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 APPARATUS FOR TRAPPING AND CRUSHING SOLID PARTICLES
 ENTRAINED IN A LIQUID STREAM
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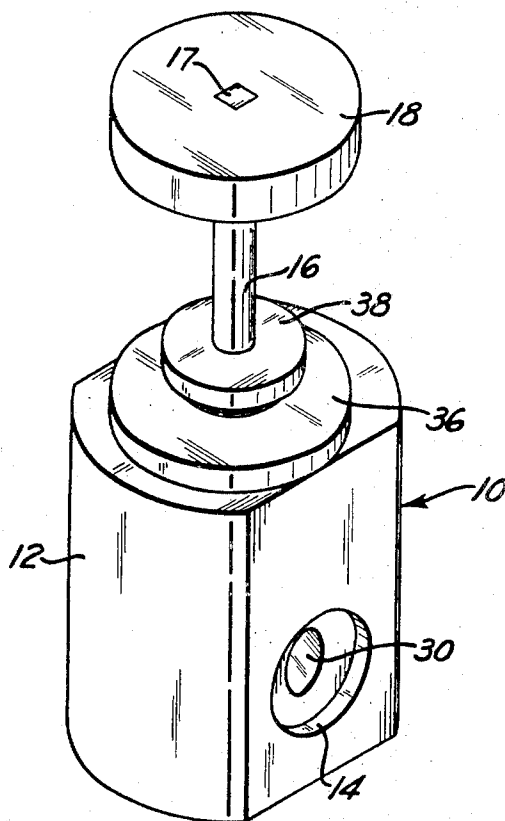


Fig. 1

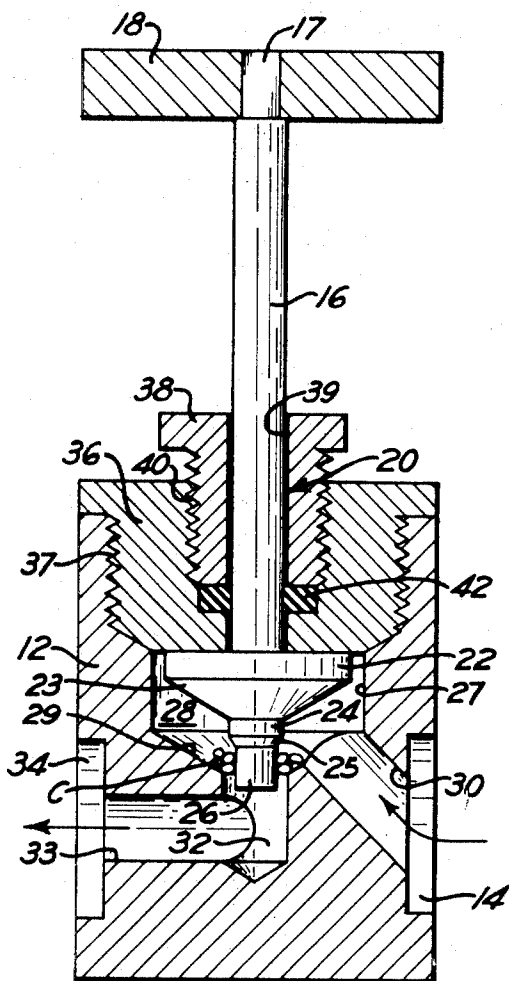


Fig. 2

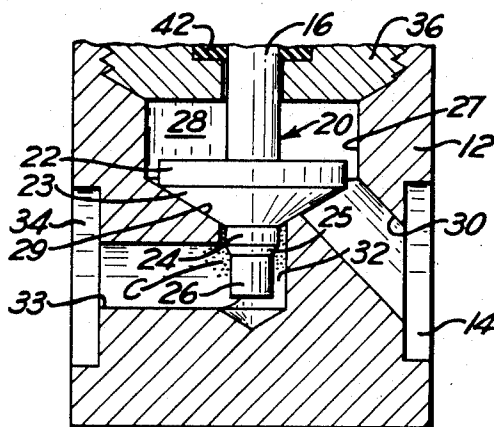


Fig. 3

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APPARATUS FOR TRAPPING AND CRUSHING SOLID PARTICLES ENTRAINED IN A LIQUID STREAM

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8 Claims

ABSTRACT OF THE DISCLOSURE

A device for trapping and crushing solid particles entrained in a liquid stream comprising an annular orifice defined by an outer fixed passageway and an inner moveable member. Upon operation of the moveable member, an enlarged portion thereof crushes the entrained particles held on the annular orifice, and congruous inclined surfaces extending outwardly of the passageway and on the moveable member further crush the particles.

