

[54] FAIL-SAFE MULTIPLE PRODUCT ASPIRATOR

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[58] Field of Search 417/191, 190, 182.5; 137/100, 137/111, 101.11, 113

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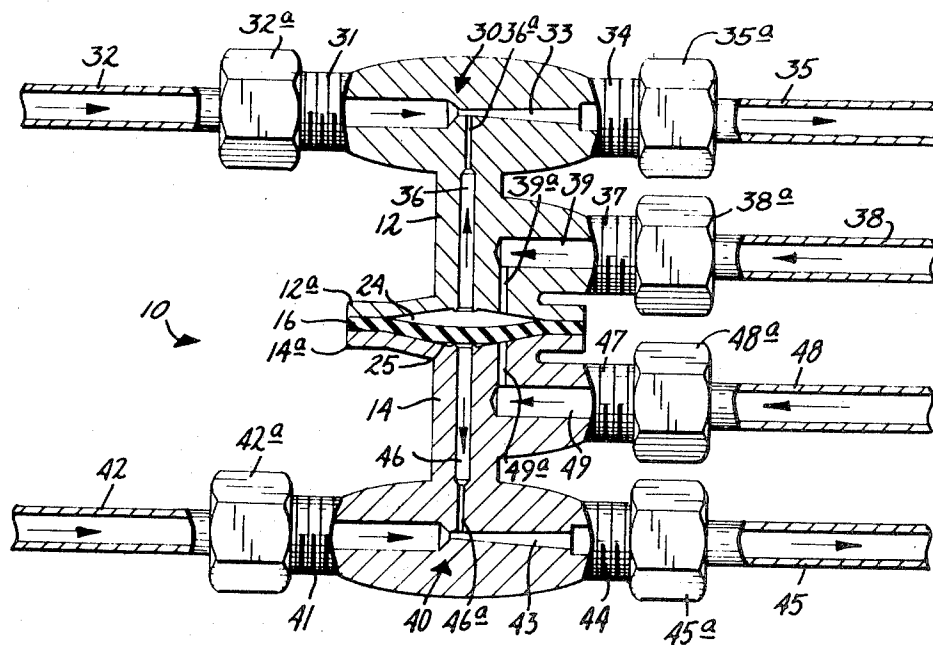
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[57] ABSTRACT

Apparatus including a dual product venturi aspirator and a fail-safe diaphragm valve. A first venturi aspirator is utilized to draw a first additive (e.g. an alkaline cleanser) into a carrier liquid (e.g. water) flowing therethrough and, similarly, a second additive (e.g. a chlorinating agent) is drawn by a second venturi into a carrier liquid flowing therethrough. A fail-safe elastic diaphragm centrally mounted between the two aspirators and in communication therewith is operable thereby for automatically terminating the aspiration of either one of the two additives upon the exhaustion of the supply of the other additive, thereby assuring simultaneous injection of the two additives into a cleansing system. Fail-safe apparatus for providing simultaneous injection of three additives is also disclosed.

