

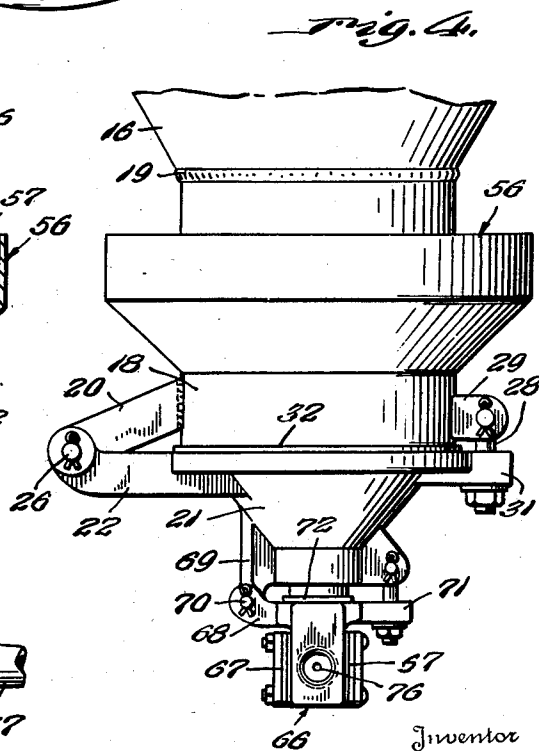
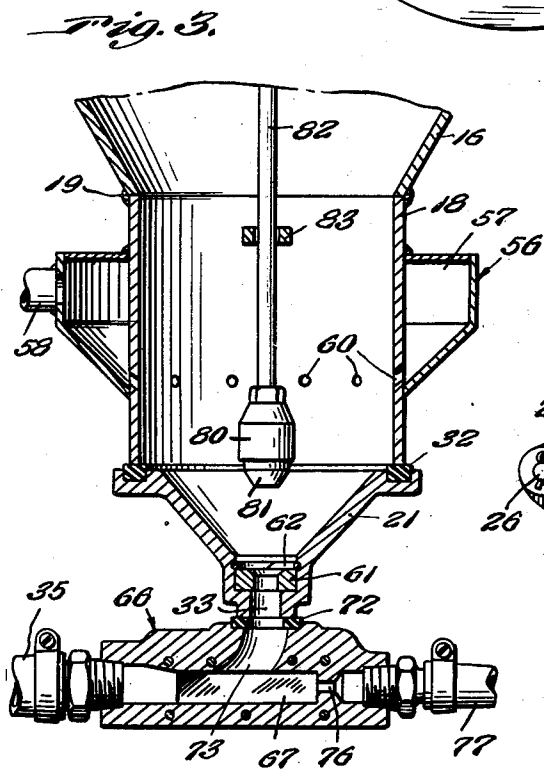
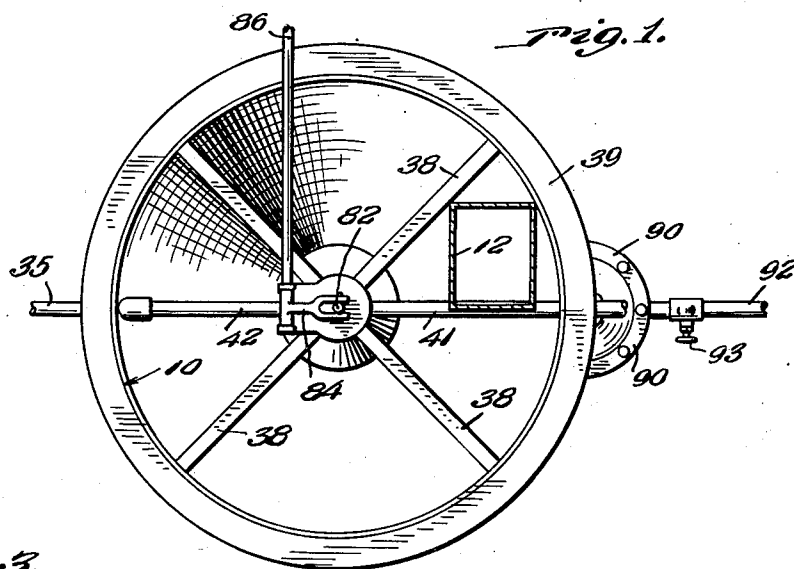
April 3, 1945.

