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Kobayashi

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[54] **PIPE INSIDE CLEANING DEVICE**

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[51] **Int. Cl.²** **B24C 3/32**

[58] **Field of Search** ..... 15/3.5, 3.51; 51/8 R, 12, 51/15; 128/66; 222/3

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[57] **ABSTRACT**

Apparatus for cleaning the inside surface of a tubular workpiece such as a pipe by blasting the workpiece surface with an abrasive slurry. The slurry is impelled by a gas supplied by a mechanism designed to impart a pulsating pressure to the blasting nozzle. One disclosed embodiment of the invention utilizes a mechanical rotary valve combined with an accumulator and another embodiment utilizes a reciprocating piston for imposing a relative high pressure onto a quantity of impelling gas and then suddenly releasing it to the blasting nozzle.

7 Claims, 2 Drawing Figures

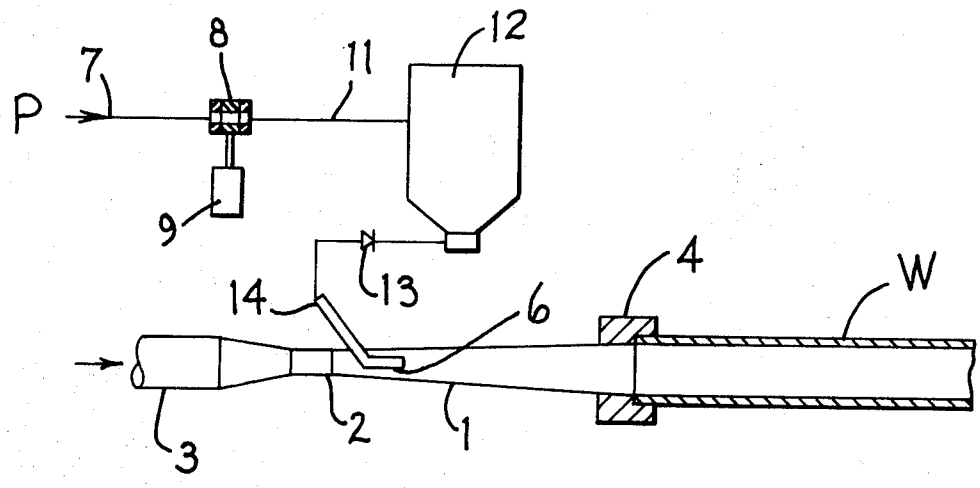


Fig. 1

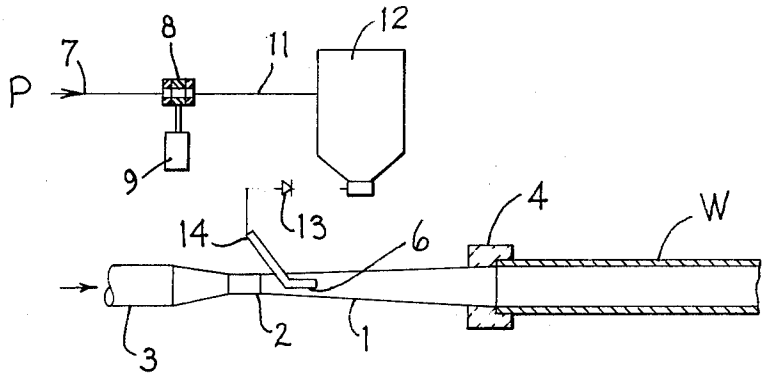
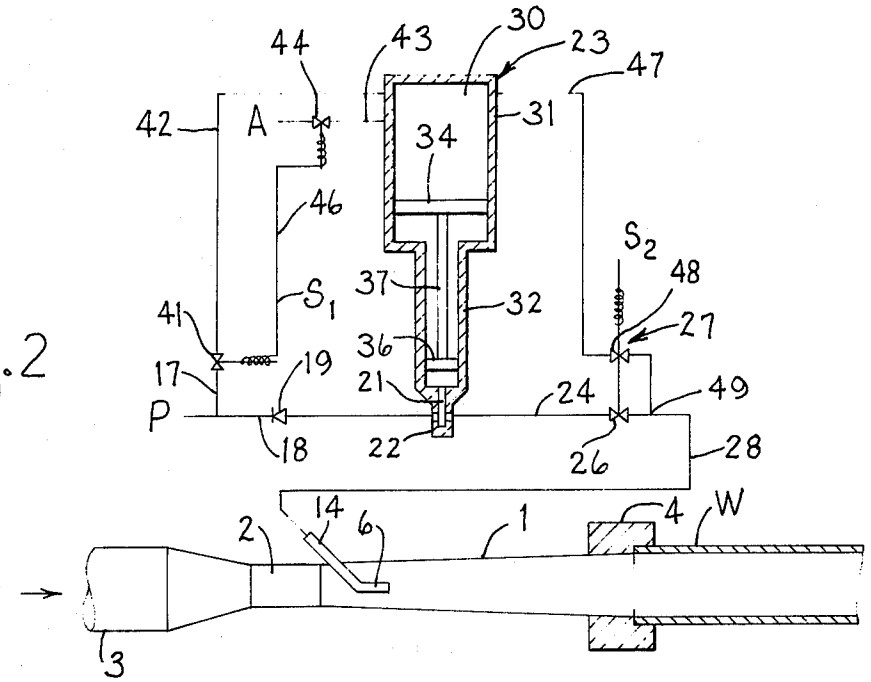

