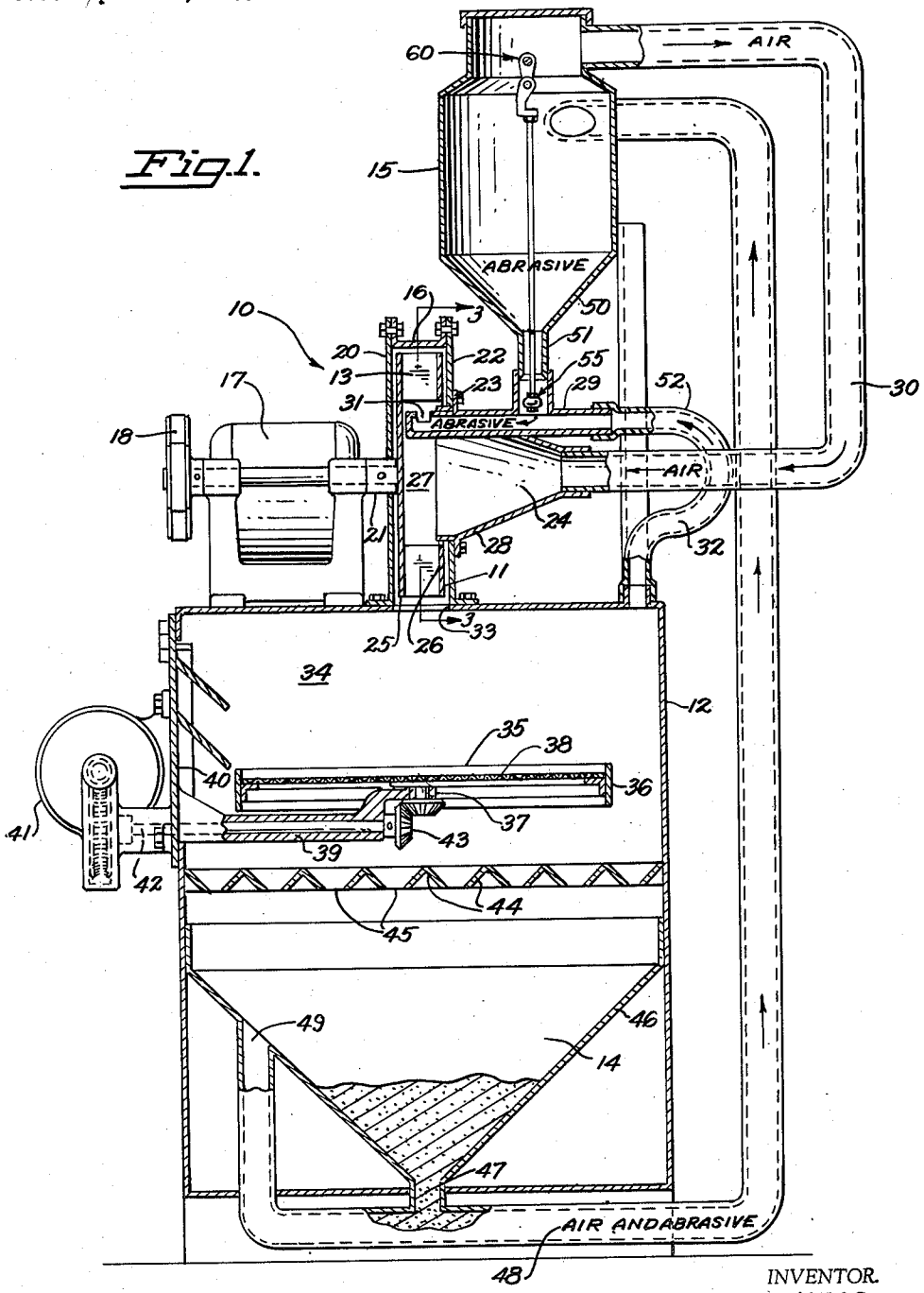
Dec. 1, 1964 W. H. MEAD 3,158,966

CENTRIFUGAL WHEEL BLASTING MACHINE

Filed April 25, 1963 3 Sheets-Sheet 1

Fig. 1.



INVENTOR.
WILLIAM H. MEAD

BY
Owen, Wickersham & Erickson
ATTORNEYS

Dec. 1, 1964 W. H. MEAD 3,158,966

CENTRIFUGAL WHEEL BLASTING MACHINE

Filed April 25, 1963 3 Sheets-Sheet 2

Fig. 2.

