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C. A. PRINCE

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METHOD OF CLEANING THE INSIDE OF PIPE

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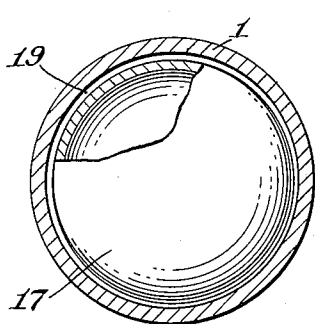
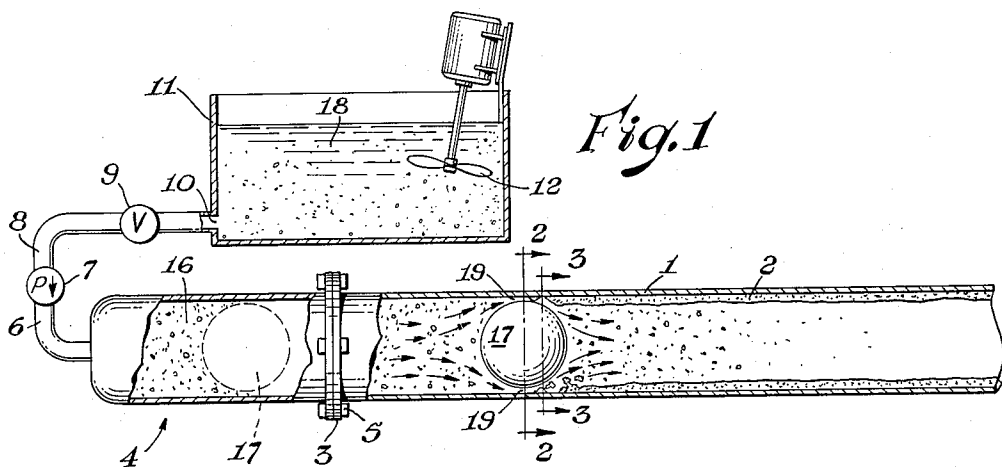


Fig. 2

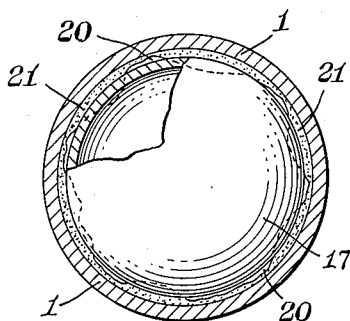


Fig. 3

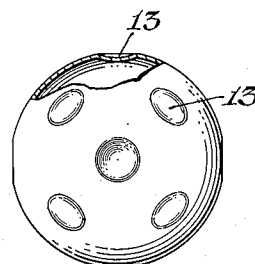


Fig. 4

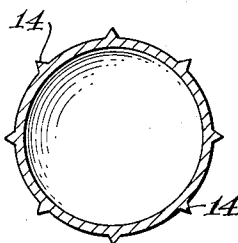


Fig. 5

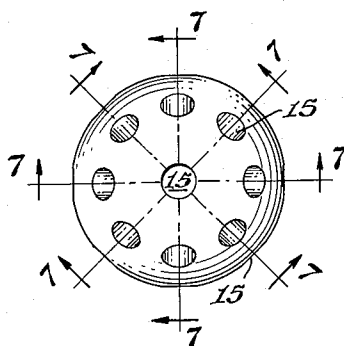


Fig. 6

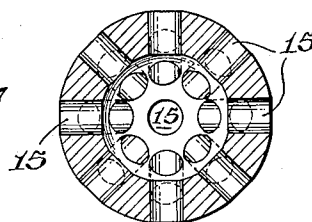


Fig. 7

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METHOD OF CLEANING THE INSIDE OF PIPE

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5 Claims. (Cl. 51—282)

The invention relates to a method of cleaning the inside of pipe. It more particularly concerns an improved method of cleaning the interior of a pipe in which scale or like incrustations are dislodged and carried out of the pipe by means including a particulated abrasive in suspension in a liquid vehicle.

The various methods which have been proposed and used heretofore of removing scale and the like from the interior surface of pipe may be classified in three groups as follows: (1) Methods involving the use of solvents. In these methods, a liquid solvent, which may also chemically attack the deposits, is introduced into the pipe and left in contact with the deposits until dissolved or sloughed off. The success of these methods depends upon the effectiveness of the solvents to either dissolve or react chemically with the deposits so as to convert them to solubles. Since not all deposits found in pipes are amenable to chemical attack or solvent action, these methods have limited application. Other disadvantages are that the solvent method usually requires filling the pipe with solvent which may be prohibitively costly, and the solvent action is oftentimes slow and may be damaging to the material of the pipe. (2) Methods involving the use of scrapers and like scale dislodging devices which are caused to traverse the bore of the pipe. Various limitations inure to these devices, such as the requirement that the pipe be of uniform diameter and smooth bore, that joints in the pipe be smooth and internally of the same diameter as the pipe itself, and that the pipe be reasonably straight and without sharp turns. (3) Methods using high velocity jets of liquid directed against the scale. In such methods, the nozzles for the jets are carried by an apparatus, usually referred to as a "mole," which is attached to a hose that supplies the liquid to the nozzles. The reaction from the jets causes the "mole" to traverse the bore of the pipe. These methods have similar disadvantages to those under (2) and are generally limited to use in short pipes of moderate diameter as there are limitations to the ability of the jets to drag the hose.

