Aug. 19, 1969 B. TAYLOR 3,461,478

APPARATUS FOR CLEANING SURFACES

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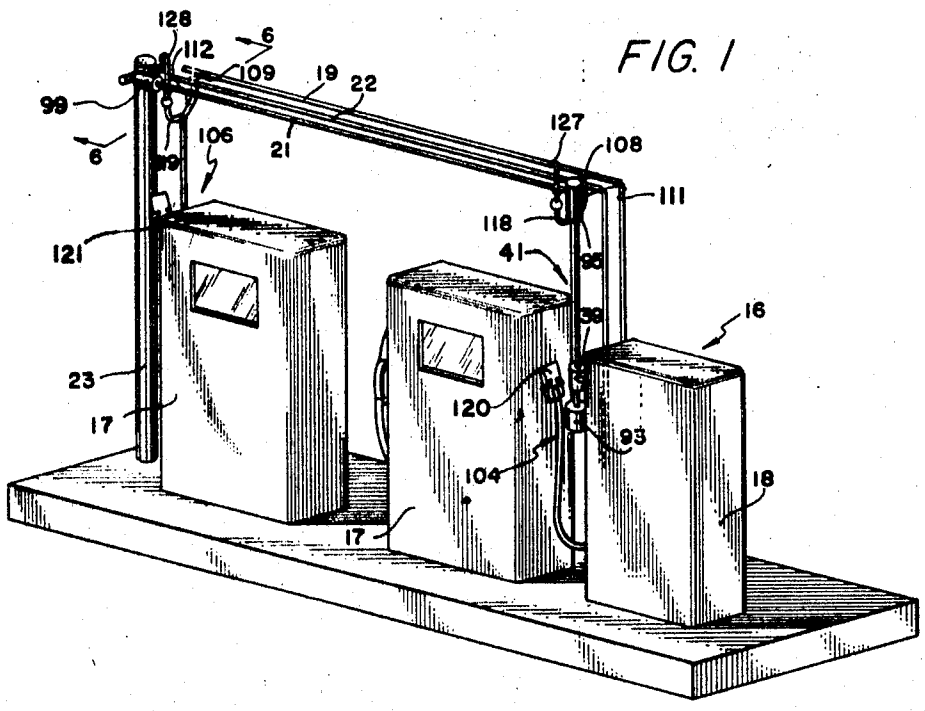


FIG. 1

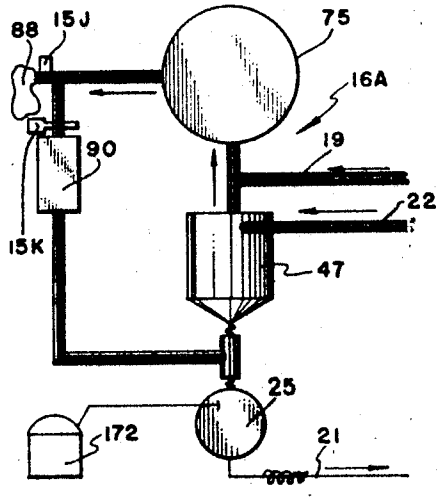


FIG. 13

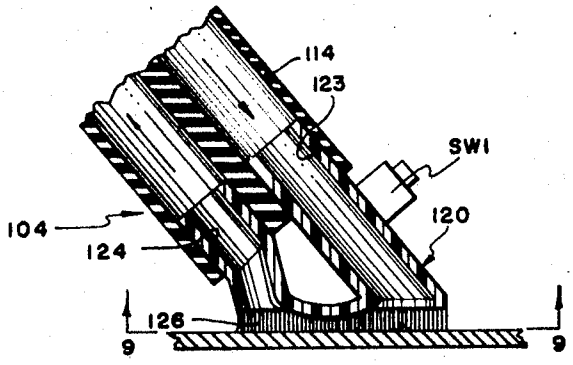


FIG. 8

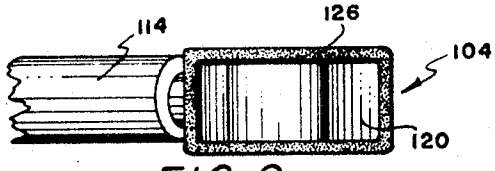


FIG. 9

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FIG. 2

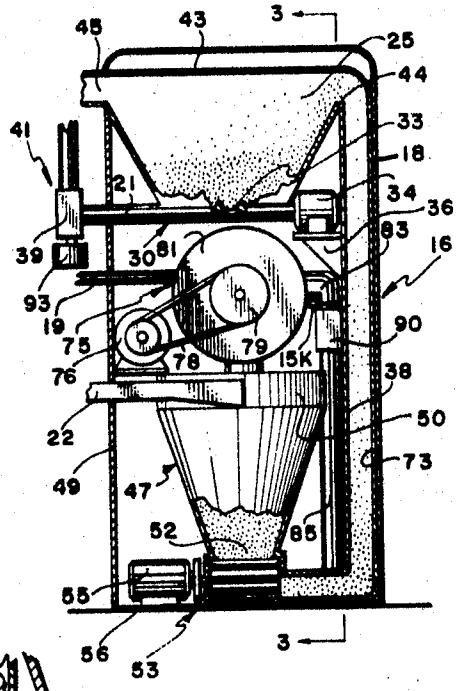
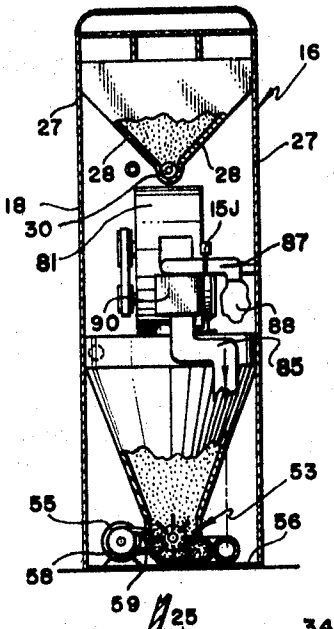