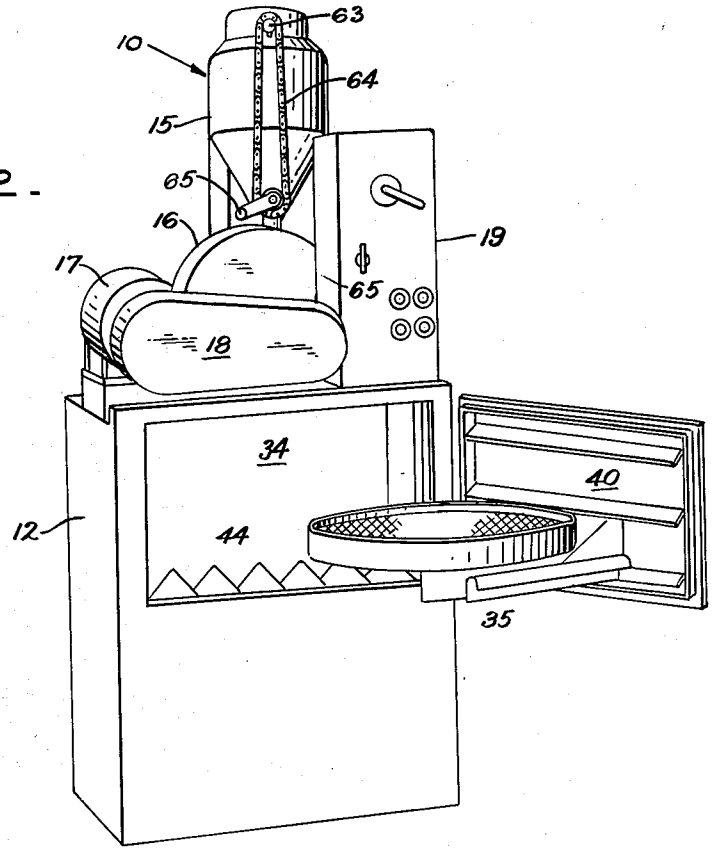
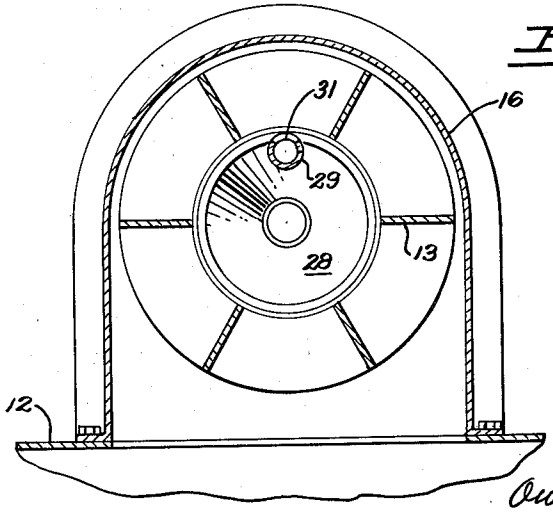


Fig. 3.



INVENTOR.
WILLIAM H. MEAD
BY
Owen, Wickersham & Erickson
ATTORNEYS

Dec. 1, 1964 W. H. MEAD 3,158,966

CENTRIFUGAL WHEEL BLASTING MACHINE

Filed April 25, 1963 3 Sheets-Sheet 3

Fig. 5

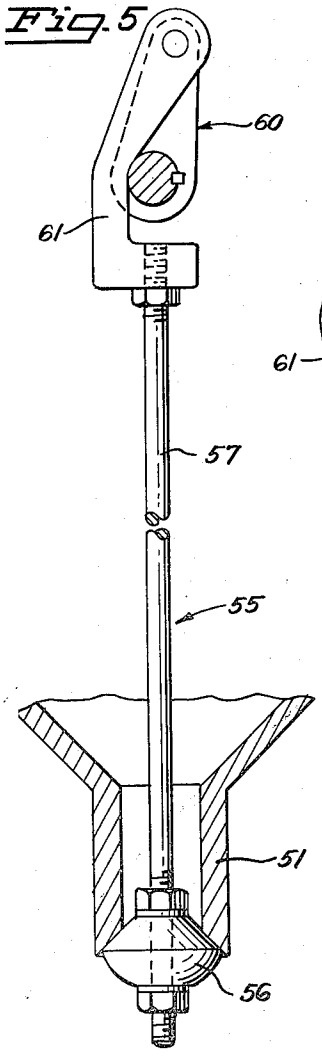


Fig. 6.

