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4 Claims. (Cl. 51—8)

This invention relates to an improved system for fluidizing and conveying any powdered or finely ground material for use in abrasive blasting apparatus.

Abrasive blasting systems employing dry, finely-divided abrasives have proven to be remarkably effective for such operations as surface finishing sheet metal, removing fine grinding lines and scratches on machined parts, and deburring irregularly shaped castings. A problem, however, with such fine abrasive blasting systems employing abrasives up to 5000 mesh arose on how to efficiently and effectively fluidize the fine abrasive, transfer it to a conveying air stream, and then impart to it an adequate velocity in a blasting device such as a blast gun.

In my application Serial No. 700,315, filed December 3, 1957, now Patent Number 2,953,875 I disclosed a blasting system for fine abrasives which utilized a suction force applied to a supply of abrasive in a hopper to induce an airflow through the hopper. Inlet air to the hopper was drawn through a porous plate in the bottom portion of the hopper to fluidize the abrasive, and the fluidized particles were then sucked into a branching conduit of the suction line connected with the blast gun. One disadvantage of the aforesaid blasting system was the relative inefficiency of the suction induced airflow in providing a means to both fluidize and meter the abrasive into a conveying airstream. Also, in addition to the suction force, another source of pressure was required at the blast gun through a two hose system to provide the blasting velocity necessary for the abrasive particles.

Therefore, one important object of the present invention is to provide an improved abrasive blasting system for handling dry, finely-ground, powdered abrasive materials which affords more efficient utilization of the blasting air for fluidizing and conveying the abrasive materials, and ejecting them at high velocity.

Another object of the invention is to provide a pressure type abrasive blasting machine that affords an increased cleaning speed with a given high pressure air consumption over that afforded by the suction type devices of the prior art.

Still another object of the invention is to provide a blasting apparatus for dry, finely divided, powdered, abrasive materials wherein compressed air from a single source can perform the function of fluidizing the abrasive while also providing the pressure for imparting the required blasting velocity to the abrasive particles through a single hose connected to the blasting gun.

Another object of the invention is to provide an abrasive blasting system wherein the abrasive material is instantly fluidized by an initial blast of air directly into a pressure container having a supply of abrasive material when the apparatus is started up.

According to the principles of my invention, when the blasting apparatus is started, air under pressure is admitted directly through a feed T to a confined pressure container having a supply of abrasive material. During this initial rush of air, which instantly fluidizes the abrasive material and pressurizes the container, a second, slower moving, steady flow of air from the same compressor source is supplied through the porous plate at the bottom of the pressure container at a slightly higher pressure than the initial direct air source. The flow of air through the porous plate continues to fluidize the abrasive material, and as soon as the pressure exceeds that of the direct air stream, which occurs in a matter of a few seconds, the flow in the feed T is reversed and the abrasive-laden

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air is metered out to the blasting gun. This is an important novel feature of my invention since it not only provides for rapid starting of the blasting process but also provides for the constant efficient metering of the abrasive material at a relatively low consumption of pressurized air when the steady state flow is reached shortly after starting.

Another object of the invention is to provide a pressurized abrasive blasting system for finely divided abrasive materials which automatically scavenges the dust from and supplies clean abrasive to the pressure pot after each shutdown.

Other objects and advantages of my invention will be apparent from the following description and from the drawings in which:

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

FIG. 2 is an enlarged plan view of the feeder fluidizer shown on the apparatus of FIG. 1. Portions have been broken away to show greater detail.

FIG. 3 is a view in elevation and in section taken along the line 3—3 of FIG. 2.

An abrasive blasting system 10 according to the principles of my invention is shown in FIG. 1 and comprises a steel pressure pot 11 which is loaded with a supply of abrasive material 12. The size of the abrasive material may be from 100 mesh to 5000 mesh depending on the work to be done.