This invention pertains to a device for removing entrained particles of coke from streams of high viscosity fuel oil.

Heretofore, in the general field of removing solid particles from liquid streams, screens of various types and configurations were most generally utilized. Screens suffer from the disadvantage that they must be periodically cleaned which often entails disassembly of the device in which the screen is mounted. Such disassembly requires that the device be taken out of the flow line, which results in a stoppage of flow for a period of time.

The present invention provides a novel and a simple device to solve the problem of removal of particles from liquid streams. The present invention provides an annular orifice defined by a moveable member extending into a larger opening in a fixed member. The fixed member is provided with a conical surface extending outwardly from the mouth of the opening, and the moveable member is provided with a mating conical surface. By operating the moveable member, the annular orifice is made smaller, and the trapped particles on the annular orifice are crushed between the mating conical surfaces, after which the conical surfaces are moved apart, and the now crushed entrained particles are flushed away by the liquid stream. Thus, the disadvantages of the screen types of devices are overcome. The device is operated externally and operation of the device has no appreciable effect on flow. The device needs no disassembly during its normal operation. There are no internal parts requiring cleaning.

More specifically, the invention has been used in conjunction with the burning of high viscosity fuel in commercial applications. The presence of solid particles of coke in this fuel has been a problem in that the coke fouls the burner nozzle to which the fuel is being fed. This fuel is supplied at relatively high pressure and high temperature, and prior screening type devices would be unsatisfactory in that substantial hazards to personnel would result from handling the fuel at such high temperatures and high pressures as would be required in order to dismantle the equipment to clean or replace the screen.

Another advantage of the invention is its extreme simplicity. The preferred embodiment of the invention has only one moving part, and that one part is returned to its normal position after each operation either by hand as part of the operation or by the pressurized fuel itself, thereby eliminating any springs or other return means.

While the invention has been designed for and has been used in conjunction with solid particles of coke in

high viscosity, high temperature, and high pressure fuel streams, it will be understood by those skilled in this art that the invention may be utilized with any liquid stream and with virtually any solid particles entrained therein, so long as the solids are susceptible to being crushed by a reasonable amount of force, as will appear more clearly below.

The above and other advantages of the invention will be pointed out or will become evident in the following detailed description and claims, and in the accompanying drawing also forming a part of the disclosure, in which: FIG. 1 is an elevational perspective view of an apparatus embodying the invention; FIG. 2 is a longitudinal, cross-sectional view thereof; and FIG. 3 is a view similar to that to a portion of FIG. 2 showing the down or crushing position of the moveable member.

Referring now in detail to the drawing, 10 designates a coke crushing device embodying the invention. Device 10 comprises a body member 12 formed with an inlet orifice 14 on one side surface thereof. Orifice 14 is shown somewhat diagrammatically, in that it may also include means, such as screw threads, O rings, or the like to attach a fuel supply conduit to said orifice. Extending upwardly from the top of the device 10 is an operating stem 16 formed with a square cross-section end portion 17, on which is mounted an operating member 18. Stem portion 16 and operating member 18 form part of a moveable member assembly 20, see FIG. 2. At its lower end, within the body, moveable member 20 comprises an enlarged portion 22, a downwardly and inwardly conical portion 23, a bottom enlarged cylindrical portion 24, a smaller diameter cylindrical orifice defining tip 26, and a conical shoulder portion 25 interconnecting cylindrical portion 24 and tip 26.

