

[54] **APPARATUS FOR PREPARING AND DISPENSING DRINKS**

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[63] Continuation-in-part of Ser. No. 856,064, Sept. 8, 1969, abandoned.

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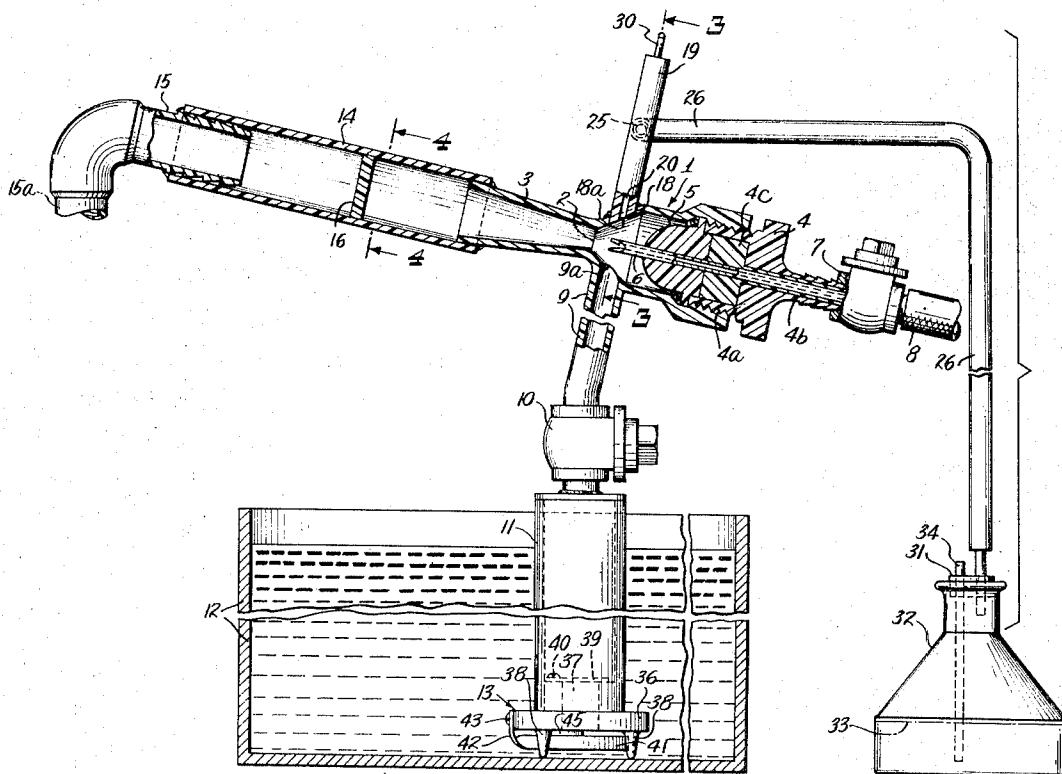
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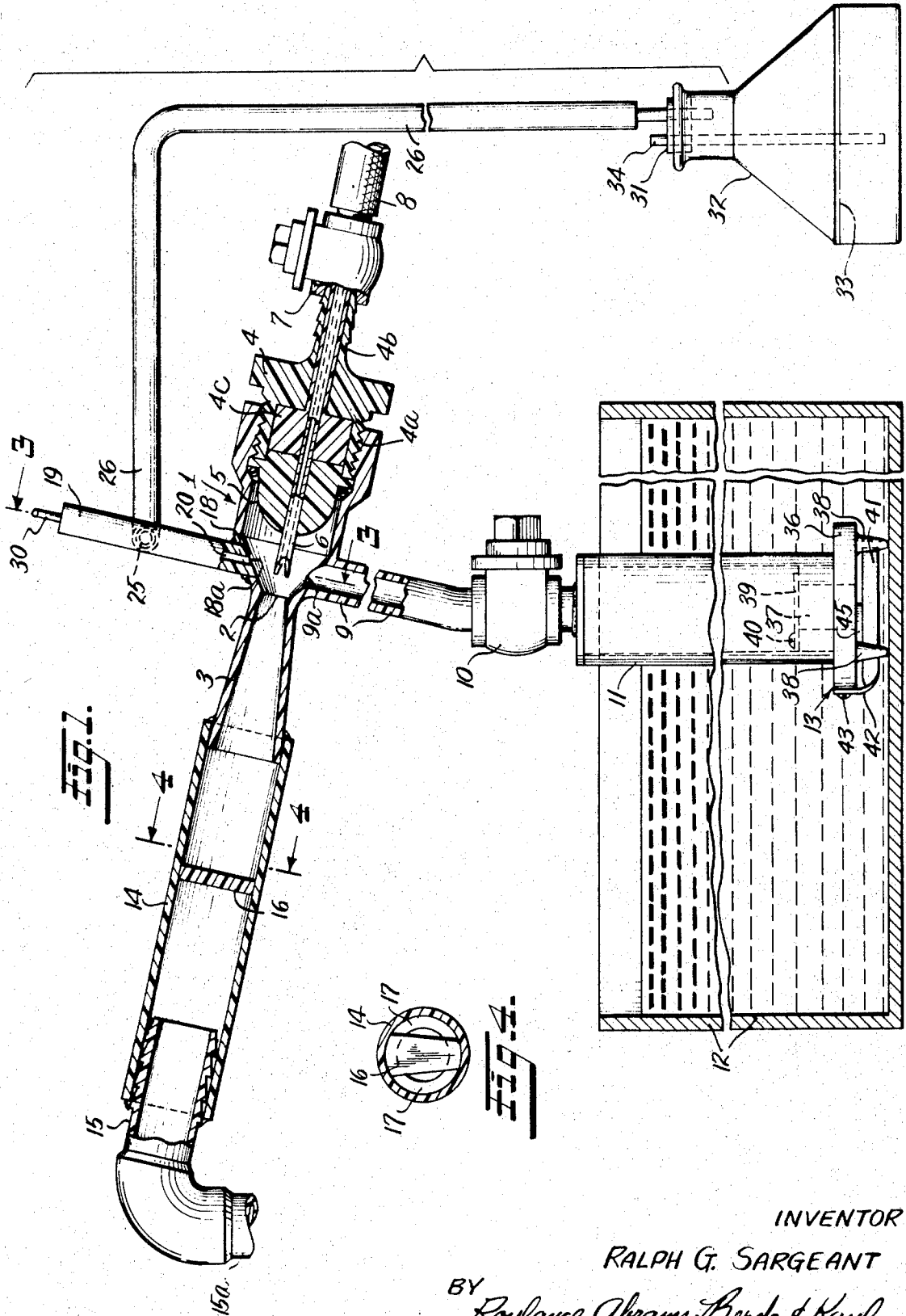
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[57] **ABSTRACT**