10 Claims, 3 Drawing Figures



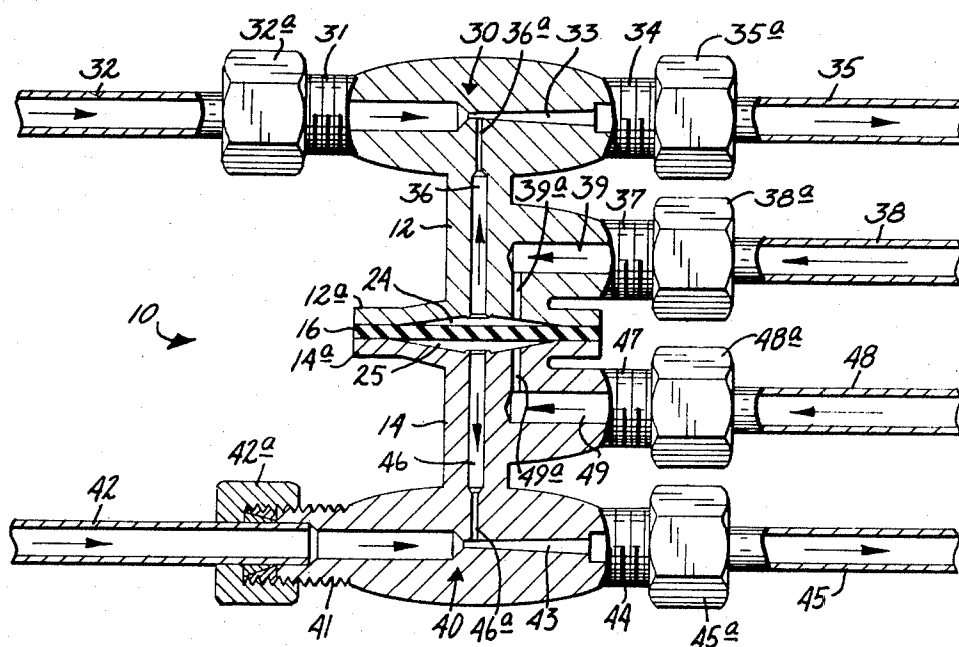


FIG. 1

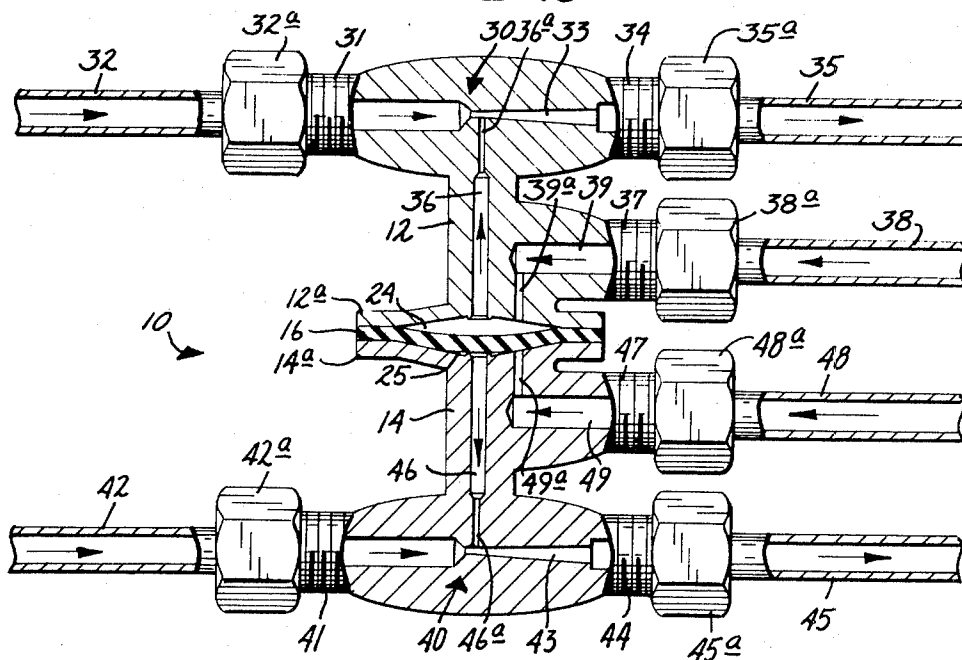


FIG. 2

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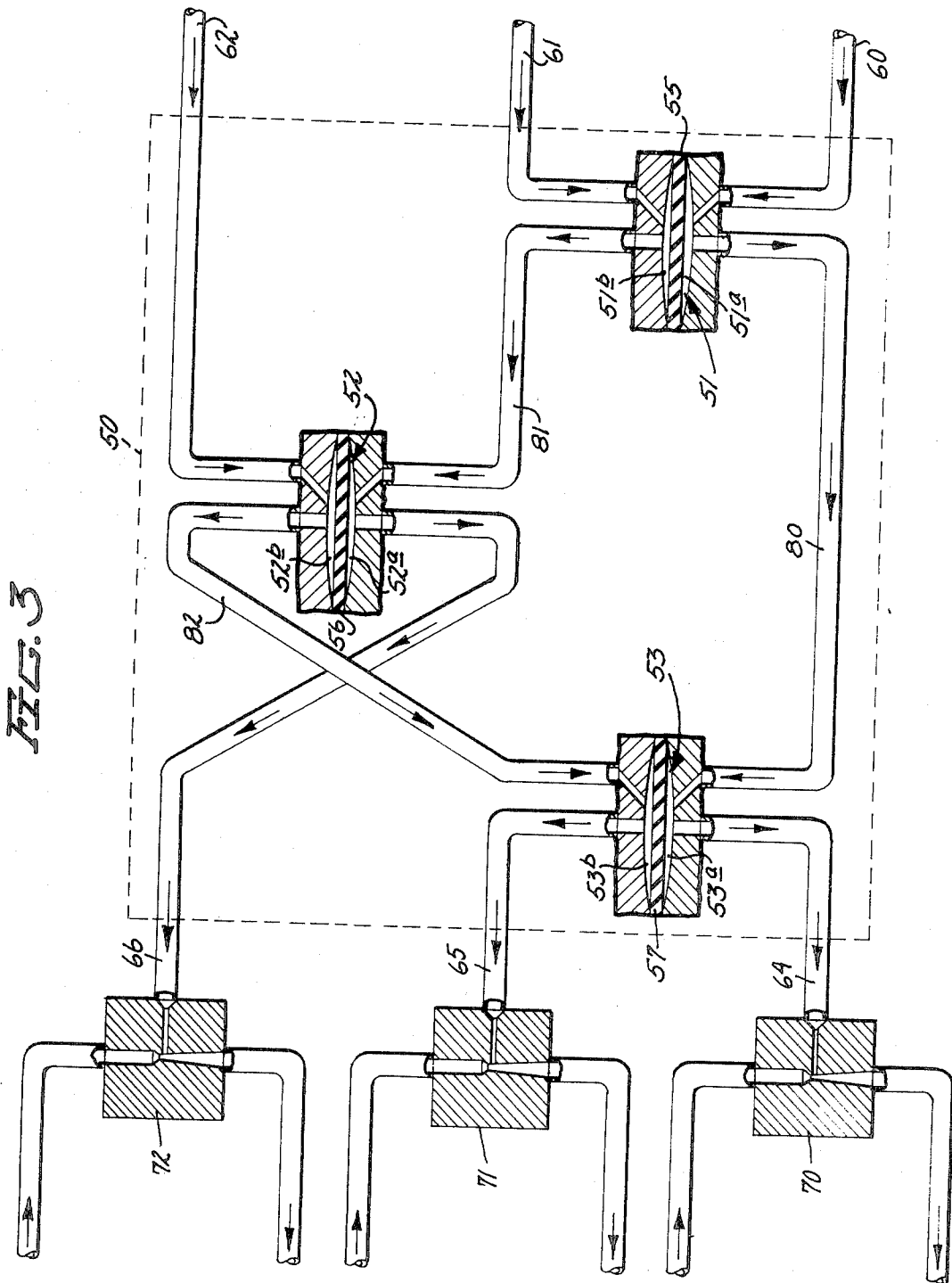


FIG. 3

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FAIL-SAFE MULTIPLE PRODUCT ASPIRATOR

BACKGROUND OF THE INVENTION

The present invention pertains to fail-safe multiple product injection apparatus.

In a variety of applications, it is desirable to inject two or more fluid products or additives into a carrier fluid. For example, in various cleansing systems such as the machine-dish-washing systems utilized in connection with practically all commercial dining facilities and in a rapidly increasing number of private homes, it is quite common to add to the wash water both a caustic material (e.g., an alkaline compound) and a chlorinating agent to provide optimum cleansing and germicidal properties. Since additive solutions of alkaline and chlorine compounds are chemically incompatible at full strength, the additives are generally stored in separate containers and individually injected into the wash water wherein the diluted additives are chemically compatible and provide the desired cleansing and germicidal action.

