United States Patent [19]

Murray

[11] **3,853,481**

[45] **Dec. 10, 1974**

[54] **BALANCE BEAM FEEDER**

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[22] Filed: **Nov. 16, 1973**

[21] Appl. No.: **416,384**

[52] **U.S. Cl.** ..... **23/267 A,** 23/267 E, 23/272.7, 23/272.8, 23/272.5, 137/268, 222/190, 222/57, 222/58, 210/169

[51] **Int. Cl.** **B01d 11/02,** B01f 5/10

[58] **Field of Search** ..... 23/267 A, 267 E, 272.7, 23/272.8, 272.5; 137/268; 222/190, 77, 57, 58; 210/167, 169

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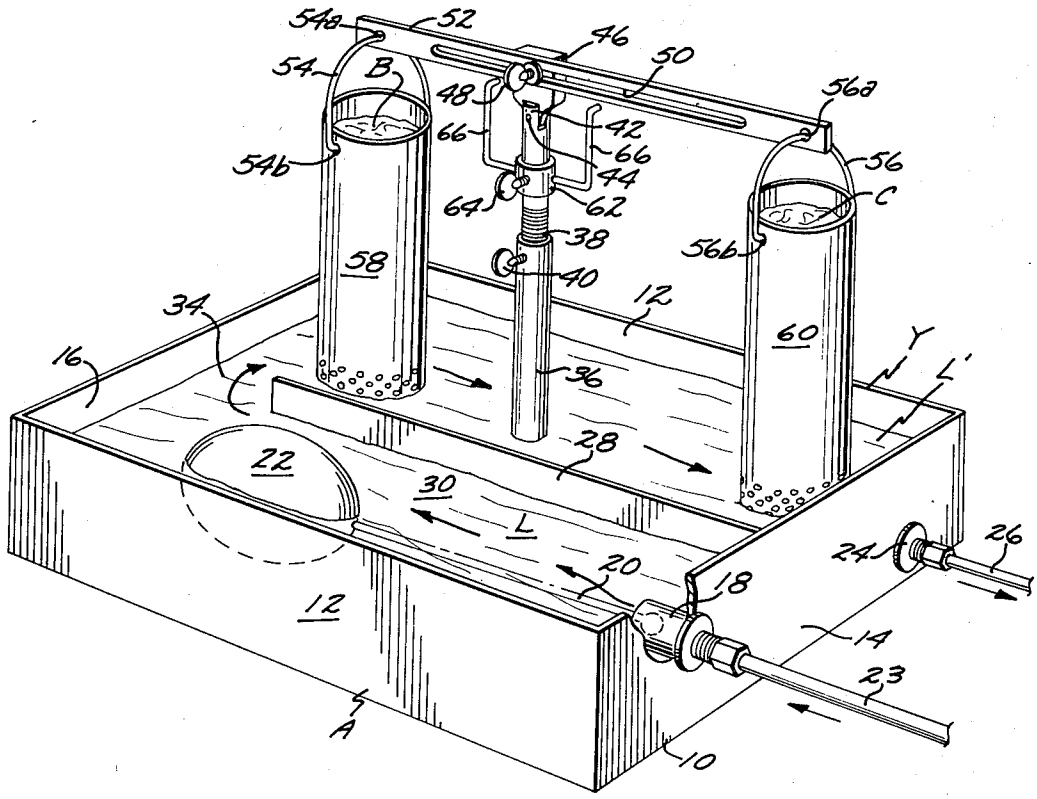
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[57] **ABSTRACT**

A balance beam feeder and method of using the same to automatically dissolve first and second compounds in a moving stream of a liquid in which they are soluble to provide a stream of a solution of said compounds in which they are present in a desired weight ratio, for reaction purposes.