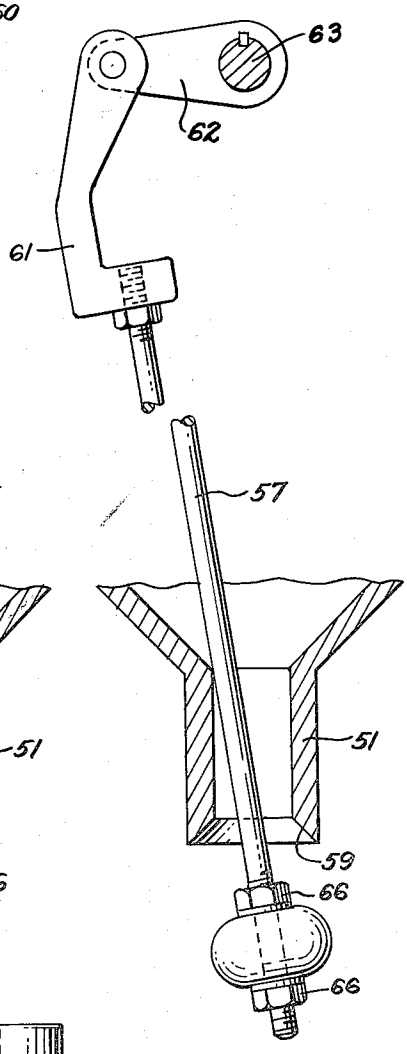
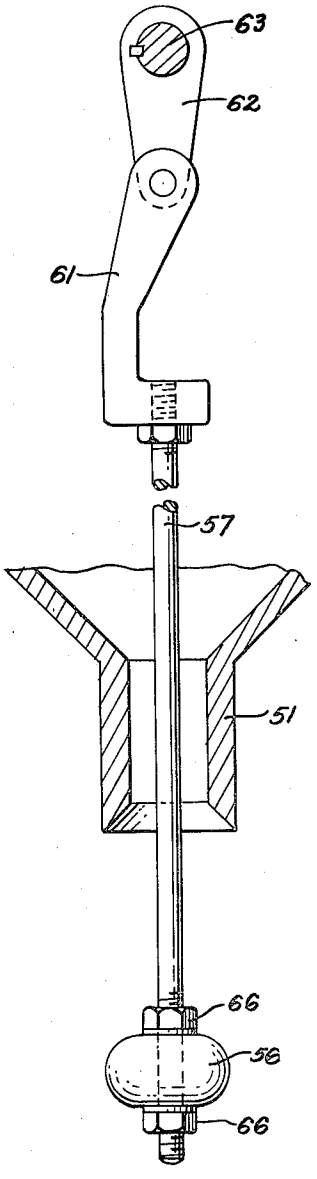


Fig. 7.



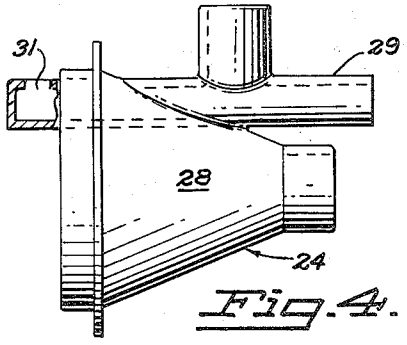


Fig. 4.

INVENTOR.
WILLIAM H. MEAD
BY
Owen, Wickersham & Erickson
ATTORNEYS

United States Patent Office

3,158,966
Patented Dec. 1, 1964

3,158,966

CENTRIFUGAL WHEEL BLASTING MACHINE

William H. Mead, 202 Camino Al Lago, Atherton, Calif.

Filed Apr. 25, 1963, Ser. No. 275,578
12 Claims. (Cl. 51—9)

This invention relates to improvements in abrasive blasting machines of the centrifugal wheel type used in the impact treatment of metal surfaces.

Rotating wheel type blasting devices that fling or propel abrasive particles against a surface being treated have important advantages over the conventional compressed air abrasive blasting machines. They eliminate the need for bulky and expensive accessory equipment such as an air compressor and the power means to drive it. They also avoid the inherent problems of compressed air systems relating to contamination of the compressed air with oil, water or other impurities. Such contaminants eventually coat the abrasive particles that recirculate in such systems and often cause clogging or plugging of the blast apparatus while also staining the work piece due to these impurities.

