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PRESSURE BLAST APPARATUS

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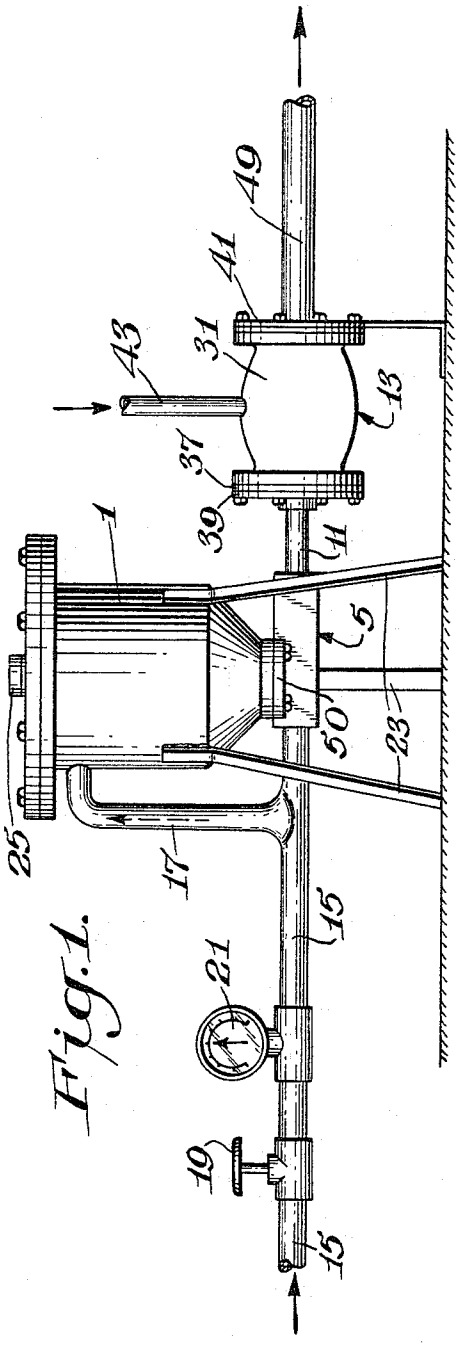


Fig. 1.

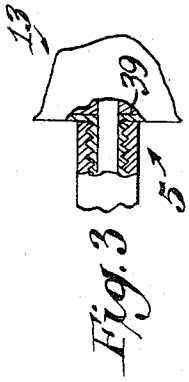


Fig. 3



Fig. 2.

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# PRESSURE BLAST APPARATUS

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This invention relates to a pressure blasting machine for projecting a stream of abrasive particles or grit against a surface to remove superfluous materials such as grease, carbon and dirt. More particularly, this invention relates to mixing chamber for use in an apparatus for cleaning the internal surface or wall of tubing.

In order to effectively clean the interal wall of metal tubes of scale, grease, dirt and the like, the use of an abrasive blast wherein abrasive particles are projected at high speed against the internal surface to be cleaned has been found to be generally desirable. However, prior attempts to provide an efficient abrasive blasting device for this purpose have proven to have various disadvantages.

Where a very small quantity of abrasive is involved, requiring a small opening in the flow regulator, and where the particle size of the abrasive is small, uniform flow of abrasives into the gas stream has always been troublesome. The particles do not feed themselves properly into the blasting mechanism. The particles have a tendency to bridge or pack in the passageway they move through and, as a result, the particle flow is cut off. The jammed particles may then suddenly break loose, and this short-cycle (on-off effect) requires careful attention to assure thorough cleaning.

There have been prior art attempts to solve the above mentioned problem but these attempts involve complicated machines and constant regulation. One prior art method is illustrated by United States Patent 2,652,662 and involves a machine which shakes the abrasive mixture into the line of flight much as a salt or pepper shaker.

In direct pressure blasting, a controlled amount of abrasive is fed from a closed tank under pressure through a hose into which the conveying gas is flowing to a nozzle or work holding chuck. The abrasive holding tank is held at nominally the same pressure as the gas feeding into the mixing chamber by a by-pass from the feed line to the top of the tank or other suitable means. According to the present invention, a mixing chamber for the gas and abrasive is provided with the bore conforming to the geometry of a venturi section. In a properly shaped bore with smoothly decreasing diameters and then smoothly increasing diameters a lower pressure exists at the smallest diameter or throat than at either end where the diameter is larger. In this invention, the abrasive from the supply tank is metered into this point of smallest diameter while the tank itself is attached in parallel to the air supply, thereby the tank has a higher gas pressure than the throat of the mixing chamber. This differential in pressure has been found very effective in promoting uniform flow of small particle abrasives. The same action occurs with heavy flow of large size abrasive.

The present invention has an object to provide a new and novel blasting apparatus containing an abrasive mixing chamber which allows a constant, uninterrupted flow of abrasive particles to flow into the line.

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Another object is to provide a new, novel, simple and economical method of producing an uninterrupted flow of abrasive particles which does not require constant regulation.