In cleansing systems, such as machine dishwashing systems, problems have previously been encountered in (1) efficiently and reliably injecting the additives into the wash water and (2) detecting the exhaustion of the supply of one or more of the additives. To illustrate, a conductivity cell is commonly positioned in the wash solution for determining changes in the conductivity thereof, thereby indicating by means of some alarm device the change in conductivity resulting from the exhaustion of the supply of the additives. Frequently, however, the exhaustion of the supply of only one of the additives does not sufficiently change the conductivity of the wash solution so as to be detectable by the conductivity cell. Consequently, it has generally been necessary to visually inspect the additive supplies at regular intervals to assure that a supply has not become exhausted. Such an inspection is rendered difficult and undesirable by the fact that it is quite common to store the additives in sealed containers positioned at a location not readily accessible to the operator of the cleansing system. Thus, apparatus for separately injecting products into a carrier fluid in a reliable manner and for assuring the simultaneous injection of the products (i.e., preventing injection of a nonexhausted product upon the exhaustion of the supply of one or more of the other products) is commercially highly desirable.

SUMMARY OF THE INVENTION

The present invention provides apparatus including a valve body having valving means positioned within a cavity therein; the cavity being divided by the valving means into first and second valving compartments. The valve body further includes first and second product inlet ports therein in communication with the first and second valving compartments, respectively. Fluid pumping means in communication with the first and second valving compartments provides pumping action for separately exhausting the fluid products introducible into the first and second valving compartments. The valving means is operable by the fluid-pumping means and, prior to the exhaustion of the supply of one of the products, maintains an equilibrium or balanced position allowing simultaneous pumping of the additive products. Upon exhaustion of one of the fluid product supplies, the dual pumping action causes the valving means to move to an unbalanced position terminating communication between the pumping means and the valving compartment having a nonexhausted supply of fluid product introducible therein. In one preferred embodiment, the valving means comprises a diaphragm member and the pumping action is provided by first and second venturi aspirators in communication with the first and second compartments, respectively. In this embodiment, the diaphragm valve is operable by the dual aspirating action to prevent aspiration of nonexhausted fluid products upon exhaustion of the supply of one of the fluid products.

The invention described summarily above provides several distinct and highly desirable advantages. First, the fail-safe valving means terminates the injection of a fluid product hav-

ing a nonexhausted supply after the exhaustion of one of the other fluid product supplies. By utilizing the power inherent in the system (e.g., the power provided by the venturi aspirators) an inexpensive, simple and fail-safe device is provided for assuring the product shutoff in one product supply line in the event a second product supply has been exhausted. This assures that the apparatus will always feed a multiple number of products (i.e., two or more products) simultaneously. Secondly, the invention provides a highly efficient aspirator network for drawing fluid products from their remote supply location and separately injecting the same into the fluid carrier flowing through the drawing aspirator. As will become apparent from reading the description hereinbelow, numerous additional advantages are provided by the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a cross-sectional top view of a preferred embodiment for providing fail-safe dual product injection and illustrating the valving diaphragm in its equilibrium position;

FIG. 2 is a cross-sectional view similar to FIG. 1 illustrating the displacement of the valving diaphragm so as to prevent the aspiration of a nonexhausted liquid product; and

FIG. 3 is a schematic illustration of an embodiment for providing fail-safe injection of three liquid products.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a unitary valve body, generally designated 10, includes first and second body sections 12 and 14, respectively, and a valving means 16 positioned within a cavity defined thereby. Body sections 12 and 14 are joined by means such as screws, glue or the like (not shown) to form unitary valve body 10. In the illustrated embodiment, first and second body sections 12 and 14 are mirror images of one another and include flange portions 12a and 14a, respectively, extending angularly outward from the longitudinal axis of the main body portion. The flange portions 12a and 14a include outer end portions extending radially outward from the longitudinal axis of body 10.

The angularly extending flange portions 12a and 14a form a cavity or opening within unitary body 10. A valving means, such as an elastic diaphragm member 16, is positioned within the cavity and tautly held by insertion thereof between the radial end portions of flanges 12a and 14a. In its balanced or equilibrium position (illustrated in FIG. 1), elastic diaphragm member 16 divides the cavity into identical first and second valving compartments 24 and 25. As will be described more fully hereinbelow and as illustrated in FIG. 2, the inner portion of elastic diaphragm 16 is displaceable and occupies either one of two extreme positions in its unbalanced state.

