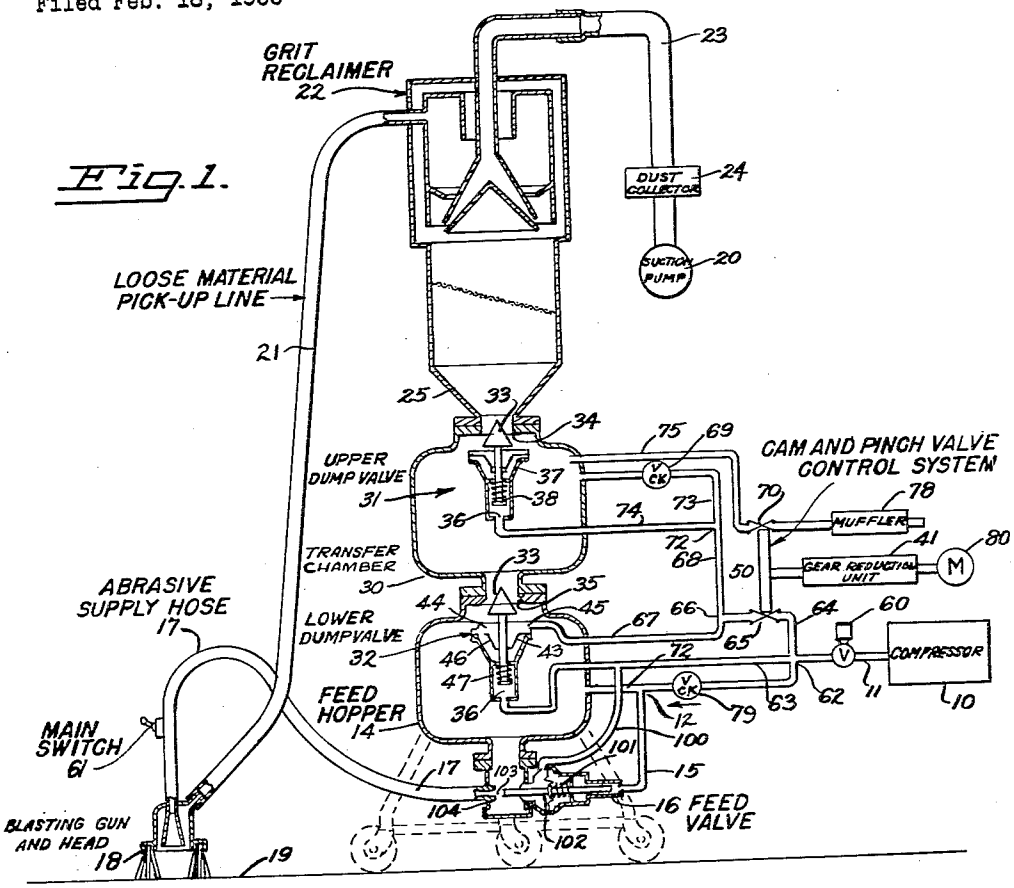
Oct. 29, 1957 W. H. MEAD ET AL 2,810,991

ABRASIVE BLASTING APPARATUS

Filed Feb. 18, 1955 2 Sheets-Sheet 1

Fig. 1.



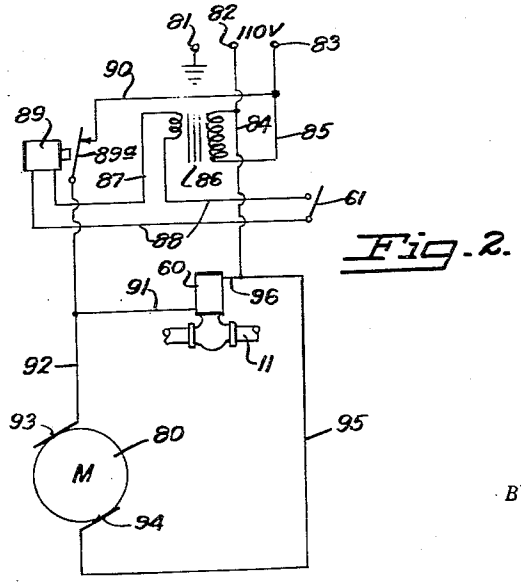


Fig. 2.

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Fig. 3.