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HYDRAULIC SAND FEEDER

2,372,957

Filed Dec. 23, 1943

2 Sheets-Sheet 1



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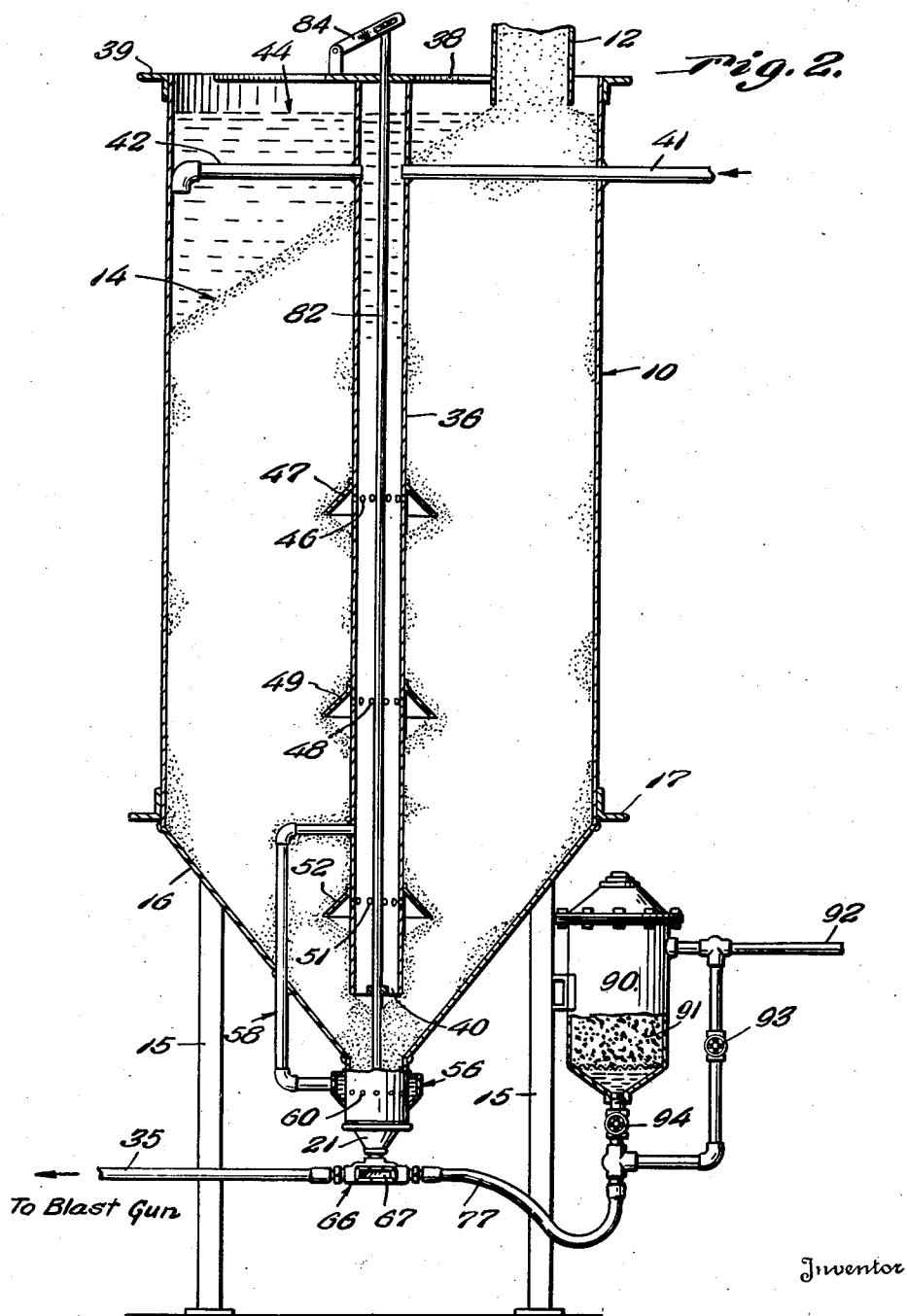
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2 Sheets-Sheet 2



