Dec. 13, 1955 B. CRIST 2,726,841

CARBONATED BEVERAGE FAUCET

Filed Oct. 6, 1952

Fig. 1

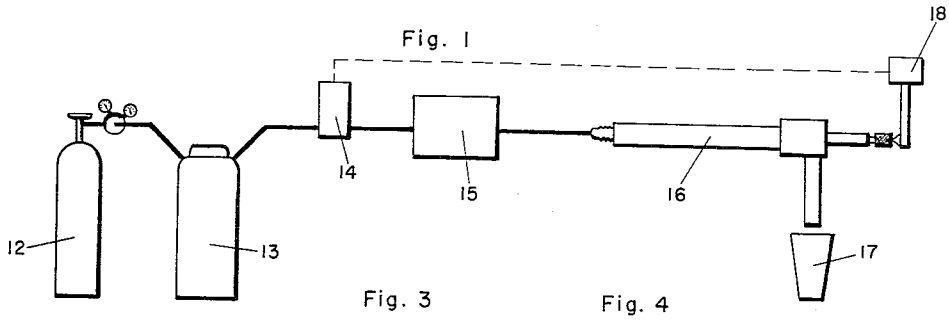


Fig. 3

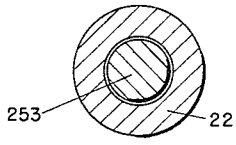
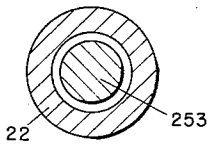


Fig. 4



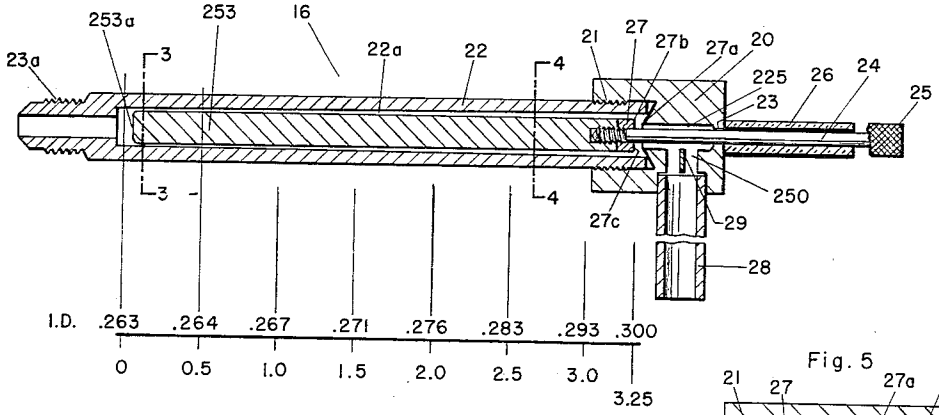


Fig. 2

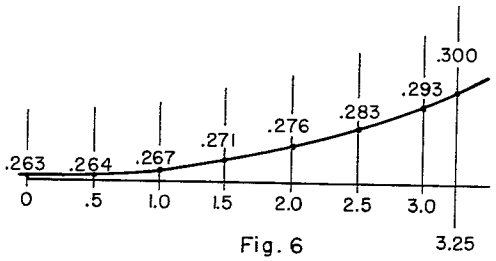
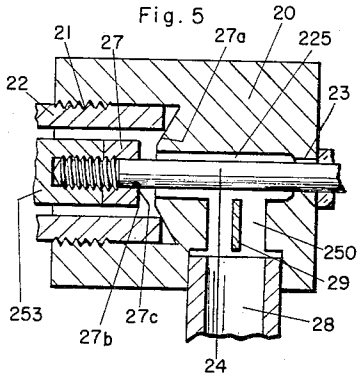


Fig. 6

Fig. 5



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CARBONATED BEVERAGE FAUCET

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12 Claims. (Cl. 251—120)

This present invention relates to beverage dispensing means and more especially to improvements in a faucet with which a pre-mixed carbonated beverage, such as a soft drink or beer, can be dispensed from a relatively high pressure source into an open container without excessive foaming or loss of carbonation.