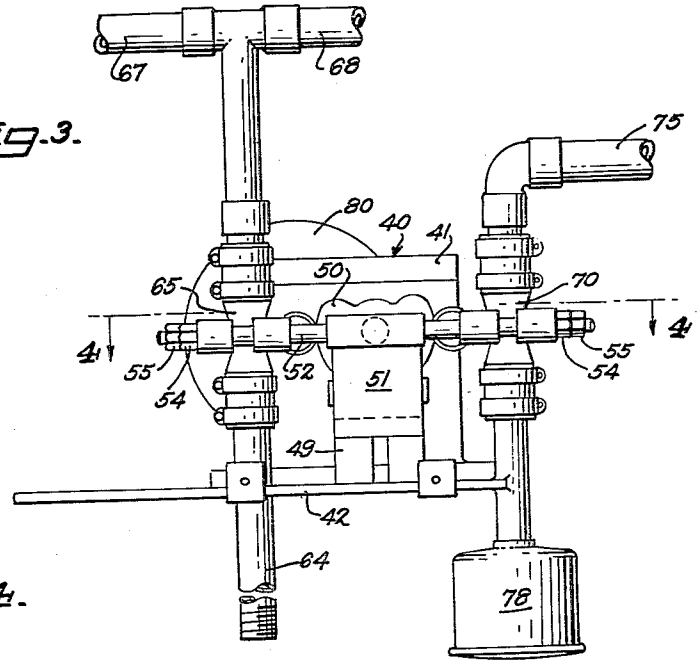


Fig. 4.

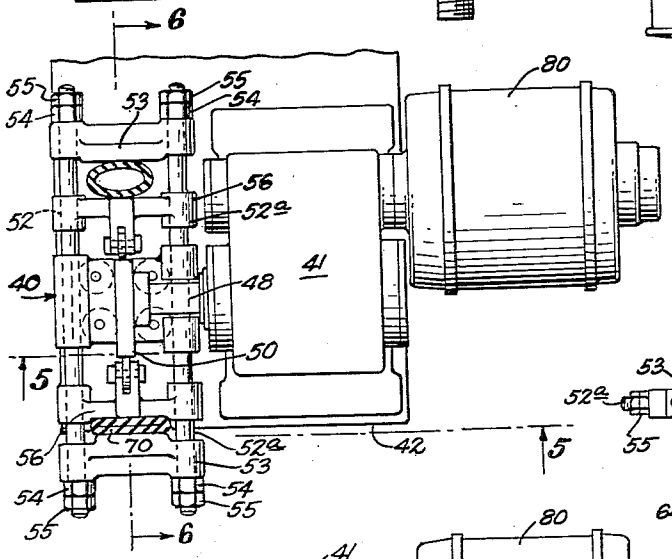
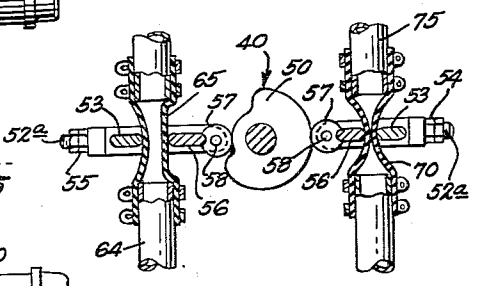


Fig. 6.



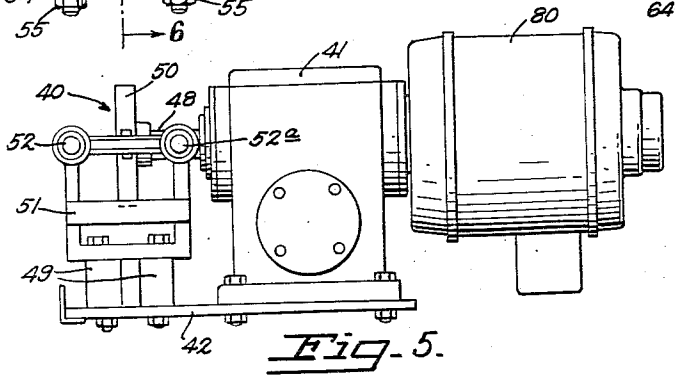


Fig. 5.

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2,810,991

ABRASIVE BLASTING APPARATUS

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Application February 18, 1955, Serial No. 489,128

10 Claims. (Cl. 51—8)

This invention relates to a method for continuous operation of a surface treating machine and to a continuously operating surface treating apparatus. More particularly, this invention relates to a method and an apparatus for continuously impelling abrasive against a surface, removing the abrasive and waste material, and reusing the abrasive. The invention also relates to a method and an apparatus for intermittently transferring material from a chamber under one set of pressure conditions to a chamber under another set of pressure conditions.