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2,372,957

HYDRAULIC SAND FEEDER

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Application December 23, 1943, Serial No. 515,445

9 Claims. (Cl. 51—12)

The present invention relates to apparatus for storing and feeding an abrasive such as sand in a flowable condition to a hydraulic blast gun wherein the sand particles are moved forwardly by means of a high velocity jet of liquid. The invention more specifically pertains to apparatus for supplying wet sand in such a fluid condition that the mixture or slurry may be drawn into the hydraulic blast gun by the injector action developed in the gun.

A hydraulic blasting system includes a gun having a nozzle through which a stream of liquid such as water is forced at high velocity. This water jet is employed to propel an abrasive medium into engagement with an article or a surface to be blasted. The abrasive is necessarily made wet by the water jet and the expended water and abrasive are collected in a sump for reuse. In view of the fact that the abrasive is wet, and since molding sand is removed from some of the articles cleaned and mixed with the spent abrasive particles, sand is usually employed as the abrasive medium. The wet sand recovered for reuse in the blasting operation presents a problem in the handling thereof in that this sand cannot be readily supplied to the blast gun. The wet sand readily packs and must be maintained in a somewhat fluid state if it is to be drawn into the hydraulic blast gun by an injector action created within the gun.

Accordingly it is an object of the invention to provide means for storing a quantity of wet sand to provide an adequate supply for a hydroblast gun including means for supplying liquid to the wet sand at various points in the storage means so as to provide a flowable mixture of sand whereby the sand slurry may be readily conveyed to the blast gun.

Another object of the invention pertains to the provision of means for preventing the abrasive material used by a hydraulic blast gun from packing within a hopper supplying the gun including means for preventing the abrasive material from obstructing the supply line leading from the hopper to the blast gun.

A more specific object of the invention resides in providing a relatively large hopper for storing a quantity of wet sand including means associated therewith for supplying liquid at various zones within the wet sand and for supplying liquid adjacent an outlet orifice for the sand to prevent packing of the wet sand and for rendering the abrasive material sufficiently fluid for moving to a hydraulic blast gun through a supply line.

A further object of the invention pertains to means for adding liquid such as water under a relatively low pressure to the supply line leading from the storage hopper to the blast gun for preventing the packing of small quantities of sand in the hose in the first instance and thereby maintaining the supply line open for the movement of the sand therethrough from the supply hopper as a result of a partial vacuum generated by the hydraulic blast gun.

Other objects and features of the invention will be more apparent to those skilled in the art of hydroblasting upon consideration of the accompanying drawings and the following detailed description wherein an exemplary embodiment of the invention is disclosed.

In the drawings:

Fig. 1 is a plan view of the hopper or bin for storing a quantity of abrasive in such a flowable condition as to be drawn into a hydraulic blast gun.

Fig. 2 is a sectional elevational view of the hopper shown in Fig. 1 and embodying features of the invention.

Fig. 3 is an enlarged sectional view of the lower end portion of the hopper illustrating details thereof.

Fig. 4 is a side elevational view of the lower end portion of the hopper taken at right angles to Fig. 3.

