Aug. 17, 1954 W. S. CAMPBELL 2,686,536

SEQUENTIALLY OPERATED VALVE FOR CONDENSER TUBE BLOWERS

Filed July 29, 1949

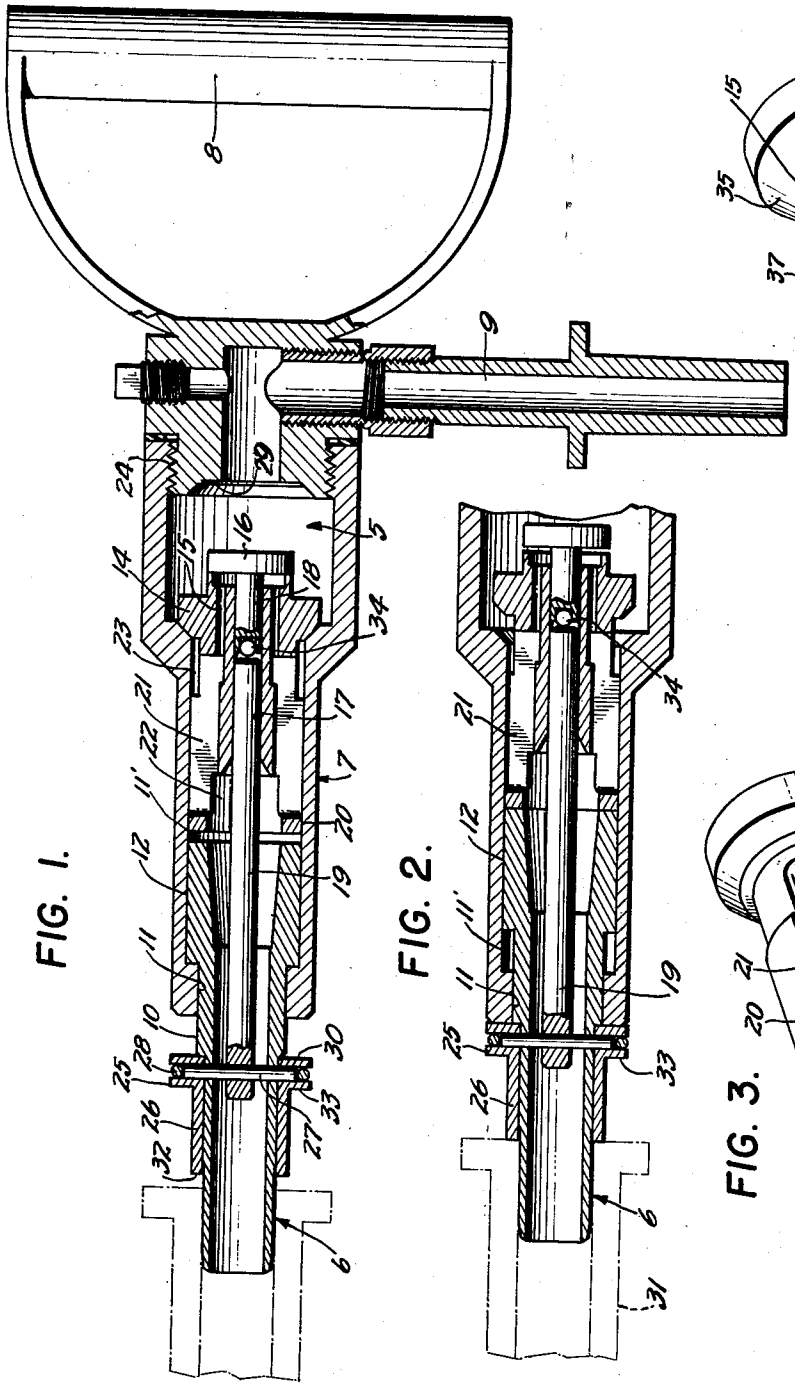


FIG. 1.

FIG. 2.

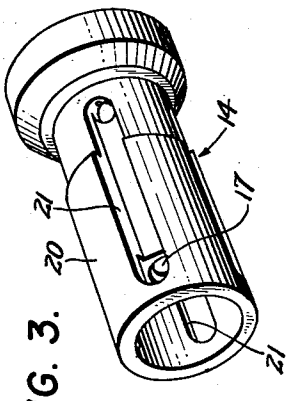


FIG. 3.