In the comparatively new field of dispensing pre-mixed drinks, such as colas, root beer, ginger ale, etc., the flavoring syrup is previously mixed with the carbonated water and held under pressure. Under these conditions difficulties are introduced in the dispensing that are not encountered in dispensers that deliver separately a flavoring syrup and the carbonated water. Valves and faucets that may be used to control mixed-in-the-cup drinks are sorely inefficient and impractical when used to control the flow of a pre-mixed carbonated drink for the reason that a mixed beverage is much more sensitive to loss of carbonation than is carbonated water alone. Also in many of the beverage syrups now used there is a foaming agent which forms a heavy foam or "collar" when CO_2 escapes from the solution. A sudden loss of say one volume of CO_2 from the beverage during the valving operation will produce a collar of as great a volume as the liquid itself. This in a cup that is filled nearly to the brim will cause an overflow of foam and generally unsatisfactory condition about the dispenser.

The present invention, accordingly, has for a primary objective the construction of a valve or faucet that may be used in the dispensing of a highly carbonated pre-mixed drink properly to control the flow and to deliver the drink into an open cup without objectionable foaming or appreciable loss of carbonation. The invention further undertakes to improve the efficiency of a faucet for handling pre-mixed carbonated beverages to somewhat on the order of 95% as compared with other valves whose efficiencies are on the order of 60%. By the aid of this invention it is now possible to deliver a beverage of say 3.7 volumes of carbonation into a cup and to retain in the drink approximately 3.5 volumes of carbonation.

Still another objective of the invention is the construction of a faucet having the ability to deliver a chilled and refreshing fresh drink from a chilled source so that the customer will not be dissatisfied and to deliver such a drink without involving use or need of extraneous cooling means about the faucet or line leading from the cooling compartment of the dispensing machine. Accordingly, the invention comprehends a construction of a faucet or valve for this purpose in which but little liquid is entrained therein when not in use, and also a faucet in which all of its components may be made of materials relatively poor as heat conductors.

Another object of the invention is the construction of an efficient faucet for carbonated beverages that embodies but few easy to manufacture and assemble elements, which may be periodically cleaned without difficulty, and which lends itself readily and conveniently adaptable for automatic operation, such as by a solenoid, to effect the opening and closing operation.

In attaining the high efficiency objectives of the invention, by which is meant low loss of carbonation, a valve structure is proposed wherein the normally high pressure that is maintained on the carbonated beverage in storage and in the system up to the faucet itself is reduced to atmospheric pressure without creating turbulence and areas of negative pressure in the flow stream. Low pressure or a negative pressure even momentarily in the liquid stream causes immediate evolution of CO_2 into gas bubbles which induces further evolution of gas from solution and results in lower efficiency.

I have found that by causing the beverage to flow somewhat as a sheet through a crevice that increases exponentially in cross sectional area and at the same time maintaining relatively small clearances throughout so that the pressure energy of the liquid is quickly dissipated with the result that the liquid leaving the faucet retains practically its full carbonated value and flows in a quiet state, without causing excessive foaming into an open cup. I have also found that in combination with an energy dissipator of this character, the character and location of the valve orifice plays an important part in quieting the flow. Best results are had if the valve is located on the downstream end of the energy dissipating means and closely adjacent the delivery spout of the faucet and also, contrary to accepted principles of valve design, that the valve seat be formed with a sharp right angle bend or even with a reverse bend and that stem or movable valve element be very blunt and not rounded or tapered. Coacting complementary cones, or a spherical element cooperating with a conical seat have been found, in endeavoring to control premixed carbonated beverages, to produce cavitation and turbulence that precipitates the evolution of CO_2 and consequent objectionable foaming and loss of carbonation, whereas a valve constructed in accordance with this invention with relatively sharp angular seats, and preferably with a seat that causes a reverse bend in the flow, has been found to give highly satisfactory results over a wide range of pressures including the range 25# to 65# per square inch.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:

Figure 1 of the drawings represents in diagrammatic form a pre-mixed beverage dispensing system incorporating this invention.

Figure 2 is a longitudinal sectional view of the improved faucet.

