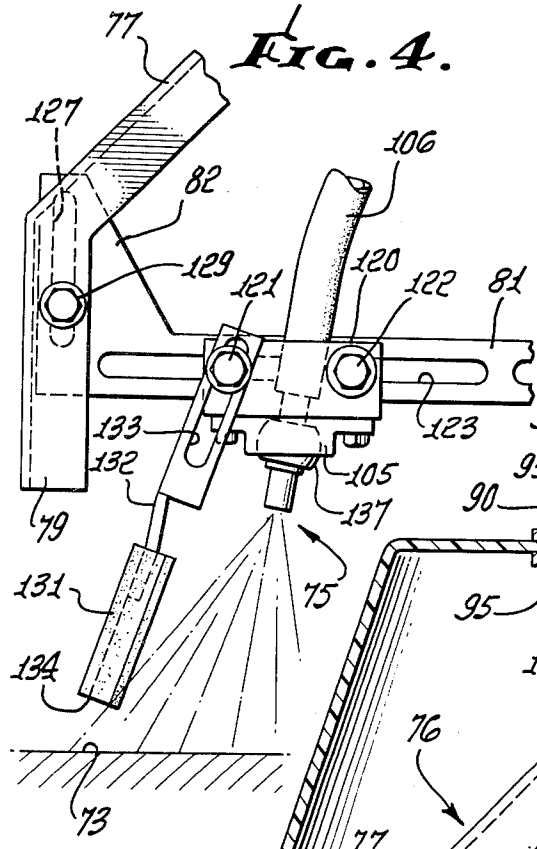

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FIG. 3.

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SANDBLAST MACHINE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our copending application of the same title, Ser. No. 483,357, filed June 26, 1974, now abandoned, which application is a continuation of Ser. No. 360,192, filed May 14, 1973, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to the type of sandblasting apparatus in which a hood is movable along a surface with the open side of the hood adjacent the surface to cooperate therwith to form a traveling chamber. A sandblast nozzle inside the chamber is directed towards the surface and is continuously shifted in position inside the traveling hood. Pump means is connected to the hood to maintain a vacuum therein and to continuously draw an air stream from the hood with the air stream entraining the solid particles that are produced by the sandblast operation.

An apparatus of this general character is disclosed in the Cardon U.S. Pat. No. 3,448,544, issued June 10, 1969.

SUMMARY OF THE INVENTION

One of the objects of the invention is to provide a hood-type sandblasting apparatus that may be used on either vertical surfaces or horizontal surfaces, but is specialized for operation on a floor surface. For this purpose the hood is mounted by springs on wheels that include drive wheels with provision for manual steering as the drive wheels are actuated by a variable speed motor. For adjustment of the clearance space between the hood and the floor surface, the hood is vertically adjustable on a frame that carries the wheels and in addition the hood is equipped with vertically adjustable circumferential skirt means.

Another object of the invention is to actuate a blast nozzle inside the traveling hood in a manner conducive to effective coverage of the floor surface. Broadly described, this object is accomplished by cyclically shifting the blast nozzle alternately towards the opposite sides of the hood. In the preferred practice of the invention the blast nozzle is continuously moved in a horizontal circular orbit.

A feature of the invention is the manner in which the blast nozzle is supported and actuated for orbital movement and the manner in which the orbiting nozzle is supplied with a sandblast stream. A rotary structure inside the hood having a vertical axis of rotation is carried by a vertical tubular support that is journalled in a first bearing in the top wall of the hood. The blast nozzle is located on the rotary structure at a radial distance from the axis of rotation for the purpose of the orbital movement of the nozzle. A hose carrying the sandblast stream extends into the hood through the tubular support along the axis of rotation of the rotary structure with an end portion of the hose diverging from the axis to the off-center blast nozzle. The blast nozzle itself is mounted on the rotary structure by a second lower bearing. The air hose is not intended to rotate on its own axis and preferably is effectively clamped to resist such rotation. Thus, the divergent end of the clamped hose is moved in the circular orbit by the second bearing on the rotary structure that embraces the blast nozzle, the second bearing rotating relative to the non-rotating blast nozzle that it embraces.

