Aug. 15, 1967 F. G. WEIS 3,335,963

NOZZLE

Filed Dec. 31, 1964

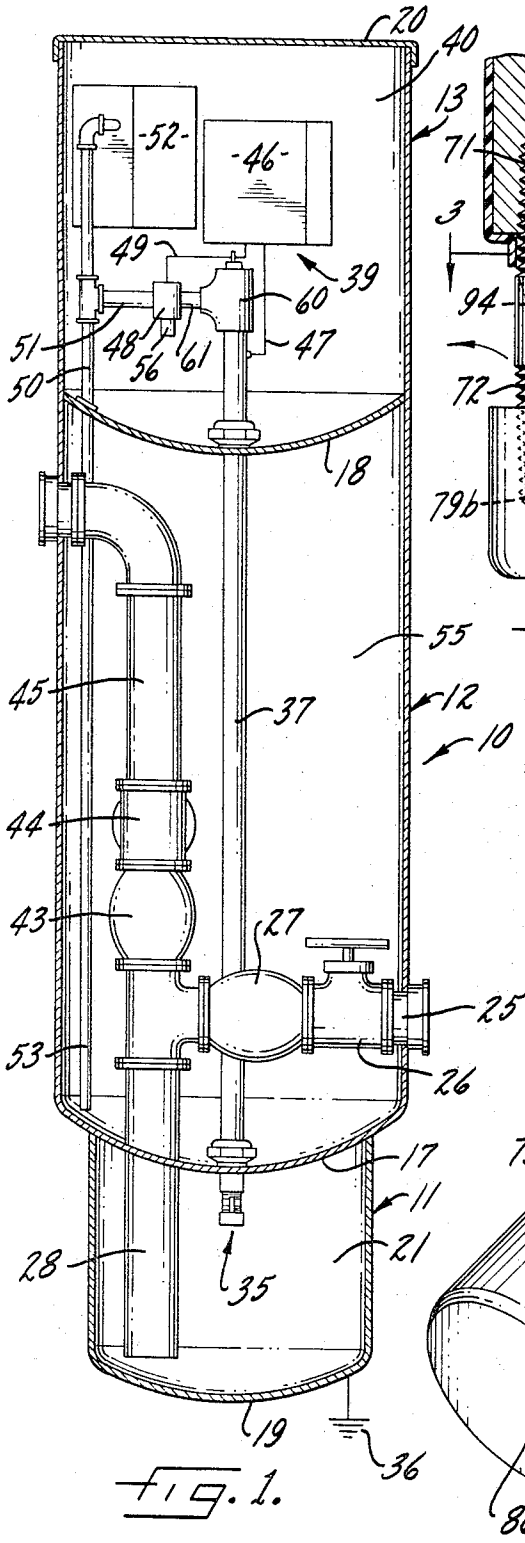


Fig. 1.

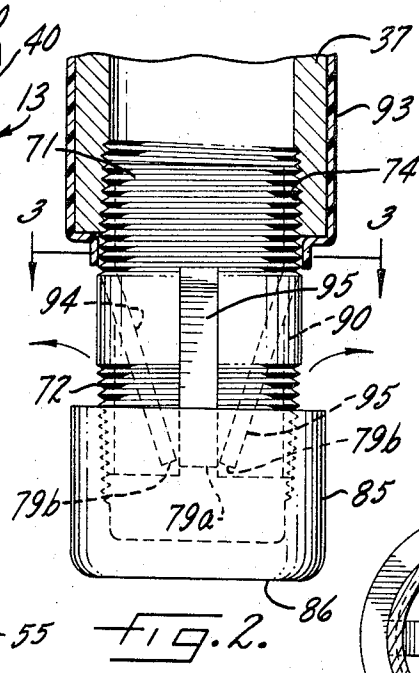


Fig. 2.

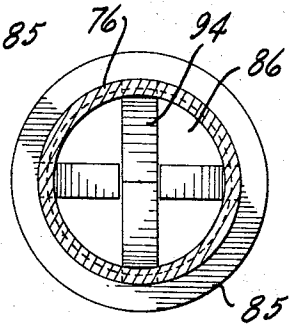


Fig. 3.

