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LIQUID BLASTING

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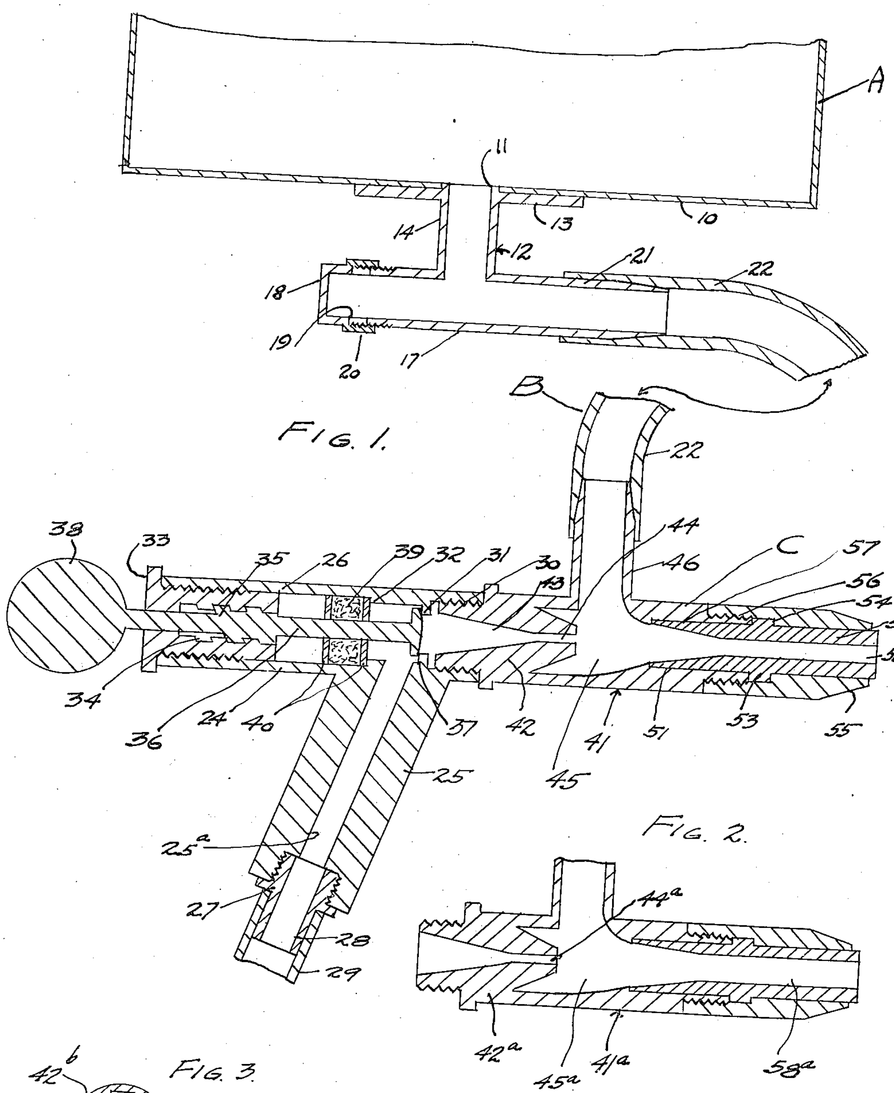

FIG. 1.

FIG. 2.

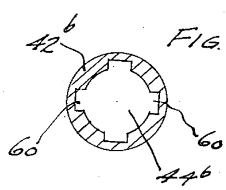

FIG. 3.

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LIQUID BLASTING

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9 Claims. (Cl. 51—11)

This invention relates to liquid blasting and more particularly to a method of blasting with abrasive in which liquid is employed as a motive force.