Apparatus for preparing and dispensing drinks, in which a diluting liquid is combined with a liquid beverage concentrate, consisting of a flow confining zone and a final mixing zone. In the flow confining zone, a high velocity stream of one of the liquids is propelled through a discharge tube having a tip located adjacent to the restricted throat of a Venturi causing the other liquid ingredient to be drawn through a suction port into this zone. The preliminary mixture is then forcibly impinged on a baffle surface located in the final mixing zone. Air can be drawn through a second suction port located in the flow confining zone.

5 Claims, 9 Drawing Figures



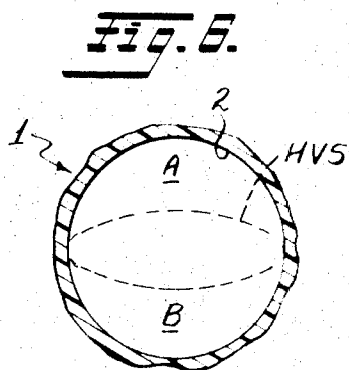
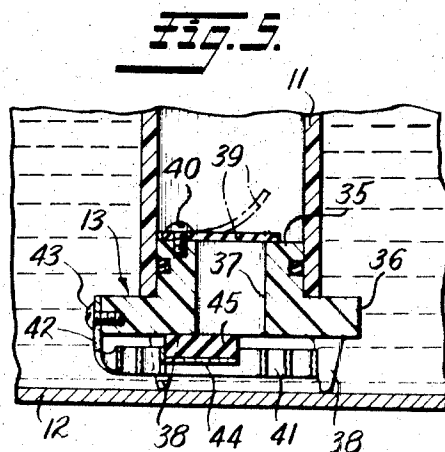
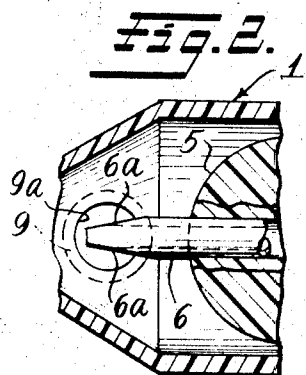
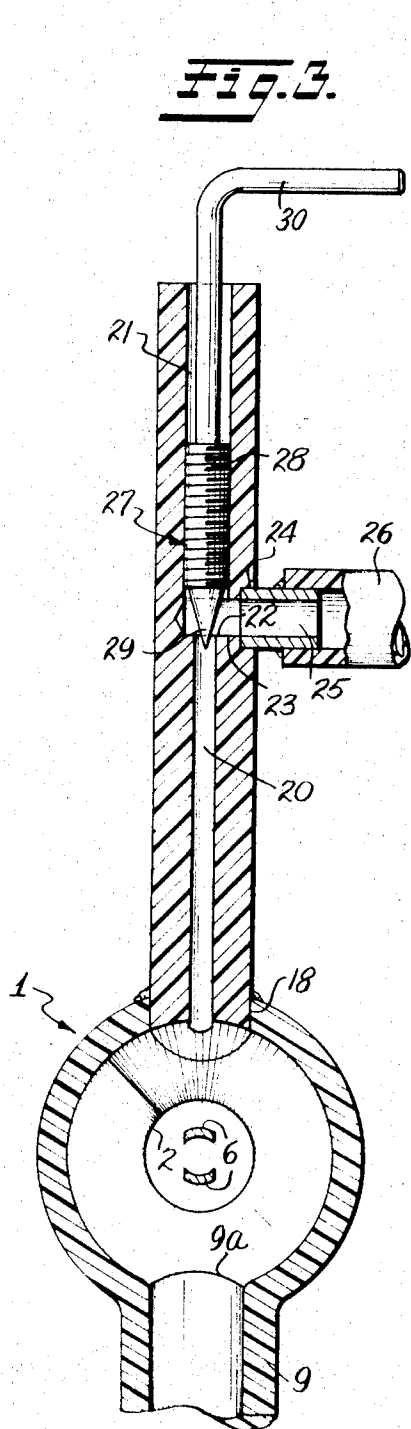