Another object is to produce a uniform flow of abrasives into a stream of high pressure ga sused in the blast cleaning of pipe interiors.

Other objects of the invention will become apparent from the following description and drawings wherein:

FIGURE 1 is a side view of the pressure blasting apparatus of the present invention;

FIGURE 2 is a section of the mixing chamber portion of the machine of FIGURE 1 as well as of the blast sealing, work clamping means preferably used when blasting long, small diameter tubing; and

FIG. 3 is a fragmentary view partially in section of a modified form of connection for the mixing chamber.

The machine of FIGURE 1 includes a tank or supply hopper **1** for receiving and storing a quantity of abrasive particles. The bottom portion of tank **1** has a discharge opening **27** (see FIGURE 2) which empties into mixing chamber **5** wherein the abrasive particles are mixed with the propellant gas. Mixing chamber **5** has a feed opening **7** for receiving the stream of gas under pressure and a discharge opening **9** for discharging the impelled stream of particles and gas therefrom. A connecting conduit **11** is attached to both the discharge opening **9** at one end and at the other end to one end of a blast sealing, work clamping means **13** (see FIGURE 2). The material to be cleaned (e.g., tubing) is attached to the opposite end of the connecting conduit.

The aparatus in FIGURE 1 includes a gas delivery conduit **15** for providing a stream of gas under pressure to mixing chamber **5** and a shunt conduit **17** connecting the gas delivery conduit to the supply tank **1** for delivering gas under pressure to tank **1**. Conduit **15** can have an optional valve **19** and gauge **21** for regulating the stream of gas.

The apparatus of FIGURE 1 is illustrated as a portable type supported on a tripod framework **23** secured to tank **1**. The machine may of course be stationary.

In FIGURE 2 a filler plug **25** is shown for the supply tank **1** which permits the loading of abrasive particles into tank **1**. The bottom portion of tank **1** has a discharge opening **27** feeding into metering orifice **28** contained in mixing chamber **5**. Tank discharge opening **27** empties into mixing chamber **5** through metering orifice **28** at the point of smallest diameter as shown. Mixing chamber **5** takes the form of a venturi section; that is, it comprises a chamber with a first smoothly decreasing diameter and then a smoothly increasing diameter, the point of smallest diameter being known as the throat.

As mentioned above, conduits **17** and **15** are connected to tank **1** and mixing chamber **5** respectively. These conduits supply equal pressure, and preferably are supplied from a common source although it is possible to have an independent supply for each.

The connecting conduit **11** interconnects mixing chamber **5** and blast sealing, work clamping means **13**. In the modification shown in FIG. 3 blast sealing, work clamping means **13** is connected directly to mixing chamber **5**.

Blast sealing, work clamping means **13** has a hollow

rigid housing 31 containing a receiving opening 33 and a discharge opening 35. Sleeve 37, which is flexible and which has flanges at its ends, is attached by means of liner clamps 39 and 41 to the inside of rigid housing 31. Clamping pressure supply conduit 43 is connected to rigid housing 31 at opening 45. Liner clamp 39 is attached to the discharge end of connecting conduit 11 by opening 40 in the clamp. Liner clamp 41 is provided with opening 47 into which the workpiece 49 is inserted.

As described above, during operation of the blasting machine equal pressure is supplied to tank 1 and mixing chamber 5 by means of conduits 15 and 17. Mixing chamber 5 is so shaped that the gas passes first through a smoothly decreasing diameter and then a smoothly increasing diameter. At the point of smallest diameter in the mixing chamber where metering orifice 28 is located, the pressure is lower than at either of its ends where the diameter is larger. Since tank 1 is under a pressure equal to the pressure of the large diameter portion of the mixing chamber 5, the abrasive particles in tank 1 are forced through opening 27 into mixing chamber 5 through metering orifice 28, are mixed with the gas stream, discharged through opening 9, carried through connecting conduit 11 and directed at the desired article.

When dealing with inside diameter blasting of a long, small diameter tubing it is preferred to use the blast sealing, work clamping means illustrated in FIGURE 2. This provides a simple means for holding the workpiece. The flexible liner or diaphragm 37 clamps tightly around the workpiece when gas pressure is supplied through its clamping pressure supply conduit 43 thereby preventing loss of abrasive around the workpiece periphery as well as preventing the workpiece from being blown out of position.

Where it is desired to insert a workpiece, clamping pressure conduit 43 and feed conduits 15 and 17 are shut off and flexible sleeve 37 is in its normal (expanded) attitude. The workpiece is inserted through opening 47 and is placed against liner clamp 39. Liner clamp 39 acts also as a locating plate and allows easy and automatic alignment of the workpiece and opening 33. Once the workpiece is in place, clamping pressure conduit 43 is opened and the pressure forces flexible sleeve 37 tightly around the workpiece. This holds the workpiece in place and prevents loss of abrasive around its periphery.

