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METHOD OF AND APPARATUS FOR CLEANING TUBULAR BODIES

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4 Claims. (Cl. 51—11)

This invention relates to methods of, and apparatus for cleaning the inner walls of tubular bodies, and it is more particularly concerned with methods of and apparatus for cleaning comparatively small diameter tube pipes, such as boiler tubes and the like, but it is not limited to such use.

In the past, it has been the practice to clean fire-tube boilers with mechanical tools such as scrapers, brushes and the like, or by blowing live steam through the tubes while the boiler is in use. In water tube boilers it has been necessary to take the boiler out of service and scrape the tubes in an effort to remove the scale. These methods, especially in the case of the water tube boiler, are not only laborious but they also fail to efficiently remove the scale and sometimes, especially if scrapers are used, result in damage to the tubes by reason of the non-uniform internal diameter thereof. Also, with new tubular elements of comparatively small diameter, such as boiler tubes and the like it has been impossible to efficiently mechanically clean the interior, with the result that costly and time consuming pickling operations have been resorted to.

It is the primary object of this invention to do away with all of the cleaning operations previously used and employ an abrasive blast applied directly against the walls of the tubes.

Another important object of this invention is to devise a blast nozzle assembly that may be introduced into comparatively small tubes, and which will efficiently clean the tube walls, and yet which is simple in design and low in cost.

It is a further object of the invention to provide a novel tube-cleaning nozzle which is so designed as to efficiently direct the abrasive against the tube walls and which will blow the dislodged material from the tubes.

This invention also aims to provide a nozzle assembly that is sufficiently small to be introduced into, and advanced through tubes of comparatively small diameter, and that will direct streams of abrasive against the tube walls at angles sufficiently great to effect efficient cleaning thereof.

Further objects of the invention will become apparent as the specification proceeds in connection with the annexed drawing, and from the appended claims.

In the drawing:

Figure 1 is a longitudinal sectional view through a tube having one form of nozzle assembly of the invention, the section through the nozzle proper being along the line 1—1 of Figure 2.

Figure 2 is a transverse sectional view taken along the line 2—2 of Figure 1, with the nozzle removed from the tube.

Figure 3 is a view similar to Figure 2, but illustrates a modified form of nozzle also forming part of this invention.

Figures 4 and 5 are fragmental sectional views illustrating further modified forms of nozzles of this invention, and

Figure 6 is a fragmental sectional view of another form of nozzle embodying this invention.

With continued reference to the drawing, wherein like reference characters have been employed to designate like parts throughout the several views thereof, and with particular reference to Figures 1 and 2, a tube 10 is illustrated, and it may be a boiler tube or the like. Tube 10 is supported for cleaning by any suitable means 11, which may be a clamping mechanism if desired; and in the case of a boiler tube it may constitute the tube sheet itself.

The nozzle assembly is shown in operative position within tube 10 and its comprises a body 12, having a large diameter portion 13 and a preferably integral small diameter portion 14.

Portions 13 and 14 are connected by a preferably conical surface portion 15. Body 12 is provided with a longitudinal passage 16, and the part of passage in portion 13 functions as an abrasive-air supply conduit, while the portion of passage 16 located in reduced portion 14 is adapted to contain abrasive in static condition, to minimize wear of the parts, as will presently appear.

Communicating with passage 16, and disposed at an angle thereto, are a plurality of preferably radial blast jets 17, which are adapted to conduct abrasive from passage 16 and direct it against the inner wall of tube 10, for removing scale therefrom.

Blast jets 17 are seen to terminate at inclined surface portion 15, and surface portion 15 is preferably inclined so as to be disposed substantially at 90° with respect to the axes of jets 17. The number of jets employed, and the angle that they will assume with respect to passage 16 will be determined by the particular requirements of the tubes that are to be cleaned. Although these values may be varied within certain limits, it has been found that a nozzle employing three or four jets disposed at an angle of approximately 45° to the central passage has

given excellent results in tubes having diameters in the neighborhood of two inches.

The abrasive-air blast may be supplied to the central passage of body 12 in any suitable manner, but in the present instance a conduit 18 is threaded into a recess 19 in body 12, and a gasket 21 is clamped between the parts to prevent leakage. Conduit 18 may be connected to any suitable device for supplying an abrasive air mixture thereto, for instance a machine of the character shown in the application of William A. Rosenberger, Serial No. 710,555, filed February 9, 1934.

If a tube only slightly larger than body 12 is being cleaned, conduit 18 may be of a flexible nature and large diameter portion 13 be relied upon to guide the nozzle assembly within the tube. Conduit 18, however, is preferably of rigid construction, so that the nozzle assembly is positively maintained in substantially parallel relationship to the tube axis at all times, irrespective of the size of the tube.