In the early prior art the rotating wheel devices were used with relatively heavy abrasive material such as shot or grit and required large cumbersome feeding mechanisms to convey the abrasive material from a storage hopper to the wheel. Such systems also employed additional mechanical apparatus to collect the used abrasive material and to raise it back up to the feeding hopper and conveyor for reuse. Such machines were thus built only as large relatively expensive units such as permanent factory installations and they failed to meet the need for smaller, less expensive centrifugal wheel blasting machines particularly adaptable for use with finer abrasives. Later, in order to eliminate the heavy, complicated feed mechanisms of the early rotating wheel devices, some machines were devised which utilized the suction force produced by the wheel itself to draw the abrasive material into the wheel where it could then engage and be flung outwardly by the wheel vanes. See the U.S. Patent to Eckler et al., 2,267,018.

One serious problem which arose with the latter type centrifugal flinging wheel machines of the prior art was that they were inefficient and unable to produce a controllable concentrated beam or pattern of abrasive material on the work being treated. The reason was that the abrasive material was drawn into the wheel while completely dispersed in the main air stream that conveyed it to the collecting hopper. Prior to my invention, there was no way for effectively controlling the separation of the abrasive material from the main air stream so that it could be ejected into the rotating wheel at an exact predetermined location and thereby control its pattern of impact on the work being treated.

It is therefore one principal object of the present invention to overcome the aforesaid problem and provide an improved centrifugal wheel blasting apparatus wherein the abrasive material is first entrained in an air stream from a collecting hopper in order to convey it up to the wheel after which it is separated out of the main air stream so that it can be ejected into the wheel in a stream separate from the main air stream and a predetermined location relative to the throwing vanes of the wheel.

Another object of my invention is to provide a centrifugal wheel blasting system which is capable of handling relatively finely divided abrasive materials and wherein such abrasive when thrown from the wheel is controlled effectively with respect to the direction of flight, the area covered by the thrown abrasive, and the intensity of impingement.

Another object of the present invention is to provide an abrasive blasting apparatus utilizing a vane wheel for

throwing the abrasive material and for creating a suction force around its central axis wherein the rate of flow of abrasive into the wheel can be controlled separately from the flow of air. This feature enables the flow of abrasive to be controlled for different surface treatment results and to be stopped completely without stopping the wheel so that the apparatus cabinet can be opened and the parts being surface treated can be removed and replaced without waiting until the wheel has slowed down and then restarted. By operation of a simple valve, the abrasive may be made to flow again and the apparatus will resume its blasting operation immediately.

A still further object of the invention is to provide a centrifugal throwing wheel blasting system which is capable of operating at reduced noise levels as compared with similar machines of the prior art.

Other objects, advantages and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view in elevation and in section showing a blasting apparatus embodying the principles of the invention;

FIG. 2 is a somewhat smaller view in perspective of the blasting machine of FIG. 1 with the cabinet door open;

FIG. 3 is an enlarged fragmentary view in elevation and in section taken along the line 3—3 of FIG. 1;

FIG. 4 is an enlarged view in elevation showing combined inlet fitting for air and the feed tube for abrasive material being directed into the throwing wheel;

FIG. 5 is an enlarged fragmentary view in elevation and partially in section showing the control valve on the abrasive material outlet of the cyclone separator, the valve being in the closed position;

FIG. 6 is a view in elevation and partially in section showing the valve of FIG. 5 in the half way open position;

FIG. 7 is a view in elevation and in section showing the valve of FIGS. 5 and 6 in the fully open position.

Broadly considered, my blasting apparatus **10**, as shown in FIG. 1, comprises a rotatable throwing and suction wheel **11** mounted on a cabinet **12** within which is supported a machined or cast metal part being surface treated. The wheel **11** has a plurality of vanes **13** that propel or fling the abrasive material centrifugally in a controlled beam or pattern into the cabinet **12**. The vanes also create a suction force at the center of the wheel that first entrains the spent abrasive in an airstream and then conveys it from a collecting hopper **14** situated below the part being treated in the cabinet **12**, to a cyclone separator **15** located above the wheel. At the separator **15** the abrasive material is centrifugally separated from the main air stream before the air is drawn directly into the wheel **11**. The abrasive material, in accordance with the invention, is metered from the separator **14** in a small separate stream to one side of the main air stream and is ejected radially within the wheel at a predetermined circumferential location. The abrasive material thus free from any influence of the main stream is therefore efficiently and effectively propelled by the wheel vanes **13** into the desired beam or pattern within the cabinet **12**.