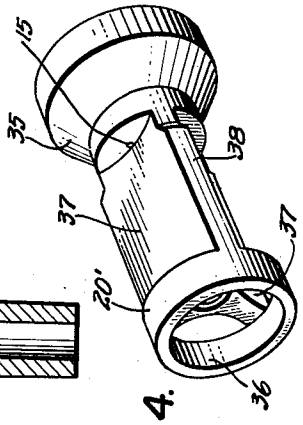


FIG. 4.

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Patented Aug. 17, 1954

2,686,536

UNITED STATES PATENT OFFICE

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SEQUENTIALLY OPERATED VALVE FOR CONDENSER TUBE BLOWERS

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Application July 29, 1949, Serial No. 107,480

2 Claims. (Cl. 137—630.15)

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My invention relates to tube cleaners and in particular to devices for applying high-pressure fluids such as steam directly to flue or condenser tubes for flushing the same. This invention is in the nature of an improvement over the disclosure contained in my co-pending application, Serial No. 641,776, filed January 17, 1946, now Patent No. 2,593,101, dated April 15, 1952.

A number of devices have been proposed and are in use for supplying pressurized fluids to condenser tubes for cleaning purposes. Most of these devices require manual actuation of a valve in order to admit the cleaning fluid. Frequently, the tubes to be cleaned are constricted by excessive deposits, so that application of pressurized fluid may result in the backward ejection of cleaning fluid. When steam is employed, this difficulty can result in serious injury to the user of the device.

It is, accordingly, an object of my invention to provide an improved tube cleaner of the character indicated.

It is another object to provide a tube-cleaning device offering improved features of safety and of operating ease.

Another object is to provide an improved tube-cleaning device wherein the valving parts may be rendered more accessible for cleaning and for replacement.

A further object is to provide improved valve means for a pipe cleaning attachment of the character indicated.

It is also an object to provide a tube-cleaning device having an improved automatic valving mechanism for readily admitting pressurized cleansing fluid only when the device is properly fitted to the tube to be cleaned.

It is a further object to provide an improved tube-cleaning device in which valving means automatically admits pressurized fluid to a pipe to be cleaned only when the device is urged against the pipe.

Other objects and various features of novelty and invention will be hereinafter pointed out or will become apparent to those skilled in the art.

In the drawings, which show, for illustrative purposes only, a preferred form of the invention:

Fig. 1 is a longitudinal, sectional view of my improved tube-cleaning device, shown with the valving mechanism in its normally closed position;

Fig. 2 is a sectional view of a portion of the device of Fig. 1, illustrating the valving mechanism in its open position;

Fig. 3 is a perspective view of a valve element of the device of Fig. 1; and

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Fig. 4 is another perspective view showing an alternative valve element for employment in the device of Fig. 1.

Broadly, my invention resides in the provision of an improved automatic valving mechanism for a tube cleaner having an input chamber 5 and a discharge-orifice member or nozzle 6. The valving mechanism is normally seated to seal off chamber 5 from orifice member 6. Member 6 is adapted for displacement with respect to chamber 5, and means are provided for opening the valve mechanism upon displacement of nozzle 6. In operation, nozzle 6 is displaced only when the device is urged against the open end of a tube to be cleaned. This action results in opening the valve—thus admitting pressurized cleaning fluid to the tube to be cleaned. If the device is insufficiently urged against the tube, or if the tube has been flushed and the device is being removed, the pressure of the fluid in chamber 5 over the upstream area of the valve is sufficiently great to force an immediate closure of the valve. Thus, before the valve is actually removed from the tube, complete closure has been effected and the danger of fluids escaping from the interfit of discharge member 6 with the tube is very substantially reduced.

In complete form, the valve means of my invention includes a first member which is normally seated to cut off the major part of the possible flow between chamber 5 and nozzle 6. A second or pilot-valve member is normally seated to cut off the remainder of this possible flow, and this second valve is positioned to coact with displacement of member 6. In operation, since the second valve presents a comparatively small upstream area, the device may be urged with relative ease into operating relation with the tube to be cleaned. Opening of the second valve member admits fluid at high-pressure to the downstream side of the first valve member, thus partially balancing the pressures on the main valve and making possible easy complete opening of the valve.

Referring to the form shown in the drawings, the device is built around a main body or housing 7 having a handle 8 for portability and to facilitate urging the device against a tube to be cleaned. The handle 8 may be formed as a part of a bonnet, removably attached to the body 7, as by threads 24. Main body 7 includes chamber 5 at its upstream end and an inlet pipe 9 for connection to a source of supply of cleaning fluid. Orifice member 6 is in sliding engagement with the housing 7, and in the form shown this fit is concentric—that is, an outer cylindrical portion 10 is displaceable longitudinally in a bore 11 forming a

part of housing 7. The discharge member 6 may include an enlarged inner end, as at 12, for sliding coaction with a counterbore 11' in the main housing or body 7. The bottom of the counterbore may thus in conjunction with the enlarged end 12 provide a means of retaining the orifice member 6 in assembled relation with the body 7.

