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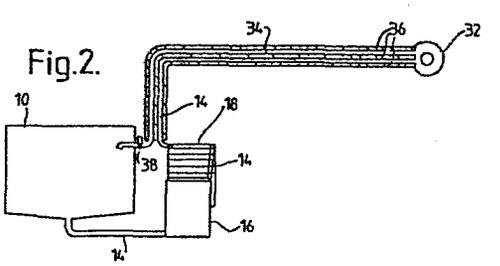
## (54) Improvements in or relating to beverage dispensing apparatus.

(57) Apparatus for dispensing a beverage consisting of a fluid circuit having a flow pipe and a return pipe, cooling means for cooling the beverage, pump means for continuously circulating the beverage around the fluid circuit, one or more dispensing valves or taps in the fluid circuit through which the beverage is dispensed, and a reservoir for containing the beverage, said reservoir being connected to the apparatus by quick release coupling means to facilitate removal thereof. Where the beverage is to be formed of two or more liquids, a metering pump is provided to effect mixing of the beverage and the supply thereof to the reservoir. The reservoir may also be of the disposable collapsible type which is again provided with quick release coupling means to enable it to be removed from the apparatus.

Fig.2.

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"Improvements in or relating to beverage dispensing apparatus"

This invention relates to beverage dispensing apparatus and more particularly, but not exclusively, to apparatus for dispensing a beverage such as a fruit juice.

Beverage such as fruit juice formed from, for example, a mixture of a fruit juice syrup or concentrate and water are subject to the growth of bacteria particularly, if left in a stagnant condition for any period of time. Furthermore, it is desirable in beverage dispensing apparatus for dispensing such a beverage to ensure that the apparatus can be readily cleaned in order to again inhibit the growth of bacteria.

The growth of bacteria in a beverage can be inhibited by, for example, increasing the hydrogen ion concentration, p.H. value, of the beverage by the addition of a preservative such as benzoic acid. However, the beverage which is thus dispensed is not what could be termed a "pure" fruit juice due to the addition of such a preservative.

It is also known that the growth of bacteria in a beverage of this type can be kept to a minimum by maintaining the beverage at a temperature below 40 degrees Fahrenheit.

The object of this invention is to provide apparatus for dispensing a beverage formed of, for example, a "pure" fruit juice or the like, in which the growth of bacteria is inhibited or can be kept to a minimum.

According to one aspect of this invention, apparatus for dispensing a beverage includes a fluid circuit which comprises a flow pipe and a return pipe, pump means for continuously circulating the beverage around the fluid circuit, cooling means for cooling the beverage, and an outlet in the fluid circuit through which the beverage is dispensed.

Preferably, the return pipe constitutes a restriction or is provided with a restriction to maintain pressure in the fluid circuit and provide adequate flow through the outlet.

Preferably, also, the restriction provided in the return pipe is adjustable to adjust the pressure in the fluid circuit.

The apparatus, preferably, includes a reservoir for containing the beverage.

Preferably, the flow pipe is connected to a lower portion of the reservoir.

Preferably, also, where the beverage is formed from a concentrate which is diluted with a dilutant, such as water, a concentrate container is mounted in the beverage reservoir.

A metering pump is, preferably, connected to the concentrate container for drawing concentrate therefrom and supplying the concentrate and the dilutant in a predetermined ratio to the beverage reservoir.

According to another aspect of this invention, apparatus for dispensing a beverage comprises fluid supply means, an outlet through which the beverage is dispensed, and a reservoir for containing the beverage, wherein the reservoir is connected to the apparatus by quick release coupling means to facilitate removal thereof.

Preferably, the reservoir is slidably mounted on or forms part of a slidable tray or door of a housing for the apparatus to enable the reservoir to be wholly or partially removed from the apparatus.

Preferably, also, the quick release coupling means is adapted to be self sealing to enable the reservoir to be removed whilst wholly or partially full of beverage.

The fluid supply means, preferably, includes a fluid circuit which comprises a flow pipe and a return pipe, and pump means for continuously circulating the beverage around the fluid circuit. Preferably, the quick release coupling means is adapted to releasably connect the reservoir to the flow pipe and return pipe of the fluid circuit and, where the beverage is formed from a concentrate which is diluted with water and the reservoir contains a concentrate container and metering pump, the quick release coupling means is also adapted to releasably connect the reservoir to a water supply pipe.

A cleaning tank of similar construction to the reservoir is, preferably, provided so as to be capable of insertion into the apparatus after removal of the reservoir therefrom.

Preferably, the cleaning tank is provided with two compartments, one compartment, which is to contain a cleaning fluid, being adapted to be connected by the quick release coupling means to the flow pipe and the other compartment, which is to receive the cleaning fluid after circulation through the apparatus, being adapted to be connected by the quick release coupling means to the return pipe.

Preferably, also, the two compartments in the cleaning tank are formed by a partition wall in the cleaning tank.

Where it is desired to continuously circulate cleaning fluid through the fluid circuit, the partition wall, preferably, extends upwardly from the base of the cleaning tank for a distance which is less than the full height of the cleaning tank so that when, prior to commencement of the cleaning operation, both compartments are substantially filled with cleaning

fluid, communication between the two compartments is provided during the cleaning operation by the flow of cleaning fluid over the partition wall from said other compartment to said one compartment.

According to a further aspect of this invention, the reservoir may be a flexible collapsible reservoir which is connected to a junction of the flow pipe and the return pipe by quick release coupling means.

Preferably, the connection between the reservoir and the junction of the flow pipe and the return pipe is provided with non-return valve means adapted to permit flow of beverage from the reservoir into the fluid circuit but to prevent reverse flow of fluid from the fluid circuit into the reservoir.

Preferably, also, bleed valve means is provided in the return pipe portion of the fluid circuit to allow filling thereof.

According to yet another aspect of this invention, a metering pump for use in apparatus for dispensing a beverage formed of a concentrate and a dilutant comprises two chambers each having a piston mounted therein, the pistons in the two chambers being drivably connected together so that movement of the piston in one chamber under the action of the dilutant produces movement of the piston in the other chamber to draw concentrate from a concentrate container into said other chamber.

Preferably, the piston in said one chamber is movable by the dilutant against the action of resilient means so that when the supply of dilutant is disconnected, the piston is moved by the resilient means to displace dilutant from said one chamber and produce corresponding movement of the piston in the other chamber to displace concentrate therefrom.

Preferably, also, valve means is provided for controlling the supply of dilutant to said one chamber of the metering pump.

According to yet a further aspect of this invention, a vending machine having a coin or token operated mechanism for initiating the vending of a beverage comprises apparatus for dispensing a beverage according to said one aspect or said other aspect or said further aspect of this invention.

According to another further aspect of this invention, a method of dispensing a beverage comprises continuously circulating the beverage under pressure around a fluid circuit, cooling the beverage, and dispensing the beverage directly from the fluid circuit.

Preferably, the beverage is stored in a reservoir and the beverage is continuously circulated from the reservoir around the fluid circuit.

Preferably, also, the beverage is mixed from a concentrate and a dilutant in predetermined ratios and supplied to the reservoir by a metering pump operated by the dilutant.

Preferred embodiments of this invention will now be described, by way of example only, with reference to the accompanying drawings of which:-

Figure 1 is a diagrammatic plan view of a beverage dispensing apparatus according to a first embodiment,

Figure 2 is a diagrammatic side elevation of a fluid circuit portion of the apparatus,

Figure 3 is a diagrammatic side elevation of a metering pump of the apparatus in a first position,

Figure 4 is a diagrammatic side elevation of the metering pump of the apparatus in a second position,

Figure 5 is a front elevation of a beverage dispensing apparatus according to a second embodiment,

Figure 6 is a plan view of the beverage dispensing apparatus shown in Figure 5,

Figure 7 is a partially sectioned side elevation of the beverage dispensing apparatus shown in Figure 6,

Figure 8 is a diagrammatic sectional side elevation of a quick release coupling for use in the beverage dispensing apparatus in its connected condition,

Figure 9 is a diagrammatic sectional side elevation of the quick release coupling shown in Figure 8 in its disconnected condition,

Figure 10 is a circuit diagram of a beverage dispensing apparatus according to a third embodiment,

Figure 11 is a diagrammatic sectional side elevation of a bleed valve for use in the apparatus shown in Figure 10 with the bleed valve in its inoperative position, and

Figure 12 is a diagrammatic sectional side elevation of the bleed valve shown in Figure 11 in its operative position.