Stability of the rotary structure is achieved by providing a counterbalance for the blast nozzle with the counterbalance located diametrically across the circular orbit from the location of the blast nozzle. Both the distance of the blast nozzle from the axis of rotation and the distance of the counterweight from the axis of rotation are adjustable to permit change in the diameter of the circular orbit. With a given blast stream and a given rate of travel of the hood, the abrasive affect of the blast stream on the floor surface may be intensified by narrowing the orbit of the blast nozzle or vice versa and by lowering the orbit or vice versa.

The hood is provided at its bottom rim with a skirt structure of rubber-like material that extends towards the floor and that readily yields to minor obstacles projecting from the floor, such as rivets, bolt heads, and the like. In the preferred embodiment of the invention the hood is provided with an outer skirt and an inner skirt both of which bend radially inwardly at floor level. A circumferential brush reinforces the outer skirt from the inside of the skirt against inward collapse of the outer skirt and spring members extending downward from the inner wall of the hood reinforce the inner skirt against inward collapse. A feature of the invention is the provision of a baffle that orbits with the blast nozzle to prevent abrasion of the skirt structure by the blast stream.

A further object of the invention is to prevent pollution of the atmosphere by the solid particles that are produced by the sandblasting operation and also to prevent accumulation of such particles inside the traveling hood. For this purpose a high velocity air stream is continuously withdrawn from the hood with consequent maintenance of a relatively high vacuum in the hood. The high vacuum prevents escape of the solid particles from the hood by creating effective radially inward flow of air under the bottom of the circumferential skirt structure of the hood. At the same time, the high velocity air stream entrains the solid particles and carries them through a hose to an air cleaner that isolates the solid particles. The orbiting blast nozzle thoroughly agitates the solid particles inside the hood to insure that the solid particles are entrained by the outgoing high velocity discharge stream.

The invention teaches that important advantages may be achieved by using a jet air pump to create the high velocity discharge stream from the interior of the hood. For this purpose the inlet end of a diffuser is attached to the hood and compressed air is fed to a jet nozzle in the inlet end of the diffuser. One advantage of this arrangement is that such an air pump is capable of creating as high a rate of discharge flow as may be needed for efficient operation of the apparatus. Another advantage is that a jet air pump has no moving parts and is exceptionally light in weight. A further advantage is that the jet air pump may be actuated from the same source of compressed air as the orbiting blast nozzle.

A still further object of the invention is to provide an apparatus of the character described that is capable of functioning as a vacuum cleaner at exceptionally high efficiency. Conversion from sandblasting operation to vacuum cleaning operation requires only the closing of a single valve to isolate a sand pot from the stream of compressed air that is fed to the blast nozzle. The resulting blast of clean air from the orbiting nozzle is

highly effective to agitate debris on the floor surface and thus promote entrainment of the debris by the high velocity air stream that is created by the jet air pump.

This versatility of the apparatus makes possible impressive savings, for example, in the sandblasting of the interior of an upright storage tank. Sandblasting the upright inner surfaces of such a tank results in the accumulation on the floor surface of a deep layer of the solid particles that are created by the sandblast operation. It has been found that one-third of the total cost of sandblasting the interior of an upright tank is in the cost of removing the accumulated deposit of solid particles in the heretofore prevalent manner. With the present apparatus functioning as a vacuum cleaner, the layer of accumulated particles may be removed expeditiously with no manual labor. After the accumulated layer of solid particles is removed by the vacuum operation, the apparatus may be converted to sandblast operation to sandblast the floor surface of the tank.

The features and advantages of the invention may be understood from the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 shows the presently preferred embodiment of the invention in side elevation with portions broken away and additionally shows diagrammatically a system for supplying the apparatus with compressed air and sandblast particles;

FIG. 1A is a fragmentary enlarged plan view as seen along the line 1A—1A of FIG. 1 showing one of the circumferentially spaced brackets for yieldingly mounting the hood on a frame that is equipped with ground wheels;

FIG. 2 is an overall plan view of the apparatus as seen along the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary vertical sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary view similar to FIG. 3 with the orbiting blast nozzle spaced a greater distance from the floor surface; and

FIG. 5 is a horizontal sectional view taken along the line 5—5 of FIG. 3.

DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT OF THE INVENTION

The drawings show a presently preferred embodiment of the invention which is generally designated by reference numeral **10**. A hose **11** supplies compressed air for the jet pump of the apparatus and a hose **12** supplies the required stream of compressed air laden with particles for sandblast operation. As shown diagrammatically in FIG. **1**, an air line from a source of compressed air has a branch with a valve V–1 connected to hose **11** and has a branch with a valve V–2 that is connected both to the hose **12** and to the top of a sand pot. A short pipe controlled by a valve V–3 connects the outlet of the sand pot to the hose **12**. An exhaust line **13** conducts spend sandblast material from the sandblast apparatus **10** to an air cleaner **14**.

As best shown in FIG. **2**, the sandblast apparatus **10** includes a carriage, generally designated **15**. Two forward corner plates **16** supporting forward dirigible wheels **17** and **18**, respectively, are parts of a steering assembly that includes a forward crossbar **19**. The opposite ends of crossbar **19** are pivotally attached by respective pins **20** and **21** to respective bell cranks **22** and **23** that control the orientation of the forward wheels **17** and **18**. The carriage **15** has a square frame comprising horizontal beams **26, 27, 28** and **29** that rests at its foreportion on the plates **16**.

Referring to FIGS. **1** and **2**, drive wheels **30** on respective right and left sides of the square frame are carried by a common drive shaft **31**. The drive shaft **31** is mounted on brackets **32** (FIG. **1**) which in turn are carried by plates **33** and **34** on respective right and left hand sides of the square frame.

A manual steering lever **36** is mounted by a pivot pin **37** on the plate **34**. A push-pull rod **38** is pivotally secured by a pin **39** to the lower end of the steering lever **36**, the opposite end of the push-pull rod being secured by a pivot **40** to the bell crank **23** that guides wheel **18**. Thus, the push-pull rod serves to rotate both bell cranks **22** and **23** to change the direction of the forward dirigible wheels **17** and **18**.

A variable speed electric motor **45** is mounted on plate **33** and its shaft **46** carries a sprocket **47** which is connected by a sprocket chain **48** to a driven sprocket **49** (FIG. **1**) that is keyed to drive shaft **31**.

A hood **50** of frusto-conical form, which may be made of glass fibre reinforced by resin, has its open side facing downward to cooperate with the floor or work surface to serve as a mobile vacuum chamber. The hood is carried by the square frame consisting of the previously mentioned horizontal beams **26, 27, 28** and **29**. The square frame has four clips **56** on its four sides, respectively, and the hood **50** has four corresponding brackets **57** spaced above the clips. As shown in FIGS. **1** and **1A**, screw threaded posts **58** extend upward from the respective clips **56** through slots **59** in the brackets **57** and carry nuts **60** that bear against the upper sides of the brackets. Coil springs **61** surrounding the respective screws **58** act under compression between the clips and the brackets for yielding support of the hood.

A tapered diffuser **62** of an air jet pump, generally designated **63**, is connected at its inlet end to the peripheral wall of the hood **50** and at its outer end is connected to the previously mentioned hose discharge **13**. The previously mentioned hose **11** supplies compressed air to an annular jet nozzle **64** in the inlet end of the diffuser **62**.

Referring to FIG. **3**, the bottom rim **66** of the hood **50** is provided with a multiple seal consisting of a circumferential outer flexible rubber-like skirt **67**, a circumferential inner flexible rubber-like skirt **68** and a circumferential brush **69**. The brush **69** is sandwiched between the outer and inner flexible skirts and serves to reinforce the outer skirt against inward collapse. The outer flexible skirt **67** may be long enough so that a radially inward toe **70** can underlie the lower edge of the circumferential brush **69**. The inner flexible skirt **68** is made such that an arcuate portion **71** extends radially inwardly from the rim **66** whereby to provide a tangential surface **72** capable of riding over the floor or work surface **73**. U-shaped retaining springs **74** secured by bolts **74'** on each of four sides of the rim **66** extend downwardly over the inner surface of the inner flexible skirt **68** for reinforcement thereof against inward collapse.

The sandblast operation is accomplished by a blast nozzle **75** which is carried by a rotatable structure or frame that is indicated generally by reference numeral

76. The rotatable frame 76 comprises diagonal struts 77 and 78 terminating in lower respective leg portions 79 and 80. A transverse beam 81 interconnects the free ends of the leg portions 79 and 80, the connection being braced by gusset plates 82 and 83.