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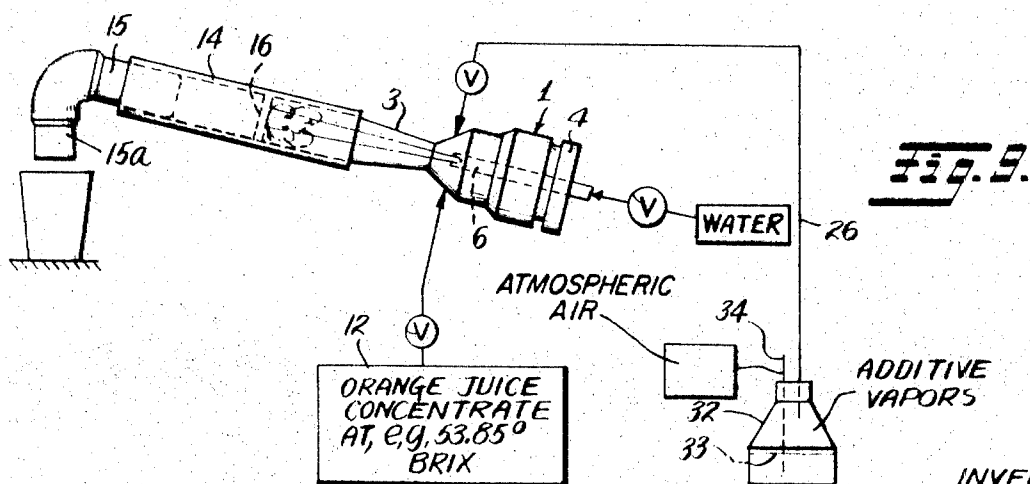
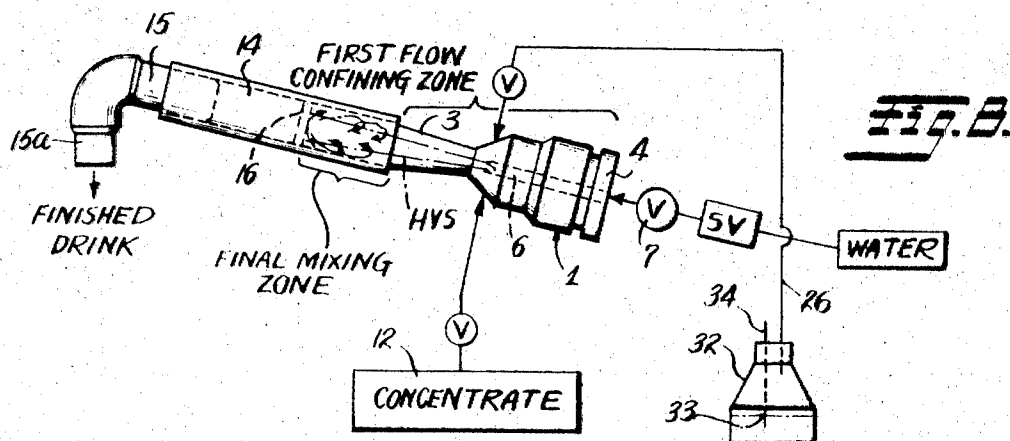
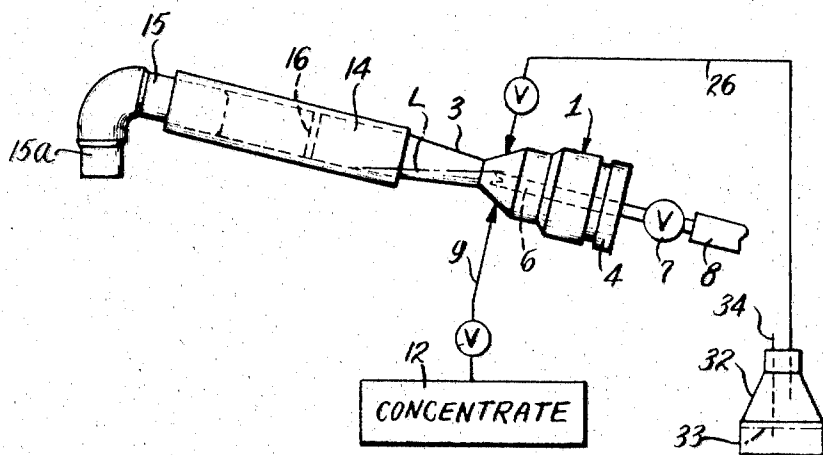
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APPARATUS FOR PREPARING AND DISPENSING DRINKS

This application is a continuation-in-part of my copending application Ser. No. 856,064, filed Sept. 8, 1969, now abandoned, and discloses apparatus useful in carrying out the method disclosed in my copending application Ser. No. 128,711, filed Mar. 29, 1971.

This invention relates to the production of organoleptically superior beverages from beverage concentrates, and, in its most advantageous form, provides a method and apparatus for producing beverages on a per drink basis.

In the marketing of various beverage materials, such as citrus juices, it has become common practice for the producer to process the beverage raw material into a concentrate which is distributed over a wide geographic area for reconstitution into the final beverage. In that portion of the retail market in which the reconstituted beverage is prepared in the household, the concentrate can simply be packaged and distributed, and a large demand has developed for packaged concentrates because final preparation of the final beverage from the concentrate can be accomplished more easily and quickly than when, e.g., fresh oranges must be squeezed to provide juice. This portion of the market is now highly developed, and current production and distribution techniques are successful to the extent that great quantities of orange juice concentrates and the like are now consumed in the home.

However, a large additional potential market for beverage concentrates has as yet not been satisfied. This potential market is that which can be served with drink dispensers, particularly coin operated dispensers, designed to prepare and dispense beverages on a per drink basis. Though the concept of marketing beverages by coin operated and like dispensing machines which formulate a drink during each operation of the dispenser is quite old, and though many such dispensers are presently in use, the success attained to date in this field is small in comparison to the total potential market, particularly in the case of citrus juices. A general reason for such limited success is the difficulty in devising an economically practical apparatus which is dependably capable of mixing the beverage materials adequately and in the proper proportions in the short time available for the preparation of each drink. Even more serious, however, have been problems arising from the fact that the drink must be prepared from a concentrate. While various techniques have been developed for concentrating juices and other beverage materials, the methods commonly employed involve steps, such as evaporation and/or drying, which diminish or eliminate natural factors responsible for the desirable organoleptic properties which the consumer has come to recognize as characteristic of the natural product. Thus, in the case of most beverage concentrates, simply mixing the concentrate with, e.g., water, provides a drink which is relatively poor as compared to the "fresh" or "natural" beverage material.