FIG. 3



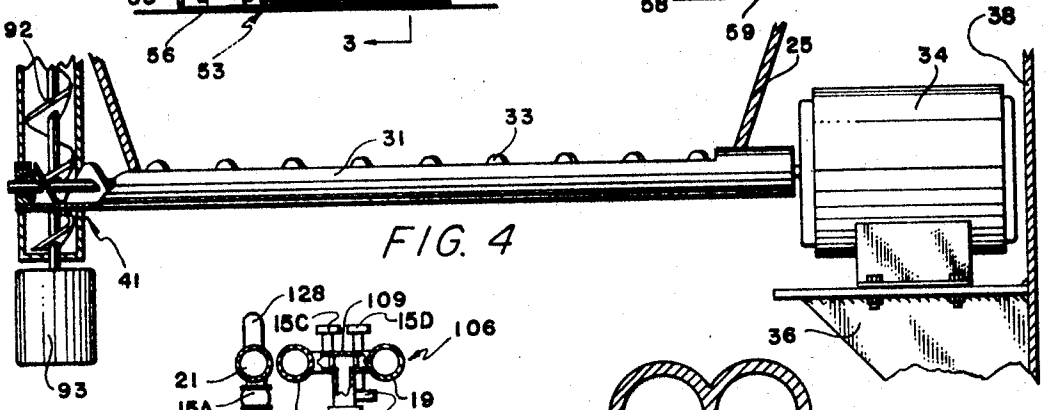


FIG. 4

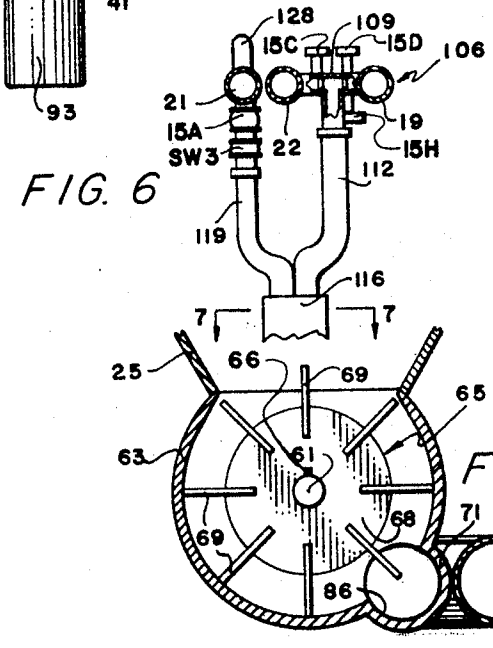


FIG. 6

FIG. 5

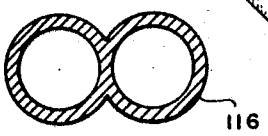


FIG. 7

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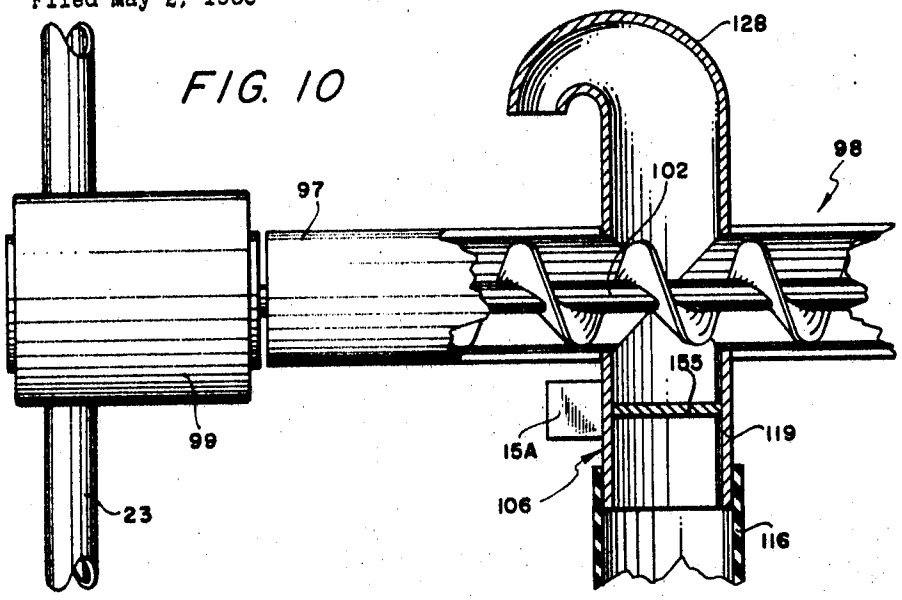
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APPARATUS FOR CLEANING SURFACES

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FIG. 10



CONDITIONAL TABLE FOR CLEANSING APPARATUS O-OPEN CONDITION O.R.-OVERIDE ACT-ACTION C-CLOSED CONDITION									
COLUMN	1	2	3	4	5	6	7	8	9
CONDITION → ITEM ↓	SYSTEM OFF	NO.1 DROP VAC. CLEANER	NO.1 DROP PART CLEANER	NO.2 DROP VAC. CLEANER	NO.2 DROP PART CLEANER	NO.1 DROP NO.2 DROP BOTH VAC CLEANER	NO.1 DROP VAC.CL. NO.2 DROP PART. CL.	NO.1 DROP PART. CL. NO.2 DROP VAC. CL.	NO.1 DROP & NO.2 DROP PART. CL.
SW1	O	O	C	O	O	O	O	C	C
SW2	O	O	O	O	C	O	C	O	C
SW3	O	O	O	C-NO ACT.	C	C-NO ACT.	C	C	C
SW4	O	C-NO ACT.	C	O	O	C-NO ACT.	C	C	C
SW5	O	C	C	O	O	C	C	C	C
SW6	O	O	O	C	C	C	C	C	C
15A	C	C	C	C	O	C	O	C	O
15B	C	C	O	C	C	C	C	O	O
15C	C	C	C	C	O	C	O	O	O
15D	C	C	C	O	O.R.BY15H	O	O.R.BY15H	O.R.BY15H	O.R.BY15H
15E	C	C	O	C	C	C	O	O	O
15F	C	O	O.R.BY15G	C	C	O	O.R.BY15G	O.R.BY15G	O.R.BY15G
15G	NEUTRAL	NEUTRAL	C	C	NO ACT.	NEUTRAL	C	C	C
15H	NEUTRAL	C	NO ACT.	NEUTRAL	C	NEUTRAL	C	C	C
15J	O	O	C	O	C	O	C	C	C
15K	C	C	O	C	O	C	O	O	O
RELAY	O	O	C	O	C	O	C	C	C