As indicated above, my improved valving mechanism comprises essentially two parts. A first or main valve member 14 is normally seated at the downstream end of the chamber 5. In the form shown, valve member 14 includes passages 15 permitting fluid communication between chamber 5 and discharge member 6. Normally, however, this communication is prevented by the seated relation of a second or pilot-valve member 16 over openings 15. In the form shown, valve member 14 is provided with a bore 17 slidably accommodating both the stem 18 of pilot valve 16 and a rod 19, for a purpose which will later be clear. Valve member 14 also includes a cylindrical outer surface 20 to be slidably guided in the counterbore 11'. The downstream end of valve member 14 may thus be positioned for actuating abutment by the enlarged upstream end of orifice member 6. Once pilot valve 16 has been displaced to an open position, a number of openings or slots 21 between an inner annular space 22 (at the downstream end of orifices 15) and an outer annular space 23 permit communication of pressurized fluid to substantially the entire downstream cross-sectional area of valve member 14, thus partially balancing the forces acting on main valve 14.

In order to provide an actuating relationship between the orifice member 6 and the pilot-valve member 16, the rod 19 may be tied to orifice member 6, as by a transverse pin 27. The pin 27 is shown passing through the orifice member 6 and also through an outer adapter or sleeve 26 having an enlarged or abutment end 25. In the form shown, the enlarged end 25 is circumferentially grooved to receive a snap ring 28 for retaining the pin 27. The abutment end 25 may not only serve to limit the insertion of nozzle 6 in a tube to be cleaned (of size to take insertion of sleeve 26), but the upstream end 30 thereof may limit upstream displacement of the nozzle or orifice member 6 with respect to the body 7.

It will thus be seen that my construction provides lost-motion connections between a number of the relatively slidable parts. The relationship is preferably such that before any valve members are actuated there must be an outer lost-motion displacement of orifice member 6 with respect to the other parts. Upon farther upstream-directed displacement of orifice 6, rod 19 is preferably first effective to unseat the pilot-valve member 16. Next, having opened the pilot valve, the upstream end of nozzle 6 is preferably effective to drive the main valve 14 into an open position. Finally, the unseating movement of main-valve member 14 may be limited by abutment of shoulder 30 with body 7.

As explained, the parts of my tube-cleaning device are normally arranged as shown in Fig. 1, the high-pressure cleaning fluid serving to keep both valves 14 and 16 seated automatically. The device is adapted for use by insertion of nozzle member 6 into the tube to be cleaned (see the dot-dashed element 31 in Fig. 2). Depending upon its size, the end of the tube will abut one of shoulders 32—33 on member 6. By thrusting against handle 8, the user can readily force an opening of pilot valve 16—thus admitting a

restricted flow of cleaning fluid to the tube and, more particularly, to the downstream effective area of valve 14. This condition necessarily means a relatively small force differential tending to keep valve 14 seated; this differential may be readily overcome by an additional thrust on handle 8, whereby the enlarged inner end 12 of the nozzle 6 engages valve 14 to unseat the same. Both valves 14 and 16 are then unseated and admit through orifices 21 and 15, respectively, full flow of cleaning fluid at high pressure.

In removing the device, when it is considered that a cleaning operation has been completed, a first decrease in thrust will disengage the enlarged inner end of the nozzle 6 from valve 14 and permit the above-mentioned pressure differential to seat main valve 14—thus substantially cutting off the flow of cleaning fluid. With subsequent decreases in thrust, and since pilot valve 16 presents a larger effective area upstream than downstream, the fluid-supply pressure in chamber 5 immediately forces a closure of valve 16. Thus, just before the thrust is removed from handle 8, the entire valving mechanism has been automatically closed and a harmful escape of cleaning fluid is not possible from the interfit of member 6 (at shoulder 32 or 33) with the pipe that has just been cleaned or that it was not possible to open by this method.

For improved performance of my valving mechanism, I prefer to employ a material such as brass for the members 14 and 16, and steel or other hard material for rod 19. Under these circumstances, repeated abutment of rod 19 with the stem 18 of the pilot valve would cause excessive wear of the brass member. To reduce this wear, I have, in the form shown, embedded a steel ball 34 in valve stem 18.