8 Claims, 5 Drawing Figures



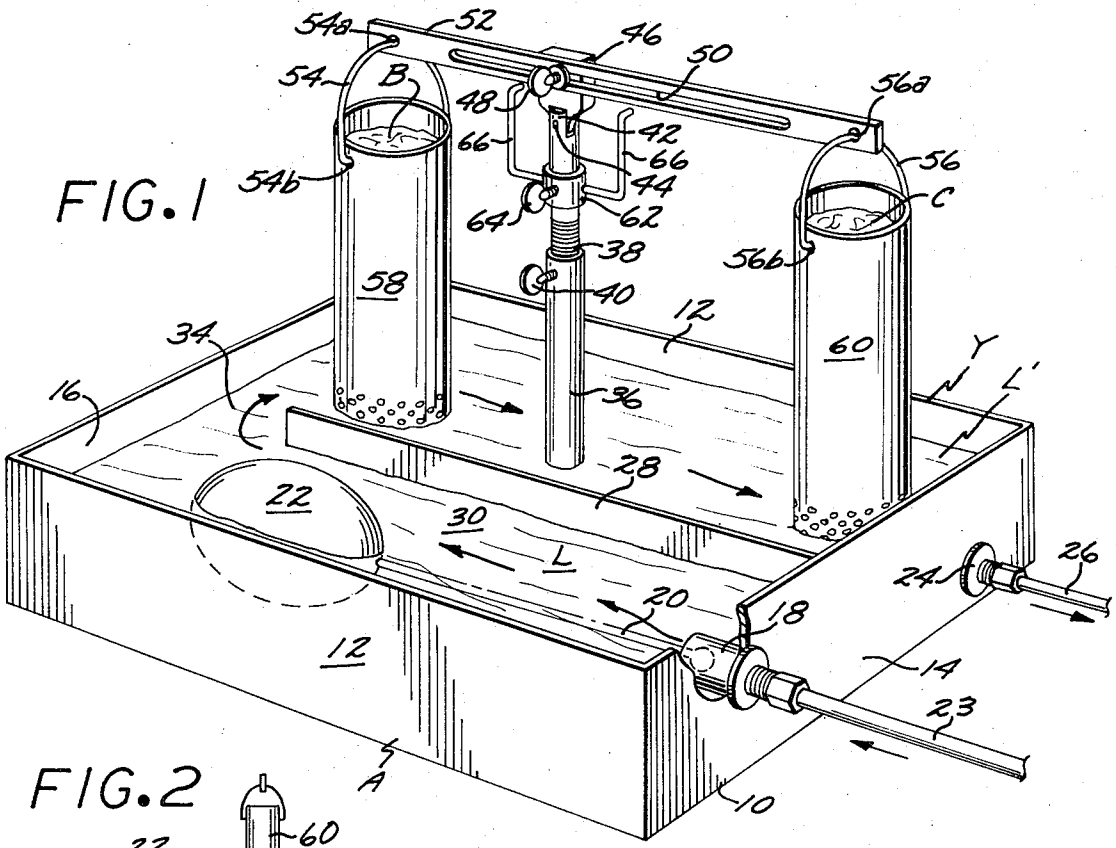


FIG. 1

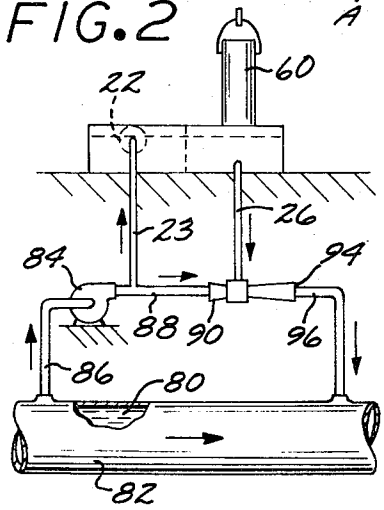


FIG. 2

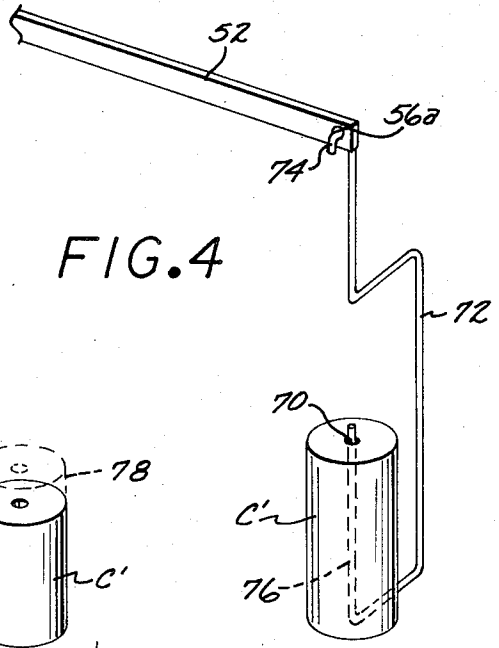


FIG. 4