Referring to the drawings there is shown at 10 a hopper or bin which is adapted to receive and store a quantity of abrasive for use in connection with a hydraulic blasting operation. In carrying out a hydroblasting operation a gun is employed to which liquid under pressure such as water is supplied to form a high velocity jet. This jet is usually so arranged as to develop a partial vacuum within the gun and thereby draw or suck the abrasive material into the gun. The high velocity jet is also adapted to entrain the abrasive material and propel the abrasive particles forwardly as a forcible blast stream into engagement with the surface or article to be blasted. In carrying out such a blasting operation the abrasive material becomes wet by the liquid propelling medium and it is customary to reuse the abrasive. In blast cleaning castings the molding sand and core sand also become wet and this material becomes intermingled with the blasting abrasive. Thus the abrasive employed in hydroblasting is usually wet sand. The wet sand provides a serious problem in endeavoring to return the wet abrasive particles to the blast gun. This wet abrasive material has a tendency to pack and

block apertures and small passages such as employed in the abrasive supply apparatus and in the feed line extending to the hydraulic blast gun. This problem has been encountered in the past in connection with hydroblasting systems and it has often been found that the prior types of sand feeding devices failed to function satisfactorily in that the wet sand packs or settles to such an extent that the gun often functions without any sand being supplied thereto. The present invention thus provides means for preventing the packing of the wet sand stored in the hopper or bin 10 and adjacent the outlet orifice therefor and at the same time rendering the sand sufficiently fluid for facilitating the movement thereof through the abrasive supply line to the gun.

The abrasive may be supplied into the hopper 10 in any suitable manner and in the embodiment illustrated a chute 12 is provided through which the wet sand is admitted to the hopper 10 from any supply source such as from classifying apparatus which processes the wet sand received from the blasting booth or room. The sand supplied to the hopper 10 may contain some moisture and as the abrasive fills the hopper 10 the outlet end of the chute 12 is blocked when the sand assumes its normal angle of repose as indicated at 14 in Fig. 2. The sand is preferably delivered to the chute or spout 12 in such quantities as to maintain the bin 10 substantially full even when the blast gun is functioning.

The hopper 10 may be supported in any suitable manner such as by means of standards or legs 15 two of which are shown in Fig. 2. The hopper or bin 10 is reinforced by an annular ring member 17 which may be welded to the bin. The legs or standards 15 preferably depend from the ring member 17. The hopper 10 may be of any suitable cross sectional shape and in the embodiment illustrated is cylindrical at the upper portion thereof. The lower end of the hopper is provided with inwardly sloping side walls and in the embodiment depicted in the drawings the base portion is frusto conical shaped as shown at 16. A substantially cylindrical shaped tubular member 18 is attached to the inverted apex portion of the conical shaped base 16. The tubular member 18 may be welded to the base portion 16 as indicated at 19 in Fig. 3 to provide a liquid tight connection between these parts. The tubular member 18 terminates at its lower end to provide a relatively large opening through which the sand may move downwardly into a cup member 21 as shown in Fig. 3.

The cup member 21 is preferably mounted in a removable manner so that the lower end of the sand hopper may be opened for the purpose of inspection and for removing any large particles which may inadvertently find their way into the sand hopper and for facilitating the assembly of parts of the apparatus as hereinafter described. Thus the cup member may be pivotally mounted at the lower end of the sand hopper. An exemplary arrangement includes an arm 22 secured to the cup member 21 and pivotally connected to a bracket 20 carried by the tubular member 18. The arm 22 and the bracket 20 may be connected by means of a pin 26 so as to provide a hinged mounting for the cup shaped member 21. The opposite side of the cup member 21 is provided with a suitable locking arrangement so as to maintain the cup member in a position to close the lower end of the tubular member 18. In the embodiment illustrated a swingable bolt 28 is car-

ried by a bracket 29 projecting from the tubular member 18. The bolt 28 passes through a lug 31 extending laterally from the cup member 21 whereby this closure member may be clamped against the lower end of the tubular member 18. A gasket such as a yieldable or resilient washer 32 may be interposed between the lower end of the tubular member 18 and the periphery of the cup member 21. An annular groove is provided in a flange portion of the cup member to facilitate the mounting of the gasket 32.