The nozzle assembly may be employed to clean old or new tubes of scale or other undesirable adhering substances. In either case the method preferably employed is as follows:

The tube is preferably supported in a substantially horizontal position and the nozzle assembly is introduced into one end thereof. The blast is then turned on. When the nozzle is first placed in use, the right hand end of passage 16 fills up with abrasive approximately to the level of the right-hand edge of jets 17, with the result that as the abrasive passes through passage 16 and suddenly undergoes a change in direction as it passes is diverted into jets 17, it does not wear the nozzle parts as the body of stationary abrasive constitutes the diverting wall.

The abrasive issuing from jets 17 strikes the inner wall of tube 10 at an angle of approximately 45°, and efficiently dislodges scale and other adhering material therefrom. As the blasting operation proceeds the nozzle is slowly moved into the tube, with the result that the entire tube surface is progressively cleaned. If desired the nozzle may be rotated while it is being advanced through the tube, but it has been found that good results are attained when it is held in a fixed angular position during the cleaning operation.

While the cleaning operation is being carried out, the strong blast of air accompanying the abrasive effectively blows the removed scale from the tube. This is brought about because of the forward inclination of the blast jets and in small pipes it is also aided by large diameter portion 13, which acts as a partial piston, for preventing escape of any large amount of air from the left-hand end of the tube. While the nozzle assembly is being advanced through the tube large diameter portion 13 may be allowed to ride upon the tube wall, but if desired, especially if the tube is of considerably larger diameter than portion 13, conduit 18 may be mounted in guides, so as to support nozzles substantially concentrically with the tube.

The rate of advance of the nozzle assembly through the tube will be determined by the condition of the tube undergoing cleaning. For instance if the tube is unusually dirty the rate of advance will be lower than if the tube is in a better condition. If desired, however, the rate may be maintained constant and differences in the cleaning required be taken care of by making two or more "passes" of the nozzle assembly through the tube. Moreover, the nozzle during both the cleaning and scavenging operations, may be moved rearwardly, or in a direction opposite to that described.

After the tube has been cleaned, the nozzle may be passed through the tube to scavenge it or free it of all traces of abrasive and freed scale particles by shutting off the abrasive supply and merely supplying compressed air to the jets.

In the nozzle of Figures 1 and 2, jets 17 are symmetrically disposed, with two jets directed upwardly and one downwardly. In some instances, especially where the tube to be cleaned is considerably larger than the nozzle, and the nozzle is allowed to ride upon the tube, it is desirable to arrange the jets in a different relationship. In Figure 3 there is disclosed a nozzle disposed in a larger pipe 10*a*, and having three jets 17*a*, one of which is directed upwardly and two horizontally. The reason for grouping jets 17*a* in this manner is to more evenly distribute the abrasive upon the walls and avoid a jet at the point where the nozzle contacts the tube.

In Figures 4 and 5 there are disclosed modified forms of nozzles having removable end caps, which may be removed for blowing out the nozzles in case of stoppage. In Figure 4 an end cap 23, provided with a gasket 24, is threaded over the end of small diameter portion 14*a* of the nozzle. In Figure 5 the end cap assumes the form of a plug 25 equipped with a gasket 26 and it is threaded into small diameter portion 14*b* of the nozzle.

In Figure 6 there is disclosed a modified form of nozzle 12*a*, and in this form of the invention jets 17 are preferably four in number and are of larger size. Also a nipple 27 is preferably cast in place with the nozzle. Conduit 18, or a flexible hose, may be threaded onto nipple 27 in any suitable manner.

Although they have not been shown in the drawing, it is to be understood that if desired, passage 16 and/or jets 17 may be equipped with replaceable abrasive resistant liners, and the appended claims are intended to embrace the invention when it assumes this form. Moreover, nozzle 12 is shown as a single integral piece, and it is preferably constructed in this manner as it may be produced accurately and at low cost, but it is to be understood that it may be made in two parts if desired. For instance, the nozzle may consist of two parts threadedly connected in the region of jets 17 without departing from the spirit of the invention.

In all of the forms of the invention disclosed, it is to be understood that the inclination of jets 17 from the axis of passage 16 may be varied to suit the requirements of the particular tube that is being cleaned, but it is preferably kept within the range of 10 to 80°. Moreover, jets 17 may be disposed in planes disposed at angles to the axis of passage 16, to impart a swirling action to the air and abrasive if desired.