Describing now the apparatus **10** in greater detail, the abrasive throwing and suction wheel **11** is mounted for rotation within a housing **16** fixed to the top of the cabinet **12**. The wheel **11** is driven by an electric motor **17** mounted adjacent thereto and connected by a belt pulley system **18** to the wheel. The drive motor **17** may be electrically connected to any suitable motor control device indicated by numeral **19** in FIG. 2 having a means for varying the wheel speed. The wheel housing **16** has a first vertical side plate **20** and a bearing **21** attached

thereto for supporting the wheel shaft. A second annular shaped side plate 22 is spaced from and parallel to the side plate 20 on the opposite side of the wheel and has an opening 23 for receiving an inlet fitting 24 that directs air and abrasive particles in separate streams into the wheel 11.

The wheel 11 comprises essentially a circular back face plate 25 and a parallel annular plate 26 connected together by the radially extending and circumferentially spaced apart vanes 13 that extend inwardly short of the wheel axis to define a central open space 27. The vanes 13 may be welded to the plates 25 and 26 or fixed thereto by means of a fir-tree type of interlocking joint or other suitable clamping means so as to be readily replaceable when worn. While it is possible to cant or curve the vanes to vary the air flow and flinging characteristics of the wheel 12, I prefer to use the straight vanes 13 fixed perpendicular and welded to the circular back-plate 25. It is obvious that the number of vanes can be varied to provide wheels with desired capabilities and efficiencies under certain blasting conditions. To decrease the wear on the vanes 13, I may cover the contact sides with a layer of some abrasion-resistant material such as tungsten carbide, which can be bonded directly to the vane surface.

The inlet fitting 24 is adapted to fit within the opening 23 of the wheel housing 16 and to direct separate streams of air and abrasive into the rotating wheel 11. It has a central portion 28 with a frusto-conical shape that is divergent in the direction of air flow into the wheel 11. Extending through the central portion 28 at one side thereof and parallel to its central axis is an attached tubular feed tube portion 29 for carrying the abrasive material. The large end of the divergent central portion 28 fits snugly within the central opening 23 of the wheel 11, and its small end is connected to a first main air duct or conduit 30 extending from the top of the cyclone separator 15 mounted closely adjacent to and above the wheel 11. The tubular feed tube portion 29 of the fitting 24 extends axially into the open space 27 within the wheel 11 and near its end is a side opening 31 that is positioned near the outer edge of the central space 27 in the wheel and directed radially outwardly. Thus, abrasive particles being metered out of the tube opening 31 are almost immediately engaged by the vanes 13. The other end of the abrasive feed tube 29 is connected by a flexible conduit 32 to the top of the cabinet.

The abrasive particles propelled by the wheel 11 are directed in a predetermined beam-like pattern downwardly through a slot or opening 33 in the top of the cabinet 12 and into the chamber 34 formed thereby. The cabinet 12 may have any convenient shape to accommodate various types of fittings or components being surface treated by the blasting system. Also, various means for supporting the fittings being treated within the cabinet 12 may be used within the scope of the invention. As shown in FIG. 1, the cabinet 11 is provided with an internal rotatable platform 35 situated directly beneath the throwing wheel 11. The platform 35 comprises generally a circular shaped frame structure 36 with a central hub 37 supporting an expanded metal or wire screen 38. It is mounted for rotation on a support arm 39 extending inwardly from a side door 40 of the cabinet 11. An auxiliary motor 41 is mounted on the outside of the cabinet 12 and is adapted to drive a shaft 42 extending therein to a bevel gear set 43 and to rotate the platform 35 at a predetermined rate. The motor 41 is also mounted on the cabinet door, and when the cabinet door 40 is swung outwardly, the work supporting platform 35 is readily accessible (see FIG. 2). Within the cabinet 12 directly below the movable work supporting platform 35 are a series of spaced apart horizontal members 44 forming a grate with openings 45 between the members through which the spent abrasive can fall downwardly into the collecting hopper 14 at the bottom of the cabinet 12. The hopper 14 has sloped side walls 46 and an orifice 47 at its lower extremity that is connected directly into the side of a second main air duct