FIG. 12

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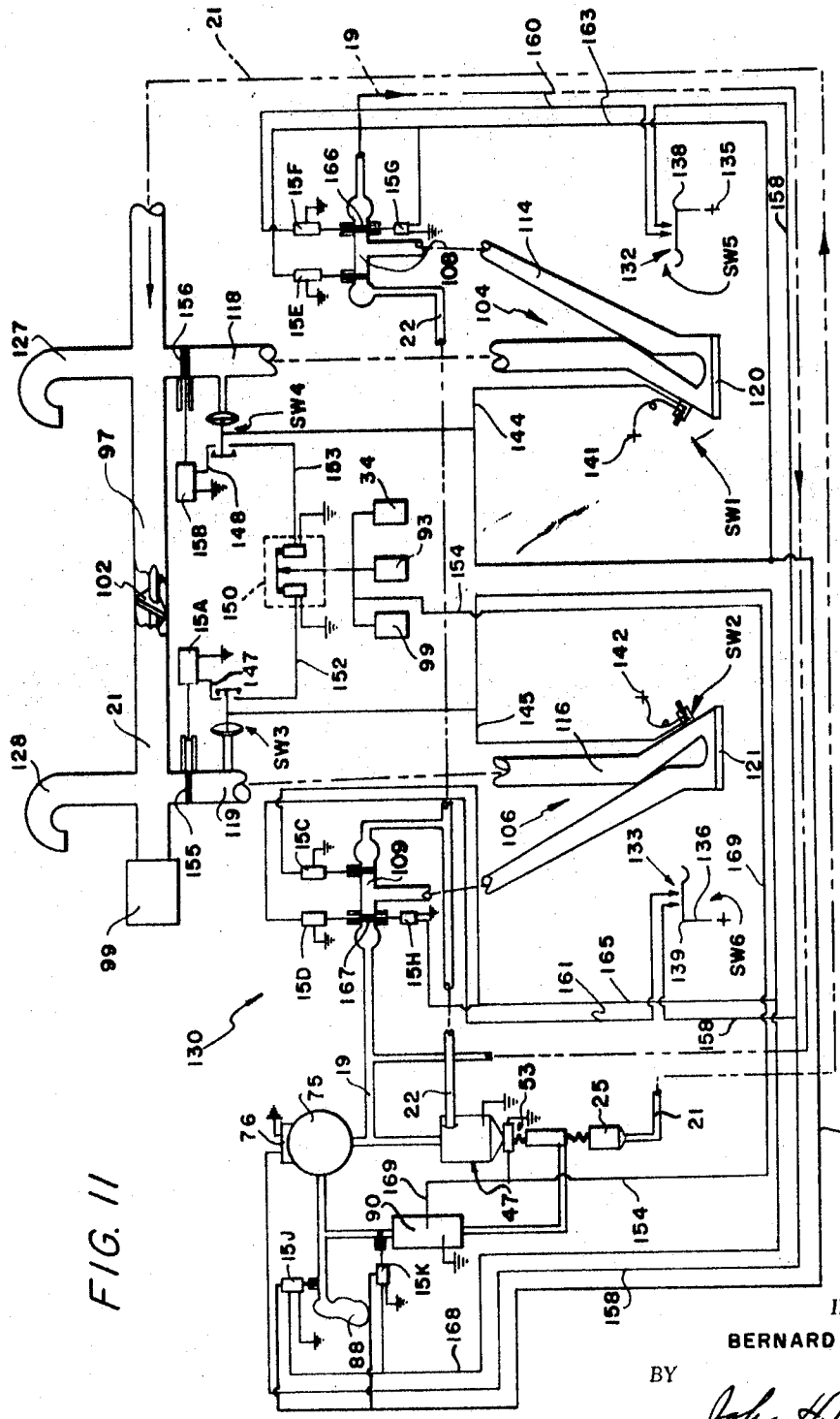


FIG. 11

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3,461,478

APPARATUS FOR CLEANING SURFACES

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Int. Cl. A47l 5/38, 5/14; B08 3/00
U.S. Cl. 15—302 4 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a surface treating apparatus, and more particularly to an apparatus used to impel particles against the surface to be treated, for example to clean the surface. The surface treating apparatus is provided with a head means engageable with a surface being worked upon; a vacuum supply means connected to the head means to create vacuum pressure therein; and a particle supply means also connected to the head means whereby the vacuum pressure created through the vacuum supply means is usable to (1) remove particles and foreign debris from the area being worked upon, and (2) to pick up and convey the particles from the particle supply means through the head means against the surface being worked upon. Still, more specifically, this invention relates to an apparatus operable through the use of vacuum pressure to apply a coating of wax or the like to a given surface or to clean the surface by impelling and continuously removing the cleansing particles and loosened impurities from the surface.