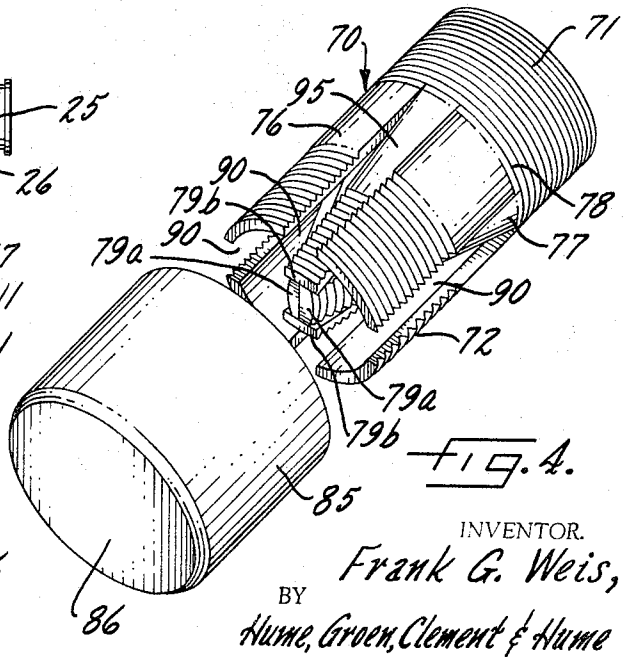


Fig. 4.

INVENTOR.
Frank G. Weis,
BY
Hume, Groen, Clement & Hume
Attorneys.

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NOZZLE

Frank G. Weis, Kansas City, Mo., assignor to Union Tank Car Company, Chicago, Ill., a corporation of New Jersey

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ABSTRACT OF THE DISCLOSURE

An electrode-nozzle for emitting gas under pressure into a sewage tank to eject the sewage therefrom. The nozzle includes a short section of pipe having four fingers cut from its side wall and bent inwardly thereof to meet at an apex. A closure cap is placed over the lower end of the nozzle closely below the apex. Gas enters the open end of the nozzle and is emitted through side wall openings left by formation of the fingers radially outwardly of the nozzle.

THE SPECIFICATION

This invention relates in general to a nozzle arrangement for emitting fluid, and to a method for constructing the nozzle arrangement. It deals more specifically with an electrode-nozzle arrangement for use in material handling apparatus which uutilizes fluid under pressure as a material ejecting agent.

It is presently known to introduce a gas under pressure into a receiver for accumulating material such as sewage or the like, in order to force the material from the receiver. The gas, which is commonly air, is preferably introduced to the receiver through a nozzle arrangement which doubles as an electrode for sensing material level in the receiver. Upon contact of the electrode-nozzle arrangement by the material as it rises in filling the receiver, a control circuit is closed through the material from the electrode to "grounded" walls of the receiver to effect introduction of the air and force material therefrom.

Where the material in question is sewage or another semiliquid substance, the introduction of pressurized air through a nozzle arrangement raises certain problems. For example, if the air is introduced in such a manner that an air stream impinges directly on the sewage, the blast of air tends to splash the semiliquid material and, not uncommonly, some of that material is deposited on the insulation surrounding the electrode-nozzle arrangement. Moisture evaporates from the deposited material over a period of time and leaves a slightly damp solid material completely encompassing the insulation jacket and providing a conducting layer which might ground the electrode to the receiver and cause the system to malfunction.

Accordingly, it is an object of the present invention to provide an improved nozzle arrangement for introducing gas under pressure to a material receiver for the purpose of forcing material therefrom.

It is another object to provide a nozzle arrangement which avoids the impingement of a steam of gas under pressure directly on liquid or semiliquid material so as to obviate splashing of the material.

It is still another object to provide a nozzle arrangement which emits gas under pressure generally radially of the axis of its inflow with very little, if any loss, in "head."