Pumping means illustrated generally as a first venturi-type aspirator 30 is positioned within body section 12. An externally threaded inlet port 31 is in communication with aspirator 30. A conduit 32 having an internally threaded coupling portion 32a is threadedly coupled to inlet port 31 and has an opposite end thereof (not shown) connected to a source of a carrier fluid (not shown) such as water. A passageway 33 of the venturi 30 is connected to an outlet port 34. A fragmented conduit 35 has a coupling portion 35 35a threadably coupled to outlet port 34. A passageway 36 operably interconnects first valving compartment 14 and venturi 30. A first fluid product inlet port 37 is in threaded engagement with a coupling portion 38a of a first product feedline 38. A passageway 39 having a restricted flow portion 39a interconnects first product inlet port 37 and first valving compartment 24 for introducing a product therein.

Similarly, body section 14 includes pumping means illustrated generally as a venturi-type aspirator 40. Carrier fluid flow through aspirator 40 is provided by the introduction of water into body portion 14 through inlet port 41. A conduit 42 having a coupling end portion 42a in threaded engagement with inlet port 41 is connected, for most applications, to the same supply of carrier fluid (not shown) as conduit 32. A

passageway 43 of the venturi 40 is connected to an outlet port 44. A fragmented conduit 45 having a coupling end portion 45a is threadedly engaged with outlet port 44. A passageway 46 in body section 14 operably interconnects valving compartment 25 and venturi 40. A second product inlet port 47 is threadedly engaged to an internally threaded coupling portion 48a of a second product feedline 48. A passageway 49 having a restricted flow portion 49a interconnects second product inlet port 47 and second valving compartment 25 for introducing a product therein.

In utilizing the above-described fail-safe dual product aspirator in conjunction with a cleansing system such as a machine dishwasher, the first fluid product or additive will commonly be a caustic material such as an alkaline cleanser and the second additive will commonly be a chlorinating agent. In such an application, conduits 35 and 45 will be interconnected by a mixing valve (not shown) and a single solution feedline will be connected to the dishwasher. It should be understood, however, that the present invention has application in numerous systems (other than in conjunction with a cleansing system) wherein it is desirable to assure simultaneous injection of two or more additives.

Body sections 12 and 14 comprising unitary valve body 10 can be manufactured from numerous materials. For example, polypropylene has proven to be one desirable material as a result of its high chemical resistance and relative inexpensiveness. The venturi aspirators 30 and 40 are preferably molded in the respective body sections during the manufacture thereof. As illustrated, the passageways 33 and 43 of aspirators 30 and 40, respectively, are slightly flared; such a flare characteristic having been found to increase the efficiency of the aspirator. However, it should be understood that the aspirators can also be located separate from valve body 10. Further, it should be understood that aspirators 30 and 40 can be replaced by other pumping means such as a conventional electromechanical pump connected to the respective valving compartments by suitable conduit means. Such other pumping means would exhaust the additives introducible into the valving compartments and operate the valving means in a manner similar to that described in conjunction with the venturi aspirators.

The valving means has been illustrated and described as a flexible diaphragm member. Diaphragm member 16 can be composed of various materials. For example, ethylene propylene is highly desirable as a result of its high resistance to attack by chemicals. In the embodiment illustrated, diaphragm 16 has a diameter of approximately $2\frac{1}{2}$ inches and a thickness in the order of three thirty-second inches. It should be understood, however, that other valving means will also suffice for purposes of the present invention. For example, elastic diaphragm member 16 can be replaced by alternative valving means such as a conventional check valve, bellows or pistons. The alternative valve means would, of course, operate on the same principle as described in conjunction with elastic diaphragm member 16.