Such problems have proved particularly vexing to those attempting to market orange juice by supplying a juice concentrate to be reconstituted on a drink-by-drink basis in coin operated and like dispensers. The commercially practical procedures for manufacturing orange juice concentrates markedly reduce certain natural flavor constituents, such as orange oil, orange

essence, and essence oil, so that mixing of the concentrate with water provides a reconstituted drink having a flavor and aroma recognized by the consumer as falling short of fresh orange juice. Similarly, even when such concentrates are thoroughly mixed with an amount of water accurately controlled to provide the proportions of natural juice, the drink is organoleptically unlike the natural juice. Typically, consumers recognize a different, less desirable, "mouth feel." Prior-art workers have sought to overcome these difficulties in various ways. Thus, it is common to add small proportions of orange oil and orange essence to finished orange juice concentrates, but such additions have proved of relatively little value in improving the flavor of the reconstituted beverage. Similarly, orange juice concentrates are frequently "cut back," at the point of manufacture, by the addition of orange pulp and fresh juice, with some moderate improvement thus being achieved in the reconstituted drink. It has also been proposed to aerate the reconstituted beverage, but this too has provided only a nominal improvement in the finished product. In general, drinks prepared from orange juice concentrates on a per drink basis in dispensing machines have fallen far short of that level of quality which consumers generally attribute to orange juice, and such acceptance as has been achieved in this field appears to stem mainly from the fact that the drink can be obtained quickly from a conveniently located dispenser.

A general object of the invention is to provide an apparatus whereby organoleptically superior beverages can be prepared on an individual, per drink basis from beverage concentrates.

Another object is to provide an apparatus for producing orange drinks of improved flavor, aroma and other organoleptic properties from orange juice concentrates.

A further object is to accomplish more effective aeration in the reconstitution of beverages with a beverage concentrate.

Yet another object is to provide for accurately controlled introduction of small proportions of volatile additives into a beverage as the beverage is prepared on an individual drink basis from a beverage concentrate.

The apparatus includes means defining a flow-confining zone of Venturi form, a small diameter supply tube, typically an 11 ga. surgical cannula, arranged to project a high velocity stream of one liquid axially through the flow-confining zone, and means located downstream of that zone and defining a final mixing zone, there being a transverse baffle member in the final mixing zone onto which the stream discharged from the flow-confining zone is forcibly impinged. The flow-confining zone is equipped with a supply duct communicating with the portion of that zone on the upstream side of the Venturi restriction, and a second liquid constituent is supplied via this duct and a metering orifice, such as may be provided by a suitable valve. A second supply duct also communicates with the inlet end of the flow-confining zone to admit air into that zone via a second orifice. The high velocity stream discharged from the small diameter supply tube carries the second liquid constituent and air through the Venturi restriction as a preliminary mixture, and it is this preliminary mixture which is impinged on the baffle.

Advantageously, the flow-confining zone and final mixing zone are arranged coaxially along a line slanting forwardly and upwardly, in such fashion that, when each drink is dispensed and the high velocity stream stopped, a quantity of finished drink drains back into the inlet portion of the flow confining zone, to be forwardly projected again when mixing of the next drink commences.

In order that the manner in which the foregoing and other objects are attained according to the invention can be understood in detail, particularly advantageous embodiments thereof will be described with reference to the accompanying drawings, which form a part of the original disclosure of this application, and wherein:

FIG. 1 is a longitudinal sectional view, with parts shown in side elevation, of an apparatus embodiment by which the method can be carried out;

FIG. 2 is an enlarged fragmentary longitudinal sectional view illustrating the tip of the discharge tube of the apparatus of FIG. 1;

FIGS. 3 and 4 are transverse sectional views taken generally on lines 3—3 and 4—4, FIG. 1, respectively;

FIG. 5 is an enlarged fragmentary vertical sectional view illustrating a check valve and thermostatic control employed in the apparatus of FIG. 1;

FIG. 6 is a semi-diagrammatic view illustrating the relationship between the cross-sectional shape of the high velocity stream and the Venturi throat during operation of the apparatus of FIG. 1;

FIG. 7 is a view, similar to FIG. 1 but semi-diagrammatic in form, illustrating the condition of the apparatus just prior to operating the same to prepare and dispense a drink;

FIG. 8 is a view similar to FIG. 7 illustrating the condition of the apparatus during operation; and

FIG. 9 is a diagram illustrating one particularly advantageous method embodiment of the invention.

Referring to the drawings in detail, and first to FIGS. 1-6, the device disclosed is a mixing device according to a particularly effective apparatus embodiment of the invention and is adapted to be used in a drink dispenser which dispenses drinks individually, mixing each drink at the time it is dispensed. The device comprises a Venturi mixing device including a body 1 defining a restricted throat 2 and an outwardly and forwardly flaring discharge chamber 3. The end of body 1 opposite chamber 3 defines an inlet chamber which is internally threaded, and into this threaded portion there is fitted an externally threaded plug member 4, the interengaged threads being indicated at 4a, FIG. 1. The combination of the inlet chamber, the throat 2, and the discharge chamber constitutes a flow-confining zone in which, as later explained, a preliminary mixture of the constituents of the drinks is formed.

At its end opposite the Venturi, plug member 4 has an axial extension 4b. A cylindrical bore extends axially through the entire plug member and is greatly enlarged at the end of plug member which is directed toward the interior of the Venturi. The enlarged portion of this bore encloses a thick disc 4c of resilient material, and a rounded nose member 5, both the disc and nose member having axially aligned bores. A small discharge tube 6 extends completely through body member 4 and through the axial bores of members 4c and 5, the length of tube 6 being such that the tip thereof extends beyond

the nose member 5 to a point adjacent throat 2 of the Venturi. The tube 6 is of such small diameter that, with liquid supplied thereto at a practical pressure of, e.g., 25 p.s.i., the liquid will be discharged as a high velocity stream. Typically, discharge tube 6 can be a surgical cannula modified by having the tip tapered, so that the tip includes two flat, forwardly converging, side surfaces 6a each interrupted by a forwardly opening notch formed by intersection of the side surface with the cylindrical inner wall of the tube, as best seen in FIG. 2.

In the assembly just described, it will be understood that the position of plug member 4 relative to body 1, adjusted by relative rotation of the plug member and body, determines the axial position of the tip of tube 6 relative to the throat 2 of the Venturi. It will also be understood that member 4c serves to provide a fluid-tight seal between tube 6 and plug member 4, and that the nose member 5 decreases the space within the body of the Venturi device on the input side of the throat so that a higher vacuum can be produced.