To the bottom of the pressure pot 11 is attached a feeder-fluidizer 13 which includes a feed T housing 14 with a feed T 15 extending vertically through it and terminating at a restricted orifice 16 in the lower portion of the pressure pot 11 (FIG. 3). The lower end 17 of the T 15 is connected into a straight tube section 18 which is welded or otherwise suitably attached to the bottom of the T housing 14, said T 15 and said tube 18 forming a branching T-shaped conduit section. The tube section 18 is threaded at one end 19 to facilitate its attachment by a conduit 20 to a blasting gun or nozzle 21 and the opposite end 22 of the tube section 18 is also threaded to connect with a conduit 23. A suitable source of compressed air such as a compressor unit 24 supplies air at the desired pressure e.g. (100 p.s.i.) through an outlet conduit section 25 to operate the apparatus. The compressor can be turned on or off to start or stop the blasting operation. A conduit 26 extends directly from the conduit section 25 and supplies air to the housing 14 of the feeder fluidizer 13 at the outlet pressure, i.e., 100 p.s.i. The outlet section 25 is also connected at its exit end to a standard spring check valve 27 having a constant pressure drop orifice so that at the outlet end of the spring check valve 27, which connects to the conduit 23, the air is at a reduced pressure (e.g. 95 p.s.i.).

The feeder-fluidizer 13 is shown in greater detail in FIGS. 2 and 3. The housing 14 is preferably disc shaped, having a circular center cavity 28 surrounded by a circular shoulder or recess 29. The recess 29 supports a circular porous stone partition 30 of substantially uniform thickness through which extends the feed T 15. The porous stone partition 30 provides a large plurality of tortuous air passages through its interstices so that when air is forced against its lower surface 31 a turbulent exit air flow is produced on its upper side 32 which fluidizes the fine, powdered abrasive 12 in the bottom of the pressure pot 11. Any suitable porous material having many small multi-directional passages which produces this turbulent air effect may be used for the partition 30. I have found that the well-known resin bonded quartz filter is a highly effective material for this purpose.

At the upper end of the pressure pot 11 is attached a collecting hopper 33 and to the top of the hopper 33 is

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fixed a cyclone 34 of the well known separator type having an air inlet 40. By use of a separator the treating abrasive material may be re-used several times, thereby permitting the economical use of relatively expensive treating materials. As diagrammatically shown, the blast gun 21 may be operated within a confined blasting cabinet 35 from which the spent abrasive and debris particles are conveyed through a conduit 36 to the cyclone 34. A screen 37 is fixed within the hopper 33 to filter out any large pieces of debris which may be returned through the separator 34 and which should not be recycled through the blast gun 21.

As shown schematically in FIG. 1, a dust removal conduit 38 is connected from the pressure pot 11 through a valve 39 to the cyclone separator inlet 40. The valve 39 is a standard pinch valve and is mounted on an outlet fitting 41 located near the upper portion of the pressure pot 11. The pinch valve 39 has a diaphragm 42 which forms one wall of a chamber 43, the diaphragm 42 being responsive to pressure to shut off the flow of air through the conduit 38. A conduit 44, attached to the compressor 24, may be connected to a T-fitting 45 which is also connected by a conduit 46 to the chamber 43. Extending from the other branch of the T-fitting 45 is a preferably rigid conduit 47 which extends through the wall of and into the pressure pot 11.

In operation it is desirable to close the pressure pot 11 whenever abrasive material is being fed from it to the blast gun 21. When this operation ceases it is desirable to have any reclaimed abrasive in the collector hopper 33 flow into the pressure pot 11. To provide for the flow of abrasive into the pressure pot, a plate 48, having an orifice 49 separates the pressure pot 11 and the hopper 33. A valve plug 50 is fitted to the opening 49 which preferably is equipped with a suitable gasket 51. The plug 50 may be made to open by gravity or by a spring 55 attached to a tubular extension 56 on the plug 50 which slides freely on a tubular support 52 mounted on the end of the rigid conduit 47. The valve 50 is held closed by air passing through the branch conduit 47, the support tube 52, and a bellows 53 rigidly secured by a ring 54 to the tubular support 52. Thus, the plug valve 50 closes as soon as air comes into the line 47. This seals the pressure pot 11 so that the air applied to the pressure pot 11 through the feed T 15 and the porous plate 30 will be confined in the pressure pot 11 as it initially fluidizes the abrasive 12. As the air pressure increases in the pressure pot 11 due to its confinement when the valve 50 is closed, the air flow in feed T reverses its direction and then exits as abrasive-laden air through the orifice 16 of the feed T 15. As soon as the air pressure is turned off, the valve plug 50 drops due to the spring 55 plus the weight of the treating material above it and refills the pressure pot 11. In this way automatic refilling of the pressure pot 11 is effected.