It is a further object to provide a nozzle arrangement of the aforedescribed character which doubles as an electrode for sensing material level in the receiver.

The foregoing and other objects are realized in accord with the present invention by providing a nozzle arrangement which diverts the vertical inflow of gas under pressure horizontally out over the surface of accumulated sewage material or the like. The nozzle arrangement

changes the direction of gas flow approximately 90° with virtually no head loss in the nozzle arrangement. The horizontally emitted flow of gas avoids direct impingement on the semiliquid sewage material, for example, and prevents the splashing of sewage material up onto the nozzle arrangement (which doubles as an electrode for sensing material level in the receiver), thus preventing the accumulation of damp solids on the electrode and avoiding short circuits which might follow.

The electrode-nozzle arrangement is simple and inexpensive in construction. It is, in fact, constructed of standard plumbing components according to a method embodying features of the present invention.

The invention, both as to its organization and method of operation, taken with further objects and advantages thereof, will best be understood by reference to the following description, taken in conjunction with the accompanying drawing in which:

FIGURE 1 is a vertical, cross-sectional view of material handling apparatus incorporating an electrode-nozzle arrangement embodying features of the present invention;

FIGURE 2 is an enlarged side elevational view, partially in section, of the electrode-nozzle arrangement seen in FIGURE 1;

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2; and

FIGURE 4 is an exploded perspective view of the electrode-nozzle arrangement embodying features of the present invention.

Referring now to the drawing, and particularly to FIGURE 1, a material handling apparatus commonly known as a sewage lift station is illustrated generally at **10**. The apparatus **10** includes a sewage receiver section **11**, an air reservoir and valve section **12**, and a control machinery section **13**. The various sections **11–13** are preferably fabricated of sheet steel and are separated by bulk-heads **17** and **18**. A dished lower head **19** forms the bottom of the sewage receiver section **11**, and an access cover **20** overlies the upper end of the control machinery section **13**.

Liquid and semiliquid sewage enters the receiver chamber **12** defined by the sewage receiver section **11** by gravity feed from an inlet pipe **25** through an inlet gate valve **26**, an inlet check valve **27**, and a receiver access pipe **28**. When the level of sewage material in the receiver chamber **21** reaches a height sufficient to encounter the electrode-nozzle arrangement **35** embodying features of the present invention, a circuit is completed from the ground **36** through the sewage material and an electrode air pipe **37** to the control machinery, seen generally at **39**, in the machinery chamber **40** defined by the control machinery section **13**.

When the actuating circuit is completed in this manner, the control machinery arrangement **39** is effective to initiate the pumping of air under pressure into the receiver chamber **21** to force the sewage material therefrom. The sewage material departs the receiver chamber **21** through the access pipe **28**, an outlet check valve **43**, an outlet gate valve **44**, and the outlet pipe **45**. The ejected sewage material is, in this manner, "lifted" to a predetermined point above the level of its starting point for discharge or other treatment or the like.

The control machinery arrangement **39** forms no specific part of the present invention and, accordingly, is not described here in great detail. From a primarily functional standpoint, however, it includes a switch box **46** which is electrically coupled to the electrode air pipe **37** by a conduit **47**. The switch box **46** is also connected to a source of power (not shown) and to an electrically operated three-way valve **48** by a conduit **49**.

The electrically operated three-way valve **48** is connected to a main air line **50** by a pipe **51**. The air line

50 is operatively connected with an air compressor unit 52 at its upper end while the lower end 53 extends into an air reservoir chamber 55 defined by the air reservoir and valve section 12. The air compressor unit 52 normally keeps the air reservoir chamber 55 filled with air at a predetermined pressure. At the same time, the three-way valve 48, through an exhaust pipe 56 to the atmosphere, normally places the sewage receiver chamber 21 in communication with the atmosphere through the electrode-nozzle arrangement 35, the electrode-air pipe 37, the joint 60, the pipe section 61, and the valve 48.