or conduit 48. The lower end of the duct 48 is preferably connected to an opening 49 in the cabinet 12 near the upper end of the collecting hopper 14, although it could be open to the atmosphere or any source of air. The second main conduit 48 is connected at its upper end to the cyclone separator 15 where the abrasive material is removed from the main conveying air stream and is supplied to the feed tube 29 by gravity from the bottom end of the separator. Thus, my invention provides a completely closed system wherein the abrasive material is constantly being reused and recirculated from the collecting hopper 14 back to the throwing wheel 11 during the operation of the apparatus. The throwing wheel 11 provides the suction necessary to carry abrasive from the lower end of the collecting hopper 14 while entrained in an air stream in the conduit 48 up to the cyclone separator 15. The separator removes the abrasive material from the air so that it can be ejected into the wheel in a separate controllable stream, thereby greatly improving the efficiency and effectiveness of the apparatus.

The cyclone separator 15 may be of the well known type having a generally cylindrical shape with a frusto-conical bottom portion 50. The second main conduit 48 which is connected to the lower end of the hopper 14 at two places to supply both a flow of air and the abrasive particles entrained therein is connected to the cyclone saparator 15 tangentially near its upper end. As the air and abrasive material are whirled about in the separator, the abrasive particles are slowed in velocity and fall downwardly into its bottom portion 50 and thence through an outlet orifice 51 connected to the feed tube 29 that extends into the throwing wheel 11. The reduced pressure created within the wheel cavity 27 acting through the open end 31 of the feed tube 29 and through the conduit 32 connected to an outer end 52 of the feed tube 29 and to the cabinet 12 causes a relatively small flow of air through the feed tube 29 which is enough to move the abrasive being metered out of the lower end of the cyclone separator through the feed tube and into the wheel 11. However, this amount of air flow is relatively small compared with the amount flowing through the conical portion 28 of the first main conduit 30.

When a blasting treatment period has been completed on a piece of work within the cabinet 12 it is desirable to stop the flow of abrasive particles immediately so that the cabinet can be opened and the work piece removed without having to wait for the wheel to slow down. Thus, a control valve 55 is provided in the bottom outlet end 51 of the cyclone separator 15 which can be actuated to cut off the supply of abrasive material immediately after a blasting cycle has been completed. While several types of valves can be used, I prefer to use the valve 55 shown in detail in FIGS. 5–7 because it provides a positive seal that immediately stops the flow of the fine abrasive material and is easily controllable, as well as being extremely reliable. As shown, the valve 55 comprises a spherical elastomeric closure member 56 mounted on the end of a rigid rod 57 that extends down through the cylindrical outlet 58 at the bottom end of the cyclone separator 15. The end 51 of the cyclone outlet 58 that opens into the feed tube 29 has an inwardly tapered rim 59 that forms a seat for the spherical closure member 56. The upper end of the rigid rod 57 is connected to an overcenter linkage 60 comprising a first link 61 having a dog leg shape and pivotally connected to a crank member 62 that is fixed to a rotatable shaft 63 situated directly above the central axis of the cyclone separator outlet 58. The shaft 63, as shown in FIG. 2, extends outside the separator 15 and is connected by a chain 64 to a manually operated control handle 65. When the shaft 63 is turned, the crank member 62 is rotated, thereby moving the link 61 and its connected rod 57 and closure member 56 relative to the open end 51 of the separator. Rotation of the shaft and its attached crank one half revolution will move the closure member 56 from a full open position

as shown in FIG. 7 with the crank member 62 extending downwardly and the rod 57 aligned with the outlet 58 of the separator, through the half open position, as shown in FIG. 6, with the crank member 62 in a horizontal position and the rod 57 extending diagonally through the outlet 58, and the fully closed position, shown in FIG. 5, with the crank 62 in the upright position and the rod 57 aligned in the outlet opening 58 of the separator with the closure member 56 being held in sealing engagement with the valve seat 59. The spherical closure member 56 may be adjusted axially in position on the rod 57 by a pair of nuts 66 on opposite sides thereof so that the amount of sealing pressure exerted by the valve 55 can be adjusted to the desired amount.