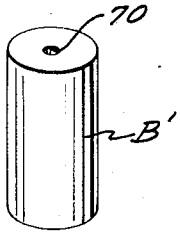


FIG. 3

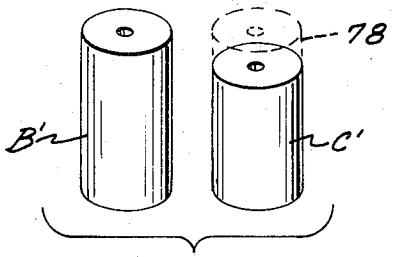


FIG. 5

FIG. 6

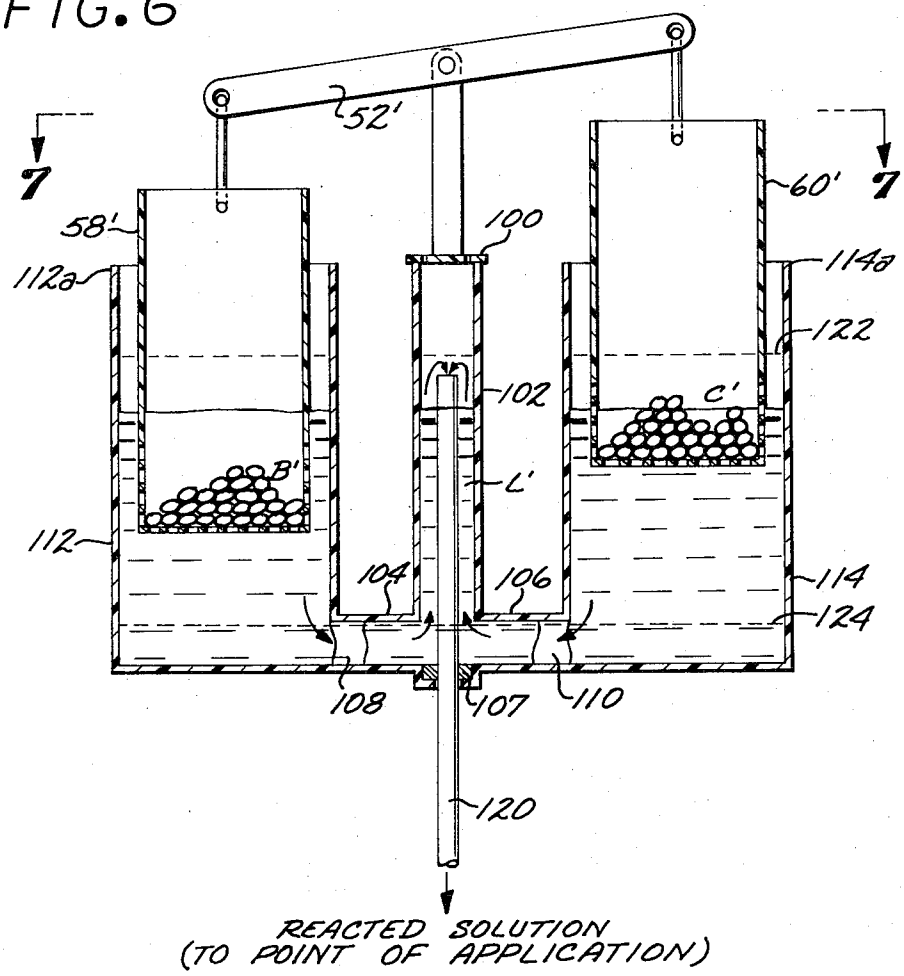
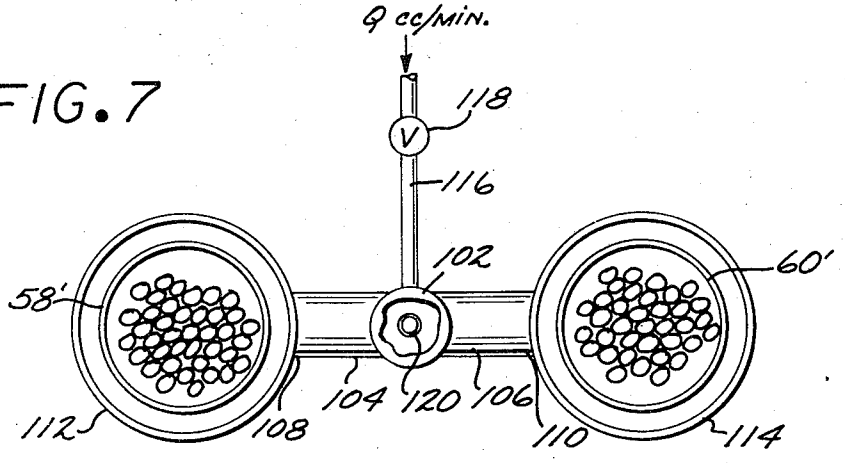

