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SPRAY GUN FOR CLEANING TUBES HAVING RADIALLY EXPANSIBLE MEANS FOR SEALINGLY ENGAGING SAID TUBE

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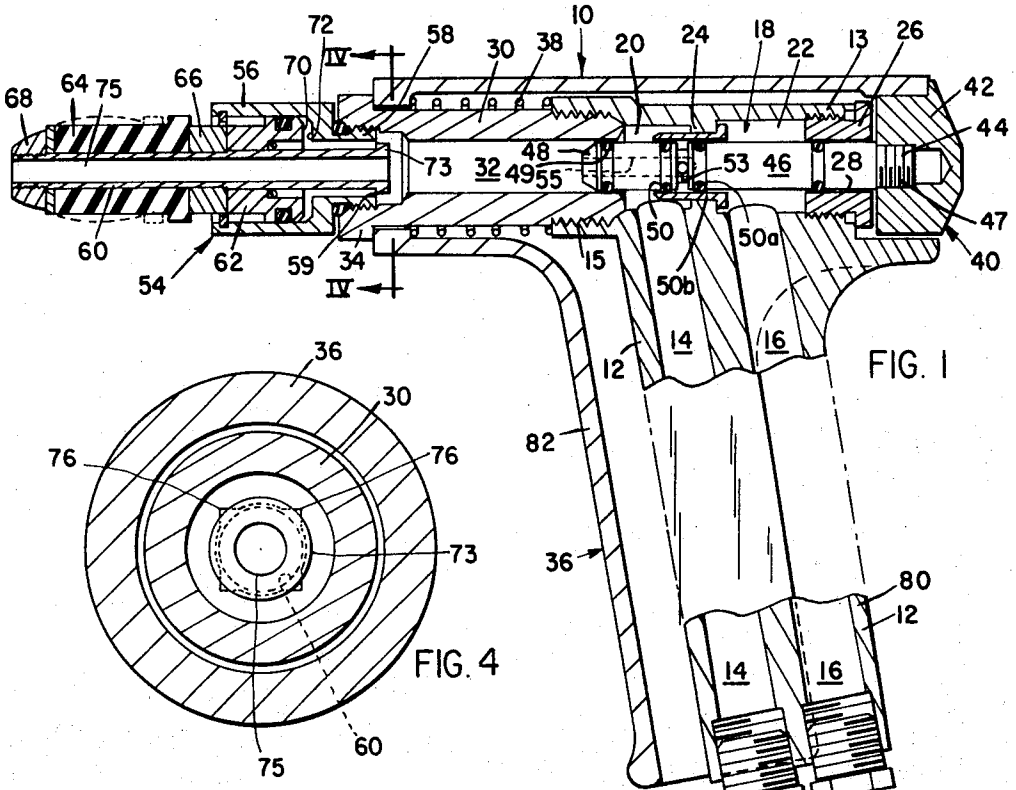

FIG. 1

FIG. 4

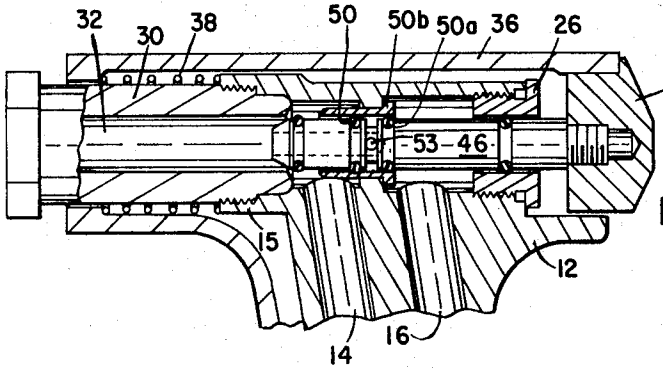

FIG. 2

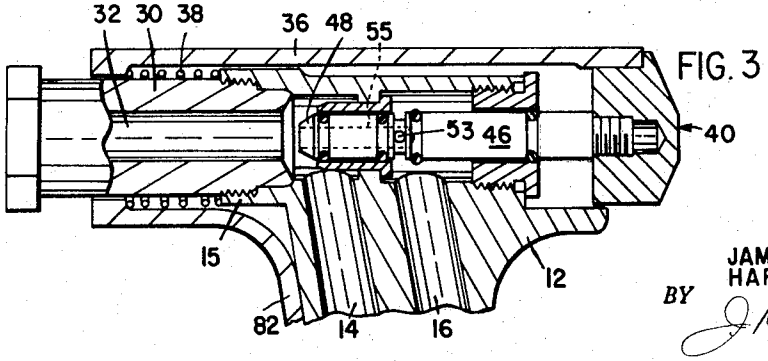

FIG. 3

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SPRAY GUN FOR CLEANING TUBES HAVING RADIALLY EXPANSIBLE MEANS FOR SEALINGLY ENGAGING SAID TUBE