Figures 3 and 4 are transverse sectional views on an enlarged scale taken along lines 3—3 and 4—4 respectively of Fig. 2.

Figure 5 is an enlarged sectional view of a portion of the faucet shown in Figure 2.

Figure 6 is graphic illustration, through somewhat distorted, illustrating the exponential rate of increase of the flow passage immediately ahead of the valve.

Referring more particularly to Figure 1 of the drawings the essential elements of the system graphically illustrated comprises a source of CO_2 gas under pressure, indicated at **12**, a closed container of the pre-mixed beverage **13**, such as root beer, cola, etc., a measuring unit **14** by which the quantity dispensed is metered, a refrigerating means **15** by which the beverage is chilled, and a faucet **16** by which the flow of high pressure carbonated

beverage is controlled and conducted relatively foam free and without apreciable loss of carbonation into a customer's cup **17**. All automatic mechanisms, coin mechanisms, cup drop devices and auxiliaries of the conventional dispenser have been deleted in the interests of clarity. The elements **12—16** inclusive are connected in series in the order enumerated and on each operating cycle a chilled drink is caused to flow to the cup. In the case of a carbonated pre-mixed beverage the drink is stored in the system under pressure of 25 to 70 pounds per square inch gauge and reduced to atmospheric pressure by the faucet of this invention without excessive foaming, violence, or loss of carbonation. Because pre-mixed carbonated beverages are so difficult to handle accounts in a large measure to the popularity of mixed-in-the-cup type of dispensers and the dearth of dispensers that will satisfactorily deliver a carbonated pre-mixed beverage. However, by this invention an objective is realized that has not been achieved heretofore with pre-mixed carbonated beverages.

Referring more particularly to Figure 2, the faucet per se **16** is illustrated in vertical section plane and except for the length of the barrel **22**, is substantially in its normal size, certain clearances and flow passageways have, however, been exaggerated for the purpose of facilitating a clearer understanding of the shapes and relationship of the several elements. In this figure, **20**, indicates a body part constructed of material relatively inert to the liquid medium such as "lucite" or "stainless steel." The body is bored and threaded as at **21** to receive a tubular barrel member **22** which is fitted at its opposite end with a compression fitting **23***a* whereby it may be readily connected and disconnected from a given system.

The bored and threaded hole **21** formed in the body **20** communicates with a smaller coaxial bore **225** which terminates in a bearing opening for a valve actuating rod **24**. The rod **24** projects from the body **20** and may be provided with an actuating knob **25**. Alternatively the knob **25** may be a coupling element for mechanical operation or function as an element of an automatic control for the measuring device **14**. In the drawing **18** indicates diagrammatically a suitable control device arranged to respond to valve rod movement which, in turn, controls the measuring device **14** through a control train indicated by the dotted line in Fig. 1.

In Figures 2 and 5, a small slot **23** is shown formed in the body **20** through the bearing opening for the rod **24** to vent the bore **225** when the faucet is closed. A resilient sleeve **26** surrounds the exposed portion of rod **24** and acts as a back valve that closes the vent **23** when the faucet is "open."

The inner end of the rod **24** has a threaded connection with a flow sheeting member **253** and a movable valve element **27**, both of which are movable longitudinally within the bore **22***a* of the barrel **22**. As shown in Figure 2, a thin passageway is provided between the flow sheeting member **253** and the inner wall of the barrel **22** which progressively increases from the entrance end (fitting **23***a*) toward the valve body **20**. I have found that best valving results are obtained in handling high pressure carbonated beverages when the length of sheeting member and barrel are on the order of 12 to 14 times the diameter of the inner member, and when the flow passageway between the inner and outer member progressively increases at an exponential rate. The chart associated with Figure 2, indicates the progressive rate of increase in the flow passageway, and wherein the inner diameter of the bore of the barrel is indicated in thousandths of an inch, in one-half inch increments, in relation to the constant diameter of movable member **253** which is .253". The graph of Figure 6 represents, in exaggerated form, the non-uniform curvature that such an exponential increase in the flow passage will produce. The relationship of increasing cross sectional area to length of travel is such that most of the pressure drop occurs in the first half inch of travel, the pressure energy being largely converted to velocity energy. In the remainder of the passage the velocity is decreased as the cross section increases, the energy being dissipated as friction losses because of the relatively small clearance between the walls.