P
7
8
9
11
12
13
14
6
4
W
1
2
3

Fig. 2


44
43
30
23
47
42
A
34
31
46
S_2
48
37
32
S_1
41
27
36
17
19
21
24
49
P
18
22
26
28
14
6
2
1
4
W
3

PIPE INSIDE CLEANING DEVICE

FIELD OF THE INVENTION

The invention relates to a method and apparatus for utilizing a wet abrasive slurry to clean the inside of a tubular workpiece and means for blasting same into the inside of such workpiece, such as a pipe, and doing so at a pulsating intensity.

BACKGROUND OF THE INVENTION

It has long been known to utilize an abrasive slurry impelled by a gas under pressure, usually air, for cleaning the inside of a tubular workpiece, such as a pipe. In such equipment it is conventional to provide an elongated venturi tube with a nozzle at the throat thereof for introducing the blasting gas into a stream of abrasive slurry. The pipe to be cleaned is fixed at the end of and coaxially with the venturi tube and receives the blasting mixture thereinto. This is effective but it is time consuming, the operation often taking as much as 5 minutes for cleaning the inside of a pipe to a desirable degree of finish.

Accordingly it is desirable to provide a method, and an apparatus for carrying out such method, by which an effective job of cleaning can be accomplished, same being to the same high degree of quality as was obtainable by previous methods, and yet substantially to reduce the amount of time required.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an schematic diagram of one form of an apparatus embodying the apparatus aspects of the invention and appropriate for carrying out the method aspects of the invention.

FIG. 2 is a diagrammatic illustration of another form of apparatus embodying the apparatus aspects of the invention and capable of carrying out the method aspects thereof.

SUMMARY OF THE INVENTION

The method aspects of the invention contemplate supplying the impelling gas to the slurry in a pulsating pattern, namely a continuous flow of gas under a manual pressure with intermittent pulses of gas under a higher pressure. This quite unexpectedly greatly increases the turbulence of the slurry in the pipe being cleaned and correspondingly and unexpectedly greatly increases the rapidity by which the cleaning operation can be carried out.

In one form of apparatus embodying the invention the gas is supplied by a rotary valve in association with an accumulator which together effects the desired pulsating supply thereof. In another embodiment of apparatus embodying the invention, gas is received into a cylinder from which it is expelled by piston under high pressure and thereby caused intermittently to enter the pipe being cleaned.

DETAILED DESCRIPTION

Inasmuch as the method aspect of the invention can be best understood by consideration of the apparatus by which same is carried out, attention will be directed toward the apparatus embodying the invention with the understanding however that the two forms of apparatus herein specifically disclosed are only two of many possible devices by which method aspects of the invention may be carried out and, though inventive in themselves, are insofar as the method is concerned only two illustrations of many appropriate forms of such apparatus.