52'
7
7
60'
58'
100
114a
112a
122
102
C'
B'
L'
112
104
106
114
124
108
107
110
120
REACTED SOLUTION
(TO POINT OF APPLICATION)

FIG. 7


Q cc/MIN.
118
V
116
102
60'
58'
104
120
106
112
108
110
114

BALANCE BEAM FEEDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

Balance Beam Feeder and Method of Using Same.

2. Description of the Prior Art

Prior to the present invention it has been difficult without complicated and expensive equipment to automatically dissolve two compounds into a moving stream of liquid in a desired weight ratio to obtain a solution containing the reaction products of said compounds.

The primary purpose in devising the present invention is to provide a simple balance beam feeder, which without external power sources, automatically and continuously dissolves first and second compounds in a moving stream of liquid in a desired weight ratio. The balance beam feeder is particularly adapted for producing aqueous solutions containing free chlorine due to the reactions of a chlorinated cyanuric acid with sodium chloride, or a mixture of sodium chloride and sodium bisulphate, or by the reaction of calcium hypochlorite with a mixture of sodium chloride and sodium bisulphate.

SUMMARY OF THE INVENTION

A container in which a first moving stream of liquid having a constant liquid level is transformed into a second stream of a solution in which first and second compounds are dissolved in a ratio that is proportional to predetermined first and second weights of said first and second compounds.

A balance beam is supported on a fulcrum above the container. First and second weights of said first and second compounds depend from first and second ends of said beam, with equal surface portions of said first and second weights being initially exposed to said first stream when said balance beam is in a horizontal position.

As said first and second weights are exposed to said first stream, the one thereof that dissolves at the more rapid rate becomes lighter than the outer of said weights. The lighter of the weights, due to the action of the balance beam, is raised to expose less surface thereof to said first stream, and the other of said weights is lowered to expose a greater area thereof to said first stream. The rates at which said first and second weights dissolve in said first stream are proportional to the surface areas of said first and second weights exposed to said first stream.

As the first stream of liquid contacts said first and second weights, the first and second weights will alternately rise and fall relative to said first stream as said balance beam seeks a balanced position. This alternate rising and falling of said first and second weights results in transformation of said first stream of liquid into a second stream of solution wherein said first and second compounds are dissolved in a ratio proportional to the ratio existing between said first and second weights.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the feeder apparatus that includes a container through which a stream of liquid moves at constant velocity to dissolve first and second rates due to the action of a balance beam from which they are supported;

FIG. 2 is a diagrammatic view of the apparatus shown in FIG. 1 being used to discharge said first and second compounds at said first and second rates into a moving stream of liquid contained in a pipe;

FIG. 3 is a perspective view of one of the first or second compounds in cake form;

FIG. 4 is a side elevational view of a support for one of the cakes from the balance beam;

FIG. 5 is a perspective view of two cakes of said first and second compounds that are to be dissolved in a stream of liquid at first and second rates that are proportional to the weights of said first and second compounds, with the weight of said first compound being greater than the weight of said second compound, and with said second cake having a filler material added thereto to increase the weight thereof to that of said first cake.

FIG. 6 is a combined side elevational and vertical cross sectional view of an alternate form of the balance beam feeder; and

FIG. 7 is a top plan view of the alternate form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A balance beam feeder assembly Y is shown in FIG. 1 that is useful in continuously forming a stream of a solution in which first and second compounds are dissolved in a weight ratio that is proportional to the ratio between first and second predetermined weights of the first and second compounds. The feeder Y permits a stream of a solution as above described to be formed when the solubility and density of the first and second compounds renders it most difficult to dissolve them in a liquid in combination.