This design thus obviates a conversion of pressure energy to velocity energy and back to pressure energy such as is obtained in a venturi or in many nozzles which give low pressures at the high velocity part of the orifice or nozzle.

In Figure 2, the valve element **27** is shown in fully opened position and in this, or in any intermediate position, the flow in the annulus about the valve and the sheeting member **253** is caused to be sharply deflected, by the slightly upturned wall **27***a* of the valve seat in the body, and converges radially inwardly as it enters the reduced bore **225** which has, in the exemplified construction, a diameter of .225".

The bore **225** communicates with a delivery port **250** which in turn communicates with a delivery tube **28**. Bore **225**, it will be observed, is drilled beyond the intersection of the delivery port **250** so that liquid is deflected on itself on first starting, thereby immediately filling the bore with liquid. In this manner a fully filled delivery port **250** is obtained which delivers a smooth flow of liquid, with a stream capable of dropping 6 inches through the air into a cup, without breaking up the flow into droplets that would cause turbulence and foaming. Good results are obtained regardless of the amount the valve seat is lifted between 1/32" and 1/8". The exit port **250**, in this example, has a diameter of .250" and preferably contains a vane element **29** to straighten the flow and prevent swirling of the beverage as it leaves the tube **28**.

As heretofore mentioned, the valve seat **27***a* should, for best results, give an abrupt turn to the flow stream, and a slight backward bend to the flow produces superior results over a 90° bend. A tapering orifice, conical, or rounded end on the valve, has the effect, on carbonated beverages, to produce regions of negative pressures and brings on excessive foaming, whereas a combination of an exponentially increasing flow passageway that terminates in an upturned valve seat as at **27***a* has the effect of eliminating regions of negative pressures and is productive of a quiet flow of the carbonated beverage.

One reason for this phenomena appears to be in the fact that a flowing liquid tends to follow, in a layer-like fashion, the contour of the surface it is flowing over. Hence enlargements in passageways, if curved and presenting greater cross-sectional area, tend to cause suction at those regions. For these reasons a rounded end or a curvature at **27***b* of the valve element **27** becomes objectionable. For similar reasons a relatively sharp bevel at the valve seat **27***a* is preferable over a flat seat or one that is tapered at too sharp an angle. A flat seat or a beveling up to 20° (from the perpendicular) again causes a small suction area just below the point **27***b* and too great a bevel, say 35° and up, would deflect the flow back against the end face of the valve **27** and tend to leave a void or cause suction in the corner **27***c* where the valve stem emerges. While it has been found that good results are obtained with seat angles from 20° to 45° (140° to 90° included angle) best results are obtained with a seat angle in the range of 28° to 30° (124° to 120° included angle).

It has been found also that a small radius at the apex annulus of the conical seat causes foaming by creating a void at the entrance end of the bore **225**, whereas a small flat or truncation of the cone at that point greatly improves the performance of the valve. The preferred design of seat is one that pitches the flow back at an angle of 28° (124° included angle) with a flat at its apex of from .010" to .015" in width.

With the present invention the flow stream is under

positive control at every instant from the moment it enters the initially restricted but ever increasing flow annulus to the moment it leaves the valve orifice (which opens to atmospheric pressure) and during the travel through the faucet the gradually thickening sheet of liquid is caused to lose its pressure energy so that it emerges from the faucet spout at a low velocity, relatively free of foam, and with substantially no loss of carbonation.

It will be observed further, that the complete absence of collecting pools and the like, and the close tolerances that are held throughout, renders it practically impossible for a faucet of this kind to entrain any appreciable quantity of beverage that could warm up and result in a warm drink. For like reasons the connecting lines between the cooling coil **15** and the faucet **16** are constructed of small diametered tubing, on the order of ⅛" I. D., which entrains very little liquid to warm up on standing.