The invention is particularly useful with surface treating methods and apparatus of the type described in the reissue patent to William H. Mead, No. 23,186, issued January 30, 1950. That device simultaneously impels treating material against a surface and suction removes the spent abrasive and waste material. By employing a grit reclaimer, such as that described in the co-pending application, Serial No. 489,127, filed February 18, 1955, by us and Alexander L. Jett, the spent abrasive can be separated from the waste material and reused.

The problem solved by the present invention are those causing interference with the continuous operation of the above type of surface treating apparatus. The problems arise from the fact that the abrasive, which is impelled against a surface by a high-pressure blast of air and is removed from the surface by a counter flow of air, carries along with it the waste material which is abraded from the surface. The abrasive grit is next separated from the waste material while still under extremely low pressure conditions. One problem which had to be solved before the apparatus could operate continuously was how to transfer the abrasive from the low pressure in the suction line to the high pressure in the blasting line without interfering with the pressure conditions in either line. Another practical problem was how to construct a transfer control apparatus for accomplishing this result which would be unaffected by the movement of abrasive grit, dust, and dirt through its lines and valves. One further problem was how to time the transfer cycle without relying on delicate clocks or solenoid valves, or other hard to maintain time control mechanisms.

The present invention provides for the first time a transfer control apparatus that employs a rugged durable cam and pinch valve system which eliminates expensive timers and solenoid valves. It provides for the first time a transfer valve system in which there are no moving parts which may become clogged or damaged by the passage of dirt or abrasive through the system. It provides for the first time an accurately controlled transfer cycle in which the entire operation may be timed by a simple motor supplying the power input. It provides for the first time a transfer control cycle which operates solely from the mechanical energy supplied by a rotating cam. Because of these many advantages, a vastly improved operating efficiency is made possible. Also, lost time due to repairs and replacement of parts in contact with the dirt and abrasive is practically eliminated. Other objects and advantages in addition to the above will appear from the following description of a preferred embodiment of the invention and from the drawings in which:

Fig. 1 is a diagrammatic view of a continuous surface treating apparatus embodying the principles of the invention, showing the piping circuit in the transfer apparatus;

Fig. 2 is a diagrammatic view of the electrical circuit employed;

Fig. 3 is a view in front elevation of a cam and pinch valve system for controlling the transfer apparatus;

Fig. 4 is a view in plan and in horizontal section along the line 4—4 of Fig. 3;

Fig. 5 is a view in side elevation of the control system of Figs. 3 and 4, with the pinch valves and connecting pipe structure eliminated for the sake of clarity; and

Fig. 6 is a detail view in vertical section along the line 6—6 of Fig. 4, illustrating the operation of the cam and pinch valve system.

The apparatus employs an intermediate chamber between the low pressure reclaimer hopper and the high pressure feed hopper. By connecting the intermediate chamber to only one of the said chambers at a time, the material is transferred first from the low pressure hopper to the intermediate chamber and subsequently from the intermediate chamber to the feed hopper. The pressure of the intermediate chamber is raised before the valve to the high pressure chamber is to be open, and after this valve is closed the pressure in the chamber is reduced before the valve to the low pressure chamber is opened. All of these valves and pressure adaptors are controlled by a novel cam and pinch valve system which alternates them according to a predetermined cycle.

Fig. 1 shows a device embodying the principles of this invention used in conjunction with a surface-treating apparatus of the type described more fully in Reissue Patent No. 23,186. A compressor **10** sends air under pressure through a conduit **11**. At a manifold **12** the air current is divided, a conduit **15** shunting some of the air into a grit-feed valve **16**. This valve **16** is preferably of a type described in the Mead Patent No. 2,521,931. Grit is introduced from a feed hopper **14** into the blast current at the valve **16** and is fed through a conduit **17** to an operating head **18**, where it is impelled against a surface **19**.

A suction pump **20** draws air through the maze carrying the spent abrasive and waste material (such as paint flakes, rust, sawdust, etc.) out of the head **18** through a suction conduit **21** into a grit reclaimer **22**, preferably of the type disclosed in pending application Serial No. 489,127, filed February 18, 1955. Here the abrasive and waste are separated, and the waste is carried out through a conduit **23** to any form of dust collector **24**. The reclaimed abrasive falls down into a reclaimer hopper **25**, still under vacuum conditions.