A first example of first and second compounds that are preferably fed into a moving stream of water by the balance beam feeder Y are trichloroisocyanuric acid and sodium chloride. The first and second compounds react to form an aqueous solution containing unstable hypochlorous acid, that is useful for bleaching, oxidizing and sterilization purposes. The first and second compounds react in the following manner:

$Cl_3(CO)_3$ +	3NaCl +	$3H_2O$ =	$Na_3(NCO)_3$ +	3HOCl +	3HCL
232.44	175.38	54.06	195.06	157.41	109.41

A second example of first and second compounds that may be advantageously fed into a moving stream of water by use of the balance beam feeder Y is sodium hypochlorite and a mixture of sodium chloride and sodium bisulphate. The first and second compounds react in the following manner when dissolved in water.

$Ca(OCl)_2$ +	$4NaHSO_4$ +	2NaCl =	$CaSO_4$ +	$3Na_2SO_4$ +	2HOCl +	2HCl
143.00	480.28	116.92	136.14	426.15	104.94	72.94

The hypochlorous acid and hydrochloric acid formed by both of the above reactions may be caused to break

down into free chlorine and water as shown in the equation below:

$$HOCl + HCl = Cl_2 + H_2O$$

The balance beam feeder Y, as shown in FIG. **1**, includes an open topped container or tray A comprising a flat bottom **10** from which a pair of side walls **12** extend upwardly, as well as first and second end walls **14** and **16**. A valve **18** that opens and closes in response to the pivotal movement of a lever **20** having a float **22** secured thereto is mounted on the left hand side of end wall **14**, as viewed in FIG. **1**. As the valve **18** moves between the open and closed positions, it serves to throttle the rate at which liquid is discharged therethrough. Valve **18** is connected to a first conduit **23** that extends to a source of liquid under pressure. A liquid outlet **24** is supported on the right hand side of first end wall **18** and is connected to a second conduit **26**. A vertical baffle **28** projects forwardly from first end wall **14**, but terminates prior to reaching second end wall **16**. The baffle **28** serves to divide the interior of container A into first and second compartments **30** and **32** that are connected by a passage **34**.

A tubular upright **36** is secured to the bottom **10**, and is disposed within second compartment **32**. A rod **38** is slidably mounted in upright **36**, and may be held at a desired elevation relative thereto by tightening a first thumb screw **40**. The upper end of rod **38** develops into a bifurcated portion **42** that supports a fulcrum-defining pin **44** on which a block **46** is pivotally supported.

A second thumb screw **48** is mounted on block **46** and engages a longitudinal slot **50** formed in an elongate balance beam **52**. First and second bails **54** and **56** are pivotally supported in openings **54***a* and **56***a* in depending positions from first and second end portions of the balance beam **52**. First and second bails **54** and **56** removably engage pairs of opposed openings **54***b* and **56***b* formed in the upper portions of first and second open-topped cylindrical receptacles **58** and **60**. The receptacles **58** and **60** are of equal weight, height, and transverse cross section.

The first and second receptacles **58** and **60** are formed from a perforated or porous sheet material that permits first and second weights of first and second compounds B and C to be contained therein and contacted by a stream of liquid flowing in second compartment **32**.

A ring **62** is slidably mounted on rod **38** and may be held at a desired elevation thereon by a third thumb screw **64**. Ring **62** supports two inverted L-shaped stops **66** that can engage the underside of beam **52** to hold it in a stationary position.

The method of using the feeder assembly Y to first prepare first and second weights of the first and second compounds B and C in the weight ratio in which it is desired to have them dissolved in a second stream of liquid discharging from the outlet **24**. The weights of first and second compounds B and C are placed in first and second receptacles **58** and **60**, with the receptacles then being secured to the first and second bails **54** and **56**, as shown in FIG. **1**. The beam **52** is then balanced by loosening second thumb screw **48** and longitudinally adjusting the beam relative thereto until the beam remains in a horizontal position. Thereafter, the second thumb screw **46** is tightened to lock the beam **52** in a fixed position.