Means are provided to form a chamber within body 12 and to collect coke or other entrained solid particles within said chamber. To this end, an internal chamber 28 is defined by a cylindrical surface 27 and a conical surface 29 in the body 12. Conical surface 29 is congruous to conical portion 23 of moveable member 20. Body member 12 is formed with a passageway 30 extending from inlet orifice 14 to chamber 28 which intersects said chamber in the region of conical surface 29.

Means are provided to permit flow of fuel out of chamber 28 and to trap any entrained solid particles in said chamber. To this end, body member 12 is formed with an exit passageway 32 which extends downwardly from the bottom of conical surface 29, and which is of a predetermined diameter. A side passageway 33 interconnects passageway 32 with an exit orifice 34. Exit orifice 34 is similar to inlet orifice 14 as to the diagrammatic showing thereof, as explained above, and feeds the fuel to the burner or burners being fed by the invention.

Means are provided to seal the upper end of the chamber 28, and so slidingly seal around the stem 16 of moveable member 20. To this end, a sealing nut 36 is threadedly fitted in a suitably formed top opening in body member 12. The interconnection between sealing nut 36 and the body member 12 is preferably by means of pipe threads 36, chemical sealing means, or the like, to form a secure fluid tight seal. Nut 36 carries a packing gland 38 formed with an internal through opening 38 of a diameter large enough to easily pass operating stem 16. Gland 38 is joined to nut 36 by means of pipe threads 40 or the like to form a tight secure seal therebetween. At its lower end, a packing member 42 formed of No. 210 anchor spiral packing, or other suitable material is provided. Gland 38 is screwed down on threads 40 to compress packing member 42 between the nut and the gland and in sliding sealing relation to operating stem 16. Actual experience has shown that the only maintenance the preferred apparatus embodying the invention required is

periodic checking or replacement of packing member 42, and this is readily accomplished by simply unthreading and adjusting gland 38.

OPERATION

Device 10 is operatively connected into a fuel supply conduit feeding a fuel burner, not shown. In the embodiment of the invention which has been successfully built and which has been in successful use for more than four months, in continuous operation 24 hours a day, seven days a week, oil of a viscosity of one million to two million Saybolt Furl Seconds at 122° F. was fed through the device to an industrial fuel burner. The oil was kept at temperatures above 370° F. to achieve proper atomization thereof in the oil burner and was delivered through the device of the invention and to the burner at pressures in the range of about 40 p.s.i. to about 90 p.s.i. This fuel contains significant quantities of entrained coke. The fuel is supplied through inlet orifice 14 and passageway 30 into chamber 28. The angle of attack of the pressurized fuel through passageway 30 against conical portion 23 holds the movable member 20 in the up position shown in FIG. 2. The relative diameters of the tip 26 and exit passageway 32 provides an annular orifice therebetween of predetermined radial dimension. As is readily apparent dependent upon the natures of the entrained particles and of the application, the thickness of this annular orifice is adjusted to retain particles larger than some predetermined size. This desideratum may be accomplished by providing different movable member assemblies 20 having various size tips 26, or by providing replaceable tips 26 and/or replaceable end assemblies comprising portions 24, 25 and 26 or one assembly 20.

As flow continues, the coke particles C collect on the orifice between tip 26 and passageway 32. When the amount of coke builds up to such an extent that burner operation, or, in the more generic sense, performance at the delivery end, experiences an effect, then the operator presses down on operating member 18 and turns the operating member to thereby crush the coke first between shoulder 25 and the sharp edge between surface 29 and passageway 32, and thereafter between the two congruent conical surfaces 23 and 29. In the actual installation described above, it was found that with a flow rate averaging about 150 g.p.h. it was necessary to perform the coke crushing operation about once per 24 hour day. Of course, it will be understood that more frequent operation of the device to remove collected solid particles is not harmful and is in fact beneficial, and therefore frequent operation at regular intervals with, for example, some correlation to shift changes, or with some automatic device to strike and turn member 18, may prove most effective. The device is of most value when an operational upset dislodges excessive coke particles in the system which will tend to plug the oil burners in a few minutes, which, of course, is immediately corrected.