Various types of surface treating apparatus are known to the prior art using a high pressure blast of air containing an abrasive material to clean a surface and a vacuum pressure to remove the abrasive and foreign particles from the cleansed area. These prior art devices are commonly used to clean areas before and after welding and have had extensive usage in the aircraft industry. However, these devices are structurally complicated, expensive, and are not readily adaptable to general commercial usage in cleansing automobile windshields and the like. Additionally, the prior art devices are costly to operate and maintain.

According to the present invention, a new cleaning apparatus is provided which includes a storage cabinet housing containing a cleansing particle supply hopper, a conveyor means operable to supply the particles to a cleansing vacuum head, a vacuum means operable to pull the particles against a surface to be treated and return the same to the housing, and separator means operable to separate the air-particle mixtures for the recycling of the particles. The apparatus is selectively operable to cleanse a given surface or apply a coating of wax or the like thereto.

In preferred specific embodiments of the invention a surface treating apparatus is provided usable in filling stations or the like to, for example, clean windshields, the apparatus including a housing having a particle supply line, an optional vacuum line, and a particle-vacuum return line leading from the housing and all operably connected to at least one cleansing vacuum head. Within the housing is mounted a particle supply hopper having auger conveyor means secured thereto and operable to positively move particles such as sponge rubber, wax, etc., through the particle supply line to the cleansing vacuum heads. A large vacuum pump mounted on an air-particle separator mounted within the housing is selectively operably connected to either the vacuum line or the particle-vacuum return line. The separator operates to remove the particles from the air-particle mixture returned from the vacuum head, and the exhaust of the vacuum pump is used to elevate the separated particles to the particle supply hopper. An electrical control circuit is operable to selectively control the supply of particles and the vacuum pressure to the one or more of the vacuum heads and includes a plurality of control switches, pressure control switches, and solenoid actuated slide valves. The surface treating apparatus is operable under one set of conditions in the electrical control circuit to create a vacuum through the vacuum supply line to the vacuum heads for use of the apparatus as a conventional vacuum cleaner. The electrical control circuit is operable to create a second set of conditions whereupon the particles are conveyed to the vacuum heads through the particle supply line by the conveyor means and pulled downwardly by a vacuum supplied to the cleansing vacuum heads through the particle-vacuum line. The vacuum heads are pressed against a surface to be treated to create air seals and the vacuum draws the particles under accelerated velocity against the surface and the particles with any foreign impurities are then carried through the particle-vacuum return line to the vacuum pump and into the air separator. There the particles are separated and conveyed upwardly into the supply hopper for continuous reusage. A heating unit can be provided to heat the exhaust air and dry the particles after usage during conveyance by this air to the particle supply hopper. It is seen that the surface treating apparatus provides a rapid means for cleaning surfaces without the use of liquids, special detergents, etc.

In another preferred embodiment of the surface treating apparatus of this invention, means are provided for supplying wax, paint or the like through the vacuum heads to a given surface for applying a protective coating thereto. It is obvious that this principle of coating by impact can be used for numerous applications to apply a desired coating to a given surface.

Accordingly, it is an object of this invention to provide a new apparatus for treating surfaces.

Another object of this invention is to provide an apparatus for cleaning surfaces by impacting with small particles.

Still another object of this invention is to provide a surface treating apparatus using vacuum principles to draw particles into accelerated contact with a given surface for cleansing or coating thereof.

A further object of this invention is to provide an apparatus having a vacuum supply, a particle supply hopper, an air separator, a plurality of vacuum heads, and control means for selectively operating the apparatus as a conventional vacuum cleaner through the vacuum supply and vacuum heads or as a cleansing structure for cleansing a given surface by particle impact therewith on moving particles from the supply hopper through the vacuum supply and vacuum heads into impact with the surface and returning the particles to the separator for recycling.

One other object of this invention is to provide an apparatus using vacuum principles to cleanse a surface by the impact of resilient particles therewith using vacuum means to convey the particles and a separator operable to remove the particles from an air-particle mixture for reuse.

Still another object of this invention is to provide a surface treating apparatus that is relatively inexpensive to manufacture, simple to operate, and substantially maintenance free.

Various other objects, advantages, and features of the invention will become apparent to those skilled in the art from the following discussion, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is perspective view of a filling station island illustrating the apparatus of this invention associated with a pair of gasoline pumps;

FIG. 2 is an enlarged sectional view of the container housing of the surface treating apparatus of this invention;

FIG. 3 is a sectional view taken along lines 3—3 in FIG. 2 with portions broken away for clarity;

FIG. 4 is an enlarged fragmentary view illustrating the auger conveyor means of the surface treating apparatus of this invention;

FIG. 5 is an enlarged fragmentary sectional view illustrating the air-lock transfer means of the surface treating apparatus of this invention;

FIG. 6 is a fragmentary sectional view taken along lines 6—6 in FIG. 1 illustrating the particle supply and vacuum feed lines of the surface treating apparatus of this invention;

FIG. 7 is an enlarged sectional view taken along lines 7—7 in FIG. 6;

FIG. 8 is an enlarged fragmentary sectional view illustrating a vacuum head of the surface treating apparatus of this invention as applied to a surface;

FIG. 9 is a bottom plan view taken along lines 9—9 of FIG. 8;

FIG. 10 is an enlarged fragmentary elevational view of the auger conveyor means of the surface treating apparatus of this invention illustrated with portions thereof broken away for clarity;

FIG. 11 is a schematic diagram showing the operational features of the surface treating apparatus of this invention with the electrical control circuit means therefor;

FIG. 12 is a conditional table showing the operational positions of the control switches and the solenoid actuated slide valves of the electrical control circuit means of this invention in various stages of operation; and

FIG. 13 is a schematic diagram of another embodiment of the surface treating apparatus of this invention illustrated for supplying materials such as waxes and the like to a surface to be treated.