Between the reclaimer hopper **25** and the feed hopper **14** is positioned an intermediate transfer chamber **30**. At its upper end is an upper dump valve **31**, and at its lower end is a lower dump valve **32**. Both valves **31** and **32** comprise air-actuated, cone-shaped plugs **33**, which are closed against the respective openings **34** or **35** by compressed air entering through openings **36** at the lower end of the valves.

The upper valve **31** opens by a combination of spring pressure and gravity, dropping when the air pressure inside the valve falls below a certain level. The valve is closed by air pressure entering at **36** which presses against the diaphragm **37** to overcome the relatively weak pressure offered by spring **38**. In its open position, the valve **31** permits grit to fall from the reclaimer hopper **25** into the intermediate transfer chamber **30**.

The lower valve **32** is adapted for quicker and more positive control. As shown, the lower valve is provided

with an upper chamber 44 having an opening 45 through which compressed air may enter from the duct or conduit 67, in a manner to be explained. Below the diaphragm 43 is a lower chamber 46, open only to the air pressure inlet 36. A spring 47 biases the valve 32 downwardly toward its open position. The force of the spring 47 augments the force of gravity and aids in providing a quick opening action.

Preferably the spring 47 is a light one; for example, a very successful valve uses a spring which exerts a force of about ten pounds. Thus the spring will not open the valve until the air pressure in the upper chamber reaches a pressure about 10 lbs. less than that in the lower chamber. Due to this relationship, the valve 32 and the whole apparatus may be operated over a very wide range of pressures without changing the spring 47, and the valve 32 will not open until the pressure in the upper chamber 44 almost balances the pressure in the lower chamber 46.

The lower chamber 46 is kept under pressure continuously during operation of the machine, and this air pressure holds the valve 32 normally up against the opening 35. However, when the air pressure in the upper chamber 44 balances the air pressure in the lower chamber 46 (in a manner to be described), the weight of the cone and other moving parts overbalances the spring 47 and the cone 33 drops, opening the valve 32. Correspondingly, the valve closes when the air pressure in the upper chamber 44 drops to a point where the air pressure pushing against the lower side of diaphragm 43 overcomes the downward pressure of spring 47.

The pressure in the reclaimer hopper 25 is normally about ten inches of mercury, while the pressure in the feed hopper chamber 14, during typical operating conditions, is normally kept at about one hundred pounds per square inch; therefore, valves 31 and 32 are never allowed to open at the same time while the apparatus is operating. Moreover, the air inside the intermediate chamber 30 is brought to a pressure approaching the pressure in the feed hopper 14 (approximately one hundred pounds per square inch in this case) before the valve 32 is opened. The pressure is reduced after the valve 32 closes and before the valve 31 opens. These conditions are obtained by means of the pressure control circuits shown in Fig. 1 and the cam and pinch valve system 40 shown in Figs. 3 to 5.

In the pressure conduit 11 is a master solenoid valve 60, controlled by a suitable electric switch 61 on the operating head 18. This switch 61 is thus used to shut the blast line off and on; it may also, if desired, be used to turn on and off the cam and pinch valve system 40, when an air motor is substituted for an electric motor.

Between the valve 60 and the T fitting 12 on the conduit 11 is an X fitting 62. At the fitting 62 two conduits 63 and 64 open off the line 11. The conduit 63 leads to the lower opening 36 of the lower dump valve 32 and air pressure therein urges the valve 32 toward a closed position. At the same time, air flowing through a branch conduit 100 opposes the pressure of a spring 101 in the feed valve 16, and when the pressure in the feed hopper approaches 40–50 p. s. i., retracts a movable fitting 102. As a result, grit moving into the gap 103 between the fitting and a nozzle 104 is impelled to a head 18 through the conduit 17 when the machine is operating.

The conduit 64 leads through a supply pinch valve 65, which can effect control of the valves 31 and 32 as well as the pressure inside the intermediate chamber 30. Beyond the pinch valve 65 is a T fitting 66, from which two conduits 67, 68 lead out. The conduit 67 leads to the opening 45 in the upper chamber 44 of the lower dump valve 32. Compressed air which passes through the pinch valve 65 is conducted to the chamber 44 and opens the valve 32. The pressures above and below the diaphragm 43 balance each other and gravity and the spring 47 open the valve 32.