The operation of my novel blasting apparatus is relatively simple, and yet it provides almost instantly a controllable, high velocity stream of abrasive particles in a concentrated stream directed into the cabinet 12. The centrifugal wheel 11 is rotated by the motor 17 with the motor control unit 19 providing the wheel with the proper speed. As the wheel rotates at the desired speed (e.g. 10,000 r.p.m.), a suction force is induced at its center cavity 27 and this force extends through the inlet fitting 24, the first main conduit 30, the cyclone separator 15, and the second main conduit 48 connected to the hopper 14 at the bottom end of the cabinet 12. Thus, as the wheel starts to rotate, air commences to circulate through the cabinet 12 through the main conduits 30 and 48, the cyclone separator 15, and through the wheel 11 where it is expelled back into the cabinet 12. Simultaneously, the abrasive material at the bottom of the cabinet 12 is entrained in the air stream and is carried upward through the conduit 48 into the cyclone separator 15. Here, the abrasive material is separated from the main air stream and falls to the bottom of the separator where it is metered downwardly through its outlet 51 into the feed tube 29. The separated air meanwhile exits from the top of the separator and passes through the conduit and the flared inlet fitting 24 into the centrifugal wheel 11. The abrasive material separated in the cyclone separator falls by gravity into the feed tube 29 and is assisted by a relatively small flow of air through the conduit 52 from the top of the cabinet 12 through the feed tube 29 and out its outlet end opening 31 facing radially adjacent the base of the vanes 13. The abrasive material is thus brought into the wheel in a concentrated stream and at exactly the proper point on the circumference of the wheel to produce an efficient high density pattern of propelled abrasive particles. This beam of abrasive particles is projected directly on the supporting platform 35 for whatever work piece is being treated and the work piece may be rotated as the blasting operation continues. The abrasive material after hitting the work piece drops through the grate openings 45 into the collecting hopper 14 where it is almost immediately sucked into the second main conduit 48. During normal operation all of the abrasive material being used is constantly circulating through the apparatus and does not accumulate in any sizable quantity in either the collecting hopper 14 or the separator 15.

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.

I claim:

1. In an abrasive blasting machine, the combination comprising:

a rotatable wheel having a plurality of vanes extending radially outwardly from an open space around the axis of said wheel;

a collecting hopper for the spent abrasive thrown from said wheel;

a main conduit communicating at one end with said open space of said wheel, open at its other end to a source of air and adapted to receive abrasive material from said collecting hopper whereby the abrasive is entrained in an air stream and conveyed through the conduit toward said wheel;

a cyclone separator connected in said main conduit above said wheel, for removing the abrasive from the air stream in said main conduit;

means for moving a stream of abrasive from said separator to one side of said open space within said wheel and means for dispensing the abrasive radially outwardly into contact with the wheel vanes;

whereby the abrasive is admitted to said wheel free from the influence of the air from said main conduit being sucked into the wheel and is centrifugally propelled by the wheel vanes into a predetermined work area.

2. In an abrasive blasting machine, the combination comprising:

a cabinet;

a rotatable abrasive throwing and suction wheel mounted on said cabinet and having a plurality of vanes extending radially outwardly from an open space around the axis of said wheel;

a hopper on the lower end of said cabinet for collecting the spent abrasive from said wheel;

a main conduit communicating at one end with said open space of said wheel, connected at its other end to said cabinet and to said collecting hopper thereby receiving abrasive material which is entrained in an air stream and conveyed through the conduit toward said wheel;

means connected in said main conduit above said wheel for removing the abrasive from the air stream in said main conduit;

means for moving a stream of the separated abrasive from said latter means into said open space within said wheel and for dispensing the abrasive radially outwardly into contact with the wheel vanes;

whereby the abrasive is admitted to said wheel free from the influence of the air from said main conduit being sucked into the wheel and the abrasive is centrifugally propelled by the wheel vanes into a predetermined work area.

3. An abrasive blasting system comprising:

a cabinet;

a rotatable abrasive-throwing and suction-inducing wheel mounted in said cabinet, said wheel having a plurality of vanes extending inwardly short of the axis of rotation to define a central open space;

means on said cabinet for driving said wheel;

a work holding means within said cabinet adjacent said wheel;

an abrasive collection hopper below said work holding means;

a separation means above said wheel for removing the abrasive material from the air stream that conveys it from the collection hopper;

a first conduit having one end open to a source of air and connected to the lower end of said collection hopper and to said separation means near its upper end;

a composite inlet means attached to said wheel including an air inlet member and a tubular feed member for abrasive material extending through said air inlet member, said tubular feed member having a side opening near one end adapted to extend within the said central space of said wheel and to dispense abrasive material radially outwardly and in contact with the wheel vanes, the other end of said feed member being open to a source of air;

a second conduit connecting the upper end of said separation means and said air inlet member adjacent

said wheel for conveying the main abrasive free air stream to the wheel;

and passage means for the separated abrasive material connecting the lower end of said separation means and said tubular feed member.