An object of the invention is to provide a method of cleaning the inside of pipe which need not be restricted as to length or diameter.

An object of the invention is to provide a method of cleaning the inside of pipe which need not be proof against attack by acids or alkalis.

A further object of the invention is to provide a method of cleaning the inside of pipe line which may include bends and turns.

Still another object of the invention is to provide a method of removing from the inside of pipe soluble as well as insoluble scale or like incrustations.

The foregoing and related objects will become apparent from the following description of the invention taken in connection with the accompanying drawing.

In the said drawing, Fig. 1 is a side elevation of a portion of a pipe line and apparatus used therewith in the practice of the invention in a preferred form.

Fig. 2 is a cross section on the line 2—2 of Fig. 1.

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Fig. 3 is a cross section on the line 3—3 of Fig. 1.

Figs. 4, 5, and 6 are elevations partly in section of three modifications, respectively, of the bore constricting object used in the pipe line of Fig. 1.

Fig. 7 is a cross section on any one of the lines 7—7 of Fig. 6.

Referring to the drawing in detail, numeral 1 indicates a pipe line having a cylindrical bore on the interior of which is a layer of scale 2 to be removed in accordance with the invention. As shown one end of the pipe line is provided with a pipe flange 3 to which is attached the lock chamber 4 by bolts 5. The lock chamber 4 is connected by a pipe 6 to the discharge side of a force pump 7. The intake side of the force pump is connected by pipe 8 and valve 9 to the outlet 10 of mixing tank 11 which is provided with a motor driven agitator 12.

In carrying out the invention, an abrasive-laden liquid is prepared, or placed, in tank 11 and preferably maintained in an agitated state by means of agitator 12. Preparation of the abrasive-laden liquid may be accomplished by mixing a suitable particulated abrasive solid with a suitable liquid vehicle capable of keeping the particles from too rapidly settling when the mixture is not undergoing agitation. Suitable abrasive materials are crushed stone, steel, or ceramics, sand, fine gravel, and the like. A generally suitable abrasive is sand of 20 to 40 mesh sieve size, although other sizes of abrasive particles may be used, such as from 1/4 inch to 150 mesh. Suitable vehicles are petroleum oils or other neutral liquids with considerable viscosity such as from 20 centipoises to 30,000 centipoises. Water or brine which has been thickened by the admixture of a suitable thickening agent may be used. Pumpable emulsions of oil and water are especially suitable for they readily maintain the abrasive particles in suspension usually without agitation once the abrasive particles and the emulsion are well mixed. An acid may be added to the water or water-oil emulsions, if desired, to give the vehicle the ability to dissolve acid-soluble constituents of the deposits to be removed. Among the thickening agents which may be used to increase the viscosity of water are water-soluble gums, e. g. gum arabic, karaya; starches; gelatin; sugar syrups; cellulose ethers, e. g. methyl cellulose, carboxy methyl cellulose; and the like. Oils may be thickened, if necessary, with metallic soaps of organic acids, blown asphalt, natural or synthetic rubber, salts of fatty acids, and the like. The amount of thickening agent to use varies with the kind and the liquid involved and is readily determined by test as by mixing the thickening agent with the liquid to be used and ascertaining its viscosity or rate at which the abrasive particles settle in the quiescent thickened liquid.

The relative amount of particulated abrasive solid and liquid vehicle therefor does not appear to be sharply critical. For example, there may be used from about 0.1 to 5 pounds of the abrasive per gallon of liquid vehicle. Preferred concentrations are between 0.25 and 3 pounds of abrasive particles per gallon of vehicle.

In applying the method to a pipe line, there is inserted into the pipe a generally spherical rigid object having a diameter slightly less than the inside diameter of the clean pipe so that the object almost blocks the bore but is nevertheless free to pass through it on being subject to hydraulic pressure as will be explained later. These objects may be referred to as bore constricting objects as they partly obstruct the flow of fluid through the bore of the pipe to be cleaned. Various forms of the generally spherical object may be used as for example a smooth sphere such as a solid or hollow steel ball, as illustrated in Fig. 1, and is useful in pipes in which the scale to be removed is of irregular thickness. Another form is illustrated in Fig. 4 in which the surface of the spherical object is provided with dimples 13. These may be in the

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form of more or less spherical recesses having, for example, a radius of 0.1 to 0.4 of that of the object. The form illustrated in Fig. 5 is generally spherical, the surface of which is provided with stubby conical projections 14. The forms of bore constricting objects illustrated in Figs. 4 and 5 are especially suitable for scale deposits of uniform thickness, although they may be used with deposits of irregular or uneven thickness. These generally spherical bore constricting objects may be advantageously perforated with passageways extending diametrically through the object. One form of perforated spherical object is illustrated in Fig. 6 having diametrically disposed passageways 15.