The inverted apex portion of the cup 21 is provided with an outlet orifice 33 through which the abrasive material is adapted to move and pass into a tube such as a hose 35 extending to the blast gun. The invention includes means for preventing the blocking of this outlet orifice by packing of the wet sand adjacent the outlet aperture. An embodiment of such means pertains to apparatus for supplying liquid to the abrasive within the hopper 10 and to the sand adjacent the outlet orifice 33. Thus liquid such as water may be supplied to the abrasive within the tubular member 18 and at various points or zones thereabove so as to prevent the packing of the wet sand and to render the abrasive in a flowable condition for moving through the outlet orifice 33. Such means may take the form of a pipe 36 arranged within the hopper 10 extending substantially vertically therethrough and maintained in such a position in any suitable manner such as by means of spider arms 38 shown in Fig. 1. The arms 38 may be welded to the tank 10 and to a reinforcing ring member 39 arranged around the upper end portion of the hopper 10. The pipe 36 is preferably closed at its upper end to prevent the entrance of foreign material thereto which would eventually obstruct the outlet orifice at the lower end of the sand hopper.

A liquid such as water is supplied to the pipe 36 from any suitable source and preferably in a quantity corresponding substantially to the quantity of sand and water withdrawn from the hopper 10 during the blasting operation. The water may be supplied to the pipe 36 through a conduit 41. A tube 42 extends laterally from the pipe 36 whereby the water supplied by the conduit 41 will also enter the bin above the sand within the hopper 10. The liquid or water supplied to the conduit 41 preferably is so controlled that the level of the water in the hopper 10 and in the pipe 36 does not rise above the level indicated at 44 in Fig. 2. The pipe 36 extends downwardly through the central portion of the hopper 10 and may be supported at its lower end by spider arms (not shown) similar to the arms 38 employed at the upper end of the bin 10. The pipe 36 terminates near the lower end of the hopper 10 and in substantial axial alignment with the tubular member 18. Thus liquid supplied through the conduit 41 is applied to the abrasive within the hopper 10 through the opening 40 at the lower end of the pipe 36.

The pipe 36 may be provided with a series of openings at spaced intervals along its length whereby the liquid or water therein may be applied to the sand within the tank or hopper 10 at various zones or points so as to prevent packing of the abrasive within the hopper. The pipe 36 may be provided with a group of openings 46 which may be arranged at circumferential spaced points around the pipe 36 through which the water may pass outwardly into the sand hopper. A shield 47 attached to the pipe 36 in any conventional manner such as by welding is provided

for preventing the abrasive within the hopper 10 from obstructing or blocking the openings 46. Another series of openings 48 may be provided in the pipe 36 at a point below the openings 46. The openings 48 are also provided with shielding means for preventing the sand entering the pipe 36 through the openings 48 and this means may take the form of an annular member 49 embracing and secured to the pipe 36. A further series of openings 51 may be provided in a still lower part of the pipe 36 and these openings are likewise maintained free of the presence of sand within the hopper 10 by means of a shield 52. The shields for the openings in the pipe 36 are preferably frusto conical shaped so that the sand when assuming an angle of repose will provide a hollow annular space under each shield. The openings arranged at different positions lengthwise of the pipe 36 thus serve to supply liquid or water to the abrasive within the tank at various zones to prevent packing thereof.

The invention includes further means for applying liquid to the abrasive or sand adjacent the outlet orifice 33 of the hopper and this means may take the form of a jacket 56 surrounding the tubular member 18. The jacket 56 may be secured to the tubular member 18 in a liquid tight manner such as by welding. The jacket arrangement thus provides an annular chamber 57 around the tubular member 18. The liquid or water from the pipe 36 may be supplied to this annular chamber 57 by means of a conduit shown at 58 in Fig. 2. The tubular member 18 is provided with a series of circumferentially spaced openings 60 all communicating with the annular chamber 57 whereby liquid or water from the pipe 36 may pass through the conduit arrangement 58 into the annular chamber 57 and through the openings 60 into engagement with the abrasive particles within the tubular member 18 to prevent packing of the abrasive therein and for rendering the wet sand in such a fluid state as to readily pass through the outlet orifice 33 provided at the lower end of the cup member 21.