The following is a discussion and description of preferred specific embodiments of the new surface treating apparatus of this invention, such being made with reference to the drawings, whereupon the same reference numerals are used to indicate the same or similar parts and/or structure. It is to be understood that such discussion and description is not to unduly limit the scope of the invention.

Referring now to the drawings in detail and in particular to FIG. 1, the surface treating apparatus of this invention, indicated generally at 16, is shown in conjunction with a pair of gasoline pumps 17 thereby illustrating a possible conventional usage of this invention in a service station application. The apparatus 16 includes a cabinet container or housing 18 having a vacuum supply line 19, a particle supply line 21, and a particle vacuum return line 22, connected and extended therefrom and the lines are supported at their outer ends by an upright post 23. These lines are operably connected to one or more vacuum-type hoses having a working head secured to the outer end thereof as will be explained.

As shown in FIG. 2 & 3, the major components of the surface treating apparatus 16 are contained within the housing 18 and includes an upper particle supply hopper 25 secured to a pair of opposed upright sidewalls 27 of the housing 18 and having downwardly extended bottom walls 28 converging to a first auger means 30. The hopper 25 opens into the first auger means 30 which has an elongated casing 31 enclosing a power auger 33 driven by a motor 34. The motor 34 is mounted on a bracket 36 secured to an upright inner support wall 38. The first auger means 30 is operable to move material particles within the supply hopper 25 outwardly into a container 39 to be picked up by second auger means 41 extended vertically therefrom. The hopper 25 has a top wall 32, an inlet opening 44, and an exhaust opening 45 whereby an air-particle mixture is moved through inlet opening 44 and the air is discharged through the exhaust opening 45 with the particles settling within the hopper 25 for conveyance by the first auger means 30.

Below the supply hopper 25 is a separator assembly 47 having the particle vacuum line 22 extended transversely

through a sidewall 49 of the housing 18 and secured to the upper portion of a separator housing 50. The walls of the separator housing 50 taper downwardly in a cone shape into an outlet section 52 leading to an air-lock transfer means 53. As shown in FIGS. 2 and 5, the air lock transfer means 53 has a motor 55 secured to a bottom wall 56 of the cabinet housing 18 which is in driving engagement through a pulley 58 and belt 59 with an elongated shaft 61 extended within a cylindrical casing 63. The casing 63 is secured as by welding to the downwardly converging walls of the separator housing 50 in an air tight relationship. A rotatable van-type wheel assembly 65 is secured to the shaft 61 by a key member 66. The wheel assembly 65 has a central hub 68 mounted about and keyed to the shaft 61 and a plurality of spaced radially extended vanes 69. The wheel assembly 65 is construced so that the vanes 69 provides a seal or air-lock with the contacting inner surfaces of the cylindrical casing 63 which is a desirable function in order to achieve proper separation of the air and particle mixture within the separator assembly 47 and to prevent air losses therefrom. It is obvious that the vanes 69 can be made of a resilient type material so as to have a wiping action with the contacting cylindrical casing 63 to provide the proper material movement and air seal.

As shown in FIG. 5, the casing 63 has a downwardly depending conveyor channel 71 integral with a lower portion thereof adapted to receive particles moved by the vanes 69 from the outlet section 52 of the separator housing 50. An air conveyor pipe 73 is secured to an outlet end at one end of the conveyor channel 71 and extends therefrom upwardly to the inlet opening 44 into the top portion of the supply hopper 25. It is seen that material from the separator housing 50 is conveyed downwardly into the channel 71 by the rotating vanes 69 for transfer into the supply hopper 25 through the conveyor pipe 73 as will be explained.

Mounted on the top surface of the separator assembly 47 is a vacuum pump assembly 75 having an electric motor 76 secured thereto as by bolts and connected by a belt 78 to a driven pulley 79 of a large vacuum pump 81. The pump 81 draws air or an air particle mixture through the vacuum line 19 or the particle vacuum line 22, respectively, into the pump assembly 75 for discharge through a conduit 83. A first conduit section 85 extends downwardly and into an inlet opening 86 in the opposite end section of the conveyor channel 71. This large air discharge from the pump assembly 75 is operable to pick up the particles in the channel 71 moved thereto by the vanes 69 and convey the same to the conveyor pipe 73 and upwardly into the supply hopper 25. A second conduit section 87 extends from the pump 81 through a filter bag 88 for discharge into the atmosphere as a conventional vacuum cleaner. A heater unit 90 is connectable to the conduit 83 and operable to heat the discharge air for drying the particles during the aforementioned conveyance to the hopper 25 for reasons to become obvious.

Returning now to the exterior of the cabinet housing 18, as shown in FIGS. 1 and 4, the second auger means 41 has an auger screw 92 driven by a motor 93 operable to elevate particles upwardly into another container 95 whereupon the particles are picked up and moved horizontally through an elongated cylindrical housing 97 by a third auger means 98. The third auger means 98 has a motor 99 mounted on the upright support post 23 operable to rotate an auger screw 102 within the cylindrical housing 97 to move particles therewithin outwardly from the cabinet housing 18 to first and second operational head means 104 and 106, respectively.

The vacuum line 19 and the particle vacuum line 22 extend from the vacuum pump 81 and the air separator housing 50, respectively, transversely of the cabinet housing 18, and subsequently angle upwardly and horizontally substantially parallel to the particle supply line 21.

The outermost end of the particle vacuum line **22** is secured to the post **23** and the vacuum line **19** is connected to the particle vacuum line **22** by pipes **108** and **109** (FIG. 1). The air-vacuum passages through either the vacuum line or the particle vacuum line **22** and the pipes **108** and **109** are selectively controlled by solenoid slide valves as will be further explained. (FIG. 6.) Intermediate of the pipes **108** and **109** are integral downwardly extended conduits **111** and **112**, respectively, connected to the upper end of special hoses **114** and **116** which are part of the first and second head means **104** and **106**, respectively. As shown in FIG. 7, the hoses **114** and **116** are separated into the two independent compartments having one connected to the conduits **111** and **112** and the other compartment connected by tube members **118** and **119**, respectively, to the particle supply line **21**. It is seen that a solenoid slide valve is mounted within each of the tube members **118** and **119** for reasons to be explained.