At their upper ends the diagonal struts 77 and 78 are welded to and supported by a collar 84. To rotationally mount the frame 76 on the upper end wall 51 of the hood, a composite bearing assembly indicated generally by the reference character 85 is provided. A tubular drive member 86 is rotatably mounted in a bearing 87 in the top wall of the hood. The bearing 87 rests on a washer 91 on the outer face of the top wall of the hood 50, and the washer 91 is connected to an inner washer 92 around an opening 94 in the hood by means of bolts 95.

A sprocket 96 integral with the tubular drive member 86 is engaged by a drive chain 97 that is driven by a drive sprocket 98 on a drive shaft 99 of a variable motor 100 for rotating the frame 76. The tubular drive member 86 supports the previously mentioned collar 84 of the rotatable frame 76 by means of screws 101. The motor 100 is supported on the previously mentioned horizontal beam 28 by a column 102.

In the present embodiment of the invention, the blast nozzle 75 is moved in a circular orbit by the frame 76 but the blast nozzle itself does not rotate on its own axis. Instead, a tiltable bearing 105 carried by the frame 76 rotates relative to the blast nozzle 75 as the tiltable bearing is carried in an orbit by the frame 76. Thus, a flexible hose 106 which is a continuation of hose 12 and not itself rotate on its own axis. The flexible hose 106 is connected to a neck 107 of the blast nozzle 75 and extends along the axis of rotation of the frame 76 through a passage 108 in the collar 84 and a bore 109 in the tubular drive member 86.

A bracket 110 on the upper side of the hood 50 carries a clamp 111 that grips the hose 106 to prevent rotation of the hose on the hose axis. A coupling 112 connects the flexible hose 106 to the supply line 12. A roller bearing 113 on the upper end of the tubular drive member 86 surrounds a collar 114 which embraces the flexible hose 106. The roller bearing 113 avoids imparting rotation of the hood to the hose.

Sundry adjustments are provided for the blast nozzle 75 so that it can be moved closer to or farther away from the work surface 73, or moved radially outwardly or inwardly with respect to the center of rotation of the frame 76, or moved to different angles of tilt.

For changing the location of blast nozzle 75 radially with respect to the axis of rotation of the frame 76, the tiltable bearing 105 is carried by an angular plate 120 shown in FIGS. 3 and 5 and the angular plate is attached to the transverse beam 81 by bolts 121 and 122. The bolts are adapted to slide in a slot 123 in the transverse beam 81 for adjustment at selected radial distances from the axis of rotation of the frame 76. A similar slot 124 on the opposite side of the transverse beam provides for adjustably positioning a counterweight 125 for the nozzle 75 by means of a bolt 126.

For moving the blast nozzle 75 to different distances with respect to the work surface 73, slots 127 and 128 are provided in the respective leg portions 79 and 80. Bolts 129 and 130 in the respective gusset plates 82 and 83 can be tightened or loosened as needed to permit the transverse beam 81 to be adjusted, for example, at the position shown in FIG. 3 or the higher position shown in FIG. 4.

A baffle 131 having a tiltable mounting shown in FIGS. 3 and 4 is secured by an arm 132 and a previously mentioned bolt 121 to the transverse beam 81. A slot 133 in the arm 132 permits the baffle 131 to be extended or retracted to position the baffle to protect the inner skirt 68 from the discharge of the blast nozzle 75 regardless of the adjustment of the nozzle location. The same connection just described also permits the baffle to be tilted variously depending upon the position of the tilt of the nozzle 75. For tiltable adjustment of the blast nozzle, bolts 135 and 136 are provided by means of which the ball-shaped body of the tiltable bearing 105 can be tightened or loosened, thereby to fix the axis of the bearing at a selected angle of adjustment.

A control box 138 of substantially conventional construction is provided to control both the variable speed motor 45 and the variable speed motor 100, suitable power being provided either by a power cord (not shown) or by a battery. Controls 139 and 140 on the control box 138 are manipulatable separately to vary the speed of travel of the rig over the work surface and to vary the speed of rotation of the frame 76 to provide for a greater or lesser cutting effect of the sandblast when the apparatus is in operation.

In operation, the apparatus is guided on the wheels 17, 18 and 30 over the work surface 73, the skirts 67 and 68 of the hood being kept in contact with the surface or close thereto. Although sand and air under pressure are driven through the flexible hose 106 and blast nozzle 75 into the interior of the hood, subatmospheric pressure is maintained in the hood by the air jet pump 63. The subatmospheric pressure inside the hood creates inward air flow under the hood to prevent any sandblast particles from escaping outwardly from under the edge of the skirt of the hood.