Extension 4b of plug member 4 is inserted directly into one port of an adjusting valve 7, the other port of valve 7 being connected to a water supply tube 8 through which water is supplied at a constant pressure whenever the dispenser is actuated to prepare and dispense a drink.

Body 1 is also provided, on the input side of throat 2, with a side or suction duct 9 which communicates with the interior of the Venturi body via a port 9a. Duct 9 is connected directly to an adjustable valve 10 which in turn is connected to one end of a feed tube 11 extending downwardly to a point immediately adjacent the bottom of a small cylindrical tank 12 in which the beverage concentrate or other constituent to be mixed with the water to form the drink is contained. A combined check valve and thermostatic flow control device, indicated generally at 13 and later described in detail, is secured to the lower end of tube 11 and serves to allow flowable material in tank 12 to be drawn upwardly through the feed tube when the device is in operation, and to prevent material from draining back into the tank when the device is not being operated.

The downstream end of body 1 is disposed in and rigidly secured to one end of a straight cylindrical tube 14 which defines a laterally confined final mixing zone. Tube 14 is aligned coaxially with Venturi body 1. The combination of body 1, plug member 4 and tube 14 is inclined upwardly (in the direction of flow) at a small angle, e.g., 10°-15°, to the horizontal. The downstream end of tube 14 is engaged over and rigidly secured to the input tube 15 of a dispensing nozzle 15a.

A baffle plate 16, in the form of a relatively thick piece of polymeric material, extends transversely across the interior of tube 14 in a location midway between tube 15 and element 3. Plate 16, as seen in FIG. 4, has curved ends engaging the inner wall of tube 14, as with a force fit, and is of tapered plan configuration with the straight side edges of the plate converging downwardly. The dimensions of baffle 16 are such that it only partially closes tube 14 so that there is a passage 17, FIG. 4, at each side between one of the tapered edges of the baffle which extend chordwise of the circular cross-section of the tube, and the corresponding portion of the interior walls of tube 14. Baffle 16 is centered on the axis of tube 14 so as to be presented as a

target to the high velocity stream discharged into tube 14 by discharge tube 6 of the Venturi device.

Body 1 is also provided, on the input side of throat 2, with a side or suction duct 18 which opens into the inlet chamber of the Venturi via a port 18a advantageously located diametrically across from port 9a. An upright rod 19 of polymeric material has its lower end disposed in duct 18 in a mechanically secure and fluid-tight fashion. Rod 19 has a through bore including a lower portion 20 of small diameter and an upper portion 21 of larger diameter, there being a transverse annular shoulder 22 at the juncture between the bore portions 20 and 21. A side port is provided in rod 19 immediately above the shoulder 22 and includes a small diameter inner portion 23 and a large diameter outer portion 24. A short stainless steel tube 25 is inserted with a force fit into portion 24 of the side port and projects outwardly from the rod 19 by a short distance adequate to allow the end of a flexible polymeric tube 26 to be secured over tube 25.

A movable metal valve member 27 is provided to cooperate with the valve seat afforded by shoulder 22. Member 27 includes a threaded straight portion 28, a pointed lower tip 29, and at its upper end a laterally projecting handle 30. Portion 28 is engaged in the bore portion 21 of rod 19 in a self-threading relationship, i.e., the threads of portion 28 forming mating threads in the wall of bore portion 21 as the valve member is inserted with rotation, the valve member having been sufficiently inserted into the rod to bring the valve tip 29 into coacting relationship with shoulder 22. The position of tip 29 relative to shoulder 22 defines an orifice to control the flow of air or other fluid (supplied via the side port) through bore portion 20 into the inlet portion of the flow-confining zone defined by body 1.

Flexible tube 26 extends through the stopper 31 of a flask 32 which serves as a supply of a volatile additive, a liquid body of the additive being indicated at 33, FIG. 1, and the portion of the interior of the flask above the liquid containing the volatile additive in vapor form. Tube 26 terminates above the surface of body 33. An air supply tube 34 also extends through stopper 31 and terminates well below the surface of the liquid, thus placing the interior of the flask in communication with atmospheric air via the liquid in the flask.

Flow control device 13, FIG. 5, comprises a cylindrical body 35 having an outwardly projecting transverse annular flange 36, body 35 being disposed in and secured in fluid-tight relation to the lower end portion of tube 11. A cylindrical bore 37 extends axially through body 35. Flange 36 is of substantially larger diameter than the outer diameter of tube 11 and the flange is provided with a series of three depending feet 38 adapted to engage the bottom wall of tank 12. A check valve member 39, in the form of a thin, normally flat disc of resiliently flexible polymeric material is disposed across the upper end of body 35, being secured thereto by a screw 40. During operation of the device to mix a drink, element 39 deflects upwardly, as indicated by the broken lines in FIG. 5, to allow upward flow of the flowable concentrate or other material in tank 12. When the mixing operation is terminated, element 39 returns to the position shown in solid lines in FIG. 5, closing bore 37 against downward flow, with the result that the combination of duct 9, the interior of

valve 10, and tube 11 is filled with concentrate or other material preparatory to mixing of the next drink.

When the apparatus is employed to mix orange juice concentrate, for example, with water, the supply tank 12 for the concentrate will be refrigerated and it is highly desirable to compensate for the effect of changes in viscosity of the concentrate which result from changes in temperature. This is particularly important in drink dispensers which mix the drink as it is dispensed, since such devices may be called upon to provide a number of drinks in quick succession, or only to provide a single drink, so that the concentrate temperature which the refrigerating means has achieved at any one time is not predictable. To provide such compensation, the apparatus is equipped with the thermostatic valve shown in FIG. 5 and comprising a bimetallic thermostatic element 41 in the form of a single bimetal strip wound in spiral fashion. At the outer end of the spiral, a portion 42 of the strip is twisted and bent upwardly to engage the periphery of shoulder 36, end portion 42 being secured to the shoulder by a screw on other suitable fastener 43. The inner end portion 44 of the bimetal strip is twisted so as to extend parallel to the bottom face of shoulder 36 and, because of the width of the bimetal strip, is spaced a significant distance below the lower end of bore 37. A valve element 45 is fastened to the upper face of inner end portion 44 and is of such thickness that its top surface is in sliding contact with the bottom face of body 35.