The hoses **114** and **116** can be of any desired length having the lower outer ends secured to vacuum heads **120** and **121**, respectively. As the hose assemblies are substantially identical, only one need be described in detail. As shown in FIG. 8, the upper end of the vacuum head **120** has separate cylindrical sections **123** and **124** connected in an air tight relationship to the separate compartments of the hose **114**. The lower portion of the vacuum head **120** resembles a standard vacuum cleaner head having an outer periphery of bristle members **126** secured thereto. The bristle or brush members **126** extend parallel to each other with the outermost ends lying in a common plane. It is obvious that a resilient material or the like can be used instead of the bristle members **126**, the main concern being the achievement of an air seal about the periphery of the vacuum head with a contacting surface to be treated while permitting easy movement of the vacuum heads over the surface. A pushbutton type switch is mounted on the vacuum head **120** for reasons to become obvious. As shown in FIG. 9, the vacuum head **120** is formed with a rectangular shaped surface contacting outline; however, various sizes and shapes could be used as desired depending on type and shape of surfaces to be treated.

As shown in FIGS. 1 and 10, immediately above the tube members **118** and **119** are mounted vent pipes **127** and **128**, respectively, secured to the cylindrical housing **97** operable to receive inlet air for passing over the auger screw **102** of the third auger means **98**. The vent pipes **127** and **128** are of an inverted J-shape so as to prevent rain and the like from contaminating the particle conveying system.

It is seen that the vacuum heads **120** and **121** are usable as a conventional vacuum cleaner with the inlet air provided around the vacuum heads and conveyed through the vacuum line **19** into the pump **81** for impurity separation in the filter bag **88** in a conventional manner. Additionally, the inlet air to the vacuum heads is provided through the vents **127** and **128** to pick up particles within the particle supply line **21** for accelerated impact under vacuum pressure with the surface to be treated. Thereupon, the air-particle mixture is conveyed through the particle vacuum line **22** into the separator assembly **47** to divide the particles therefrom for recycling in the system.

In order to provide for the proper sequential operation of the surface treating apparatus **16** of this invention, a control circuit means, indicated generally at **130**, is provided as illustrated in the schematic diagram of FIG. 11 and explained by the conditional chart of FIG. 12. Each of the vacuum heads **120** and **121** are supported on brackets **132** and **133**, respectively, selectively secured to the post **23**, housing **18**, or gasoline pumps **17** and acting as normally closed lever switches connected to power sources **135** and **136** through lines **138** and **139**, respectively. When the brackets **132** and **133** are supporting the weight of the respective vacuum heads and connected hoses, the switches designated as SW–5 and SW–6, are then normally opened to the power sources **135** and **136**. The pushbutton switches mounted on the vacuum heads **120** and **121**, hereinafter designated as SW–1 and SW–2, respectively, connect power sources **141** and **142** through conductors **144** and **145** to supply electrical current to switches SW–4 and SW–3, respectively. The switches SW–3 and SW–4 are of the pressure-type actuated by a vacuum in the hoses **116** and **114**, respectively, to complete a circuit through lines **147** and **148** to normally closed solenoid slide valves **15A** and **15B**, respectively.

The closing of either of the pressure switches SW–3 or SW–4 acts to permit energization of a relay **150** through lines **152** or **153**, respectively, to energize the first, second and third auger conveyor motors **34**, **93**, and **99**. Additionally, a conductor **154** further energizes the heater **90**, and the conveyor motor **55** on closing of the relay **150**. It is seen that the solenoid valves **15A** and **15B** control movement of sliding valve members **155** and **156** which are operable to open the respective passageways from the particle supply line **21** into the hoses **116** and **114**, respectively, when energized. It is seen that the pushbutton switches SW–1 and SW–2 are respectively operable when closed to supply current to pressure switches SW–3 and SW–4, which in turn, when closed under vacuum pressure, energizes respective ones of valves **15A** and **15B** to supply particles to the respective head means **106** and **104** as the relay **150** and auger motors **34**, **93**, and **99** are also energized.

The switches SW–5 and SW–6 are connected by a common line **158** to the vacuum pump motor **76** so that this motor is energized each time one of the vacuum heads **120** and **121** is lifted off the bracket switches SW–5 or SW–6 whereby vacuum pressure is supplied through the vacuum line **19** or the particle vacuum line **22**. Also, switch SW–5 connects the power source **135** through a line **160** to energize a normally closed solenoid slide valve **15F**, and switch SW–6 is similarly connectable through a line **161** to the power source **136** to energize a similar slide valve **15D** associated with the second head means **106**. Additionally, on closing the push button switch SW–1, a conductor **163** energizes the normally closed solenoid slide valves **15E** and **15G** on the pipe **108** of the first head means **104** and a line **164** energizes slide valves **15J** and **15K** to divert the discharge air from the pump **76** for usage on the system as a material conveyor. On closing switch SW–2, a conductor **165** energizes the normally closed slide valves **15C** and **15H** and also valves **15J** and **15K** through line **168**. All of the solenoid actuated slide valves used in the control circuit means **130** are the normally closed type except for valve **15J** which is of the normally opened type. The pairs of solenoid actuated valves **15F**, **15G** and **15D**, **15H** are of a double coil type actuating common slide members **166** and **167**, respectively, used to open and close the passageways between the vacuum supply line **19** and the hoses **114** and **116**. The solenoid coils of the slide valves **15G** and **15H** are of high strength whereby when each pair of solenoid valves are energized simultaneously, the stronger valves **15G** and **15H** act to override the respective concurrently energized valves **15F** and **15D** to close the slide members **166** and **167** and the vacuum supply line **19** to the hoses **114** and **116**. It is seen that the valves **15G** and **15H** are normally neutral and only operate to close the slide members **166** and **167** if they have been opened by the valves **15F** and **15D**, respectively.