By making the system a closed system, i.e., by having the exhaust line 13 pass directly to the air cleaner 14 through a conventional vacuum pump 146, all of the solid particles released by the operation pass to the air cleaner where they are separated from the air so that only clean air passes outwardly through an air outlet 147. The separated solid particles are collected in a hopper 148.

The clearance of the two skirts 67 and 68 from the floor may be varied by adjusting the nuts 60 to raise or lower the hood 50 or may be varied by manually sliding up or down the portion of the skirt structure that embraces the hood.

While the invention has herein been shown and described in what is conceived to be a practical and effective embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

We claim:

1. In an apparatus to sandblast a surface, the combination of:

support structure,

said support structure including a first bearing having its axis substantially normal to said surface;

rotatable structure having a tubular portion rotatable in said bearing to support the rotatable structure;

a sandblast nozzle;

a second bearing on the rotatable structure rotatably embracing the sandblast nozzle to permit relative rotation between the nozzle and the second bearing, the second bearing directing the nozzle towards said surface;

power means to actuate the rotatable structure about said axis,

said second bearing being spaced from said axis to carry the nozzle along an arcuate path in response to rotation of the rotatable structure; and

a hose to supply the nozzle,

a portion of the hose extending through said tubular portion of the rotatable structure along said axis with an end portion of the hose diverted from the axis to the blast nozzle in the second bearing.

2. A combination as set forth in claim **1** which includes means clamping said hose to resist rotation of said portion of the hose.

3. A combination as set forth in claim **1** in which said power means is a variable speed power means.

4. A combination as set forth in claim **1** which includes means to vary the radial distance of said second bearing from said axis.

5. A combination as set forth in claim **1** in which said power means continuously rotates the rotatable structure about said axis to move the blast nozzle continuously in a circular orbit.

6. A combination as set forth in claim **1** which includes means to space said first bearing a predetermined distance from said surface,

said spacing means including roller means to roll along said surface.

7. A combination as set forth in claim **1** which includes a counterbalance for the blast nozzle, said counterbalance being mounted on said rotatable structure at a position diametrically opposite from the position of the second bearing.

8. A combination as set forth in claim **7** in which both said counterbalance and said second bearing are adjustable radially of said axis.

9. A combination as set forth in claim **8** in which said rotatable structure includes a pair of opposite arms diverging from said tubular portion at acute angles relative thereto, said two arms supporting said blast nozzle and said counterweight.

10. A combination as set forth in claim **9** which includes a transverse bar interconnecting the outer ends of said two arms,

the blast nozzle and the counterweight being adjustably mounted on said transverse bar.

11. A combination as set forth in claim **1** which includes:

a hood united with said first bearing, said hood having an open side confronting said surface to form therewith a vacuum chamber;

means to draw air from the hood to maintain a vacuum therein and to entrain solid particles produced by the sandblasting operation to remove the particles from the vacuum chamber; and

means to space the hood from said surface, said spacing means including roller means in rolling contact with the surface.

12. A combination as set forth in claim **11** in which the means to space the hood from the surface is a frame carrying said roller means.

13. A combination as set forth in claim **12** which includes power means on the frame to actuate said roller means to cause the hood to travel on said surface.

14. A combination as set forth in claim **13** in which said power means is a variable speed motor.

15. A combination as set forth in claim **14** in which said roller means includes dirigible roller means; and which includes manual means to control the dirigible roller means to steer the hood.

16. A combination as set forth in claim **12** which includes means mounting the hood on said frame, said mounting means being yieldable to floatingly support the hood.

17. A combination as set forth in claim **12** which includes mounting means to support the hood on the frame, said mounting means being adjustable to vary the spacing of the hood from the surface.

18. A combination as set forth in claim **12** which includes means mounting the hood on said frame, said mounting means including:

a plurality of circumferentially spaced apertured brackets on the outer surface of the hood;

a corresponding plurality of screw threaded posts on the frame extending upward through the corresponding apertured brackets;

a corresponding plurality of coil springs surrounding the screw threaded posts in axial compression between the brackets and the frame; and

a corresponding plurality of nuts on the posts bearing against the upper sides of the brackets.

19. A combination as set forth in claim **11** which includes rubber-like skirt means on the hood extending from the hood towards said surface.