Referring to FIG. 3, the condition immediately after the crushing operation is shown. The coke C is now in the form of very fine particles. As soon as the crushing operation is complete, which is virtually instantaneous, the operator simply removes his hand from member 18 and the force of the incoming pressurized fuel in passageway 30 impinges upon surface 23 and returns movable member 20 to the position of FIG. 2. Normal flow of fuel through the device thereafter flushes the fine particles of coke out passageway 33 and into the burner where, because of its now fine size, it is easily burned along with the fuel.

The crushing operation is virtually instantaneous, and observation of the device in operation has shown that the flame issuing from the burner or burners being fed by the device of the invention flickers only slightly, and no other effect is encountered.

In actual use of the invention, it has been found that operation is usually one smooth motion, entailing push

down, twist, and pull up on operating member 18. Thus, while impingement of the fuel on conical portion 23 will move the operating member upwardly, this feature need not be utilized. In this same regard, the true proportions of the parts have been somewhat distorted in the drawing, in that enlarged portion 22 actually fits much more closely, although loosely, within cylindrical surface 27. During operation, the actual crushing of the trapped coke particles C occurs between thickened portion 24 and passageway 32, on the shoulder 25, and between the congruous surfaces 23 and 29.

While the invention has been described in detail above, it is to be understood that this detailed description is by way of example only, and the protection granted is to be limited only within the spirit of the invention and the scope of the following claims.

I claim:

1. Apparatus for trapping and crushing solid particles entrained in a fluid stream, comprising a body member formed with a chamber, means to permit the flow of said fluid stream into said chamber, means to permit the flow of said fluid stream out of said chamber comprising an exit passageway of predetermined configuration and dimensions, a movable member mounted on said body member comprising a tip portion normally positioned in said exit passageway, said tip portion being of a predetermined configuration similar to the predetermined configuration of said exit passageway and of predetermined dimensions smaller than the predetermined dimensions of said exit passageway, whereby an annular exit orifice of predetermined size is formed between said tip portion and said exit passageway to trap solid particles in said fluid stream on said annular exit orifice larger than said predetermined size of said annular exit orifice.

2. The combination of claim 1, said annular exit orifice comprising the bottom of said chamber, said chamber comprising an upwardly and outwardly tapered surface extending upwardly and outwardly from said exit passageway and forming a sharp edge therewith, said movable member comprising a thickened portion above said tip portion of predetermined configuration and dimensions which is normally positioned above said exit passageway, said movable member comprising an upwardly and outwardly tapered surface extending upwardly and outwardly from the upper end of said thickened portion, said upwardly and outwardly tapered surfaces of said movable member and of said chamber being similar to each other, whereby upon downward motion of said movable member in said chamber, said thickened portion will urge accumulated solid particles on said annular exit orifice upwardly and outwardly onto said tapered surface of said chamber, and whereby the accumulated solid particles between the tapered surfaces of said chamber and said movable member are crushed therebetween.

3. The combination of claim 2, said fluid entrance means comprising a fluid entrance passageway extending from an external portion of said body member upwardly and inwardly into said chamber and intersecting a portion of said tapered surface of said chamber, whereby pressurized fluid entering said chamber will impinge upon said tapered surface of said movable member to urge said movable member upwardly.

4. The combination of claim 1, said movable member comprising an enlarged portion positioned within said chamber, said fluid entrance means comprising a fluid entrance passageway beginning at the outside of said body member and extending upwardly and inwardly into said chamber, whereby the force of the fluid entering said chamber impinging upon said enlarged portion of said movable member will urge said movable member upwardly.

5. The combination of claim 2, said movable member comprising a conical shoulder portion interconnecting said tip portion and said thickened portion.

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6. The combination of claim 1, said movable member comprising an operating stem portion extending outwardly of said body member, means to slidably seal said stem portion in said body member, and means to permit reciprocatory and rotational motion of said tip portion with respect to the axis of said stem portion by manipulation of said outwardly extending portion of said body member.

7. The combination of claim 6, said last mentioned means comprising an operating member joined to said stem portion by a mating non-round cross-section pin and opening connection.

8. The combination of claim 6, and packing gland

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means to urge said sealing means into sliding sealing relation to said stem portion.

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