In the operation of the embodiment illustrated in FIGS. 1 and 2, a pressurized flow of carrier fluid (e.g., water) is pumped through aspirators 30 and 40; the waterflow entering valve body 10 through inlet ports 31 and 41, flowing through aspirators 30 and 40 and exiting the valving body through outlet ports 34 and 44, respectively. As the pressurized water flows through the aspirators, a partial vacuum is generated by each of the aspirators. The partial vacuum draws the first and second additives from their storage containers (at atmospheric pressure) through their respective feedlines and inlet ports into first and second valving compartments 24 and 25. The additives introduced into the respective valving compartments are drawn therethrough into the passageways 36 and 46 and separately injected into the water flowing through each aspirator. As the first and second liquid additives flow over the opposite sides of elastic diaphragm 16, the diaphragm is maintained in a balanced or equilibrium position as illustrated in FIG. 1. However, upon the termination of the supply of one of

the additives (e.g., by the exhaustion of the supply of the additive connected to conduit 38), air is drawn into valving compartment 24 rather than the liquid additive. The flow of air into compartment 24 reduces the vacuum therein upsetting the force balance on opposite sides of diaphragm 16 and resulting in the diaphragm moving toward the port in passageway 46; the port projecting slightly into valving compartment 24 and serving as an additive outlet port for the valving compartment. This force differential on opposite sides of diaphragm 16 causes the diaphragm to continue to move toward the port in passageway 46 until it engages or contacts therewith closing passageway 46 to the transmission of any additive therethrough. Thus, aspirators 30 and 40 function in conjunction with one another and with diaphragm 16 to terminate the injection of the additive supplied through feedline 45 on the termination of the flow of the additive supplied through feedline 35.

Alternatively, the inner portion of flexible diaphragm member 16 (i.e., that portion not fixedly held between the outer flange portions) is displaceable by the action of aspirators 30 and 40 so as to occupy a second extreme position (not shown) in which member 16 engages the valving compartment port in passageway 36 and prevents additive flow therethrough upon the exhaustion of the supply of additive supplied through feedline 45. Upon replenishment of the exhausted additive supply, the diaphragm returns to its equilibrium position and simultaneous aspiration of both additives occurs.

In the three product fail-safe injection apparatus illustrated in FIG. 3, a valving body 50 has included therein three valving cavities or chambers 51, 52 and 53. A valving means illustrated as diaphragm members 55, 56 and 57 is positioned within each of the chambers and divide chambers 51, 52 and 53 into pairs of first and second valving compartments 51a and 51b, 52a and 52b, and 53a and 53b, respectively. As illustrated, each of the valving compartments has an additive or product inlet port and a product outlet port therein. Product inlet conduits 60, 61 and 62 are in communication with inlet ports in valving compartments 51a, 51b, and 52b, remotely positioned supply of product (not shown). Product outlet conduits 64, 65 and 66 are in communication with outlet ports in valving compartments 53a, 53b, and 52a, respectively, and pumping means shown schematically as aspirators 70, 71 and 72, respectively. Fluid conduit means 80, 81 and 82 provide communication between the inlet and outlet ports in valving compartments 51a and 53a, 51b and 52a, and 52b and 53b, respectively, so as to interconnect each valving compartment in one of the pairs of valving compartments with a valving compartment in another of the pairs.

The three product fail-safe apparatus operates on the same principle as described previously. For example, the exhaustion of the product supplied by feedline 60 results in (1) diaphragm 55 terminating the flow of the second product (i.e., the product supplied by feedline 61) beyond valving compartment 51b and (2) diaphragm 57 terminating the flow of the third product (i.e., product supplied by feedline 62) beyond valving compartment 53b. Thus, aspiration of the two nonexhausted products is terminated upon exhaustion of any one of the products. This principle of operation can, of course, be further extended to provide fail-safe injection of more than three products.

The present invention provides fail-safe multiple product (i.e., two or more products) injection; the injection of the nonexhausted products being terminated upon the termination or exhaustion of the supply of any one of the other products. In the preferred embodiment, highly efficient venturi-type aspirators are utilized to aspirate the products and to operate the fail-safe valving apparatus. Aspirators of the type described are capable of readily drawing liquid additives through vertical lifts in the range of 15–20 feet and over substantially greater horizontal distances. Such aspiration distances are obtained utilizing a carrier fluid (e.g., water) pressure in the range of 20–40 pounds per square inch. As is

apparent from the above description, the multiple product aspirator provided by the present invention is of simple design, fail-safe and inexpensive to manufacture.