Since the spiral bimetal strip 41 is located below valve body 35, so as to be disposed between body 35 and the bottom of tank 12, the bimetal strip is constantly immersed in the orange juice concentrate or like flowable material contained by the tank. Accordingly, the bimetal strip responds to the temperature of the orange juice concentrate or like material which is to be drawn into the mixing device. The configuration and dimensions of the spiral bimetallic strip are so chosen that, when the strip is at a predetermined temperature, e.g., the mean temperature of the refrigerated concentrate, the strip holds the valve element 45 in a position partially closing bore 37. The nature of the bimetal strip is such that, when the temperature to which it is exposed decreases below the predetermined value, the spiral of the strip contracts, with the result that valve element 45 is moved progressively away from the mouth of bore 37, so that a greater portion of the mouth of the bore is open for liquid flow. Conversely, when the temperature of the concentrate decreases, the spiral of the bimetallic strip 41 expands, causing valve element 45 to move progressively across the mouth of bore 37, thus decreasing the effective size of the mouth of the bore. Accordingly, the size of the opening through which the concentrate is drawn into the mixing apparatus is adjusted inversely with respect to the temperature of the concentrate, so that the induced flow of concentrate, during operation of the mixing device, remains relatively unaffected by changes in temperature, and thus changes in viscosity, of the concentrate.

Considering use of the apparatus, assume that it is to be employed to prepare and dispense drinks, on an individual drink basis, with the drinks being formed from a flowable beverage concentrate, a supply of which is maintained in tank 12, and water, to be supplied via

tube 8. For purposes of simplicity, assume that flexible tube 24, FIG. 1, is disconnected, so that only air is supplied via side port tube 23. Assume further that the discharge tube 6 has an inner diameter of 3/32 inch and that water is supplied to tube 8 at a constant pressure of 25 p.s.i. Flow control valves 7 and 10, and that provided by rod 19 and valve element 29, are adjusted to provide a proper proportional flow of water, concentrate, and air under the operating conditions of the device at 25 p.s.i. water pressure.

At such supply pressure, the water is discharged from tube 6 at a high velocity of, e.g., in excess of 600 inches per second. Because of the tapered configuration of the tip of discharge tube 6, the high velocity stream of water emitted from the discharge tube is of elliptical transverse cross section, with the long axis of the ellipse extending horizontally, though tube 6 can be adjusted rotationally to provide any other angular disposition of the long axis of the ellipse. Accordingly, the axial position of the discharge tube relative to the throat of the Venturi can be adjusted so that only the edge portions of the stream at the ends of the long axis of the elliptical cross section thereof engage or are immediately adjacent to the circular surface defining throat 2. Thus, as indicated in FIG. 6, there are significant spaces between the high velocity stream and the wall of throat 2 at the ends of the short axis of the elliptical cross-section, i.e., at locations A and B, FIG. 6. Though the high velocity water stream does not completely fill the throat, the initial action of the stream is to generate a partial vacuum in the inlet portion of the flow-confining zone defined by body 1. Such partial vacuum causes concentrate to be drawn upwardly through tube 11, valve 10 and duct 9 into the inlet portion of the Venturi device. Accordingly, very quickly after the high velocity stream is initiated, enough concentrate is provided in the area of port 9a so that the concentrate is picked up by the water stream and carried forwardly through the throat. Such initial pick up of concentrate by the water stream first reduces and then eliminates the free spaces at A and B, FIG. 6, and the device then functions with full Venturi action to induce the flow of concentrate and air at rates which are directly dependent on the velocity of the water stream, accepting the design perimeters of the Venturi device to be constant and predetermined. Accordingly, very quickly after the flow of the high velocity water stream is initiated, the device functions to discharge forwardly into tube 14 a combination of water, concentrate, and air in the proportions desired for the drink.

In addition to providing the hydraulic flow necessary to operate the Venturi device, the high velocity water stream serves both to preliminarily mix the water, concentrate and air within body 1, and then to project the preliminary mixture forwardly through tube 14 and onto baffle 16. The velocity of the water stream is such that the mixture projected through tube 14 impinges forcibly onto the transverse surface presented by baffle 16, the result of such impingement being that the stream is disrupted in random fashion, major portions of the mixture being caused to flow rearwardly along the internal surface of tube 14 in recirculating fashion. Once a steady state of operation of the device is attained, tube 14 is full of liquid. The high velocity stream, concentrated generally along the axis of the

tube, moves forwardly at high velocity while the liquid in the outer areas of the space defined by the tube moves variously in a recirculating fashion and in a turbulent fashion. Recirculating movement is greatest in the portions of the internal area of tube 14 aligned with the ends of baffle 16, that is, the upper and lower portions of the space. A more turbulent and random flow pattern is established in the areas aligned with spaces 17, FIG. 4. Once steady state operation has been achieved, the final mixture is carried off by nozzle 15a at a flow rate determined by the aggregate flow rate of water, concentrate and air into the device.

FIG. 8 illustrates in diagrammatic fashion the steady state of operation of the device. The Venturi body 1 defines a first flow-confining zone in which (a) the predetermined proportional flow of water, concentrate and air is established and (b) an initial or preliminary mixing of the three constituents is accomplished. As indicated by broken lines at HVS, the high velocity stream discharged by tube 6 tends to persist, providing the energy necessary to carry the preliminary mixture through tube 14 and cause the same to impinge forcibly on the baffle 16. Tube 14 defines a laterally confined final mixing zone in which the preliminary mixture is converted to a completely mixed condition, but the mixing action which occurs in this zone is effected by the energy of the high velocity water stream originally emitted from tube 6. Typical flow patterns occurring in this zone and resulting in uniformity of the final mixture are indicated by the arrows in FIG. 8.