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This invention relates broadly to fluid flow control devices. More particularly, this invention relates to a device for delivering one or more fluids under pressure. Still more particularly, this invention is directed to a device of the kind employed for cleaning tubes or conduits in a heat transfer device by delivering a fluid or mixture of fluids under pressure through the interior of the tubes or conduits.

In heat transfer equipment of the kind described, there are a number of tubes through which a heat transfer fluid flows. Over a period of time, material carried in suspension in the fluid is deposited on the walls of the tube and must be removed if efficient operation of the heat transfer apparatus is to continue. This invention is directed to a device for removing the material from the walls of the tubes by supplying therethrough fluid under pressure sufficient to dislodge the material. To this end, there is provided a fluid delivery unit which regulates flow of fluid through the device to the inside surfaces of the tube. The device is such that it may be operated by an individual much in the same manner that a gun or other trigger-operated mechanism is operated. As a matter of fact, the device is generally referred to as a tube cleaning gun, for it releases the cleansing fluid in response to the squeezing of a handle mechanism.

The tube cleaning device forming the subject of this invention is comprised of a number of moving parts operable so that a first fluid such as air or a combination of fluids such as air and water may be delivered from the device directly to the tubes requiring cleaning. A primary object of this invention is the provision of an improved tube cleaning device in which the parts forming the device are easily fabricated and readily assembled so that the device may be handled by an operator without undue fatigue on the part of the operator.

Another object of the invention is the provision of a device of the kind described wherein an improved valve mechanism is employed in a body member in such a way as to be responsive to relative movement between the body member and a casing in which the valve means is mounted.

A further object of the invention is the provision of a device of the kind described wherein there is provided an improved nozzle assembly for use with the device wherein the nozzle assembly engages the tube to be cleaned in such a manner as to form a seal between the device and the tube.

Another object of the invention is the provision of an improved nozzle assembly wherein the sealing means associated therewith is actuated by utilizing the pressure represented by a part of the flow emanating from the device.

These and other objects of the invention will be apparent upon a consideration of the ensuing specification and drawings in which:

FIGURE 1 is an elevational view partly in section illustrating a fluid flow control device complete with an improved nozzle means forming the subject of this invention;

FIGURE 2 is a fragmentary view partly in section illustrating a first operating position of the unique valve means employed with the fluid flow control device shown in FIGURE 1;

FIGURE 3 is a view similar to FIGURE 2 illustrating the parts in another position wherein the two fluids employed for the purpose of cleaning tubular members may flow from the device; and

FIGURE 4 is an enlarged sectional view along lines IV—IV of FIGURE 1 illustrating the arrangement employed for the purpose of actuating the sealing means associated with the nozzle assembly.

As pointed out above, this invention is directed to a device for removing foreign material from the inside wall of a tubular member by delivering either one fluid or a combination of fluids under pressure sufficient to dislodge the material from the tube. The device includes in addition to the mechanism for delivering the fluid, a nozzle assembly which, when moved into engagement with the outer end of the tube to be cleaned, automatically provides a seal to prevent, when the device is triggered, leakage between the tube and the nozzle.

Referring particularly to the drawings, there is shown at **10** a fluid delivery device comprising a body member **12** formed of a material such as cast aluminum which includes two passages **14** and **16** provided therein. The passages **14** and **16** hereinafter referred to as the first and second passages, communicate with a chamber **18** having a first compartment **20** and a second compartment **22** formed on opposite sides respectively of an annular wall **24**. The body member **12** includes threaded portions **13** and **15** disposed at the opposite ends of chamber **18**. Threadably mounted to the body member at the end **13** of chamber **22** is a plug member **26**. Threadably mounted to the body member **12** at the end **15** of chamber **18** is a generally cylindrical adapter member **30** having an axial passage **32** extending therethrough. It will be noted that the passage **32** serves as a continuation of compartment **20** and accordingly as an outlet for fluid emanating from the chamber **18**. Adapter member **30** includes an enlarged end portion **34**, the inner surface of which is threaded for a purpose to be later described.