The size of the outlet orifice 33 is of importance in carrying out the invention and it is for the purpose of adjusting the size of the outlet opening that a removable apertured member or washer 61 is provided in the lower end of the cup member 21. The apertured member 61 may be seated on an annular shoulder formed in the cup member 21 and the size of the opening therein may be altered by replacing the washer 61 with an apertured member having a larger or smaller opening. The apertured member 61 may be held in an operative position by means of a split ring 62 engaging an annular groove in the cup member 21 as shown in Fig. 3. The apertured member 61 may be mounted on the shoulder adjacent the orifice 33 by swinging the cup member 21 to an open position. In a like manner the washer 61 may be replaced when worn by moving the cup member 21 to the open position.

The slurry of abrasive and liquid passing through the outlet orifice 33 is adapted to pass into a fitting 66 provided with transparent side walls or windows 67 whereby the flow of abrasive into the sand hose 35 may be observed. The fitting 66 is preferably removably mounted at the lower end of the sand hopper assembly so as to permit cleaning of the fitting. Thus the fitting 66 may be hinged to the lower end of the cup member 21 by means of an arm 69 pivotally attached to a bracket 69 carried by the cup member and a pin 70 providing a hinged connection

for the fitting 66. The opposite side of the fitting is provided with a lug 71 for clamping the fitting against the lower end of the cup member 21. A gasket 72 may be interposed between the fitting 66 and the cup member 21 as shown in Fig. 3. The fitting 66 is provided with a passage 73 preferably sloping towards the sand hose 35 as shown in Fig. 3.

Another feature of the invention pertains to the provision of means for supplying liquid to the fitting 66 so as to add further fluid to the sand and water escaping from hopper 10 through passage 73. The fitting 66 is provided with a relatively small passage 76 of much smaller cross sectional dimensions than the passage 73 or the area of the opening in the washer 61. Liquid may be supplied through the passage 76 under pressure such as water from a municipal water system. The water supplied through the passage 76 is thus under pressure of approximately 30 to 100 pounds per square inch and this water may be supplied through a pipe or hose indicated at 77 connected in any conventional manner to the fitting 66 adjacent the passage 76. The liquid entering the fitting through the passage 76 renders the abrasive or sand more fluid and permits this mixture to be readily drawn by the suction generated by the blast gun through the hose 35. If the sand in the hose 35 becomes sluggish in its movement or tends to clog the hose the pressure of the water supplied through the passage 76 builds up and prevents blocking of the sand hose 35. The liquid supplied through the pipe or hose 77 continues during the blasting operation but it will be noted that the suction developed in the hose 35 by the blast gun draws a greater quantity of material from the hopper 10 because the effective area of the orifice 33 has greater dimensions than the passage 76.

The invention includes means for positively interrupting the supply of abrasive from the hopper 10 when it is desired to stop the operation of the blast gun. The apparatus thus includes a plug or stopper 80 mounted for closing the opening in the apertured member 61. The stopper or plug 80 may be formed of any suitable resilient material and is preferably provided with a frusto conical portion 81 adapted to engage a corresponding seating surface on the apertured member 61. The plug or stopper 80 is mounted on the lower end of an operating rod or bar 82 movable vertically through the pipe 36 as shown particularly in Fig. 2. A guide bearing 83 may be mounted in the tubular member 18 providing a proper guiding support for the lower end of the rod 82. The upper end of the rod 82 extends through a guide opening in the means covering the upper end of the pipe 36. The rod 82 may be actuated by a crank arm 84 pivotally mounted at the top of the sand hopper 10. An operating shaft 85 may be provided for manipulating the crank arm 84 and the shaft 85 is provided for actuation by the operator of the blast gun.

Thus when it is desired to interrupt the operation of the blast gun the operator turns the shaft 85 to move the rod 82 downwardly. The downward movement of the rod 82 will cause the valve plunger 80 to close the outlet orifice whereby the movement of the sand slurry into the passage 73 will be interrupted. The injector action of the gun will continue to draw the abrasive from within the fitting 66 through the hose 35 until all of these abrasive particles are projected from the gun. After the valve 80 is closed the water or liquid entering the fitting 66 through

the passage 76 will flush any sand particles forwardly to clear the fitting and the hose 35 of any abrasive particles which may later cake in these passages particularly when the blasting operation is discontinued for a considerable period. The city water supplied through the hose 77 may be interrupted and thereafter the blast gun may be shut down without danger of the hose or gun being filled with sand so as to block the small passages therein when it is desired to again initiate the blasting operation.