The third thumb screw **64** may then be loosened to move stops **66** into contact with beam **52**. After the stops **66** have contacted beam **52**, the third thumb screw is tightened and the first thumb screw **40** loosened. The first and second receptacles **58** and **60** supported by the balance beam **52** may then be lowered concurrently to place equal surface portions of the receptacles and the first and second compounds B and C therein in contact with the first stream of liquid L that flows through the first compartment **30** to second compartment **32**. First thumb screw **40** is thereafter tightened, and the third screw **64** loosened to separate stops **66** from out of contact with the beam **52**.

As the first stream of liquid L contacts the first and second compounds B and C in compartment **32** it concurrently dissolves both compounds, but at different rates. The receptacle containing the compound B or C that dissolves the fastest will become lighter than the other receptacle, and the beam **52** will move this lighter receptacle upwardly to expose less of the surface of compound B or C therein to the action of first stream of liquid L. Concurrently, the beam **52** will lower the other of the receptacles to expose more of the surface of the compound B or C therein to the action of first stream of liquid L. When this lowered receptacle containing the compound B or C becomes lighter than the other receptacle the beam **52** will pivot to reverse the positions of the receptacles **58** and **60**.

Thus, the beam **52** will alternately pivot first in one direction and then in the opposite to raise and lower the first and second receptacles **58** and **60** in such a manner as to dissolve first and second compounds B and C in the first stream L in a weight ratio that is the same ratio as the weights of first and second compounds B and C in the first and second receptacles. Due to the above described mode of operation of the feeder assembly Y, the first stream of liquid L is transformed into a first stream of solution L′ in second compartment prior to discharge of the first stream L′ through outlet **24** and second conduit **26**.

In FIG. **3** the first compound B is shown molded into a cylindrical block B′ that has a longitudinal bore **70** formed therein. The second compound C would be molded into a block C′ of the same cylindrical transverse cross section as that of block B′. When blocks of the first and second compounds B′ and C′ are used as above described, the first and second receptacles **58** and **60** may be eliminated, with the blocks being removably supported from the beam **52** by two identical wire members **72** (FIG. **4**) that include hooks **74** which engage openings **54***a* and **56***a*, and vertically extending legs **76** that removably engage bores **70**, as shown in FIG. **4**.

Should it be desired to use first and second blocks B′ and C′ of the first and second compounds that are of different weights with a beam **52** that is not longitudinally adjustable, the lighter block C′ can have an inert material **78** added thereto, as shown in phantom line in FIG. **5**, to increase the weight thereof to that of block B′. The inert material **78** so chosen may be placed above the block C′, as shown in FIG. **5**, but it is preferable to mix the inert material with the second compound to obtain a block C′ that is not only of the same weight as block B, but one that has substantially the same dimensions. If the last procedure is followed, both blocks B′ and C′ will be completely dissolved in the first stream of liquid L at approximately the same time.

The assembly Y may be used to inject a metered quantity of the first stream of solution L' into a second stream of liquid **80** flowing in a channel or conduit **82**, as shown in FIG. **2**.

A power-driven pump **84** is provided that has the suction thereof connected to a conduit **86** that is in communication with the second stream of liquid **80**. The discharge of liquid from the pump **84** is connected to a conduit **88** that extends to a first side **90** of an eductor **92**, with the second side **94** of the eductor being connected to a conduit **96** that returns liquid discharged through the eductor back to the second stream of liquid **80**. Conduit **88** is connected to conduit **23**. Conduit **26** is connected to a tubular connection on eductor **92** that is at all times at a negative pressure.

The opening characteristics of the pump **84** and eductor **92** are such that a first quantity Q-1 of liquid is discharged into conduit **23** and an equal quantity of liquid Q-2 is withdrawn is the second stream of solution L' previously described, and which is returned to the second stream of liquid **80**.

The alternate form G of the invention as can be seen in FIGS. **6** and **7** includes the balance beam assembly elements **36** to **60** inclusive, that are mounted on the closed upper end **100** of a vertically disposed cylinder **102** that has first and second tubes **104** and **106** extending in opposite directions from the lower portion thereof. The numerals **36'** to **60'** inclusive in FIGS. **6** and **7** identify the same elements shown in FIG. **1**. Cylinder **102** has a bottom **107**.