20. A combination as set forth in claim **19** in which said skirt means embraces the hood and is slidingly adjustable axially relative to the hood to vary the extent that the skirt extends towards said surface.

21. A combination as set forth in claim **11** in which said hood is provided with an outer rubber-like skirt and an inner rubber-like skirt extending from the hood toward said surface;

and which includes a circumferentially extending brush means inside the outer skirt reinforcing the outer skirt against inward collapse.

22. A combination as set forth in claim **21** which includes spring members extending downward from the inside of the hood to reinforce said inner skirt against inward collapse.

23. A combination as set forth in claim **11** which includes a rubber-like skirt extending downward from the hood towards said surface;

and which includes baffle means movable with the blast nozzle to protect said skirt means from abrasion by the stream from the blast nozzle.

24. A combination as set forth in claim **11** in which said means to draw air from the hood comprises:

a diffuser having its inlet end connected to the hood;

a jet nozzle at the inlet end of the diffuser; and

means to supply the jet nozzle with compressed air.

25. A combination as set forth in claim **24** which includes a duct connected to the diffuser and an air cleaner connected to the duct to separate the entrained solid particles.

26. A combination as set forth in claim **24** which includes:

an air line from a source of compressed air to said jet nozzle of the diffuser;

a second air line from a source of compressed air to the blasting nozzle;

a sand pot connected to the second air line; and

means to cut off the sand pot from the second air line to cause the blast nozzle to discharge an air stream free from sandblast particles.

27. Apparatus for sandblasting a work surface, comprising: a carriage, wheels on the carriage for engagement with the surface, a hood on the carriage forming a chamber having an opening at one end, a closed end wall at the other end and a side wall between the closed end wall and the opening, a bearing assembly mounted in the end wall, a frame in the chamber, said frame comprising a rotating drive member extending through said bearing assembly and having a supported mounting therein, and a transverse beam having one end extending from the axis of rotation of the drive member radially outwardly toward the side wall of the hood, a power drive having a rotating driving connection to said drive member, a nozzle having a connection to the frame and directed toward the work surface, a supply line for sand and air under pressure extending through said bearing assembly to a connection with said nozzle, and an exhaust line from the chamber for connecting the hood to a discharge location.

28. Apparatus according to claim **27,** wherein there is an adjustment between the nozzle and the frame adjustable in a direction toward and away from the work surface.

29. Apparatus according to claim **27,** wherein there is an adjustment between the nozzle and the frame adjustable in a radial direction.

30. Apparatus according to claim **27,** wherein there is a tilt adjustment between the nozzle and the frame adjustable in a direction changing the angle between the longitudinal axis of the nozzle and the work surface.

31. Apparatus according to claim **27,** wherein there is an adjustment between the carriage and the hood adjustable in a direction toward and away from the work surface.

32. Apparatus according to claim **27,** wherein there is a perimetral rim on the side wall of the hood surrounding said opening and a flexible seal member on said rim adapted to travel over the work surface and in engagement therewith to prevent passage of sand and dirt residue from the chamber outwardly to the atmosphere.

33. Apparatus according to claim **32,** wherein said flexible seal member comprises a pluarality of inwardly turned bands.

34. Apparatus according to claim **33,** wherein said flexible seal member has a perimetrally extending brush element located between outer and inner bands.

35. Apparatus according to claim **32,** wherein there is a separator for separating sand and dirt residue from clean air, said separator being connected to a discharge end of said exhaust line, and means adapted to generate a negative pressure in said exhaust line greater than positive pressure in said chamber whereby to inhibit expulsion of sand or dirt residue into the atmosphere.

36. Apparatus according to class **27,** wherein there is a power drive on the carriage in driving engagement with the wheels, and a control interconnected with said power drive and said nozzle drive means, at least one of said drives being variable whereby to enable the speed of movement over the work surface to be varied relative to the rate of rotation of the drive shaft and thereby vary the cutting action of sand on the work surface.

37. Apparatus according to claim **27,** wherein there is a section of said supply line between the bearing assembly and the nozzle which extends obliquely outwardly and describes a frusto-conical path when the dirve member is rotated, and the side wall of said hood has a frusto-conical shape slightly wider than said frusto-conical path whereby to enable unrestricted rotation of the nozzle and at the same time substantially minimize the size of said chamber.

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