Turning now to FIG. 1 there is shown a conventional venturi tube **1** having a throat **2** and a supply conduit **3** which is connected to a suitable supply of an abrasive slurry. Said slurry may be of any conventional kind, such as a suitable solid grit carried in a liquid carrier such as water. The tubular workpiece, here a pipe, to be cleaned is indicated at W and same is connected by any convenient and conventional fitting coaxially to the discharge end of the venturi tube **1.**

Positioned concentrically within said venturi tube **1** and shortly past the throat **2** in any conventional manner is a nozzle **6** for the introduction thereinto of the impelling gas, such as compressed air. The nozzle itself is conventional and hence needs no detailing. The nozzle is supplied from a source of pressure P into a conduit **7** to a rotary valve **8.** Said valve is operated by a motor **9** energized from any convenient source not shown. The gas flows from the rotary valve **8** through a further conduit **11** into an accumulator **12** from which it flows through a check valve **13** and into a pipe **14** leading to a nozzle **6.**

The volume of the accumulator is selected in relation to the quantity of impelling gas passing therethrough such that it will convert the essentially square wave pulses of gas in the rotary valve into somewhat more smoothly modulated pulsations of compressed air supplied through the nozzle **6.** Further and preferably the accumulator **12** is also so designed as to keep sufficient gas flowing continuously through the nozzle **6** and venturi tube as to prevent the solids in the slurry from settling and clogging the equipment. Thus the output of the nozzle **6** is continuous with a plurality of peak pulsations which keeps the gas flowing continuously through the nozzle and pipe to be cleaned but with sufficient pressure peaks as to maintain the abrasive slurry within said pipe in a high degree of agitation. Thus the cleaning operation carried out very quickly and with a high level of quality.

With respect to FIG. 2 there is shown a similar venturi tube, throat, supply conduit and nozzle which is identical to that described in connection with FIG. 1 and therefore needs no further description. Likewise the pipe W is again fitted onto the end of the venturi tube **1** by a suitable fitting **4.**

In this embodiment pressure is supplied from a source P through a conduit **16** into branches **17** and **18.** The branch **18** passes through a check valve **19** into a small chamber **21** in the small end **22** of the stepped cylinder **23** described further hereinafter. From the small chamber **21** a conduit **24** leads through the ports **26** of a four-way valve **27** to a conduit **28** and thence to the supply line **14** of the nozzle **6.**

The stepped cylinder **23** comprises serially arranged sections **31, 32** and **22** of three different diameters as shown. Within said cylinders **31** and **32** there is located a first piston **34** of relatively large diameter and a second piston **36** of relatively small diameter, the two being connected by a rod **37.**

The above mentioned branch **17** connects to the inlet port of a magnetic valve **41** whose outlet port connects to a conduit **42** leading to the chamber **30** within the large section **31** of the stepped cylinder **33.** A further conduit **43** leads from said chamber **30** through a further magnetic valve **44** to the low pressure side of the

pressure system, such as atmosphere indicated at A. Appropriate circuitry **46** energized from any convenient source S-1 is connected to operate the two valves **41** and **44,** preferably simultaneously.

A conduit **47** extends from the chamber **30** to the ports **48** of the magnetic valve **27** and thence to a junction point **49** for connection to the conduit **28.**

This then provides two basic paths of flow for pressure gas originating at P and flowing to the nozzle **6,** namely, one line utilizing branch **18** and the parts connected thereto and the other branch utilizing line **17** and the parts connected thereto.

In operation, the source S-1 which will normally be a suitable timer will close the valve **41** and open the valve **44.** Likewise the source S-2 which may be further contacts of the same timer will close the ports **48** and open the ports **26.** Thus air will flow through the check valve **19** into and through the chamber **21,** thence through the ports **26** and into the nozzle **6.** This will effect a blast of impelling gas into the slurry within the venturi to cause a flow thereof in the usual manner to the interior of the pipe W to be cleaned.