In addition to the body member **12**, there is provided a hollow casing member **36** which substantially surrounds the body member **12** when assembled thereto. There is, however, a portion of body member **12** that projects beyond casing member **36** so that an operator may grasp the device in the manner of one grasping a gun. Interposed between the casing **36** and the body **12** is a spring **38** which biases casing **36** relative to body member **12** in the position shown in FIGURE 1. Casing member **36** mounts valve means **40** comprising an assembly including a head **42** which is assembled to the casing with a press fit. The head **42** includes a threaded opening **44** into which is mounted valve stem **46** having an end portion **47** provided with an external thread. Stem **46** extends through opening **28** provided in plug **26**. Stem **46** is provided with a tapered end portion **48**, having a sealing O-ring **49** adjacent thereto, which projects into opening **32** when the device is in the position illustrated in FIGURE 1. In addition, stem **46** mounts spaced O-rings **50** and **50***a* having slidable engagement with sleeve **50***b* engaging annular wall **24**. The end **48** of stem **46** acts as a valve element regulating flow between chamber **18** and the outlet passage **32** in the adapter **30**. O-rings **50** and **50***a* are mounted in spaced grooves provided in stem **46** on opposite sides of a port **53** communicating with axial passageway **55** formed in stem **46**.

As will be evident from a consideration of FIGURE 1, there is provided a nozzle assembly **54** including a casing **56** having a threaded shank **58** engaging the threaded surface formed on the flange **34** of adapter **30**. Arranged within the casing **56** is a hollow stem **60** including passageway

75 which when the nozzle assembly is mounted on the end of the device 10 forms a continuation of outlet passage 32. Disposed within casing 56 is a piston 62 encircling stem 60. Piston 62 is arranged to slide axially along the outer surface of the stem. Located axially adjacent piston 62 is a resilient sealing sleeve 64 encircling the stem 60. Spacer 66 is interposed between the piston 62 and the flange on sleeve 64. A washer 68 is threadably assembled about the stem 60 to prevent axial movement of the sealing member 64.

As shown in FIGURE 1, the nozzle assembly 54 is threadably mounted to the adapter 30 which is in turn threadedly connected to body member 12. Movement of piston member 62 from the retracted position shown in FIGURE 1 to an advanced position to the left is accomplished by introducing a part of the fluid flowing in opening 32 to the space 70 between the rearward end of piston 62 and the surface 72 on casing 56.

In order that a portion of the fluid flowing from adapter outlet 32 through hollow stem 60 of the nozzle assembly be diverted to advance piston 62 and cause resilient sleeve 64 to expand to a sealing position relative to the tube to be cleaned as shown in dotted lines in FIGURE 1, the inside surface of shank portion 58 of casing 56 is provided with spaced axial grooves 76. Preferably, these grooves are formed by a broach in the manner well-known to those familiar with metalworking techniques. The circular end 73 of the hollow stem overlies the end 59 of the shank portion 58 in the manner illustrated in FIGURE 4. The depth of grooves 76 is such that communication between the groove and the outlet passage 32 may obtain so that fluid flowing in the passage 32 will enter the grooves 76 and collect in space 70 to actuate piston 62.

Considering the operation of the fluid flow control device illustrated in FIGURE 1, it will be appreciated that the connectors 79 provide a means for uniting the device 10 with the sources of fluid such as compressed air and water. Flexible conduits, not shown, are connected to the ends of connectors 79 so that air under pressure can be supplied to the device through passage 16 and water under suitable pressure may be supplied to the passage 14. As pointed out above, the fluid flow control device is particularly suited for cleaning debris or deposited material from the inner surface of a tube in a heat transfer unit. In this regard, it should be noted that in many instances the material deposited on the interior wall of a tube to be cleaned may adhere to the wall surface so strongly that it may be necessary to employ a brush-like element or plug propelled by the fluid transmitted by the tube cleaning device. The plugs or brushes are well known to those skilled in the art and inasmuch as they do not contribute to this invention, further explanation is deemed unnecessary. As will be understood by those skilled in the art, the heat transfer unit will comprise a plurality of tubular members mounted in a tube plate so that one end of the tube is exposed upon removal of the headers normally associated with heat transfer units. The fluid flow control device 10 is moved so that the nozzle member engages the open end of the tube to be cleaned. Preferably, the parts are constructed so that the forward end of the nozzle assembly penetrates the interior of the tube to a predetermined distance.