When the sewage material accumulating in the receiver chamber 21 contacts the electrode-nozzle arrangement 35 embodying features of the present invention in the manner hereinbefore discussed, completion of the electrical control circuit results in the operation of switching components (not shown) in the switch box 46 to effect electrical operation of the three-way valve 48. The valve 48 is shifted to terminate normal communication of the chamber 21 with the atmosphere and place the air reservoir chamber 55 in communication with the sewage receiver chamber 21. Air under pressure flows through the air-electrode pipe 37 and the electrode-nozzle arrangement 35 into the chamber 21 to forcibly eject material therefrom.

According to the present invention, fluid under pressure introduced to the sewage receiver chamber 21 through the electrode nozzle arrangement 35 is directed horizontally outwardly over the surface of the sewage material in the receiver section 11. The surface of the sewage material is not agitated by a stream of air under pressure and splashing of the sewage material is thus avoided. As a result, sewage material laden with semi-solids does not splash up onto and encrust the electrode-nozzle arrangement 35 with the beneficial result of avoiding short circuits through the damp encrusted material and malfunctions of the apparatus 10 which follows.

While the stream of air under pressure entering the nozzle arrangement 35 is diverted approximately 90° to be emitted substantially horizontally outward over the surface of the sewage material accumulating in the sewage receiver chamber 21, virtually no air pressure head loss is effected by the electrode-nozzle arrangement 35 in so diverting air flow. The electrode-nozzle arrangement 35 achieves this minimal pressure drop through the unique control of the air flow within the nozzle arrangement in a manner which will hereinafter be discussed in greater detail.

The electrode-nozzle arrangement 35 is illustrated in substantial detail in FIGURES 2–4. The electrode- nozzle arrangement 35 includes a short two and one-quarter inch section of standard one and one-half inch steel pipe. The pipe 70 is threaded at its upper end, as at 71, and at its lower end, as at 72. The threaded upper end 71 is turned into the internally threaded lower end 74 of the electrode air pipe 37, the pipe 37 extending through the bulk head 17 into the sewage receiver chamber 21 in suitably sealed, air-tight relationship.

Prior to being turned into the threaded lower end 74 of the electrode air pipe 37, the cylindrical wall 76 defining the pipe section 70 is sawed or otherwise cut upwardly through its threaded lower end 72 to form four fingers 77 displaced 90° from each other around the circumference of the pipe section 70. The fingers 77 are cut so that they extend approximately two-thirds of the length of the pipe section 70 upwardly from its lower end 72 and terminate adjacent the base 78 of the threads of the threaded upper end 71 thereof.

When the fingers 77 have been cut from the wall 76 of the pipe section 70, they are bent inwardly of the wall to terminate at their free ends 79 immediately adjacent each other in the manner illustrated in FIGURE 4. In this regard, it will be noted that the opposed finger ends 79*a* come into abutting relationship while the opposed finger ends 79*b* are spaced by the width of the finger ends 79*a*.

Once the fingers 77 have been formed in the manner hereinbefore discussed, a standard pipe cap 85 is threaded onto the remaining lower segmentally cylindrical wall sections 81 of the pipe section 70. As will be recognized, the base 86 of the pipe cap 85 forms a closed lower end on the electrode-nozzle arrangement 35. There thus remain four generally rectangular, circumferentially spaced ports 90 in the electrode-nozzle arrangement 35.

As so constructed, the nozzle-arrangement 35 is finally turned into the internally threaded lower end 74 of the electrode air pipe 37 extending into the sewage receiver chamber 21. At this point a plastic sleeve 93 is shrunk onto the lower end 74 of the electrode air pipe 37 and the exposed threaded portion of the upper end 71 of the pipe section 70. The plastic sleeve 93 acts as an insulator extending down to the upper ends of the fingers 77 so that only the lower two thirds of the electrode-nozzle arrangement 35 acts as a contact probe for sensing the height of the sewage material in the chamber 21. In this regard, it should be recognized that the pipe cap 85 acts as the primary contact surface.