Insertion of the bore constricting object into the pipe to be cleaned is facilitated by lock chamber 4 which is detached from the pipe line and the object inserted into the space 16 as indicated at 17. The lock chamber with the bore constricting object in it is then attached to the pipe line by means of the flange bolts 5 as shown in position in Fig. 1.

Abrasive-laden liquid 18 maintained in a state of agitation, if necessary, by agitator 12 in tank 11 is then pumped therefrom, while valve 9 is open, by pump 7 into the lock chamber 4, thereby forcing the bore constricting object 17 from the lock chamber into the pipe line 1 where it encounters the scale deposit 2. Scale removing action then develops. This results from the pumping pressure applied to the abrasive-laden liquid and the action of the bore constricting object which directs the abrasive-laden liquid into the annular space 19 forming an abrasive liquid jet against the scale which, in the case illustrated, is generally of irregular thickness as shown in Fig. 3. Jetting thus occurs at the places, e. g. 20, where the bore constricting object is not in actual contact with the scale. As jetting and abrasion of the scale continues, the parts of the scale in contact with the bore constricting object, e. g. 21, wear away allowing the object to move on. As the scale is thus dislodged, the bore constricting object moves along the pipe leaving it substantially scale free.

Although a bore constricting object having a smooth surface, such as a sphere generally operates well, as shown in Figs. 1, 2, and 3, the modifications illustrated in Figs. 4, 5, and 6 have the advantage that there is little or no danger of them hanging up in the pipe in the event that the scale is of such uniformity of thickness as not to permit the abrasive liquid to pass at any point between the surface of the bore constricting object when smooth and the interior of the pipe. It is manifest that by dimpling the surface of bore constricting object, as in Fig. 4, or by providing projections, as in Fig. 5, space is thereby provided for passage of abrasive liquid between the surface of the bore constricting object and the scaled pipe so that scale removal by jetting and abrasion is obtained irrespective of the uniformity of thickness of the scale layer. With the modification shown in Fig. 6, jetting action is assured at all times by the passageways 15 which also have the advantage of directing additional jets of abrasive liquid against the scale irrespective of the orientation of the bore constricting object.

Since the bore constricting object is only slightly smaller than the bore of the pipe to be cleaned, it does not advance through the pipe beyond where the scale is so that complete removal of scale is assured as the bore constricting object traverses the pipe.

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The following example is illustrative of the invention:

Example

A pipe line 120 feet long with an inside diameter of 4.25 inches was incrustated with a layer of scale about 0.0625 inch thick. To one end of the pipe line was attached a short length of clean pipe of the same diameter containing a smooth steel ball 4.125 inches in diameter. An abrasive liquid mixture, formed by mixing water with gum karaya in the proportions of 0.3 pound of gum and 2 pounds of 20-40 mesh sand per gallon, was pumped into the clean portion of the pipe behind the ball so as to drive it into the scaled pipe using an injection rate of 10 gallons per minute of the sand-laden thickened liquid. The pressure varied during the injection but did not exceed about 250 p. s. i. As the injection continued movement of the ball along the pipe could be detected from the noises which were emitted as jetting and scale removal took place adjacent to the wall. The ball did not move at a uniform rate but remained in some locations longer than others in its journey through the pipe. About 200 gallons of the sand-laden thickened liquid were introduced into the scaled pipe before the ball emerged from the pipe at which time approximately 98 gallons of the abrasive-laden thickened liquid had by-passed the ball. Examination of the pipe after the ball had traversed the length of the pipe and emerged from it indicated substantially complete removal of the scale.

I claim:

1. The method of dislodging scale from inside a pipe line having a generally uniform diameter cylindrical bore which comprises inserting into the pipe line at one end a generally spherical rigid object having a diameter slightly less than that of the inside of the pipe line and introducing into the pipe line behind the said object an abrasive-laden liquid under pressure so as to force the abrasive liquid between the said object and the inside of the pipe line to produce jetting and abrasion against the scale and move the said object along the bore of the pipe line as the scale is thereby dislodged.

2. The method according to claim 1 wherein the said rigid object is a smooth sphere.

3. The method according to claim 1 in which the said rigid object is a sphere having a dimpled surface.

4. The method according to claim 1 in which the surface of the said rigid object is provided with stubby projections.

5. The method according to claim 1 in which the said rigid object is provided with a plurality of passageways passing therethrough diametrically in various directions.

References Cited in the file of this patent

UNITED STATES PATENTS

597,185	Huebner	Jan. 11, 1898
1,415,600	Mannion et al.	May 9, 1922
1,475,431	Evans	Nov. 27, 1923
1,808,870	Strasburg	June 9, 1931
2,087,694	Malmros	July 20, 1937
2,382,262	Scherer et al.	Aug. 14, 1945
2,478,961	Wortham	Aug. 16, 1949
2,605,596	Uhri	Aug. 5, 1952
2,668,307	Preen	Feb. 9, 1954

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