The apparatus may include means for adding a rust inhibiting substance to the hydroblast stream. Thus a tank 90 may be mounted on the standards 15 as shown in Fig. 2. The tank 90 may include rust inhibiting material 91 such as potassium dichromate crystals. The water supplied through the hose 77 passes through a pipe 92 and a valve 93. When it is desired to include the rust inhibiting substance in the blast stream the valve 93 may be closed and a valve 94 opened whereby the water from the city main passes through the tank 90 into the presence of the rust inhibiting crystals 91 and into the fitting 66. In a like manner the water from the city main may be completely interrupted by closing the valves 93 and 94 or the water from the city main without rust inhibiting material may be supplied by closing the valve 94. A valve (not shown) may be arranged in the pipe 92 to interrupt the supply of auxiliary liquid to the passage 76.

In operation of the apparatus the abrasive material is admitted to the hopper 10 in sufficient quantity to substantially fill the bin. The abrasive is usually wet as hereinabove described and these wet particles assume substantially the position illustrated in Fig. 2. A liquid is supplied to the hopper 10 through the conduit 41 and the tube 42 so as to substantially saturate the abrasive material within the bin.

The initiation of the blasting operation will cause a partial vacuum to be generated in the blast gun as a result of the high velocity liquid jet passing therethrough. The partial vacuum will be developed within the supply line 35 and therefore applied in the passage 73 and in the orifice 33. Then the valve 80 may be moved by raising the rod 82 to open the outlet orifice for the hopper 10. The liquid supplied to the pipe 36 will in part escape through the openings 46 and the openings 48 and the openings 51 to various zones within the hopper 10. This liquid will prevent packing of the abrasive vertically above the outlet orifice 33. The liquid may also pass from the pipe 36 through the pipe arrangement 58 into the annular chamber 57 and through the openings 60 into engagement with the abrasive particles in the lower end portion of the hopper and within the tubular member 18. This liquid and that supplied through the opening 40 renders the abrasive in the lower portion of the hopper sufficiently fluid for flowing through outlet orifice 33 to be drawn through the hose 35 to the blast gun.

The liquid supplied by the hose 77 may be admitted to the fitting 66 when the blast operation is initiated to further maintain the abrasive in a flowable condition as it passes through the fitting 66 and the hose 35. The liquid supplied through the passage 76 is in such small metered quantities as compared to the volume of abrasive material entering the fitting through the passage 73 as to permit an adequate supply of

abrasive material to pass to the blast gun. The liquid under pressure moving through passage 76 also tends to prevent the formation of any blocked condition within the sand hose 35 and within the fitting 66.

The valve 80 is moved to a closed position when it is desired to stop the blasting operation. The blast gun is preferably operated for a short period after the valve 80 is closed so as to draw the residual abrasive particles from the passage 73 and the fitting 66 and the sand hose 35. The liquid supplied through the passage 76 may be continued during this period to further assist in removing residue particles from the supply line and for clearing the blast gun of abrasive particles. Thereafter the liquid under high pressure providing the high velocity blast jet in the gun may be stopped after which the valves 93 and 94 may be closed to interrupt the supply of liquid through the passage 76.

While the invention has been described with reference to specific structural details it will be appreciated that changes may be made in the apparatus. Such changes may pertain to the shape of the hopper 10 and variations in details of mounting the various parts may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. In apparatus for feeding abrasive particles to a hydraulic blast gun, a hopper for storing wet abrasive particles, inwardly converging walls at the lower end of said hopper, means closing the lower end of the hopper and having a discharge orifice therein, means providing an annular chamber around the hopper adjacent said converging walls, means supplying liquid into said annular chamber, and said hopper having circumferentially spaced openings therein communicating with said annular chamber whereby liquid is supplied to the abrasive adjacent the discharge orifice.