Since, when the apparatus is first started up, the overall space defined by body 1 and tube 14 is essentially empty, a short initial operation is carried out with the mixture discharged through nozzle 15a to waste, since the very first liquid emerging from the device, on start up, will not be completely mixed. When steady state operation has been achieved, the apparatus is deactivated, e.g., by simply terminating the water flow by shutting off the solenoid valve SV, FIGS. 7 and 8. With the discharge of water stopped, some of the final mixture drains from nozzle 15a, until the liquid reaches a natural level L, FIG. 7. At this point, it is to be noted that valve element 39 is closed, preventing any drain back from body 1 into tank 12. Accordingly, when the apparatus is first operated to dispense a finished drink, throat 2 of the Venturi device is completely filled with liquid which is a mixture of water, concentrate and air. While this residual mixture may not be completely uniform, it has been subjected to an extensive amount of mixing. When a drink is to be mixed and dispensed, the solenoid valve SV is again opened and the high velocity stream of water is again discharged from tube 6. In this operation, a full Venturi action is instantly established, since the throat of the Venturi body is initially filled with the residual liquid remaining from the last operation of the device. The operation is now essentially that previously described, save that the first liquid appearing in the dispensing nozzle 15a is essentially completely mixed and has the proportions desired for the final drink. Operation of the solenoid valve SV is controlled to limit the flow of water through tube 6 to a predetermined time period which will be adequate to deliver just that amount of finished drink desired.

It is to be particularly noted that the air induced via bore 20 of rod 19 is introduced into the preliminary

mixture formed within body 1. Thus, the air employed for aerating the drink is combined with and distributed through the water and concentrate before final mixing of the drink is effected in the zone defined by tube 14. Further, final mixing in that zone is accomplished as a result of forcible impingement of the preliminary mixture into baffle 16, with the attendant turbulent flow and recirculation. Since partial mixing has already occurred before the mixing zone, the air is distributed throughout the final drink in uniform manner and as relatively small bubbles. In the case of orange juice, for example, this results in the dispensed drink having a foamy "head" and a distinctly improved "mouth feel," in comparison with drinks heretofore provided in dispensing machines.

Such uniform, small bubble aeration is capitalized on to provide a way to incorporate in the drink controlled proportions of volatile additives, such as orange oil, orange essence, or essence oil, in the case of an orange juice drink. Thus, the air introduced into the mixture is carried through flask 32, entering the flask via air tube 34. With the flask containing a liquid body of orange oil, for example, a substantial amount of orange oil vapors exist in the flask above the liquid. Each time a drink is mixed and dispensed, a controlled volume of air is drawn into flask 30, and a corresponding volume of the air-vapor mixture is drawn downwardly through the liquid to the lower end of tube 26. Accordingly, during preparation of a drink with the apparatus of FIG. 1 by the method hereinbefore described, each cycle of operation of the apparatus introduces a predetermined volume of air which in turn carries a predetermined amount of the vapors of the volatile additive. This feature is of particular importance in preparation of orange juice drinks since there has heretofore been no practical and economical way of metering small quantities of the relatively corrosive additives on a continuous basis.

In a typical example of preparing an orange juice drink according to the invention, tank 12 is filled with an orange juice concentrate having a density of 53.85° Brix and a viscosity of 3,000 centipoises at 75° F., no additives having been introduced into the concentrate. Water is supplied to tube 8 at a constant pressure of 25 p.s.i., yielding a discharge velocity at the tip of discharge tube 6 slightly in excess of 690 inches per second when valve SV is open. Orange essence is provided in flask 32. The aeration valve comprising elements 19 and 27 is adjusted to provide a flow of the air-orange essence vapor into the inlet chamber of body 1 equal to 0.35 cu. in./sec. With an 8 oz. cup held under dispensing nozzle 15a, valve SV is opened and maintained open until the cup is full, requiring a time of approximately 3 sec. The drink supplied to the cup comprises water and orange juice concentrate at a ratio of 4:1 by volume, the design parameters of body 1, discharge tube 6, and feed tube 11 having been chosen to cause one part of concentrate to be induced to flow through port 9a for each part of water discharged from tube 6 when the water supply is maintained at 25 p.s.i. In addition to water and orange juice concentrate, the drink comprises a small proportion of orange oil. Immediately upon filling of the cup, the drink is very foamy, there being an attractive and distinct head approximating that obtained by rapidly agitating fresh

orange juice. When the drink has been allowed to stand quiescent for a few minutes, the density becomes stable at approximately 13° Brix. The drink is characterized by a marked flavor and aroma, distinctly superior to that of the usual reconstituted orange juices of the prior art. This improvement arises not only from the superiority of the mixing action and aeration achieved according to the invention but also from the fact that the orange essence is incorporated in a thorough and effective fashion, being present in each increment of air incorporated in the drink. The improved effect of introduction of the volatile additive is observable immediately as the drink is withdrawn from the dispenser, since some of the introduced air escapes during foaming of the drink, and carries with it some of the orange oil vapor. The taste of the drink is markedly improved, possibly because some of the essence oil present in the drink is present in the air distributed through the liquid.

The apparatus can be operated with orange juice concentrates with densities in the range of 40°-72° Brix and viscosities at 75° F. of 3,000-7,000 centipoises, and is particularly advantageous when concentrates of higher density, e.g., in excess of 50° Brix, are employed. In using the apparatus to make orange juice drinks, the volatile additives are introduced in small proportions, e.g., 0.003-0.005 percent by volume for orange oil, 0.00001-0.0001 percent by volume for orange essence, and 0.0001-0.00075 percent by volume of oil of orange essence. In considering the proportion of volatile additive to be employed, it must be kept in mind that only a portion of the volatile additive is retained in the liquid of the drink, a substantial proportion thereof escaping to the atmosphere during foaming and subsequent escape of the air from the drink.