At the same time the gas flowing into the chamber **21** will drive the piston **36** upwardly and since the valve **44** is open to the atmosphere same will move substantially to the top of the chamber **30** although, if desired, a quantity of trapped gas may be provided in the upper end thereof to prevent said piston **34** from striking the end of the cylinder. After a predetermined period of time, which will normally be only a few seconds, the source S-1 changes and the magnetic valves **41, 44** and **27** change their position, valve **41** now being open, valve **44** now being closed, ports **26** being closed and ports **48** open. The pressure gas now flows through the branch **17** and conduit **42** into the cylinder **30** and with the ports **48** open it flows onto the nozzle **6.** This continues the supply of gas to the nozzle and simultaneously develops a pressure within the chamber **30** which, acting upon the relatively large piston **34,** generates sufficient force to drive the relatively small piston **36** downwardly. This compresses the gas in the chamber **21** to a magnitude of compression substantially above that of the source P since ports **26** are closed and the check valve **19** prevents reverse flow from the chamber **21** to the conduit **18.** The source S-2 now changes to close ports **48** and open ports **26.** This permits flow from the chamber **21** through the conduit **24** into the conduit **28** and thence to the nozzle **6.** Thus a burst of gas at high pressure exits from the nozzle **6** but again due to the characteristics by which pressure is expelled from the chamber **21** the pressure pattern exiting from the nozzle **6** is a smoothly modulated pulse rather than an abrupt square wave pulse.

The source S-1 now returns to its original condition which closes valve **41** and opens valve **44.** Thus flow returns to the branch **18** and parts connected thereto and the upper end of the chamber **30** returns to its initial low pressure. Pressure fluid again enters into the chamber **21** driving the piston **36** upwardly and the cycle repeats.

As in the apparatus of FIG. **1,** the intermittent supply of impelling gas through the nozzle **6** into the slurry causes an extremely high level of turbulence within the type W and thereby causes a highly effecting cleaning operation and one which is much more rapid than in previously known systems.

Although a particular preferred embodiment of the invention has been disclosed above for illustrative purposes, it will be understood that variations or modifications thereof which lie within the scope of the appended claims are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for utilizing an abrasive slurry for cleaning the inside of a tubular workpiece, such as a pipe, and having a nozzle for introducing a supply of impelling gas such as air into an abrasive slurry for directing same under pressure and with a high degree of turbulence into the interior of said tubular workpiece, the improvement in means for supplying said impelling gas comprising;

means for supplying gas under pressure to said nozzle at a constant minimum value and including means for intermittently raising said pressure.

2. The device of claim **1** wherein said means for raising said pressure does so at a smoothly modulated curve for both the ascending side of the pressure pulse and the descending side thereof.

3. The device of claim **2** wherein said means for raising said pressure comprises an intermittently open and closed valve and an accumulator, the pressure source feeding said impelling gas through said valve into said accumulator and the gas flowing out of said accumulator to said nozzle, the volume of said accumulator being so correlated to the volume of flow of said gas that there is a constant flow of gas therethrough with pressure peaks at the outlet thereof corresponding to the open positions of said valve.

4. The device of claim **3** wherein said intermittently open and closed valve is a rotary valve.

5. The device of claim **1** including a source and conduit means supplying impelling gas from said source to said nozzle, accumulating means for accumulating gas and supplying same into said conduit means as a pulse at a higher pressure than the normal pressure within said conduit means.

6. The device of claim **1** including a source of gas under pressure and first conduit means for conducting same from said source to said nozzle;

an accumulator for accumulating a quantity of said gas; piston means including force magnification means; and gas pressure means intermittently operable for energizing said piston means to impel a pulse of gas from said accumulating means into said conduit means.

7. The device of claim **1** including conduit means for conducting impelling gas from a source of pressure to said nozzle;

a chamber having a first diameter and said conduit means connected thereto so the gas flowing through said conduit means will also fill said chamber;

a check valve preventing flow of gas from said chamber back toward said source;

pressure responsive means including a cylinder and piston of diameter larger than that of said chamber; and

conduit and valve means deriving pressure from said source and intermittently supplied to said cylinder;

whereby gas so supplied to said cylinder will create a force therein of sufficient magnitude to actuate said piston to create in said first chamber a pressure in excess of the pressure of said source and drive a pulse of gas from said chamber into said conduit and thence to said nozzle.

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