The present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:—

1. In a nozzle assembly for blasting the inner walls of tubular bodies, an elongated, generally cylindrical member adapted to be inserted in a tube with its axis parallel to the axis of the tube, said member comprising a large diameter portion and a small diameter portion merging into each other, said large and small diameter portions having a longitudinal passage therein, said passages communicating with each other and being disposed in substantially axially aligned relationship, said large diameter portion having at least one jet therein communicating with the longitudinal passage thereof, said jet terminating at the surface of said member where said large and small diameter portions merge into each other, said jet being operable to direct abrasive against the walls of said tube, and means adapting the longitudinal passage of said large diameter portion for connection to a source of compressed air and abrasive, said large diameter portion having a diameter which is not greatly different from the diameter of said tube.

2. The nozzle assembly described in claim 1, wherein said large and small diameter portions are of substantially equal length and said longitudinal passages are of substantially equal diameter.

3. The nozzle assembly described in claim 1, wherein said large and small diameter portions are connected by a conical surface.

4. In a nozzle assembly for abrading the inner walls of comparatively small tubular bodies such as boiler tubes and the like, an elongated, generally cylindrical member adapted to be inserted in a tube with its axis parallel to the axis of the tube, said member having a large diameter rear portion and a small diameter front portion which each merge into a conical surface provided on said member, said front and rear portions having a longitudinal passage therein, said passage being disposed in substantially axially aligned relationship to the axis of said member, said longitudinal passage terminating at the rear end of said rear portion and opening into means provided on said member adapting it for connection to a source of compressed air and abrasive, said longitudinal passage terminating at the other end in said front portion, said large diameter portion being of a diameter which is not materially less than the diameter of said tube whereby it may be centered by engagement with the walls of the latter, said rear portion having a plurality of jets provided therein communicating with said longitudinal passage and terminating at said conical surface intermediate said front and rear portions, said jets being disposed obliquely to the axis of said member and adapted to direct abrasive obliquely against the walls of said tube, the portion of said longitudinal passage of said front portion of said member defining a closed-ended passage adapted to trap a predetermined quantity of abrasive.

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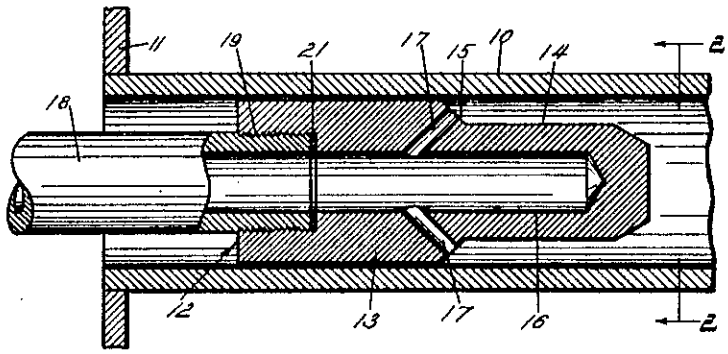

Fig. 1

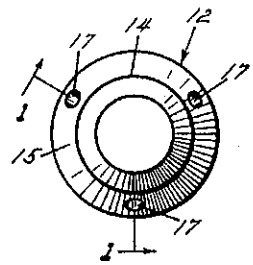

Fig. 2

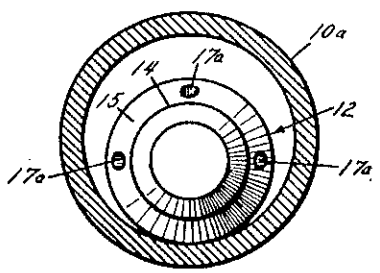

Fig. 3

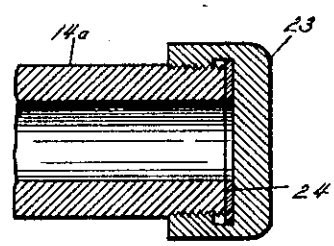

Fig. 4

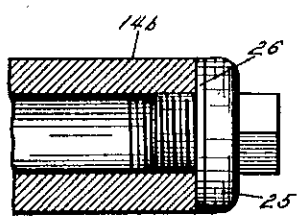

Fig. 5

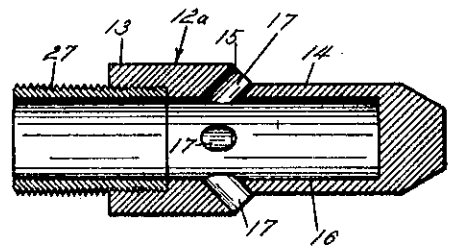

Fig. 6

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