Though the invention has particular advantage in connection with production of orange juice drinks, the apparatus can be used to produce drinks from concentrates of pineapple juice, coffee, chocolate, with or without added essence, and soft drinks syrups such as, e.g., cola drink syrups.

In the case of pineapple juice drinks, the apparatus can be operated as hereinbefore described, employing a pineapple juice concentrate of, e.g., 60° Brix concentration and adjusting the apparatus to provide one part by volume of the pineapple juice concentrate for each 5.5 parts by volume of water discharged via tube 6. Air flow at a small rate of, e.g., 0.3 cu. in./sec. is established by adjustment of metering valve member 27, the air being passed through flask 32 and there being a quantity of pineapple essence in the flask. The finished drink has a density of 10.5°-11° Brix and organoleptic qualities essentially like fresh pineapple juice.

In the case of coffee drinks, a coffee concentrate of 40-50 percent solids content by weight is provided in tank 12. Such a concentrate can be prepared by brewing coffee conventionally to provide coffee having a 20 percent solids content and concentrating the fresh coffee to, e.g., a 45 percent by weight solids content in a conventional evaporator. The apparatus is operated as hereinbefore described, using hot water as the liquid diluent discharged via tube 6, and operating the apparatus to provide, in the finished drink, a solids content of 20 percent by weight. In this example, aeration is avoided, valve member 27 being closed.

Hot chocolate drinks are mixed and dispensed in the same fashion, using a chocolate syrup as the concentrate in tank 12.

Volatile flavor and/or aroma additives for use in accordance with the invention can be produced, for example, in accordance with the teachings of my U. S. Pat. No. 3,428,463, issued Feb. 18, 1969. In using the apparatus to prepare fruit juice drinks according to the invention, the air flow induced into the preliminary mixture, as via port 18a, can be maintained in the range of 0.1-1.0 cu. ft./sec., with the optimum flow rate depending upon the nature of the juice concentrate employed and upon the characteristics desired for the finished drink. Particularly advantageous results are achieved when the air flow is maintained in the range of 0.25-0.5 cu. in./sec.

Superiority of the apparatus appears to be based primarily upon the action of the high velocity stream discharged from tube 6, with a proportioning and preliminary mixing action occurring in the venturi device, and a final mixing occurring in tube 14. Optimum results are attained with higher velocities for the stream discharged. Thus, in the case of fruit juice drinks prepared from a juice concentrate having a density in excess of 40° Brix, water stream velocities in excess of 500 in. per sec. are highly advantageous, such velocities resulting in thorough mixing of the concentrate with the water and also making it possible to generate the relatively high partial vacuum required to cause the required amount of the concentrate to flow into the inlet chamber of the device. Effectiveness of the high velocity stream in accomplishing thorough mixing depends upon disruption, random mixing flow and recirculating mixing flow which occurs as a result of impingement of the stream on the baffle 16. In general, successful operation of the apparatus can be achieved with high stream velocities at the tip of the discharge tube, and with the baffle spaced a few inches from the tip of the discharge tube.

What is claimed is:

1. In an apparatus for mixing beverage materials including at least a flowable beverage concentrate and a liquid diluent, the combination of
 - body means defining
 - an inlet chamber having at least one suction port, an outlet, and
 - a flow restriction located between said inlet chamber and said outlet;
 - a discharge tube extending into said inlet chamber and having a discharge tip adjacent to and coaxial with said flow restriction,
 - said discharge tip having two diametrically opposed forwardly converging end surfaces which intersect the wall of the bore thereof, whereby the stream discharged from said tip is caused to have a transverse cross section which has a longer axis, extending across said converging surfaces, and a shorter axis, extending generally parallel to the intersection of said converging surfaces,
 - the bore of said discharge tip being small in comparison to said flow restriction and said discharge tip being so located relative to said flow restriction that, when liquid is supplied to said discharge tube at a predetermined pressure,

said shorter axis of the transverse cross section of the stream discharged from said tip will be smaller than the corresponding dimension of said restriction as the stream passes through said restriction;

means whereby liquid can be supplied to said discharge tube;

tubular means having

an inlet end connected to said outlet of said body means,

an outlet end spaced from said inlet end, and

wall means defining a final mixing zone extending from said inlet end toward said outlet end;

transverse means located within said tubular means at the end of said final mixing zone and presenting a baffle surface extending across the path of travel of the stream discharged by said discharge tube, there being space between said baffle surface and said wall means via which liquid can flow from said final mixing zone; and

conduit means connected to said outlet end of said tubular means for conducting liquid away from said tubular means.

2. The combination defined in claim 1, wherein said flow restriction is circular, and the bore of said discharge tip is cylindrical and said converging surfaces are flat, whereby the transverse cross section of the stream discharged from said tip is substantially elliptical.

3. The combination defined in claim 1, wherein said transverse means has at least two side edges which are spaced from the surrounding wall of said tubular means.

4. The combination defined in claim 1, and further comprising

infeed conduit means connected to said body means to communicate with said inlet chamber via said suction port; and

check valve means in said infeed conduit means to allow flow through said infeed conduit means into said inlet chamber,

the combination of said body means and said tubular means being inclined upwardly at a small angle in the direction of travel of the stream discharged from said discharge tube, said infeed conduit means extending downwardly from said body means,

whereby, upon termination of a mixing operation in which a liquid is discharged from said discharge tube and a flowable beverage concentrate is supplied via said infeed conduit means, a residual body of a mixture comprising the liquid and the concentrate will remain in said body means and at least partially fill said restriction.

5. The combination defined in claim 1, wherein said inlet chamber has a first and a second suction port with said ports being generally mutually opposed across the direction of travel of the stream discharged by said discharge tube, the combination further comprising infeed conduit means connected to said first suction port and depending from said body means for supply of a beverage concentrate to said inlet chamber; and

other infeed conduit means connected to said second suction port to admit air to said inlet chamber, said body means being so disposed that said second suction port is located above the line of travel of the stream discharged by said discharge tube.

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