The present invention accomplishes the fluidizing and feeding of finely divided abrasive particles in an efficient manner by use of positive air pressure in the pressure pot 11 rather than a relatively inefficient vacuum or suction type system. With my novel arrangement of elements a single source of air pressure can be utilized to: (1) fluidize the abrasive through the porous plate 30; (2) close the dump valve 50; (3) convey the abrasive-laden air into the stream of blasting air from the same air source; (4) impart the necessary blasting velocity to the abrasive particles; and (5) release the pressure in the pressure pot 11 after the blasting run has been completed so that the dump valve can open and allow new abrasive to flow into the pressure pot.

Briefly summarizing the operation of my blasting apparatus 10 with reference to FIG. 1, when pressure is initially supplied from the compressor 24, it is supplied through line 46 to close the diaphragm 42 of the pinch valve 39 in the blowoff conduit 38 and it also flows in-

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the top of the pressure pot 11. Pressure from the compressor 24 is also supplied simultaneously through the conduits 25 and 26 to the feed T 15, the space 28 in the housing 14 beneath the porous plate 30, and through the spring loaded check valve 27 into conduit 23 where the pressure is reduced somewhat from the pressure in conduit 25.

Since there are no obstructing valves in the conduit 44, air flows in line 47 and the valve 50 is actuated to close off the collecting hopper 33 just before a surge of air flows through the line 23 and upward through feed T 15 into the pot 11. This initial surge of air into the pot 11 causes a large reverberating turbulence which creates an almost instantaneous fluidizing action of the abrasive material 12. The pressure in the pot 11 rises rapidly and simultaneously, air applied through the conduit 26 to the housing 14 commences to flow up through the porous plate 30. As the air exits along the upper surface 32 of the plate 30 its turbulence causes a further steady fluidizing action on the abrasive 12 in the pot 11. The pressure in the pot 11 due to these two air input sources, rapidly reaches an equilibrium pressure equal to the pressure of the air through the feed T 15, and since the pressure through the porous plate 30 is greater than this pressure coming directly through the line 23 the flow of abrasive-laden air now is downward into the orifice 16 of the feed T 15. At the lower end 17 of the feed T 15 this metered, abrasive-laden air then joins the main stream of the higher velocity air from conduit 23 through the tube 18 and thence to the blast gun 21.

The feature of my blasting apparatus which provides for the initial starting surge of pressure within the pressure pot 11 after the valve 50 has quickly closed is important, because it provides almost instant response to the system and there is little or no energy lost in initially fluidizing the material. Also, because of the initial fluidization a relatively small amount of air is required to flow through the porous plate 30 to maintain a steady metered flow of abrasive to the blasting air stream in the steady state operating condition. Thus, a single source of compressed air fluidizes the abrasive and also conveys it at the proper velocity through the blasting gun. The result, in effect, is a blasting system with increased speed yet without an increase in pressure air consumption.

In constructing the blasting system according to the present invention the sizes of the various components such as the porous plate 30 will be chosen according to the size of the abrasive and the size of the blast gun. The amount of pressure drop provided by the valve 27 can be varied to vary the steady-state pressure differential between the pressure pot 11 and the pressure in conduit 18 to thus vary the flow of abrasive. Also, the feed T 15 can be varied in size and the orifice 16 of the feed T 15 may be set at varying distances above the porous plate so that a larger amount of debris particles can collect on the plate rather than feed into the blasting stream. This debris can be cleaned out during shutdowns.

The embodiment of the invention which I have described refers to the preferred form thereof and it is evident that numerous changes in details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit or scope of the invention as hereinafter claimed.