The operator then squeezes the handle formed by the shank portion 80 of body member 12 and the shank portion 82 of casing 36. This action causes relative movement between the body 12 and the casing 36 compressing spring 38 in the process. The parts are so arranged that initial compression caused by the squeezing action forces the body member 12 forwardly relative to the casing. Thus, adapter member 30 moves relative to valve stem 46 in the manner shown in FIGURE 2 so that passage 14 communicates with outlet 32 through chamber 18. Thus, water under pressure is delivered to the interior of the tube. At the same time, a portion of the water flowing from outlet 32 enters, via opening 76, the space 70 behind piston 62 causing the piston to advance forwardly and radially expand the sealing sleeve 64.

Continued movement of the body member forwardly relative to the casing by application of additional hand pressure causes port 53 to communicate with passage 16 so that air now enters outlet 32 via axial passageway 55. Thus, a combination of water and air under relatively high pressure is supplied to the tube causing the debris to be washed from the walls through the tube and be collected at that point.

With the nozzle assembly described, a sealing action is obtained particularly in those instances when the tube to be cleaned is severely plugged so that the tube is in effect pressurized until the fluid pressure delivered requires a pressure large enough to remove the material in the tube. Without a positive seal of the kind described, leakage could occur to the discomfort of the operator.

While we have described a preferred embodiment of the invention, it will be understood that our invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

We claim:

1. Fluid delivery means comprising a body member having at least one passage for connection with a source of fluid under pressure and outlet means for transmitting fluid from the body member; valve means selectively communicating the passage and the outlet means; and nozzle means associated with the body member outlet, said nozzle means including fluid actuated piston means slidably mounted therein said piston being slidable in response to fluid flowing from said body member and an elongated resilient sleeve in axial alignment with said piston, said sleeve being radially expansible in response to pressure applied axially thereto by said piston, said radial expansion accomplishing said sealing action.

2. Fluid delivery means as set forth in claim 1 wherein said nozzle means includes a casing member communicating with the outlet means, and hollow stem means arranged within said casing, said fluid actuated movable means includes piston means disposed within said casing slidably encircling said stem, said piston means having communication with said fluid flowing through said outlet, and said resilient sealing means includes an axially confined radially expansible resilient sleeve so that movement of the piston in response to fluid applied thereto causes said sleeve to advance axially and expand radially to effect a seal when the fluid delivery means is applied to an opening of a size comparable to the circumference of said nozzle means.

3. A fluid flow control device for delivering either a single fluid or a plurality of fluids under pressure to a conduit comprising a body member having a first passage for connection with a first fluid source, a second passage for connection with a second fluid source, a chamber having a first compartment communicating with said first passage and a second compartment communicating with said second passage, plug means threadably mounted in said body at one end of said chamber, casing means surrounding a substantial portion of said body member so as to leave at least a portion of said body member exposed, an adapter member having an axial opening extending therethrough threadably mounted in said body so as to form an outlet communicating with said chamber, valve means including a head portion connected to said casing, a valve stem extending inwardly of said head through said plug through the body member chamber in alignment with the axial opening in the adapter, a first valve element having an axial sealing surface mounted on said stem controlling flow between the first and second compartments of said chamber, a second valve element mounted on said stem controlling flow between the second compartment and the adapter opening, said valve elements being spaced on said stem so that relative movement between the stem and body member will first cause said

first valve element to move to a first position whereby communication between the adapter opening and the chamber is limited to a path including said first compartment and continued relative movement between the stem and body member will establish communication between the first and second compartments and the outlet opening, spring means surrounding said adapter engaging said body member and said casing means to bias said casing and valve means to a position wherein said valve elements prevent communication between said chamber and said adapter opening and nozzle means for sealing said device relative to said conduit.

4. The invention set forth in claim **3** wherein said nozzle means comprises a casing threadably connected to said adapter to form an extension thereof, a hollow stem coaxially arranged within said casing to form an extension of said adapter opening serving as an outlet passage for said device, piston means arranged within said casing surrounding said stem for slidable movement along said stem, a flexible sleeve encircling said stem, said sleeve being in axial alignment with said piston, means forming at least one passage for the flow of a portion of the fluid

delivered to said nozzle for advancing said piston to radially expand said flexible sleeve.

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