When pressure is released from the knob **25**, the pressure of the liquid acting on the head end **253***a* of the movable inner member promptly moves the valve to closed position. When closed, the bore **225** is quickly vented by inleakage that can occur through the clearance hole **23**, and the customer receives the measured quantity in the cup and without the mess of after-dripping. Also a valving faucet constructed in accordance with this invention consists essentially of but a few reamed and threaded parts easily disassembled for periodic cleaning and when reassembled in the field, requires no critical fitting or matching of any of its parts.

Whether manually or automatically operated a faucet embodying this invention is "failure safe" in its operation.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention, and therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following procedural combinations, or equivalents thereof, by Letters Patent of the United States:

1. A faucet for dispensing a pre-mixed carbonated beverage comprising a body member having transversely arranged intersecting openings therein, a hollow barrel communicating with one of the openings extending from the body member and adapted to be connected with a source of carbonated beverage under pressure, said body member having a valve seat formed therein at the terminus of said barrel member and ahead of the other opening in the body, a movable valve member positioned within the barrel member for cooperation with the said valve seat, said movable valve member having an extension projecting upstream from the valve seat and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused on entering the barrel to flow in a relatively thin sheet about the extension, and said members being so shaped and proportioned one to the other that the sheet of fluid is caused to thicken at an exponential rate toward the valve seat, and means to actuate the valve.

2. A faucet for dispensing a pre-mixed carbonated beverage comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of beverage under pressure, said body member having a valve seat formed therein at the terminus of said barrel member and an exit opening on the downstream side of the valve seat, a movable valve member positioned for cooperation with the said valve seat, said movable valve member having an extension projecting upstream from the valve seat and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused to enter the barrel and flow in a relatively thin sheet about said extension, and said members being so constructed and proportioned one to the other that the sheet of fluid is caused to thicken at an exponential rate toward the valve seat, and means to shift the valve member and its extension axially of the barrel to open the valve to fluid flow.

3. A faucet for dispensing a pre-mixed carbonated beverage comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of beverage under pressure, said body member having an abrupt angle valve seat formed therein at the terminus of said barrel member and an exit opening on the downstream side of the valve seat, said valve seat offering a surface area substantially perpendicular to the direction of the flow, a movable valve member positioned for cooperation with the said valve seat, said movable valve member having an extension movable therewith projecting upstream from the valve seat and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source acting upon the extension tends to move the extension and the valve toward valve closed position and is caused when the valve is opened to flow to enter the barrel and flow in a relatively thin sheet about said extension, and said members being so constructed and proportioned in size one to the other that the sheet of fluid is caused to thicken at an exponential rate toward the abrupt angle valve seat, and means to shift the valve member and its extension axially of the barrel and against the pressure head to open the valve to fluid flow.

4. A faucet for dispensing a beverage containing approximately 3.7 volumes of carbonation with approximately 95% efficiency comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of beverage under pressure, said body member having a valve seat formed therein at the terminus of said barrel member, a movable valve element positioned within the bore of the barrel member for cooperation with the said valve seat, said movable valve element having a cylindrical portion extending upstream from the valve element and constructed so as to fit the bore of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused to enter the barrel in a relatively thin sheet, and the bore of said barrel member being so shaped that the diameter thereof progressively increases at an exponential rate in the direction of flow so that the sheet of fluid is caused to thicken as it approaches the valve seat, and means to actuate the valve.

5. A faucet for dispensing a beverage containing approximately 3.7 volumes of carbonation with approximately 95% efficiency comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of beverage under pressure, said body member having a valve seat upturned against the flow formed therein at the terminus of said barrel member, a movable valve element positioned within the bore of the barrel member for cooperation with the said valve seat, said movable valve element having a cylindrical portion extending upstream at least ten times its diameter from the valve and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused to enter the barrel and flow in a relatively thin sheet about said cylindrical portion, and the bore of said barrel member being formed with an inner diameter that progressively increases in the direction of flow so that the sheet of fluid thickens at an exponential rate toward the upturned valve seat, and means to actuate the valve.