2. In apparatus for feeding abrasive particles to a hydroblast gun, a hopper for storing wet abrasive particles, said hopper having a discharge orifice in a lower portion thereof, a pipe embedded in the abrasive particles above said discharge orifice, means for supplying liquid into said pipe, said pipe having an opening therein through which the liquid may escape into the hopper, and means extending outwardly from said pipe terminating in an edge so spaced from the pipe that the abrasive issuing at its angle of repose below said edge engages the pipe below said opening.

3. In apparatus for feeding abrasive particles to a hydraulic blast gun, a hopper for storing wet abrasive particles, said hopper having a discharge orifice in a lower portion thereof, a pipe extending vertically of the hopper through the abrasive particles above said discharge orifice, means for supplying liquid into said pipe, said pipe having openings therein through which said liquid may escape into the presence of the abrasive within the hopper, and an annular shield carried by the pipe preventing the abrasive particles from obstructing said openings.

4. In apparatus for supplying abrasive to a hydroblast gun, a hopper for receiving wet abrasive particles, said hopper having an outlet orifice in a lower portion thereof, means for supplying liquid under substantially no pressure to a plurality of points adjacent said outlet orifice to prevent packing of the abrasive particles within the hopper and to render the abrasive fluid for

movement through said outlet orifice, a fitting receiving the abrasive particles passing through said outlet orifice, a suction line drawing the abrasive from said fitting to a blast gun, and means for supplying liquid under pressure to the fitting for maintaining the abrasive therein in a flowable condition and for assisting movement of the abrasive to the blast gun.

5. In apparatus for feeding abrasive particles to a hydraulic blast gun, a hopper for storing a quantity of wet abrasive particles, removable means closing the lower end of the hopper and having a discharge orifice therein, means supplying liquid into said hopper adjacent said discharge orifice, and a removable apertured member within said closure means defining the effective opening of the discharge orifice.

6. In apparatus for feeding abrasive particles to a blast gun, a hopper for storing abrasive particles, a hinged cup member closing the lower portion of the hopper and having a discharge orifice therein, a shoulder on the cup member around said discharge orifice, a washer resting on said shoulder forming the effective area of said discharge orifice, releasable means retaining the washer on said shoulder, and means for guiding the abrasive passing through said discharge orifice to the blast gun.

7. In apparatus for feeding abrasive to a hydraulic blast gun, a hopper having a discharge orifice in a lower portion thereof, a pipe mounted in said hopper substantially aligned with said discharge orifice for supplying liquid to abrasive particles within the hopper, a valve for closing said discharge orifice, and means within said pipe for actuating said valve to close and open the discharge orifice.

8. In apparatus for feeding abrasive particles to a hydraulic blast gun, a hopper for storing a quantity of wet abrasive particles, said hopper having a discharge orifice in a lower portion thereof, a fitting having a passage therein registering with said discharge orifice, means for guiding the abrasive from said fitting to the blast gun, means supplying liquid into the hopper adjacent said discharge orifice whereby the abrasive particles flow from the hopper through the discharge orifice into said fitting for movement to the gun, and transparent side walls for said fitting whereby the movement of abrasive through the fitting may be observed.

9. In apparatus for feeding abrasive particles to a hydraulic blast gun, a hopper for receiving a quantity of wet abrasive particles, said hopper having an outlet orifice in the lower portion thereof, a pipe within the hopper embedded in the abrasive particles and terminating adjacent said outlet orifice, said pipe having openings therein at spaced intervals along the pipe, means providing an annular chamber around the hopper adjacent the outlet orifice, said hopper having openings therein providing communication between the interior of the hopper and the annular chamber, a conduit connecting said annular chamber to said pipe, means for supplying liquid into said pipe whereby the liquid may move downwardly in the pipe and through said conduit into said annular chamber and supply liquid through all of said openings into the presence of the abrasive to render the abrasive fluid for movement through said outlet orifice.

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