When air under pressure is directed into the electrode-nozzle arrangement 35 through the air electrode pipe 37, at the instance of sewage material completing the control circuit by contacting the cap 85 of the electrode-nozzle arrangement, the specific arrangement of converging fingers 77 and the bottom 86 of the pipe cap 85 cause the entering air to be directed substantially horizontally out over the surface of the sewage material. This phenomena of horizontal or substantially horizontal air flow out of the electrode-nozzle arrangement 35 is effected because the converging fingers 77 inside the pipe section 70 provide relatively flat baffle surfaces 93 in front of the incoming air stream. A lower pressure area thus tends to develop on the outermost surfaces 94 of the fingers 77 and a portion of the incoming air tends to be drawn around the fingers to fill this partial vacuum or low pressure area. The tendency is for this air rushing around the sides of the fingers to be emitted in a horizontal plane over the surface of the sewage material being ejected.

In addition, some of the stream of incoming air goes on past deflecting fingers 77 to the bottom 86 of the pipe cap 85 where it is deflected back upwardly. This upflow of air is deflected in a generally horizontal plane outwardly of the plane of the nozzle arrangement 35 by the contact with the inclined outer surfaces 94 of the inwardly converging fingers 77. Contrary to what might be expected (and unlike broadly conventional orifice type outlets), there is little, if any, head loss effected by the nozzle arrangement 35.

The electrode-nozzle arrangement 35 embodying features of the present invention thus effects an efficient discharge of the sewage material from the receiver chamber 21 without causing any substantial turbulence on the surface of the material which might result in a splashed layer of semisolid material forming on the nozzle arrangement 35. The possibility of a conducting layer of this damp sewage material causing a short circuit between the noninsulated lower end of the nozzle arrangement 35 and the bulk head 17 forming the upper wall of the material receiver chamber 21 is thus substantially obviated.

It should now be recognized that a highly improved electrode nozzle arrangement for use in material handling apparatus such as a sewage lift station has been described. It should also be recognized, however, that a new and improved method of manufacturing a nozzle arrangement has been described. By the use of simple type elements such as the short pipe section 70 and the pipe cap 85, a highly efficient fluid emission nozzle or electrode-nozzle is constructed simply, expeditiously, and economically.

I claim:

1. In a material receiver chamber, a nozzle for emitting fluid under pressure, comprising: a generally cylindrical nozzle wall, a lower end on said wall, an open

upper end in said wall, a plurality of fingers formed from said wall and extending inwardly and downwardly of said wall in cantilevered relationship so that their free ends meet at an apex within said wall, and a corresponding plurality of outlets in said wall where said fingers are formed therefrom, said outlets left by the forming of said fingers extending downwardly in said wall to said lower end, and means closing said lower end of said wall closely below the free ends of said fingers, whereby fluid under pressure entering said open upper end substantially along the axis of said generally cylindrical wall is emitted from said ports generally perpendicular to said axis.

2. In a material receiver chamber, a nozzle for emitting fluid under pressure, comprising: a generally cylindrical nozzle wall having a lower end and an open upper end, a plurality of fingers formed from and extending inwardly of said wall, the free ends of said fingers being formed from the lower end of said wall and said fingers extending upwardly in said wall for a predetermined distance, a cap overlying the lower end of said wall to form a closed lower end on the nozzle and a plurality of outlet ports defined in said wall by the formation

of said fingers, whereby fluid under pressure entering said open upper end substantially along the axis of said cylindrical wall is emitted from said nozzle through said ports substantially perpendicular to said axis.

3. The nozzle of claim 2 further characterized in that said fingers terminate at said free ends immediately adjacent each other approximately on said axis of said generally cylindrical wall.

4. The nozzle of claim 2 further characterized in that said predetermined distance which said fingers extend upwardly in said wall is approximately two-thirds of the length of said wall.

5. The nozzle of claim 2 further characterized in that said nozzle wall and said cap are fabricated of electrically conductive material whereby said nozzle also serves as an electrode tip.

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ALAN COHAN, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,335,963 August 15, 1967

Frank G. Weis

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 26, for "uutilizes" read -- utilizes --;
same column 1, line 59, for "steam" read -- stream --.

Signed and sealed this 27th day of August 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents