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Zygiel

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[54] **METHOD AND APPARATUS FOR MIXING FLUIDS**

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[51] **Int. Cl.** **137 564.5,** G05d 11/02

[58] **Field of Search** 137/101.11, 210, 137/205.5, 212, 564.5, 607, 3, 12.5; 222/129.2, 132, 135, 207; 239/405; 261/DIG. 7

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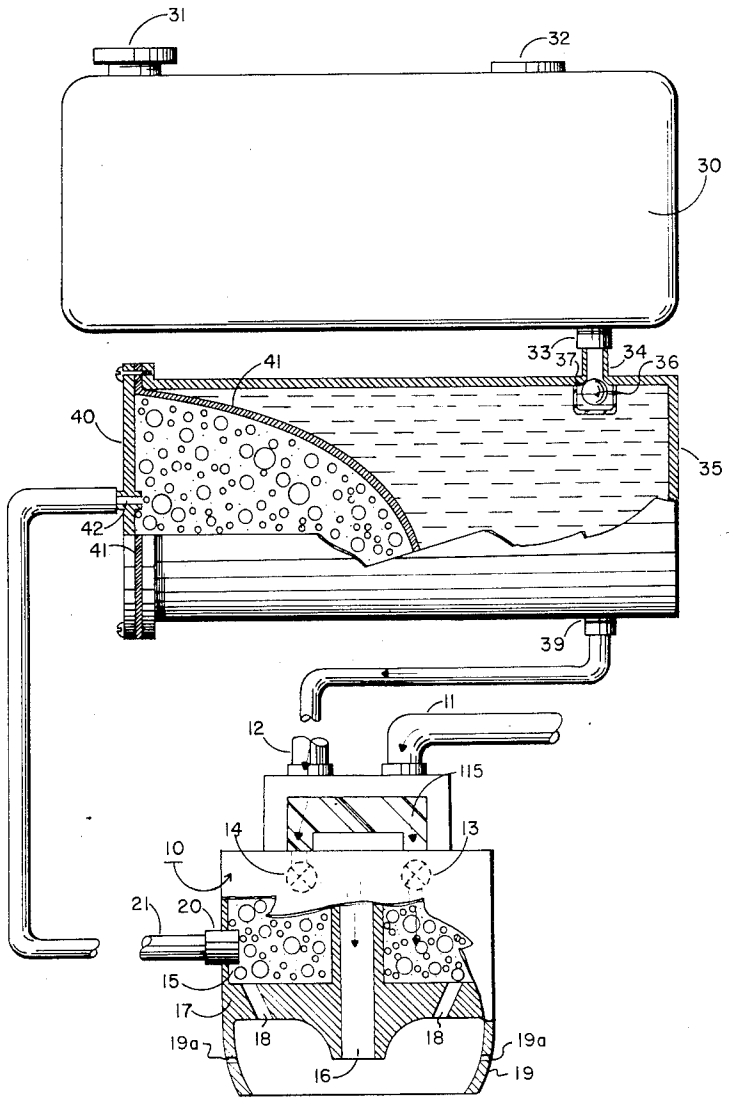
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[57] **ABSTRACT**

Disclosed is fluid mixing apparatus employing a metering chamber divided by a flexible diaphragm. Two fluids are simultaneously injected into a mixing nozzle. The ratio of fluids is controlled by a feedback line which translates pressure from the first fluid outlet to the second fluid and thereby maintains a relatively constant ratio between the head pressures on the two fluids.

11 Claims, 2 Drawing Figures



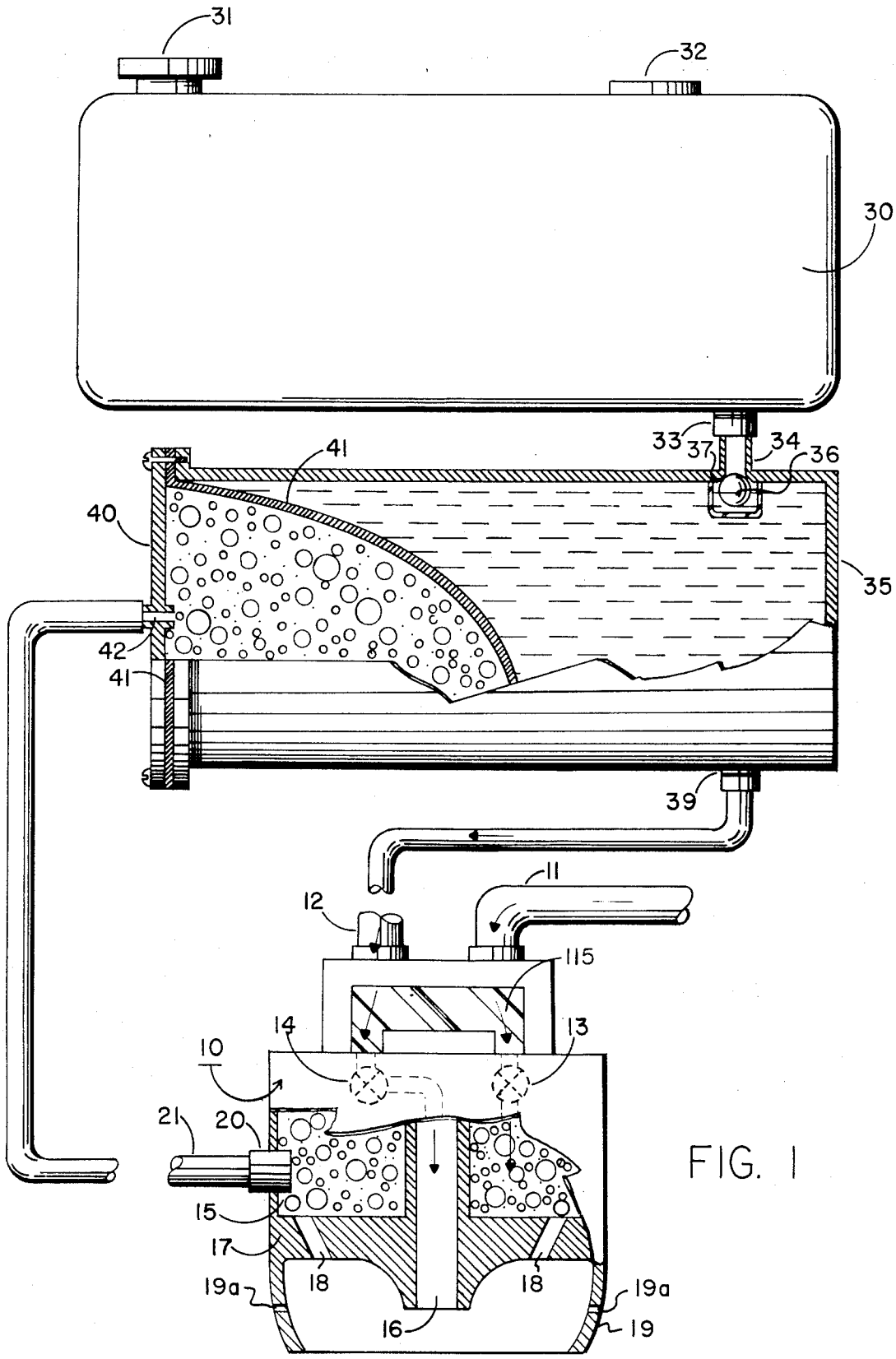

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11
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115
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21
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15
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19a
18
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19a
16
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FIG. 1

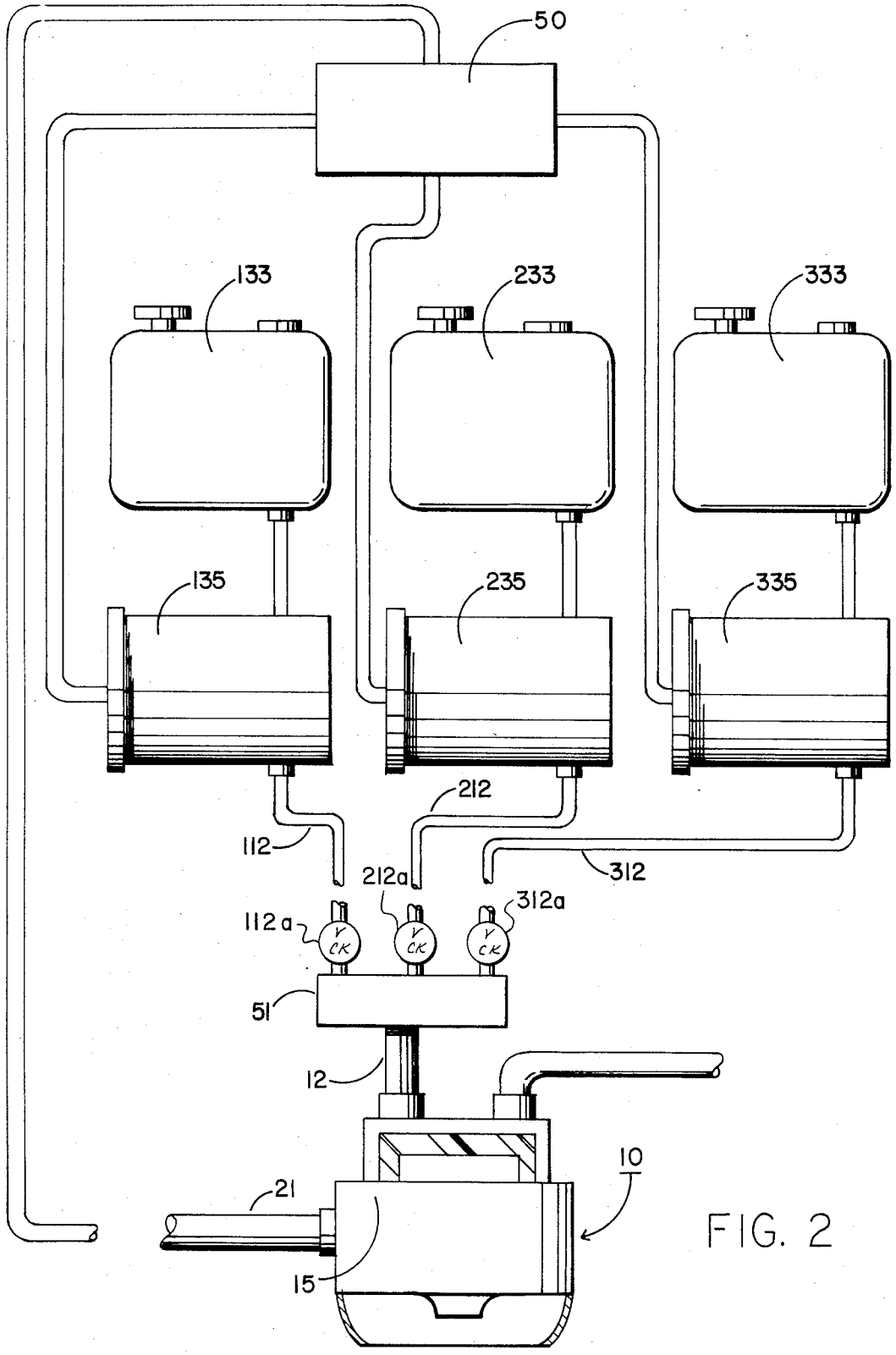

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233
333
135
235
335
212
112
212a
312
312a
112a
CK
51
12
10
21
15

FIG. 2

METHOD AND APPARATUS FOR MIXING FLUIDS

This invention relates to a fluid mixing and dispensing apparatus. More particularly it relates to a fluid feed-back controlled apparatus for injecting metered amounts of one fluid into a stream of another fluid.

In various fluid handling systems it is desirable and often required to inject metered amounts of one fluid into a stream of another fluid. Accordingly, various types of fluid handling systems have been developed.

In many fluid mixing systems it is desirable that the mixing apparatus be extremely simple, inexpensive and operable without the use of electrically operated valves or the like requiring an external power source. For example, artifically and naturally flavored beverages are commonly sold in concentrated syrup form which may be mixed with water or carbonated water to prepare individual beverages. Because of the instability of carbon dioxide saturated liquids, the beverages are conventionally prepared by mixing a measured amount of syrup with a measured amount of carbonated water, thereby producing a carbonated beverage, immediately prior to serving. Conventionally, such dispensing apparatus employs a mixing and dispensing valve wherein the carbonated water and syrup are supplied under pressure to simultaneously operable valves. Upon operation of the two valves concentrated syrup and carbonated water are injected into a single stream and the mixed liquids dispensed into a container. The ratio of syrup to water is determined by the relative sizes of the valve openings and head pressures on the liquids. Since the valve openings are of fixed dimensions, variations in head pressure on either liquid will cause variations in the mix ratio. Because of the instability of carbonated water, head pressure on a closed container of carbonated water may vary widely during and between periods of use. Accordingly, unless the pressure on the syrup reservoir is varied proportionately the ratio of syrup to carbonated water may vary widely, resulting in dispensed beverages of inconsistent quality.

In accordance with the present invention a dispensing apparatus is provided in which the head pressure on the concentrate container is directly proportional to the head pressure of the carbonated water. Accordingly, as the pressure in the carbonated water stream varies the head pressure on the syrup is subjected to a proportional change, thereby resulting in a drink mixture of uniform and consistent quality. The apparatus includes a feedback line connected between the dispensing nozzle and an enclosed concentrate reservoir. The feed-back fluid is injected into the reservoir but separated from the fluid therein by a diaphragm. Accordingly, pressure on the feedback system will vary with pressure of the carbon dioxide water stream. The pressure variations in the carbon dioxide water stream are thereby transferred to the concentrate reservoir causing a proportionate change in the concentrate head pressure.

Through the use of the pressure feed-back system a proportional pressure dipensing apparatus is provided which employs no electrically or manually operated valves and may be completely operable without the use of any external power source. The apparatus may be inexpensively fabricated from conventional materials and advantageously automatically maintains a constant ratio of concentrate to water regardless of the pressure on the water stream. As an added advantage water in the feed-back loop is allowed to drain through the mixing nozzle at the end of the mixing cycle, thereby automatically washing the mixing nozzle.

Other features and advantages of the invention will become more readily understood when taken in connection with the appended claims and attached drawings in which:

FIG. 1 is a diagrammatical representation of the preferred embodiment of the invention, and

FIG. 2 is a diagrammatical representation of a multihead dispensing unit employing the mixing and dispensing apparatus.

A diagrammatical representation of a beverage mixing and dispensing device employing the principles of the invention is illustrated in FIG. 1. While the illustration relates to apparatus for mixing concentrated syrup with carbonated water to provide a carbonated beverage, it will be readily appreciated that the principles of the invention may be applied to various other systems wherein one fluid is injected into a stream of another fluid. The apparatus as shown in the preferred embodiment is illustrated merely to demonstrate the principles of the invention as applied to one conventional dispensing system.

As illustrated in FIG. 1 the apparatus comprises a conventional dispensing head **10** into which carbonated water and concentrated syrup are injected through separate inlet lines **11** and **12**, respectively. The flow of water through the dispenser is controlled by valve **13**. Likewise, the flow of syrup is controlled by valve **14**. As illustrated, valves **13** and **14** are conventionally operated simultaneously by a single actuating lever **115**.

In the conventional dispensing apparatus water passes through valve **13** into a chamber **15**. The syrup passes through valve **14** into a downwardly projecting nozzle **16** centrally located in chamber **15**. Annular chamber **15** has a downwardly extending opening which is partially obstructed by a diffuser plate **17** having apertures **18** passing therethrough. Accordingly, water passing through line **11** and valve **13** into annular chamber **15** is directed downwardly through diffuser **17** into a mixing nozzle **19**.

In the preferred embodiment the apertures are slanted inwardly and horizontally so that the water passing therethrough forms a swirling stream. The syrup is injected through line **12**, valve **14** and inlet **16** into the water stream each time the actuating lever **115** is actuated.

Inlet **16** is preferably centrally located so that the syrup is injected into the approximate center of the swirling water stream, thereby assuring complete mixing of syrup and water. The mixture then exits through nozzle **19**. If desired, nozzle **19** may be provided with holes **19a** which will allow fluid to escape from nozzle **19** if the lower end is accidentally obstructed, thereby insuring that the syrup metering appratus will not be accidentally damaged by over pressurization.

With valves **13** and **14** closed, all fluid drains from inlet **16** and chamber **15**. However, when the lever **115** is actuated to open valves **13** and **14** carbonated water flows through valve **13** into chamber **15**. Then, depending upon the size of apertures **18** in diffuser **17** and the pressure on the carbonated water, the chamber **15** is filled with carbonated water. The pressure on the water in chamber **15** is, of course, dependent upon the size of apertures **18** and the pressure in line **11**.

In accordance with the invention a by-pass outlet **20** communicating with by-pass line **21** is connected with chamber **15** through which fluid may flow into by-pass line **21** whenever the pressure on the fluid in chamber **15** exceeds atmospheric pressure.

Carbonated water is provided to inlet line **11** by any conventional source or from a carbonater as described in co-pending application Ser. No. 215,925 filed Jan. 5, 1972. Concentrated syrup is supplied from a reservoir **30.**

The reservoir **30** is provided with a conventional filler cap **31** and filtered air inlet **32.** The air inlet is provided simply to maintain the pressure within the reservoir **30** at atomospheric and may be conveniently located in the filler cap **31** if desired. Reservoir **30** is provided with an exit aperture **33** at its lowest point communicating with a conduit **34** which conducts fluid into a metering chamber **35.** Conduit **34** is provided with a check valve which allows syrup to drain under the force of gravity from the reservoir **30** into metering chamber **35** but prevents fluid flow in the reverse direction. For this purpose a simple caged floating ball **36** may be provided which seats in the neck **37** of the inlet aperture. Accordingly fluid will flow freely from reservoir **30** through conduit **34** into metering chamber **35** but cannot flow in the reverse direction.

In the preferred embodiment the metering chamber **35** is an open-ended cylindrical chamber with outlet **39** near its closed end. The open end is covered with a sealing plate **40.** A flexible diaphragm **41** is positioned between the open end of chamber **35** and the sealing plate **40.** Diaphragm **41** may be a thin flexible plastic or elastic material such as rubber which may be easily distorted. In the preferred embodiment diaphragm **41** is a thin collapsible cylinder which may be expanded with very little pressure differential thereacross. An inlet means **42** is provided in sealing cap **40** providing fluid communication between by-pass line **21** and the interior of chamber **35.** It will thus be observed that as fluid flows through by-pass line **21** into chamber **35,** diaphragm **41** is distorted but maintains physical separation between carbonated water injected into the chamber and the syrup in the chamber.

For operation a supply of carbonated water is connected to inlet **11** and beverage concentrate placed in reservoir **30.** The concentrate will drain through outlet **33** and counduit **34** into the metering chamber **35** until metering chamber **35** is filled with concentrate. Since diaphragm **41** is thin and collapsible, the syrup will collapse the diaphragm **41** and completely fill the metering chamber **35.** The concentrate will also fill the exit conduit **12.**

Activation of lever **115** opens valves **13** and **14** simultaneously. Accordingly, carbonated water flows through valve **13** into chamber **15** and through by-pass line **21** into metering chamber **35.** As carbonated water flows through by-pass line **21** the diaphragm **41** is distorted to equalize the pressure thereacross, while separating the syrup and water. As the pressure on the concentrate is increased ball **36** blocks the aperture **37** and syrup is forced through exit **39,** line **12** and into the outlet **16.** It will thus be observed that as the pressure on the carbonated water in line **11** is increased, pressure in by-pass line **21** and on diaphragm is also increased, thereby proportionally increasing the pressure on the syrup. Accordingly, the ratio of water to syrup remains relatively constant regardless of the pressure on the carbonated water line **11.**

When valve **13** and **14** are closed, stopping the flow of carbonated water and syrup through lines **11** and **12,** respectively, the water drains from chamber **15,** thus releasing the pressure in line **21** and on diaphragm **41.** Accordingly, syrup concentrate flows from reservoir **30** into the metering chamber **35,** refilling the metering chamber and forcing the water therein to return to chamber **15** by way of by-pass line **21.** The released water passing back through chamber **15** washes the nozzle **19** after each operation.

From the foregoing it will be observed that the by-pass mechanism provides means for varying the head pressure on the concentrate in direct relation to the pressure on the carbonated water. Accordingly, the ratio of syrup to water is relatively constant regardless of water pressure. It will also be observed that the mechanixm advantageously avoids the use of any electrically operated valves or pumping mechanism and operates automatically with very few moving parts. Accordingly, the apparatus may be inexpensively constructed to provide apparatus which dispenses concentrated beverage mixes with a high degree of consistency and uniformity.

As noted above, the by-pass pressure will be dependent on the size and number of apertures in the diffuser **17.** In conventional systems water is injected into chamber **15** under about 50 psi pressure. It has been found that when the diffuser has about twelve apertures **18** of about 0.031 inch diameter, the pressure in by-pass line **21** will be about 3 to 6 psi and will vary with variations in water inlet pressure. To provide maximum mixing, the apertures **18** should be slanted about 32° from vertical and tilted about 8°.

Referring now to FIG. **2.** a modified apparatus utilizing the principles of the invention is illustrated. The modified apparatus of FIG. **2** comprises a dispensing head **10** as described hereinabove with reference to FIG. **1.** The mixing head **10** is provided with a by-pass line **21** communicating with chamber **15** as described hereinabove.

The system illustrated in FIG. **2,** however, includes a plurality of individual reservoirs **133, 233,** and **333** and metering chamber **135, 235** and **335** as described hereinabove with reference to FIG. **1.** By-pass fluid flowing through line **21** is selectively directed to one of the metering chambers **135, 235** or **335** by means of a selector valve **50** which may be manually or automatically operated.

Concentrate of different flavors is placed in each reservoir **133, 233** and **333** and the outlet lines **112, 212,** and **312** from each metering chamber, respectively, are in fluid communication with a manifold **51** which in turn communicates with the concentrate inlet **12.** Outlet lines **112, 212** and **312** may be provided with a check valves **112*a*, 212*a*** and **312*a*** to prevent intermixing of concentrate or with a selector valve which operates in conjunction with selector valve **50** to allow fluid to flow from the selected outlet only.

It will be observed that the apparatus illustrated in FIG. **2** operates in essentially the same manner as apparatus illustrated in FIG. **1.** However, the operation of selector valve **50** permits the alternate selection of different flavors of concentrates to be mixed with the carbonated water.

While the invention has been described with particular reference to apparatus for mixing concentrated syrups with carbonated water, it will be readily understood that the principles may be readily applied to other fluids. For example, concentrated natural juices may be mixed with water in the same manner. Likewise, other arrangements may be employed utilizing the principles disclosed to provide multi-head dispensers and the like.

It is to be understood that although the invention has been described with particular reference to specific embodiments thereof, the forms of the invention shown and described in detail are to be taken as preferred embodiments of same, and that various changes and modifications may be resorted to without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. Apparatus for mixing fluids comprising

a. first valve means for injecting a first fluid into a mixing chamber adapted for directing said fluid in a downwardly directed stream,

b. second valve means for injecting a second fluid into said stream,

c. a reservoir for said second fluid,

d. a metering chamber in fluid communication with said reservoir,

e. check valve means permitting fluid flow from said reservoir into said metering chamber and preventing fluid flow from said metering chamber to said reservoir,

f. by-pass means for conducting said first fluid from said mixing chamber to said metering chamber,

g. diaphragm means within said metering chamber for separating said first fluid and second fluid, and

h. means for conducting said second fluid from said metering chamber to said second valve means.

2. Apparatus as defined in claim **1** wherein said reservoir and metering chamber are constructed to permit gravity flow of said second fluid from said reservoir to said metering chamber.

3. Apparatus as defined in claim **1** wherein said diaphragm means is a collapsible membrane secured to the periphery of said metering chamber and adapted to be expanded by said first fluid entering said metering chamber via said by-pass means.

4. Apparatus as defined in claim **1** including means for simultaneously opening said first and second valve means.

5. Apparatus as defined in claim **1** wherein said mixing chamber is an annular chamber surrounding the outlet for said second fluid and includes a plurality of apertures surrounding the nozzle of said outlet, whereby first fluid escaping from said mixing chamber forms a downwardly directed stream which flows over the end of said nozzle.

6. Apparatus as defined in claim **5** wherein said apertures are arranged to generate a swirling flow of liquid passing therethrough.

7. Apparatus for selectively mixing fluids comprising

a. first valve means for injecting a first fluid into a chamber adapted for directing said fluid in a downwardly directed stream

b. second valve means for injecting another fluid into said stream

c. a plurality of reservoirs for other fluids,

d. a plurality of metering chambers, one metering chamber being in fluid communication with one of said reservoirs,

e. means permitting fluid flow from each reservoir into the metering chamber in fluid communication therewith and preventing fluid flow from said metering chambers to said reserviors,

f. by-pass means and switch valve means operative to selectively conduct said first fluid from said chamber to any of said metering chambers,

g. diaphragm means for separating said first fluid and other fluid in said metering chamber, and

h. means for conducting fluid from said metering chambers to said second valve means.

8. Apparatus as defined in claim **7** wherein said means for conducting fluid from said metering chambers includes a conduit from each of said metering chambers to a second switch valve means operative to selectively switch any one of said conduits into fluid communication with said second valve means.

9. Apparatus as defined in claim **8** including means for simultaneously activating said switch valve means and said second switch valve means.

10. Apparatus as defined in claim **7** wherein said means for conducting fluid from said metering chambers to said second valve means comprises a conduit from each metering chamber to said second valve means, each conduit terminating at a check valve which permits fluid to flow from said metering chamber to said check valve only when the pressure in said metering chamber is greater than atmospheric.

11. The method of mixing fluids comprising the steps of

a. injecting a first fluid into a first chamber having apertures therein for directing said fluid into a downwardly directed stream,

b. injecting a second fluid into said downwardly directed stream from a second chamber,

d. diverting fluid from said first chamber to said second chamber, and

d. separating said first fluid and said second fluid by a flexible diaphragm, whereby said first fluid diverted to said second chamber exerts pressure on said second fluid in said second chamber.

* * * * *