4. The abrasive blasting system as described in claim 3 including a valve means for controlling the rate of flow of abrasive material from said separation means into said feed member and thus into said wheel.

5. The abrasive blasting system as described in claim 4 wherein said valve means comprises a resilient closure member adapted to seat in an outlet orifice at the lower end of said separation means, and linkage means extending inside said separation means and fixed to said closure member to move said closure member to a predetermined position relative to said orifice thereby controlling the rate of flow of said abrasive material into said tubular feed member.

6. The blasting system according to claim 5 wherein said linkage means comprises a rotatable shaft, a crank arm fixed to said shaft and pivotally connected to link member fixed to one end of an elongated rod, said rod extending through said orifice of said separation means, said closure member being mounted near the other end of said rod.

7. The blasting system according to claim 6 including means on said rod for adjusting the position of said closure member thereon and thereby adjusting the sealing force of said closure member against said orifice.

8. An abrasive blasting system comprising:

a cabinet;

a rotatable abrasive-throwing and suction-inducing wheel mounted in said cabinet, said wheel having a plurality of vanes extending inwardly short of the axis of rotation to define a central open space;

means on said cabinet for driving said wheel;

a work supporting means within said cabinet adjacent said wheel;

an abrasive collection hopper extending below said work supporting means and having an outlet at its lower end;

a cyclone separator above said wheel;

a first conduit having one end connected to said cabinet and also said outlet at the lower end of said collection hopper, said first conduit being connected at its other end to said cylone separator;

a composite inlet means attached to said wheel including a conical shaped divergent air inlet member and a tubular feed member for abrasive material extending through said conical shaped air inlet member, said tubular member having a side opening near its free end extending beyond the large end of said conical air inlet member and within said central space of said wheel and thereby adapted to dispense abrasive material radially outwardly at a point closely adjacent the inner ends of said wheel vanes;

means connecting the other end of said feed member to the inside of said cabinet;

a second conduit connecting the upper end of said cyclone separator and said air inlet member adjacent said wheel for conveying the main abrasive free air stream to the wheel;

and means connecting said feed member with the lower end of said cyclone separator.

9. The abrasive blasting system of claim 8 including

means for completely stopping the flow of abrasive material to said wheel from said cyclone separator whereby work can be removed from said cabinet without waiting for the wheel to stop rotating.

10. The abrasive blasting system of claim 8 including a door on said cabinet, means fixing said work supporting means on said door, said work supporting means comprising a rotatable platform, and drive means for revolving the said platform at a predetermined rate during operation of the system.

11. An abrasive blasting machine comprising:

a wheel having vanes extending radially outwardly from an open space around the axis of said wheel, said vanes being adapted to fling abrasive particles centrifugually from its tips and to cause a reduced pressure in said open space when said wheel is rotated;

a main conveying duct having one end in communication with said open space of said wheel with its other end connected to an air supply and means for supplying abrasive material into said conduit thereby to convey it to a location above said wheel;

means situated above said wheel and connected in said main conveying duct for separating the abrasive material from the air stream being drawn into said wheel;

feed means for conveying the separated abrasive into said open space of said wheel near the outer edge of said open space and for directing the abrasive radially outwardly into the wheel vanes.

12. An abrasive blasting machine comprising:

an abrasive flinging means having vanes extending radially outwardly from an open space around the axis of said wheel adapted to create a reduced pressure in said open space when said wheel is rotated;

a main conveying duct having one end connected to said open space around the axis of said wheel and connected to a supply of air at its other end, and means for providing said main duct with a supply of finely divided abrasive particles, the suction force of the wheel thereby entraining the abrasive particles in the air stream and conveying them to a location above said wheel;

cyclone means connected in said main conveying duct between said wheel and said supply of air for separating the abrasive material from the conveying air stream;

means for receiving the separated abrasive and the conveying air stream into said open space of said wheel in separated streams, the abrasive particles being ejected radially outwardly near the outer edge of said open space and adjacent the inner ends of the wheel vanes.

References Cited in the file of this patent

UNITED STATES PATENTS

2,204,588	Guite	June 18, 1940
2,231,951	Rosenberger	Feb. 18, 1941
2,267,018	Eckler et al.	Dec. 23, 1941
2,429,742	Barnes	Oct. 28, 1947
2,682,135	Gladfelter	June 29, 1954

FOREIGN PATENTS

839,265	Great Britain	June 29, 1960