The conduit 68 leads to a T fitting 72. There, the conduit 68 is divided into a conduit 73 passing into the tank 30 and a conduit 74 leading to the dump valve 31. Thus, when the pinch valve 65 is open, the valve 31 is closed almost immediately, and when the pressure inside the tank 30 reaches approximately the level of the pressure inside the hopper 14, the valve 32 opens.

Preferably, the conduits are of sufficiently small diameter so that the pressure does not build up instantaneously in the upper chamber 44 of the valve 32 or inside the intermediate chamber 30. After the valve 31 has closed, three or four seconds may elapse before the pressure in the chamber 46 and the chamber 30 approximates the pressure in the hopper 14. In this way there will be no drop in pressure when the valve 32 opens. Otherwise, there will not be complete continuity, and a portion of the surface 19 may be skipped and not treated during the time necessary to equalize the pressure. This is one problem which the present device solves in the manner just indicated.

A bleed conduit 75 leads from the tank 30 to a second pinch valve 70 and when the valve 70 is open, air may pass out through a muffler 78 to atmosphere. The muffler 78 silences the noise from the rush of air. Also in the piping circuit are check valves 69 and 79 which prevent any grit from the transfer tank 30 and feed hopper 14 from getting back into the master solenoid 60 and damaging it.

The electrical circuit is shown in Fig. 2. Preferably, a three line A. C. supply is used, with one wire 81 grounded. From the second side 82 and the third side 83 of a 110-volt A. C. supply, wires 84 and 85 lead to a 110-volt-6-volt transformer 86. From each pole of the 6-volt side, wires 87 and 88 lead to a 6-volt relay 89, line 88 passing through the master switch 61. From one pole of the relay actuator 89*a*, a wire 90 leads to the side 83 of the 110 volt input line. From the other side of the relay actuator 89*a*, one wire 91 leads to the master solenoid 60, and another wire 92 leads to post 93 of a simple electric motor 80 which supplies the power for the cam and pinch valve control system 40. The other post 94 of the motor 80 is connected by a wire 95 to the supply wire 84, while the solenoid 60 is similarly connected to the wire 84 by the wire 96. In this way, both the motor 80 and the valve 60 are energized by the switch 61. When the current is on, the valve 60 is always open, and the control system 40 operates continuously.

Figs. 3 to 5 illustrate the unique cam and pinch valve system 40 which is used to control the operation for the transfer apparatus. The control system comprises a cam 50 which is slowly rotated by the motor 80 acting through a gear reducing unit 41. Supported adjacent the cam 50 by a base plate 42 are the pinch valve 65 and 70 which regulate the flow of air in the supply and exhaust lines, respectively. Also supported on the base plate by spacers 49 and a bracket 51 is a cam follower mechanism. This mechanism transmits the movement of the cam into a valve control operation so that when valve 65 is open, the valve 70 is closed, and vice versa.

The follower mechanism includes a relatively long guide rod 52 positioned outside the cam and pinch valves and a pair of shorter guide rods 52*a* on the inside. Joining the extending ends of the rods are valve stop members 53 which are positioned to engage the outer surfaces of the pinch valves 65 and 70. The exact position of the stop members may be varied as desired by adjusting nuts 54 and lock nuts 55 threaded onto the ends of the guide rods. Completing the following mechanism are cam followers 56 which are mounted for sliding movement along the rods 52, 52*a* with their outboard edges contacting the inner surfaces of the pinch valves 65, 70. Preferably, the cam followers include follower bearings 57 mounted on shafts 58 to rotatably engage the slowly moving perimeter of the cam 50.

When the motor 80 is operating the cam 50 rotates continuously, causing the cam followers 56 to be pushed

sideways along the guide rods **52**, **52***a* in alternation. In an outthrust position, each cam follower acts to pinch off the flow through the adjacent valve by squeezing the sides of the valve against one another. As the cam continues to rotate, the natural resiliency of the pinch valve as well as the air flowing through the valve tends to restore the valve to its normal cylindrical shape, urging the cam follower **56** inwardly against the cam **50** and causing the valve to reopen. In this way, the opposing pressures produced by the cam **50** and the wall resiliency of a pinch valve are able to combine with one another to open and close the pinch valves **65** and **70** in alternation. This operation is illustrated in Fig. 6 where the cam **50** has forced the right hand cam follower **56** into a valve closed position, while the left hand cam follower has been biased to a valve open position by the wall of valve **65**.

It should be mentioned that effective operation of the pinch valves **65** or **70** requires that they be constructed of materials particularly adapted to withstand continuous flexing as well as continuous abrasive impact. A suitable construction for the pinch valve might be two different types of a synthetic resilient material having a reinforcing material sandwiched between. For example, a sandwich of relatively soft rubber on the inside to absorb abrasive contacts, a reinforcing fabric liner, and an outer layer of tougher rubber to provide the desired flexing characteristics has proved highly satisfactory in actual use. However, it is clear that many additional constructions and compositions would be suitable for the purpose.

The novel functioning of the cam and pinch valve control system **40** provides a number of unique advantages in the operation of the transfer apparatus. It permits the passage of sizable quantities of abrasive through the pinch valves **65** and **70** without fear of damage to the valve structures, as there are no moving parts in the valves to get out of order, It permits the passage of abrasive without danger of the valves becoming clogged, since their smooth inner surfaces offer no resistance to particle flow. It permits hard abrasive materials to be impelled at high speeds through the valves without undue wear, as the abrasive impacts will be absorbed by the resilient wall of the valve. It permits an entire transfer cycle to be accurately and continuously timed by the action of a simple motor and gear reducing unit rotating the cam **50**. It permits a cycled valve operation dependent only on the mechanical energy supplied by a rotating cam. These features make possible the additional advantage of virtually eliminating work stoppages due to repair or replacement of the valve and timing mechanisms. They also make possible a substantial economy in both operating and equipment costs.

In operation, when the master switch **61** is turned on, the solenoid valve **60** is opened to admit air from the compressor **10** through the conduit **11** to the feed tank **14** and to the sliding fitting **102** of the feed valve **16**, so that an air blast is sent to the head **18** through the conduit **17**. Air also is admitted through conduit **63** to the lower dump valve **32**, and through hose **100** to the actuating chamber of feed valve **16**. When the air pressure in tank **14** reaches approximately 40–50 p. s. i., the air which has passed through hose **102** retracts the fitting **100** and opens the feed valve **16** so that abrasive is carried to the head **18** by the flow of air through conduit **17**. At the same time, switch **61** is turned on, the motor **80** is started, causing the cam to rotate through its cycles.

For convenience, we shall assume that the pinch valve **65** is closed to begin with. Therefore, no air flows from the conduit **11** into the conduit **64**, and consequently none flows in the conduits **67**, **73**, and **74**. The upper dump valve **31** is held open by its spring and by gravity. The lower dump valve **32** is closed, because there is no pressure in its upper chamber **44** and the lower chamber **46** is under high pressure. The suction pump **20** is operating, and it keeps the reclaimer hopper **25** at a vacuum of about 10 inches of mercury. Any reclaimed grit remaining in the reclaimer **25** falls past the open valve **31** and is stored in the tank **30**.

After a period of time determined to occur before all the grit is used out of the tank **14** the rotating cam **50** opens the pinch valve **65** and closes the pinch valve **70**. Air then flows from the conduit **11**, through the conduit **64**, into the conduits **67**, **73** and **74**. From the conduit **74** air passes into the upper dump valve **31** and closes it almost immediately. Air passing through the conduit **73** fills the tank **30**, and the pressure soon approaches and equals the pressure in the feed hopper **14**. At the same time, air fills the upper chamber **44** of the valve **32**, and when it reaches a pressure closely approaching that in the lower chamber **46**, the valve is opened by its spring **47** and its co-acting forces. Grit inside the tank **30** can then fall down through the open valve **32** into the feed hopper **14**, replenishing it without interfering with the pressure conditions in the blast line.

When the cam **50** reaches another predetermined position, the pinch valve **65** is closed and valve **70** is re-opened. Conduits **67**, **73**, and **74** are cut off from their supply of air, while conduit **75** is opened to the atmosphere. Air immediately bleeds out of the upper chamber **44** of the lower dump valve **32** through conduit **68**, and enters transfer tank **30**. When the pressure has dropped only a short way (usually a pound, or less) the air pressure in the lower chamber **46** closes the lower dump valve **32**. The air in the tank **30** is vented to the atmosphere through the conduit **75** and muffler **78**. Simultaneously the air in the upper dump valve **31** flows back through the conduit **74** into the conduit **73**, through the tank **30** and the conduit **75**, and out to atmosphere. When the pressure is low enough (i. e., approaching atmospheric), the upper dump valve **31** opens, and what little air remains is immediately sucked out by the pump **20**. In a typical installation the pump **20** draws 300 cubic feet of air per minute. Since the volume of the chamber **30** is only a cubic foot or so, this small pressure differential will not affect the operation at the head. When the valve **31** opens, the grit stored up in the chamber **25** may then fall down again into the chamber **30** completing the cycle.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What is claimed is:

1. An apparatus for abrasive-blasting comprising, in combination, a low pressure chamber, an intermediate chamber, a high pressure chamber, means for impinging granular material against a surface to be treated and a valve control means for facilitating the transfer of granular material from the low pressure chamber to the intermediate chamber via a first transfer valve and from the intermediate chamber to the high pressure chamber via a second transfer valve without affecting the pressures in said low and high pressure chambers, said valve control means comprising a supply pinch valve for opening and closing a first conduit in operative fluid communication between a source of compressed air on the one hand and said intermediate chamber and said transfer valves on the other hand; an exhaust pinch valve for opening and closing a second conduit in operative fluid communication between said intermediate chamber and said transfer valves on the one hand and an exhaust outlet to atmosphere on the other hand; and a single rotating cam in operative engagement with said pinch valves, said cam being so constructed that in one of two cam positions said supply pinch valve is closed and said exhaust pinch valve is open while in the other cam position said exhaust pinch valve is closed and said supply pinch valve is

open, whereby rotation of said cam causes the air pressure in said intermediate chamber alternately to be raised to approximately the level of the high pressure chamber when said supply pinch valve is open and then to be lowered to atmospheric level when said exhaust pinch valve is open, as said transfer valves are correspondingly opened and closed in alternation.

2. The device of claim 1 in which said operative engagement is provided by a pair of cam follower means in contact with said cam, one said follower means being positioned between said cam and each of said pinch valves.

3. In an apparatus for abrasive-blasting comprising a high pressure chamber, a low pressure chamber, a pressure-equalizing chamber disposed intermediate said high and low pressure chambers, means for impinging materials against a surface to be treated and a valve control system for facilitating the transfer of materials from the high pressure chamber to the low pressure chamber through the intermediate chamber via first and second transfer valves between said intermediate chamber and said high and low pressure chambers respectively, wherein said valve control system is particularly adapted to resist both wear and clogging due to flow of said granular materials through the system, a source of air under high pressure connected at all times to said high pressure chamber; an air supply line in fluid communication with said intermediate chamber and with both said transfer valves, so as to urge said first transfer valve closed and to balance pressures holding said second transfer valve closed, the combination with said valve control means of said supply line having a flexible, collapsible, substantially unobstructed portion; a supply pinch valve operable on the exterior of said collapsible unobstructed portion to open and close said supply line to connect it to and disconnect it from said source of air under high pressure, whereby air under high pressure flows into said intermediate chamber when said supply line is open, said first transfer valve then being closed, and when pressure builds up in said intermediate chamber, opens said second transfer valve leading to said high pressure chamber; an exhaust line having a flexible, collapsible, substantially unobstructed portion also in communication with said intermediate chamber and with both said transfer valves; an exhaust pinch valve for opening and closing said exhaust line to connect it to and close it off from atmosphere; a cam mounted for rotation; a power source for rotating said cam; and means mechanically linking each of said pinch valves to said cam, whereby in one position of said cam said supply pinch valve will be squeezed closed while said exhaust pinch valve will hold itself open, and in another position of said cam said exhaust pinch valve will be squeezed closed while said supply pinch valve will hold itself open, whereby cyclic control of the operation of said transfer valves and of air pressures in said intermediate chamber is made possible.

4. The device of claim 3 in which said mechanical linking means includes a cam follower in contact with each said pinch valve and follower bearings supported by each said cam follower in contact with said cam.

5. An apparatus for continuous abrasive-blasting, comprising a low pressure chamber, a high pressure chamber, means for impinging material against a surface to be treated and means for transferring, without upsetting the pressure concerned, material from the low pressure chamber to the chamber that is maintained at high pressure by a high pressure line, said transferring means comprising: an intermediate chamber placed below said low pressure chamber and above said high pressure chamber; a first air-operated valve between said intermediate chamber and said low pressure chamber; a second air-operated valve between said intermediate chamber and said high pressure chamber; a first pinch valve adapted to open for simultaneously admitting air from said high pressure line to said first air-operated valve to close it, for admitting air from said high pressure line to said intermediate chamber to build up the pressure therein, and for admitting air from said high pressure line to said second air-operated valve so that it will open when the pressure in said intermediate chamber reaches a predetermined value, said first pinch valve also being adapted to close for simultaneously cutting off all air from the high pressure line to both said air-operated valves and said intermediate chamber; a second pinch valve adapted to open to bleed air from said second air-operated valve to close it, to bleed air from said intermediate chamber so that its pressure may be reduced, and to bleed air from said first air-operated valve so that it may open when its pressure drops below a certain point; a cam alternately opening said first pinch valve and simultaneously closing said second pinch valve for one part of a cycle, and closing said first pinch valve and simultaneously opening said second pinch valve over a second part of said cycle; and a motor for rotating said cam; both said pinch valves incorporating a flexible air conduit and external pinching means so that any granular materials inadvertently impelled through said conduit will not tend to clog or cause undue damage to the pinch valves or interfere with the controlling action of said cam and pinch valves.

6. An apparatus for continuous abrasive-blasting comprising a feed hopper for storing abrasive material; an air blast line; a feed valve for feeding material into said line; an operating head where material is impinged against a surface; a suction line for withdrawing material and waste from said surface; a separator for salvaging material out of waste; a reclaimer hopper for receiving salvaged material; an intermediate hopper between said reclaimer hopper and said feed hopper; a first pneumatic transfer valve between said reclaimer hopper and said intermediate hopper; a second pneumatic transfer valve between said intermediate hopper and said feed hopper; a motor-operated cam; and first and second pinch valves operated by said cam alternately to close said first valve and open said second valve and to close said second valve and open said first valve, the first pinch valve opening and closing a conduit joining said air blast line pressure to said pneumatic valves and said intermediate hopper, so as, when open, to close said first pneumatic valve, build up pressure in said intermediate hopper, and then open said second pneumatic valve, the second pinch valve opening and closing a bleed conduit to atmospheric pressure from said pneumatic valves and said intermediate hopper so as, when open, to close said second pneumatic valve, reduce pressure in said intermediate hopper, and open said first pneumatic valve.

7. An apparatus for transferring granular material from a low pressure chamber to a chamber maintained at high pressure by a high pressure line, without upsetting the pressures concerned, comprising: an intermediate chamber placed below said low pressure chamber and above said high pressure chamber; a pair of pneumatic valves, one located between said intermediate chamber and each of the other said chambers to respectively open and close the passages between said chambers; a supply pinch valve including conduit means with a flexible tube portion and external pinching means, adapted when opened to simultaneously admit gas from said high pressure line to the upper of said pneumatic valves to close it, to admit gas from said high pressure line to said intermediate chamber to build up pressure therein, and to admit gas from said high pressure line to the lower of said pneumatic valves to open it when its pressure and the pressure in said intermediate chamber reach a predetermined value, said supply pinch valve also being adapted when closed to simultaneously cut off all gas from the high pressure line to said pneumatic valves and said intermediate chamber; an exhaust pinch valve including conduit means with a flexible tube portion and external pinching means, adapted when opened to bleed gas from said

lower pneumatic valve to close it, to bleed gas from said intermediate chamber so that its pressure may be reduced, and to bleed gas from said upper pneumatic valve so that it may open when its pressure drops below a certain amount; a continuously rotating cam alternately opening said supply pinch valve and simultaneously closing said exhaust pinch valve for one part of a cycle and closing said supply pinch valve and simultaneously opening said exhaust pinch valve for another part of said cycle.

8. An apparatus for continuous abrasive-blasting comprising in combination, a low pressure chamber, a high pressure chamber, an intermediate chamber disposed between said low and high pressure chambers, means for impinging material against a surface to be treated, a first transfer valve between said low pressure chamber and said intermediate chamber, a second transfer valve between said intermediate chamber and said high pressure chamber and a control means alternately closing said first valve and opening said second valve and closing said second valve and opening said first valve, said control means comprising a supply pinch valve and an exhaust pinch valve, each of said pinch valves including conduit means having a flexible, substantially open unobstructed portion and external pinching means for each respective unobstructed portion, a rotating cam means engaging said external pinching means to alternately open said supply pinch valve and simultaneously close said exhaust pinch valve for one portion of rotation and to close said supply pinch valve and simultaneously open said exhaust pinch valve through another portion of rotation.

9. The device of claim 8 in which said cam means comprises a single cam element having contact with both of said external pinching means.

10. The device of claim 9 in which each of said external pinching means comprises a cam follower in contact with the respective unobstructed portion and a follower bearing supported by the cam follower in contact with the cam element.

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