Concurrently, with the closing of either one of the switches SW–1 and SW–2, and the corresponding pressure switches SW–4 and SW–3, the relay **150** is closed to energize the conveyor motors **34**, **93**, and **99**, and the airlock motor **55** are through the line **154**. The optional heater **90** can be energized selectively as desired depending on the moisture content of the particles used in the

system or connected by a line 169 to line 154 so as to operate whenever the relay 150 is energized.

In summary, the control circuit means 130 includes a plurality of normally open switches SW–1—SW–6, inclusively, operable to energize the relay 150 and the normally closed solenoid slide valves 15A–15H, 15K, and the normally open slide valve 15J as shown in column 1 of the table of FIG. 12. The various positional relationship of the switches and valves are given for a desired operational condition of the first and second head means 104 and 106 for sequentially operating the numerous motors in the system.

In the use and operation of the surface treating apparatus 16 of this invention, on using the first head means 104, hereinafter referred to as drop #1, solely as a vacuum cleaner (column 2 of FIG. 12), the vacuum head 120 is lifted off the bracket switch SW–5 which simultaneously energizes the vacuum pump assembly 75 through line 158 and valve 15F is open through line 160 to open the slide member 166. Because the push button switch SW–1 has not been energized, the valves 15B, 15E, and 15K remain closed, and 15J remains open whereby air is drawn by the vacuum pump 76 through the vacuum line 19 into the first hose 114 so as to act as a conventional vacuum cleaner. Although the pressure switch SW–4 is closed by the vacuum pressure when the vacuum head 120 of the drop #1 is placed against a given surface to be treated, the solenoid slide valve 15B, the relay 150, and the auger motors 34, 93 and 99 are not energized as the push button switch SW–1 is opened. It is noted that the slide valve 15G remains on the inactive or neutral position; however, the solenoid valve 15F is energized to hold the slide member 166 open.

In the operation of the second head means 106, hereinafter referred to as drop #2, as a vacuum cleaner (column No. 4), the vacuum head 121 is lifted off the bracket switch SW–6 to energize the vacuum pump 76 through the line 158 and the solenoid valve 15D. The drop #2 thereupon acts as a conventional vacuum cleaner similarly as described for drop #1 as shown on the conditional chart of FIG. 12. Since the push button switch SW–2 is not closed, the vacuum pressure is drawn through the hose 116, vacuum line 119, vacuum pump assembly 75, and discharged through the filter bag 88 to the atmosphere.

In the use of the drop #1 or first head means 104 as a particle cleaner as shown in column 3 of FIG. 12, the drop #1 initially acts as a conventional vacuum cleaner as above-described on lifting the vacuum head 120 off the bracket switch SW–5. For the particle supply portion, the switch SW–1 is manually closed to concurrently supply portion, the switch SW–1 is manually closed to concurrently supply current to the pressure switch SW–4 from the power source 141 through line 144, energize solenoid valves 15E and 15G through lines 144 and 163, and energize valves 15J and 15K through the line 164. Because the solenoid valve 15G is stronger than the also energized valve 15F, the slide valve member 166 is held in the closed position whereby the first hose 114 is open to the particle-vacuum return line 22. On applying the drop #1 vacuum head 120 to a surface to be cleaned, the pressure switch SW–4 is closed by the vacuum pressure to energize the solenoid valve 15B, the relay 150, start the auger motors 34, 93, and 99, and energize the motor 55 an the heater 90. This conveys particles from the supply hopper 25 outwardly through the cylindrical housing 97 for dumping into the tube member 118. With the slide valve 15B open, the particles and air supplied through the vent 127 are pulled downwardly into the hose 114 under vacuum pressure. The vacuum is provided through the particle-vacuum line 22, the hose 14, and the drop #1 vacuum head 120 to draw the particles downwardly into impact with the surface to be cleaned. The particles are foreign impurities picked up from the surface are then pulled through particle vacuum line 22 into the air separator assembly 47. The exhaust air of the vacuum assembly 75 is now directed by the valves 15J and 15K through the optional heater 90 for drying and is used to convey the particles back to the supply hopper 25 to complete the cycle. It is seen that the transfer means 53, and heater 90 are only energized when switches SW–1 or SW–2 are energized and the respective vacuum pressure switches SW–4 and SW–3 are closed by contact with the surface to be cleaned. This regulates the proper timing and supply of the particles so as to appear only at the time at which the vacuum heads are against the surface to be cleaned.

As shown in column 5 of FIG. 12, the drop #2 head means 106 operates similarly as a particle supply cleaner with the solenoid valve 15H overriding the also energized solenoid valve 15D to open the drop #2 hose 116 to the partial vacuum line 22 as above-described for the drop #1 head means 104.

The cleaning apparatus 16 can be used with the first and second head means 104 and 106 acting as conventional vacuum cleaners as shown in column 6 of FIG. 12, or with one acting as a vacuum cleaner and the other as a particle cleaner as shown in columns 7 and 8, or as both head means being used simultaneously as particle cleaners (column 9). It is seen that the controlled supply of particles to the first and second head means 104 and 106 with the impact of the particles against the surface to be cleaned operates to remove dirt and the like in a highly efficient and rapid manner. In cleaning windshields, for example, the use of a liquid solution and subsequent drying operations is not required and this results in a tremendous time and labor-saving operation.

The particles used in the surface cleaning system can be of any suitable composition such as a sponge material, a foam material, sawdust, and the like which acts as an abrasive material without scarring or damaging the surface to be cleaned. However, it is obvious that any degree of abrasion can be obtained as desired by the choice of particles to be used with application by the novel supply means of this invention.