What is claimed is:

1. Apparatus comprising:

- a. a valve body defining a cavity therein;
- b. valving means positioned in said cavity and dividing said cavity into first and second valving compartments;
- c. means defining first and second fluid product inlet ports in said valve body in communication with said first and second valving compartments, respectively; and
- d. fluid pumping means in communication with each of said first and second valving compartments for separately exhausting therefrom the fluid products introducible therein through said first and second product inlet ports, respectively; and
- e. said valving means is operable by said fluid pumping means for movement between an essentially equilibrium position allowing simultaneous fluid flow into said first and second valving compartments and a nonequilibrium position terminating the fluid flow into one of said first and second valving compartments on the termination of the flow of fluid product introducible into the other of said first and second valving compartments.

2. The apparatus of claim 1 including first and second fluid passageways in communication with said first and second valving compartments, respectively, for providing fluid product flow therefrom wherein said valving means is operable by said fluid pumping means to terminate said fluid product flow in one of said first and second fluid passageways on the termination of said fluid product flow in the other of said passageways.

3. The apparatus of claim 1 wherein said pumping means includes first and second fluid aspirator means in communication with said first and second valving compartments, respectively, for providing said fluid flow into said first and second valving compartments, exhausting the fluids products from the first and second valving compartments, and for operating said valve means between said equilibrium and nonequilibrium positions.

4. The apparatus of claim 3 wherein said first and second fluid aspirator means include first and second venturi-type aspirators, respectively.

5. The apparatus of claim 4 wherein said valving means includes a generally elastic diaphragm member moveable between said equilibrium position and first and second nonequilibrium positions wherein fluid flow into one of said first and second valving compartments is terminated.

6. Dual product aspirator-valving apparatus, comprising:

- a. a valve body;
- b. means defining a cavity in said valve body;
- c. valving means positioned within said cavity and dividing said cavity into first and second fluidtight valving compartments;
- d. first and second inlet ports in said body in communication with said first and second fluidtight valving compartments, respectively, suitable for introducing a first fluid

product into said first compartment and a second fluid product into said second compartment;

- e. first and second venturi aspirator means positioned within said valve body including inlet and outlet ports for allowing passage of a carrier fluid therethrough; and
- f. means defining first and second passageways operably interconnecting said first and second valving compartments and said first and second aspirators, respectively, for allowing aspiration of the first and second fluid products by said first and second aspirators, respectively, and for allowing operation of said valving means by said aspirators to terminate the aspiration of one of said fluid products upon exhaustion of the supply of said other fluid product.

7. The apparatus of claim 6 wherein:

- a. said valving means comprises a generally elastic diaphragm member; and
- b. said first and second valving compartments are of substantially identical shape.

8. The apparatus of claim 7 wherein:

- a. said valve body includes first and second body sections each having an outwardly extending angular flange portion; and
- b. said angular flange portions of said first and second body sections are positioned adjacent one another so as to form said cavity in said valve body.

9. The apparatus of claim 8 wherein:

- a. said flange portions of said first and second body sections include an outer end portion extending radially outward from said respective first and second body sections; and
- b. said flexible diaphragm member includes an outer portion thereof positioned between said outer end portions of said flanges and tautly held thereby.

10. Apparatus comprising:

- a. means defining a plurality of valving chambers;
- b. valving means positioned within each of said valving chambers and dividing each of said chambers into first and second valving compartments;
- c. a fluid product inlet port in each of said valving compartments for introducing a fluid product therein;
- d. a fluid product outlet port in each of said valving compartments for exhausting therefrom the fluid introduced therein through said inlet port;
- e. fluid conduit means in communication with a first plurality of said product inlet ports and a first plurality of said product outlet ports for interconnecting each of said first and second valving compartments with another of said first and second valving compartments; and
- f. fluid pumping means in communication with the remaining plurality of product outlet ports for exhausting fluid products from each of the first and second valving compartments and for operating said valving means to terminate communication between said pumping means and each of said valving compartments having fluid product introducible therein upon the termination of a flow of product introducible into another of said valving compartments.

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