In the art of abrading and cleaning, it has been customary to use steam or air as the motive power for projecting the abrasive or cleaning substance. The use of water is more desirable than steam or air in that it costs less, prevents silicosis, washes back the abrasive to a point where it may be again employed, avoids burning the surfaces being abraded, provides better vision for the operator etc. The use of water, however, or other liquid for blasting purposes has been generally regarded as impracticable because of the apparent necessity of using a large volume of water for the small amount of abrasive carried, and also because of the lack of equipment to produce the required stream velocities. In only a few cases has an attempt been made to use water for motive power and these attempts have been unsuccessful.

An object of the present invention is to provide a blasting method in which a relatively small quantity of liquid is employed to project a relatively large amount of abrasive. A further object is to provide a method by which a solid stream of water or other liquid, either hot or cold, and under high pressure, is employed to project abrasive or other materials against surfaces to be abraded or cleaned.

I have discovered that an extremely small stream of water or other liquid, when projected with sufficiently high pressure, and in a substantially solid stream, can be employed to impart its velocity to a relatively large quantity of granular abrasive fed about the periphery of the stream and confined in close relation to its periphery for a sufficient interval to direct the abrasive in the same direction or path followed by the stream. In other words, a pencil-like stream under pressures in excess of say, six hundred pounds, can deliver a larger volume of abrasive when the abrasive is supplied about the periphery of the stream and is confined for the most part in contact with such rapidly moving periphery long enough for the abrasive to be directed forwardly into a path parallel with that of the stream.

I have found it desirable to introduce the sand or other abrasive about the periphery of the stream because this method provides the largest area of contact between the abrasive and stream, and also because the substantially solid core of water seems to serve as a piston for grinding the abrasive particles into the surface under treatment. If the sand particles were fed to the moving stream without means for confining the particles, there would be a tendency for the sand grains to fly off at angles from the stream while at the same time, striking other sand grains and preventing them from coming into contact with the stream. By confining all of the sand in close relation to the liquid stream for a brief interval, the grains which contact the stream and are hurled forwardly and outwardly are directed into a path parallel with that of the stream so that the stream and abrasive move forwardly with substantially equal velocity and are uni-directional.

Various types of apparatus may be employed in conjunction with my method. For the purpose of illustration, I have shown one form of apparatus in which the method may be satisfactorily used, which apparatus is shown in the accompanying drawing, in which—

Figure 1 is a broken sectional view of apparatus in which the method embodying my invention may be carried out; Fig. 2, a sectional view of a modified form of discharge pipe; and Fig. 3, a transverse sectional view of a modified form of water inlet at a point where it opens into the suction chamber.

In the illustration given in Fig. 1, A designates a bin or hopper for sand or other suitable material; B, a conduit extending between bin A and the discharge pipe; and C, a regulatable discharge pipe or blast or spray gun.

The bin A may be of any suitable construction. In the illustration given, the bottom wall 10 of the bin is centrally apertured at 11. An outlet fitting 12 is provided with a circular flange 13 which is secured to wall 10. The fitting is provided with a vertical pipe portion 14 having its bore aligned with the opening 11 of bottom wall 10. The fitting 12 is provided with a horizontal pipe portion 17 communicating with the pipe portion 14 and being closed at one end 18. If desired, the pipe portion adjacent end 18 may be provided with an air intake opening 19, and a valve closure 20 threadedly engages the pipe in such a manner as to control the admission of air through inlet opening 19. The horizontal pipe portion 17 is also provided with a free end 21 to which a rubber tube 22 or other form of conduit may be attached.

The blast or spray gun C may also be of any suitable construction. The fluid inlet casting 24 comprises a handle or fluid inlet portion 25 and a horizontal pipe portion 26. The handle portion 25 is provided with a longitudinal bore 25a and is tapped at its lower end to receive the attachment plug 27. Plug 27 is provided with a shank 28 adapted to be received within fluid inlet tube 29. The horizontal pipe portion 26 is threaded at its forward end 30 and is provided adjacent the forward end with a valve seat 31. To the rear of the valve seat is an annular shoul- der 32 adapted to serve as a packing retainer. The rear end of pipe 26 is closed by plug 33 which threadedly engages the end of the pipe. The plug 33 is centrally apertured and is provided inte- riorly with threads 34 adapted to engage threads 35 on the valve stem 36. The valve stem 36 is provided on its inner end with a valve head 37, and at its outer side with a control knob 38. A packing 39, enclosed between two retaining mem- bers 40, is supported adjacent shoulder 32.

The discharge piece C is also provided with an integral casing member 41 which, if desired, may be in the form of a casting. The member 41 is provided at its rear side with a threaded exten- sion 42 adapted to engage the interior threaded portion 30 of the inlet member 24. Member 41 is provided at its rear side also with a longitudinal tapered opening 43, the opening 43 merging with a passage 44 of substantially uniform diameter. Passage 44 opens into a large central suction chamber 45. Integrally formed with the casting 41 is a vertical extension 46, the extension 46 providing a vertical passage 47 communicating with the top of suction chamber 45. The upper end of extension 46 is equipped with retaining ridges 48. At an intermediate point, the exten- sion 46 is provided with an air slot 49 controlled by an adjustable sleeve 50 threadedly engaging a portion of the extension 46. The forward end of casing 41 is recessed at 51 to receive a rubber discharge tip 52. The tip 52 is provided with an annular flange 53 received within a recess 54 of a retaining ring 55. The retaining member 55 threadedly engages a reduced end portion of member 41 at 56, thus permitting the discharge tip 52 to be removed and replaced when desired. The discharge tip 52 is provided with a tapered passage at 57 which merges into a substantially straight passage 58.

In the modification shown in Fig. 2, the dis- charge piece 41a is substantially the same as dis- charge piece 41 of Fig. 1, except that the discharge passage 58a of Fig. 2 is much larger than the pas- sage 58 of Fig. 1, thus permitting liquid to be discharged from the inlet passage 44a through chamber 45a and passage 58a without touching the walls of the discharge piece.

In the modification illustrated in Fig. 3, the discharge piece is provided with a casting por- tion 42b affording a liquid inlet 44b, the periph- ery of which is increased by grooves or rifling 60. The slots or rifling 60 adjacent the main passage 44b produce a liquid stream of the same general outline as that illustrated in Fig. 3. Such a water stream has an increased surface area which may be utilized to deliver a greater quantity of granular abrasive.

In the operation of the process, water or other suitable liquid is forced under high pressures, say 600 to 1500 pounds or more, through the channel 25a and discharge port 44 and thence through chamber 45 and passage 58. In the illustration shown in Fig. 1, the passages 44 and 58 are so proportioned that the stream substantially seals the outer portion of passage 58 so that the suc- tion is produced within chamber 45. The suction in the chamber 45 aids in drawing abrasive from container A through conduit B.

In the construction shown in Fig. 2, the pas- sage 58a is much larger than the inlet passage 44a so that the stream does not seal the outer portion of passage 58a. Preferably, the sand or other abrasive is forced through conduit B into the chamber 45a.

In the operation of either of the discharge pieces C, the sand or other abrasive may be fed by pressure or by any other suitable method. It will be observed that in the operation, there is substantially no wear of the nozzles.

As an illustration of a specific operation of my method, the following may be stated. Water under a pressure of 700 pounds was passed through a circular inlet one-eighth of an inch in diameter into a suction chamber, and thence out through a discharge tube aligned with the inlet, the di- ameter of the discharge tube being five-sixteenths of an inch. Dry sand was sucked through a con- duit communicating with a container as illus- trated in Fig. 1. The one-eighth inch stream suc- cessfully carried fifty pounds of sand per minute, discharging the sand against the surface to be abraded while using only eight gallons of water per minute. The above process was used for effectively removing mill-scale from nickel-steel plates as fast and as as well as such plates are cleaned with dry sand air blast machines. In cleaning castings, the water served the additional function of removing core sand. The removed core sand and the granular abrasive were carried by the water stream to a drain where the back sand and abrasive were reused.

In the use of air, there is a tendency for the surface being treated to burn and thereby to become discolored. Also, the cloud of dust par- ticles from the surface and from the abrasive tends to obscure vision as well as increasing the danger of silicosis. Steam likewise increases the difficulty of handling, danger from scalds and danger due to interference with vision. It does not tend to reduce dust. It loses its force quickly on leaving the nozzle and has no washing effect. In contrast with the use of air and steam, I find that water, when employed as described hereto- fore, accomplishes as much while also washing the surface and permitting the recovery of abra- sive. There are also the additional advantages mentioned of preventing the burning of surfaces abraded, giving better vision, preventing silicosis, lower cost, etc.

As far as my knowledge goes, I find that prior attempts to use water have failed because too great a quantity of water was found necessary. The use of an annular stream of water enclos- ing the core of sand would require too great a quantity of water for the amount of sand car- ried. This method also cushions the impact and prevents abrasion. The forcing of water under relatively low pressures would result in an ex- cessive use of water. On the other hand, if a relatively small stream is passed under high velocity through a discharge piece with the body of water forming a substantially solid stream and the periphery of the stream being brought into contact with sand or other abrasive and maintained in contact for an interval, a great quantity of sand can be effectively handled, the water being small in volume but sufficient to serve the purpose of projecting the abrasive and washing the surface.

While in the foregoing specification, I have suggested certain specific pressures as desirable, it will be understood that the invention may be employed under various conditions with changes in such pressures to accommodate the process to different classes of work, while still employing the invention. Also, it will be understood that the dimensions suggested in the illustrations are for the purpose of illustration only, and wide variations can be made therefrom while utilizing the invention.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible, in view of the prior art.

I claim:

1. A method of the character set forth for blast-treating a surface, comprising: passing a non-expansive liquid in a confined stream discharged under pressures in excess of 600 pounds per square inch through the central portion of a tubular member thereby maintaining a space between said stream and member, and supplying within said space to the periphery of said stream within said tubular member a coating of granular abrasive.

2. A method of the character set forth for blast-treating a surface, comprising: passing a non-expansive liquid in a confined stream through the central portion only of the bore of a tubular member and discharged under pressures in excess of 600 pounds, and supplying a coating of granular abrasive to the periphery of said stream within said member.

3. A method of the character set forth for blast-treating a surface, comprising: passing a non-expansive liquid in a confined stream and under pressure through a loading zone in which granular abrasive is drawn to the periphery of said stream, and supplying granular abrasive to said zone, said stream body being passed through said zone under sufficiently high pressures in excess of 600 pounds per square inch to carry said abrasive as a coating on its periphery without substantial penetration of said stream.

4. A method of the character set forth for blast-treating a surface, comprising: discharging against said surface a composite stream having an outer coating of granular abrasive and an inner core of liquid, said stream being discharged under sufficient pressure to maintain said inner core substantially unpenetrated by said abrasive.

5. A method of the character set forth for blast-treating a surface, comprising: discharging against said surface a composite stream body discharged under pressures in excess of 600 pounds per square inch and having its components traveling substantially at the same velocity, said stream having an inner core of liquid and an outer coating of granular abrasive, said outer coating being substantially unmixed with said liquid.

6. The method of blast-treating a surface comprising: impinging against said surface a stream of liquid externally coated with granular abrasive and discharged under pressures in excess of 600 pounds per square inch.

7. The method of blast-treating a surface, comprising: traversing said surface with a substantially annular stream of granular abrasive, said abrasive carrier being discharged under pressures in excess of 600 pounds per square inch.

8. The method of blast-treating a surface, comprising: traversing said surface with a substantially annular stream of granular abrasive, said abrasive being carried by a liquid core discharged under pressures in excess of 600 pounds per square inch.

9. The method of blast-treating a surface comprising discharging against said surface under pressures in excess of 600 pounds per square inch a confined stream of liquid substantially unmixed with solids and externally coated with a granular abrasive.

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