The first and second tubes **104** and **106** are telescopically and sealingly engaged by first and second tubular members **108** and **110** that are on their outer ends connected to the lower interior portions of first and second containers **112** and **114** that have open upper ends **112***a* and **114***a* respectively. The lower interior portion of cylinder **102** is connected to a conduit **116** through which a liquid L' that dissolves the first and second compounds B' and C' may flow at a desired rate. The rate of flow of liquid L' into cylinder **102** is regulated by a control valve **118** that is situated in conduit **116**. Flow of liquid through conduit **116** is from a source (not shown).

A vertically disposed siphon tube **120** extends upwardly through the bottom **108** and terminates in cylinder **102** below the closed upper end **100** thereof. Siphon tube **120** has an internal bore **122** of such transverse cross section that liquid L' will drain downwardly therethrough by gravity at a more rapid rate than liquid L' flows into cylinder **102** through conduit **116**.

In using the alternate form G of the invention the first and second receptacles **58** and **60** have weights of first and second compounds B' and C' placed therein in the ratio in which it is desired to have them dissolved in the liquid L'. The beam **52'** is then longitudinally adjusted as previously described in connection with beam **52** to have the receptacles **58'** and **60'** and first and second compounds B' and C' in balance with the receptacles **58'** and **60'** extending downwardly into first and second containers **112** and **114**. The first and second containers **112** and **114** due to the telescopic engagement of first and second tubes **104** and **106** with first and second tubular members **108** and **110** may be so moved relative to cylinder **102** that the receptacles **58'** and **60'** are freely movable in the first and second containers.

The use and operation of the alternate form G of the invention is extremely simple. After the first and second compounds B' and C' have been placed in the first and second receptacles **58'** and **60'** and the beam **52** adjusted to a balanced condition, the valve **118** is adjusted to allow liquid L' to flow into cylinder **102** at a slower rate than the liquid will drain downwardly by gravity through siphon tube **120**.

As such flow of liquid L' starts the first and second containers **112** and **114** are in communication with the ambient atmosphere as the interior of cylinder **102** due to the siphon tube **120**. Liquid L' will rise in the first and second containers **112** and **114** and cylinder **102** until it reaches a horizontal level **122** above the upper end of siphon tube and air in the confined space **102***a* in cylinder **102** starts to be compressed, with liquid L' being forced downwardly in siphon tube **120** as a result thereof. the liquid L' so forced into siphon tube **120** immediately forms a siphon due to the force of gravity thereon.

The water level **122** is so chosen that the lower portions of the perforated receptacles are immersed therein, and the first and second compounds B' and C' dissolving therein in the desired ratio as the balance beam **52'** oscillates to accomplish this result in the manner previously described in connection with the balance beam **52**. Liquid L' having the first and second compounds B' and C' dissolved therein in the desired weight ratio will continue to discharge downwardly through siphon tube **120** until the liquid L' is lowered to the level **124** in first and second containers **112** and **114** and cylinder **102**. At level **124** air may flow through the upper portions of first and second tubes **104** and **106** and first and second tubular members **108** and **110** from first and second containers **112** and **114** and the siphon in the tube **120** is broken. It will be particularly noted that as the liquid L' has the level thereof lowered from level **122** to level **124** it is out of contact with first and second compounds B' and C' for a portion of time, and the first and second compounds do not become mushy as would occur if they were in constant contact with the liquid L'. After the siphon has been broken in tube **120** as above described the operation is again repeated to bring additional quantities of the first and second compounds into solution in liquid L' in the desired weight ratio. The operation will continue intermittently and without attention until the first and second compounds B' and C' are depleted, whereupon the control valve **118** is closed by the operator (not shown) and the first and second receptacles **58'** and **60'** are refilled with the first and second compounds in the desired weight ratio.

It will of course, be apparent that a balance beam similar to the beam **52'** may be provided, that has a fixed fulcrum and supports two receptacles **58** and **60** of equal weight and in which equal weights of first and second compounds B' and C' are contained. In such a situation the first and second compounds B' and C' will dissolve in the liquid L' in a substantially equal weight ratio.

The solution formed from dissolving the first and second compounds B' and C' in liquid L' discharges from siphon tube **120** into a container (not shown) for ultimate use.

The structures of the inventions and methods of using the same have been described previously in detail and need not be repeated.