When the described tube-cleaning device is not in operation and is to be stored, the absence of a pressure-differential across pilot valve 15 means that this element will freely "float" in valve 14. To prevent permanent dislocation of these valve parts, there is provided in chamber 5 a ledge 29 against which pilot valve 16 may abut, if necessary. It will be clear that even if both valves have become unseated while not in use, reapplication of high pressures to the inlet chamber 5 will effect immediate valve closure—thus readying the device for use.

It will be appreciated that the described construction of valve member 14 is such as to permit relatively free flow of cleansing fluid therefrom and yet lends itself readily to fabrication, as on an automatic screw machine. After the blank has been thus formed, the slots or grooves 21 may be milled or routed in a relatively simple operation.

In Fig. 4, I show another main valve construction suitable for use in place of the main valve 14 of Fig. 1. In Fig. 4, the valve may again include a seating surface 35, and a cylindrical outer surface 20' to be slidably guided within the counterbore 11'. The downstream end, or base, may be bored, as at 36, and fluted slabs may be cut out of the cylindrical surface 20', as at 37, to provide extended guiding feet 38 with relatively unobstructed openings for the free passage of a substantial flow of cleaning fluid. Small axial passages 15 may communicate between the fluted openings 37 and the downstream side of the pilot valve 16.

It will be appreciated that I have described a relatively simple and highly efficient and safe valve-cleaning apparatus. In particular, my

construction is characterized by easy assembly and disassembly of the parts. Merely upon threaded removal of the handle assembly, as at 24, the entire upstream end of the chamber 5 may be opened and the main valve 14 and the pilot valve 16 dropped out for inspection, cleaning, and replacement.

While the invention has been described in considerable detail and preferred forms illustrated, it is to be understood that various changes and modifications may be made within the scope of the invention as defined in the appended claims.

I claim:

1. In a tube-cleaning device, a tubular housing comprising a barrel with an enlarged chamber at one end thereof and a ferrule of reduced diameter at the other end, an exteriorly projecting discharge tube slidably guided in said ferrule and providing an inner portion of enlarged diameter for slidably guided engagement with the bore of said barrel, a reciprocable main valve provided with a head which is disposed in said enlarged chamber and adapted when closed to seal said enlarged chamber from said barrel, said reciprocable main valve being also provided with a stem which is slidably guided in said barrel, the stem of said main valve having a bore extending longitudinally therethrough, the head of said main valve having at least one port communicating with said barrel, a reciprocable pilot valve provided with a head which is disposed in said enlarged chamber and adapted when closed to seal the port in the head of said reciprocable main valve, said reciprocable pilot valve being also provided with a stem which is slidably guided in the longitudinal bore in the stem of said main valve, and an actuating element for said pilot valve, said actuating element being slidably disposed in the longitudinal bore in the stem of said main valve and connected to and axially movable with said discharge tube, said actuating element and said discharge tube being disposed for axial abutting engagement with the stems of said pilot valve and said main valve, respectively, to open said valves in that order but being otherwise wholly disconnected therefrom.

2. In a tube-cleaning device, a tubular housing comprising a barrel with an enlarged chamber at one end thereof and a ferrule of reduced diameter at the other end, an exteriorly projecting discharge tube slidably guided in said ferrule and providing an inner portion of enlarged diameter for slidably guided engagement with the bore of said barrel, a reciprocable main valve provided with a head which is disposed in said enlarged chamber and adapted when closed to seal said enlarged chamber from said barrel, said reciprocable main valve being also provided with a stem which is slidably guided in said barrel, the stem of said main valve having a bore extending longitudinally therethrough, the head of said main valve having at least one port communicating with said barrel, a reciprocable pilot valve provided with a head which is disposed in said enlarged chamber and adapted when closed to seal the port in the head of said reciprocable main valve, said reciprocable pilot valve being also provided with a stem which is slidably guided in the longitudinal bore in the stem of said main valve, an actuating element for said pilot valve, said actuating element being slidably disposed in the longitudinal bore in the stem of said main valve and connected to and axially movable with said discharge tube, said actuating element and said discharge tube being disposed for axial abutting engagement with the stems of said pilot valve and said main valve, respectively, to open said valves in that order but being otherwise wholly disconnected therefrom, and a removable bonnet for closing the outer end of said enlarged chamber, said bonnet being disposed in alignment with said barrel to enable said main valve and said pilot valve to be dropped out of said tubular housing when the bonnet is removed.

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