Blast sealing, work clamping means 13 is preferably installed as close as possible to mixing chamber discharge opening 9. It is possible to locate the clamping means some distance frome the mixing chamber. Preferably, however, blast sealing work clamping means 13 and mixing chamber 5 are placed in a single unitary housing.

Typical action of the inventive mixing chamber is illustrated by following. A mixing chamber is provided with inside diameter of 0.25 inch at the entrance of gas. The chamber is of smoothly decreasing diameter for a length of .887 inch. The smallest inside diameter is .0625 inch for a length of .0625 inch. The mixing chamber then smoothly increases in diameter for 2.125 inches reaching an inside diameter of 0.25 inch at the discharge end. At the point of smallest inside diameter (i.e., .0625 inch), an opening is provided measuring .025 inch in diameter. This mixing chamber is attached to a workpiece consisting of a 20 foot long tubing having an inside diameter of .060 inch. A stream of gas (no abrasive) was used to measure the pressure differential generated by the mixing chamber of the instant invention. At 300 p.s.i.g. inlet pressure the pressure at the smallest inside diameter was 281 pounds giving a 9 pound differential. At 500 p.s.i.g. inlet pressure the presure at the smallest inside diameter was 495 p.s.i.g. (pounds per square inch gauge) or a 5 pound differential.



To satisfactorily blast clean the bore of long, small diameter tubing it is necessary to generate sufficient abrasive velocity to thoroughly scour the tube wall. While most generally used pressure blast cleaning is done at pressures of 100 p.s.i.g. or lower, this pressure is not high enough to generate the velocities needed for small bore blasting. As an example: a 17 ft. long tube with a 3/32" bore requires 380 p.s.i.g. to obtain an 80 p.s.i.g. discharge pressure; a 19 ft. long tube with a 1/16" bore requires 500 p.s.i.g. inlet pressure to obtain 75 p.s.i.g. discharge pressure. Blasting the bores of tubes nominally 20 ft. long with a nominal bore diameter of 1/16" requires approximately 500 p.s.i.g. inlet pressure for efficient operation.

Small bore tubing blasts can be accomplished most satisfactorily with fused aluminum oxide or similar material 100 mesh size or finer.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope hereof, it is to be understood that this invention is not limited to the specific embodiments hereof, except as defined in the appended claims.

I claim:

1. A pressure blast apparatus for projecting a stream of abrasive particles comprising a hopper for receiving and storing a quantity of said abrasive particles under pressure, an opening in said hopper for receiving gas under pressure, and a discharge opening in said hopper for discharging said abrasive particles, a mixing chamber attached to said hopper at said discharge opening for receiving said discharged particles therefrom, an opening in said mixing chamber for receiving a stream of gas under pressure, and a discharge opening in said mixing chamber for discharging said particles and said stream of gas, the interior of said mixing chamber conforming to a venturi configuration with the point of discharge from said hopper into said mixing chamber being at the point of smallest diameter in the venturi configuration.

2. The apparatus of claim 1 wherein a gas supply conduit is connected with said mixing chamber for supplying gas under pressure, said conduit being branched with the branch being connected with said hopper.

3. The apparatus of claim 1 wherein a connecting conduit is attached to said mixing chamber discharge opening, and a blast sealing work clamping means is attached to said connecting conduit, said work clamping means comprising a hollow rigid housing, containing a receiving and a discharging opening in said housing, a flexible sleeve contained within said housing being capable of tightly gripping a workpiece inserted therein upon application of pressure to the exterior of said flexible sleeve, a receiving clamping means attached at said receiving opening of the rigid housing, a receiving opening in said receiving clamping means to allow passage of gas from said connecting conduit into said rigid housing, a discharge clamping means attached to said discharge opening in said rigid housing, a discharge opening in said discharge clamping means to allow the discharge of gas from said rigid housing and the insertion of a workpiece into said rigid housing, both said clamping means holding said flexible sleeve to said rigid housing between said receiving and discharging openings, said rigid housing containing a receiving means for the introduction of pressure between said rigid housing and said sleeve.

4. The apparatus of claim 1 wherein blast sealing, work clamping means is attached directly to said mixing chamber discharge opening, said work clamping means comprising a hollow rigid housing, containing a receiving and a discharge opening in said housing, a flexible sleeve contained within said housing being capable of tightly gripping a workpiece inserted therein upon application of pressure to the exterior of said flexible sleeve, a receiving clamping means attached at said receiving opening of the rigid housing, a receiving opening in said receiving clamping means to allow passage of gas from

said mixing chamber into said rigid housing, a discharge clamping means attached to said discharge opening in said rigid housing, a discharge opening in said discharge clamping means to allow the discharge of gas from said rigid housing and the insertion of a workpiece into said rigid housing, both said clamping means holding said flexible sleeve to said rigid housing between said receiving and discharge openings, and said rigid housing containing a receiving means for the introduction of pressure between said rigid housing and said sleeve.




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