I claim:

1. An apparatus for use in automatically dissolving first and second compounds in a first moving stream of a liquid in which they are soluble to provide a second moving stream of a solution in which said first and second compounds are dissolved in a weight ratio that is proportional to first and second weights of said first and second compounds, said apparatus including:

a. first means for defining a first moving stream of said liquid of substantially constant velocity; and

b. elongate balance beam means pivotally supported by a fulcrum means intermediate the ends thereof and having first and second ends that initially support first and second containers having perforate lower ends holding first and second weights of said first and second compounds respectively in said first stream in such relative vertical positions that said first stream contacts equal surfaces of said first and second compounds thereof, with said balance beam means moving the one of said containers holding the weight of said one compound that dissolves most rapidly upwardly to expose less of said surface thereof to said first stream and lowering the other of said containers that holds the weight of said other compound further into said first stream to expose more of said surface thereof to said first stream until said weight of said other compound has been so decreased by dissolving in said first stream that it is lighter than the weight of the said one compound in said upwardly moved container, whereupon the movement of said first and second containers is reversed, with the cycle of upward and downward movement of said first and second containers continuing and transforming said first stream into said second stream of solution.

2. An apparatus as defined in claim 1 wherein said first means includes:

c. a container having a liquid inlet and a liquid outlet spaced therefrom, and with said first stream of liquid moving in said container from said inlet to said outlet;

d. second means for discharging said liquid to said inlet at a first rate;

e. third means for withdrawing said liquid from said container at a second rate that is less than said first rate effected by said second means; and

f. fourth means for controlling the rate at which liquid discharges into said container through said inlet to that of said second rate at which said third means discharges liquid through said outlet to maintain said liquid at a predetermined constant surface level in said container.

3. An apparatus as defined in claim 2 wherein said fourth means is a float-controlled valve operatively associated with said inlet, and the float of said valve disposed within said container.

4. An apparatus as defined in claim 3 wherein said second means is a power-driven pump, the suction side of which is in communication with a second moving stream of said liquid into which it is desired to discharge said second stream of solution, said pump having a discharge that is in communication with said inlet of said container, with said third means being an eductor that receives a portion of said discharge of said liquid from said pump and returns the same to said second stream of liquid, which eductor includes a tubular portion that is at a negative pressure and in communication with said outlet in said container, with said portion of said liquid discharged to said eductor by said pump being such as to cuase said eductor to withdraw said second stream of solution from said container and discharge the same into said second moving stream of liquid concurrently with said liquid that has passed through said eductor from said pump being discharged thereinto.

5. An apparatus as defined in claim 1 which further includes:

means for longitudinally adjusting said beam relative to said fulcrum means to permit said first and second weights of said first and second compounds to be supported in any desired ratio from said beam, and with said beam being in a horizontal position.

6. An apparatus as defined in claim 1 which further includes:

means for raising and lowering said balance means relative to said first means to permit the magnitude of the surfaces of said first and second weights of said first and second compounds in contact with said first stream of liquid to be varied when said first and second weights are in balance on said balance means.

7. An apparatus as defined in claim 1 wherein said first and second compounds are in particled form.

8. An apparatus for use in automatically dissolving first and second compounds in a first moving stream of a liquid in which they are soluble to provide a second moving stream of a solution in which said first and second compounds are dissolved in a weight ratio that is proportional to first and second weights of said first and second compounds, said apparatus including:

a. first means for defining a first moving stream of said liquid of substantially constant velocity; and

b. elongate balance means pivotably supported by a fulcrum means intermediate the ends thereof and having first and second ends that initially support first and second means holding means which hold first and second weights of said first and second compounds, respectively, in said first stream in such relative vertical positions that said first stream contacts equal surfaces of said first and second compounds, with said balance beam means moving the one of said holding means holding the weight of said one compound that dissolves most rapidly upwardly to expose less of said surface thereof to said first stream and lowering the other of said holding means holding the weight of said other compound into said first stream to expose more of said surface thereof to said first stream until the weight of said other compound in said lowered holding means has been so decreased by dissolving in said first stream that is is lighter than the weight of said one compound in said upwardly moved holding means, whereupon the movement of said first and second holding means is reversed, with the cycle of upward and downward movement of said first and second holding means continuing and transforming said first stream into said second stream of solution, said first and second weights of said first and second compounds being in the form of solid cakes thereof, and the holding means being adapted for removable engaging said cakes to support said cakes from the first and second ends of the balance beam means.

* * * * *