Although various vacuum pressures can be used depending on the composition of the particles, the use of sawdust of approximately .080 inch average diameter fed at a rate of 10 lbs. per minute under one to five inches of mercury pressure at the pick up heads has been proven to be satisfactory in cleaning automobile windshields. If the particles are fed at approximately 4500 feet per minute against the windshield, a moderately dirty and normal sized windshield can be cleaned in 10–15 seconds. It is obvious that the density, type of particles used, and feed rate may be varied to change the end result and cleaning time.

The surface treating apparatus can be used in numerous applications such as cleaning all types of glassware, automobile bodies, ceilings, walls, etc.; degreasing parts of all types; peening a given surface by small shot to give a desired appearance; polishing and buffing to achieve a desired surface finish; and the particles can be used as physical therapy to apply a combination of suction and impact to controlled sections of the human body. It is obvious that the particles would be varied for these different applications whereby small rubber or plastic balls, abrasive particles, foamed plastic particles, glass beads, steel shot, and the like can be used.

Another embodiment of the invention is illustrated in FIG. 13, indicated generally at 16A having the vacuum pump assembly 75, the air separator assembly 47, supply lines 19, 21, 22, optional heater 90, vacuum heads 120 and 121, and the particle hopper 25 as previously described. Additionally, the new surface treating apparatus 16A has a coating supply mechanism 172 operable to inject material into the supply hopper 25 for movement through the particle supply line 21 to the head means 104 and 106. This material can be small particles of wax, liquids, chemicals or the like which will impact the surface to be coated in the same manner as previously

described for the cleansing particles but leaving a film thereupon. It is obvious that numerous types of coating materials can be used to efficiently and effectively cover a given area by applying waxes, paints, rust inhibitors, and the like. The coating particles are applied to a given surface in a similar method as previously described for the use of cleaning particles.

As will be apparent from the foregoing description in the preferred embodiments of the applicant's new and novel surface treating apparatus, relatively simple means have been provided which are readily usable to clean or coat a given surface by unskilled labor. Furthermore, applicant's apparatus eliminates a great deal of time-consuming and tedious work involved in cleaning windshields and the like.

I claim:

1. An apparatus for treating surfaces, comprising:
(a) head means adapted for applying to a surface in an air sealed relationship,
(b) vacuum means connected to said head means to supply a vacuum pressure to the surface,
(c) particle supply means and particle separating means connected to said head means to selectively feed particles to said head means whereby the vacuum pressure pulls said particles at an accelerated velocity into impact against the surface for treating thereof,
(d) vent supply means mounted on said particle supply means operable to supply air at atmospheric pressure thereto so that the air operates under the vacuum pressure to pick up, and move said particles through said head means to the surface being worked thereupon, and
(e) control means having a plurality of valve members, control switches, and a circuit means connecting said valve members and said control switches to said head means, said vacuum means, and said supply means, said control means having members connected together, actuatable and operable under one set of conditions to energize said vacuum means only to operate said head means as a vacuum cleaner receiving intake air supply from the area about said head means, said control means having members connected together, actuatable and operable under a second set of conditions to energize said vacuum means, said head means, and said supply means through vacuum pressure when said head means is applied to the surface in the air sealed relationship.

2. An apparatus as described in claim 1, wherein:
(a) one of said control switches has a member to actuate and operate same upon change of pressure thereon and being of a normally open type connected to said head means, and said one control switch is operably connected in said control means to automatically close upon vacuum pressure being applied thereto to permit energization of said supply means and said separating means under said second set of conditions but not under said first set of conditions.

3. An apparatus as described in claim 2, wherein:
(a) another of said control switches mounted on said head means manually operable to energize said one control switch and certain ones of said valve members to energize said supply means and said separating means to feed particles into impact with the surface on closing said one control switch when said head means is applied to the surface in the air sealed relationship.

4. An apparatus for treating a given surface, comprising:
(a) a vacuum head means having an elongated hose member and a head member secured to one end thereof, said hose member separated into a particle supply section and a vacuum section,
(b) vacuum supply means including a vacuum pump having an inlet pipe connectable to said vacuum section of said head means and a discharge pipe,
(c) particle supply means having a storage hopper and conveyor means to selectively convey particles through a conduit connected to said particle supply section of said head means,
(d) separator means having an intake pipe connectable with said vacuum section of said head means, an exhaust pipe connected to said vacuum supply means, and a discharge section, said separator means having a particle discharge conveyor means and a conduit connected thereto, to said exhaust pipe of said vacuum supply means, and said hopper whereby in operation exhaust air from said vacuum supply means operates to pick up and convey separated particles from said conveyor means to said storage hopper through said conduit conveyor means to said storage hopper through said conduit,
(e) control means having solenoid slide valves and control switches interconnected by a circuit means, said control means operably connected to said head means, said vacuum supply means, said particle supply means, and said separator means, said control means having a bracket switch supporting said head member,
(f) means connecting said bracket switch to said vacuum pump whereby said pump is energized on movement of said head member of said bracket switch for air intake through said inlet pipe as a conventional vacuum cleaner, and
(g) one of said control switches mounted on said head member operable to energize certain ones of said slide valves, and another one of said control switches mounted on said hose member, connected in said control means and operable under vacuum pressure to energize said particle supply means and said separator means whereby particles are supplied through said conduit to said head means and pulled into impact with the surface of the vacuum pressure.

References Cited

UNITED STATES PATENTS

1,752,664	4/1930	Forcier.	
2,217,815	10/1940	Rector et al.	134—7 XR
2,384,458	9/1945	Dubay	134—7 XR
2,455,514	12/1948	Mead.	
2,770,924	11/1956	Mead et al.	
3,265,445	8/1966	Cronin.	
3,307,296	3/1967	Ashworth	51—8

FOREIGN PATENTS

874,693	4/1953	Germany.

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