6. A faucet for dispensing a carbonated beverage with

approximately 95% efficiency comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of beverage under pressure, said body member having a valve seat positioned at an acute angle to the direction of flow formed therein at the terminus of said barrel member, a movable valve element positioned for cooperation with the said valve seat, a movable cylindrical member positioned within the barrel and extending upstream from the valve and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused to flow in a relatively thin sheet about said cylindrical member, and said barrel member being formed with an inner diameter that progressively increases in the direction of flow so that the sheet of fluid is caused to thicken at an exponential rate toward the valve seat, said valve seat having its exit opening of an area proportioned to avoid cavitation at the valve and means to actuate the valve against the pressure head of the beverage.

7. A faucet for dispensing a carbonated liquid without appreciable loss of carbonation comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of liquid under pressure, said body member having a valve seat formed therein, a movable valve element positioned for cooperation with the said valve seat, a movable substantially cylindrical member ahead of the valve extending upstream from the valve approximately twelve of its diameters and constructed so as to fit the interior of the barrel relatively closely at its upstream end so that pressure liquid from the source is caused to enter the barrel and flow in a relatively thin sheet about said movable member, the bore of said barrel and the exterior of said movable member being so constructed and proportioned that the sheet of fluid is caused to thicken at an exponential rate toward the valve seat, and said body member having an exit opening formed therein at the downstream side of the valve and of a diameter smaller than the bore in the barrel so that the liquid in passing the valve is caused to converge as it flows toward the exit opening, and means to actuate the valve.

8. A faucet for dispensing a carbonated liquid without appreciable loss of carbonation comprising a body member, a hollow barrel member extending from the body member and adapted to be connected with a source of liquid under pressure, said body member having a valve seat formed therein, a movable valve element positioned within the barrel member and having a relatively flat end surface for cooperation with the said valve seat, a movable member extending upstream from the valve and fitting the interior of the barrel relatively closely so that pressure liquid from the source is caused to enter the barrel and flow in a relatively thin sheet about the said movable member, the bore of said barrel and the exterior of said movable member being so constructed that the sheet of fluid is caused to thicken at an exponential rate toward the valve seat, and said valve seat having a generally conical surface converging upstream adapted to deflect the flow partially upon itself before the flow passes the valve, and said body member having an exit opening formed therein at the downstream side of the valve and of a diameter smaller than the bore in the barrel so that the liquid in passing the valve is caused to converge as it flows toward the said exit opening, and means to actuate the valve.

9. The combination of claim 8 in which the valve seat is formed with a flat at its upstream end paralleling the plane of the end surface of the valve element.

10. The combination of claim 8 in which the valve seat is at the apex of the conical surface, said surface having a taper in the range of 120° to 90° included angle.

11. A faucet for dispensing a pre-mixed carbonated beverage without appreciable foaming comprising a body member having transversely arranged intersecting conduits formed therein including a first conduit having an annular seat formed about its entrance end and a second conduit at the downstream side of said valve seat extending laterally from said first conduit and constituting a delivery conduit and a third conduit formed coaxial with the said first conduit and located at the upstream side of and terminating at the said valve seat adapted to be connected at its outer end with a source of carbonated beverage under pressure, said annular valve seat being inwardly tapered and disposed so as to present a generally conical surface converging in a direction upstream, and a movable valve member having a substantially flat end face cooperatively related to and adapted to seat upon the apex of the conically surfaced valve seat for controlling the flow of beverage through the faucet, said movable valve member having an elongated generally cylindrical extension movable therewith extending from a point adjacent the valve seat upstream within said third conduit a distance at least three of its diameters, said valve-member extension having a cross-sectional area only slightly smaller than the area of the interior of the said third conduit so as to cause the fluid entering the third conduit to flow in a relatively thin continuous sheet about the valve-member extension to the valve seat and to reach the said seat as a tubular sheet and there to be deflected inwardly on itself by the action of the converging surface of the valve seat, and means to actuate the valve member and its said extension in the direction of the axis of the said coaxial conduits and against the pressure head whereby to effect a flow of the beverage through the faucet without appreciable foaming.

12. The combination of claim 11 in which the said laterally extending delivery conduit is larger in area than the area of said first conduit and communicates with the said first conduit at a point intermediate its ends so that a portion of said first conduit extends past the entrance of said delivery conduit.

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