I claim:

1. A device for fluidizing and metering a flow of finely-divided abrasive particles contained in an air stream comprising, in combination: a source of air under pressure; a pressure vessel containing a supply of fine abrasive particles; a housing secured to the bottom of said vessel; a porous partition having a large number of tortuous air passages and separating said housing from said pressure vessel while forming a space in said housing below said partition; a first conduit extending from said air pressure source and connected to said housing below said partition; a second conduit extending from said air

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pressure source and connected to a blast nozzle; an abrasive feeding tube at the bottom of said pressure vessel extending through said porous partition and said housing, and having an orifice at its upper end open to the interior of said pressure vessel, said tube also being connected at its lower end to said second conduit; and pressure reducing means in said second conduit for reducing the air pressure in said second conduit and thereby controlling the metering of abrasive particles through said feeding tube; whereby when said device is started up, a flow of air is provided upward through said second conduit and said feed tube directly into said vessel to rapidly fluidize said supply of abrasive particles therein, after which, when equilibrium pressure is reached within said pressure vessel, the abrasive particles are continuously fluidized by the flow of compressed air through said first conduit and said porous partition and a flow of abrasive-laden air is metered downward through said feed tube and into the air stream of said second conduit extending to said blasting device.

2. A device for treating the surface of materials with fine abrasive particles contained in an air stream, comprising in combination: a compressor; a pressure vessel having a lower opening and containing a supply of fine abrasive particles; a housing secured to the bottom of said vessel and covering said lower opening; an air pervious porous plate member extending across said lower opening, between said housing and said pressure vessel and forming a space in said housing below said porous plate member; a feed tube extending from said pressure vessel from near its bottom, said tube terminating at its upper end above said porous plate member and thereby open to the interior of said pressure vessel, and having a lower end extending outside of said pressure vessel; a first conduit extending from said compressor and connected to said housing below said porous plate; a second conduit extending from said air pressure source to a blasting device and connected at an intermediate point to said lower end of said feed tube extending from said pressure vessel; and check valve means for reducing the air pressure in said second conduit below that of said first air line; whereby when said device is started up, a flow of air is provided upward through said second conduit and said feed tube directly into said vessel to rapidly fluidize said supply of abrasive particles therein, after which, when equilibrium pressure is reached within said pressure vessel, the abrasive particles are continuously fluidized by the flow of compressed air through said first conduit and said porous plate and a flow of abrasive-laden air is metered downward through said feed tube and into the air stream of said second conduit extending to said blasting device.

3. A blasting apparatus for treating the surface of materials with fine abrasive particles contained in an

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air stream comprising, in combination: an air compressor; a pressure vessel; a supply hopper for abrasive materials located above said pressure vessel; an opening between said hopper and said pressure vessel to provide for the flow of abrasive material from said hopper into said pressure vessel; pressure responsive valve means connected to said air compressor and movable into a position to close said opening; a housing secured to the bottom of said vessel; an air pervious partition of porous material having a multiplicity of tortuous air passages and separating said housing from said pressure vessel while forming a space in said housing below said partition; an abrasive feeding tube extending from the bottom of said pressure vessel at its lower end and terminating at its upper end in an orifice on the upper side of said porous partition and thereby open to the interior of said pressure vessel; a first conduit extending from said air compressor and connected to said housing below said partition; a second conduit extending from said air compressor connected to said abrasive feeding tube below said housing and connected to a blast nozzle at its outlet end; and valve means for providing a greater air pressure in said first air line than said second air line; whereby when said blasting apparatus is started up a flow of air is provided from said air compressor to said valve means to close said opening between said hopper and said pressure vessel, and air also flows upward through said first air line through said porous partition to fluidize said abrasive in said pressure vessel, and to force a flow of abrasive-laden air downward through said abrasive feeding tube into said second conduit and thence to the blast nozzle.

4. The blasting apparatus of claim 3 including means responsive to said compressor for providing an immediate release of pressure in said pressure vessel and for scavenging dust particles from said pressure vessel, said means comprising: an outlet conduit extending from said pressure vessel and connected to said supply hopper, valve means in said outlet conduit connected to said compressed air source having diaphragm means for closing said conduit in response to air pressure during the blasting operation and for opening said conduit to release the air pressure in said vessel when the blasting operation ceases.

References Cited in the file of this patent

UNITED STATES PATENTS

2,292,897	Nielsen	Aug. 11, 1942
2,455,514	Mead	Dec. 7, 1948
2,667,015	Berg	Jan. 26, 1954
2,759,266	Cassani	Aug. 21, 1956
2,953,875	Mead	Sept. 27, 1960