Referring now to Figures 1 to 4 of the drawings, in a first embodiment, dispensing apparatus for dispensing a beverage formed of a mixture of fruit juice concentrate and water comprises a reservoir 10 for containing the mixed beverage. The reservoir 10 is provided with an external lining 12 formed of an insulating material such as polystyrene or the like.

A flow pipe 14 connects the lower portion of the reservoir 10 to an electrically driven pump 16. The pump 16 is connected to a cooling coil 18 mounted in a cooling bath 20 by a further portion of the flow pipe 14.

A conventional refrigeration system indicated generally at 22 including a compressor 24, fan 26, condenser 28, and a refrigeration coil 30 is provided to effect cooling of the water in the bath 20.

A further portion of the flow pipe 14 extends from the cooling coil 18 to one or more dispensing valves or taps 32. The dispensing valves or taps 32, of which only one is shown in the drawings, draw the beverage directly from the flow pipe 14 and dispense the beverage when the valve or tap 32 is opened. When the valve or tap 32 is closed, the beverage supplied thereto through the flow pipe 14 is returned, in the case of the valve or tap 32 shown, to a return pipe 34, which extends parallel to the flow pipe 14 and is connected to the reservoir 10 at a point below the level of the beverage therein.

It will be appreciated that the dispensing valve or tap 32 thus constitutes part of the beverage supply circuit and beverage is not retained in a stagnant condition in said valve or tap.

The flow pipe 14 and the return pipe 34 are enclosed within a layer of insulating material 36 to ensure that the beverage during its passage through the flow pipe 14 and the return pipe 34 is kept at the lowest possible temperature, which in order to inhibit bacteriological growth should be below 40 degrees Fahrenheit.

In addition, the pump 16 continuously circulates the beverage from the reservoir 10 through the flow pipe 14 via the cooling coil and returns the beverage to the reservoir 10 via the return pipe 34 so that the beverage is not left in a stagnant condition and this again inhibits bacteriological growth.

A restriction 38 having an adjustable aperture is formed in the return pipe 34 adjacent to or at its point of connection to the reservoir 10 so that the pressure of beverage in the flow pipe 14 created by the pump 16 can be adjusted to provide adequate flow through the or each dispensing tap 32.

A concentrate container 40 is mounted in the reservoir 10 and is connected to a metering pump indicated generally at 42.

A pump 42 comprises a first chamber 44 having a piston 46 slidably mounted therein and movable against the action of a spring 48. The lower portion of the first chamber 44 of the pump 42 is connected via a solenoid operated valve 50 to a cooling coil 64 mounted in the cooling bath 20. The cooling coil 64 is connected to a regulated mains water supply 66 so that in one position of the valve 50, pre-chilled water is supplied under pressure through the cooling coil 64 and the valve 50 to the chamber 44 to move the piston 46 against the action of the spring 48 to the position shown in Figure 3 of the drawings.

The pump 42 is also provided with a second chamber 52 having a piston 54 which is a close sliding fit mounted therein. The piston 54 is drivably connected to the piston 46 by a connecting rod 56 and the lower portion of the second chamber 52 is connected via a non-return valve 58 to the concentrate container 40.

When the piston 46 is moved against the action of the spring 48 to the position shown in Figure 3 of the drawings, concentrate is drawn from the container 40 into the second chamber 52 via the non-return valve 58 in the direction of arrow A.

The solenoid operated valve 50 is then moved to a second position disconnecting the chamber 44 from the water supply and allowing water therein to flow via the valve 50 to an outlet 60 leading to the reservoir 10 as the piston 46 moves under the action of the spring 48 to the position shown in Figure 4 of the drawings.

The connection of the piston 46 to the piston 54 by the connecting rod 56 produces corresponding movement of

the piston 54 to discharge the concentrate in the chamber 52 via a non-return valve 62 in the direction of arrow B through the outlet 60 into the reservoir 10.

It will be appreciated that the ratio of the mixture of concentrate to water is determined by the ratio of the cross-sectional areas of the chambers 52 and 44 and thus the pump 42 supplies a mixture having a consistent ratio of concentrate to water irrespective of the length of travel of the pistons 46 and 54.

The reservoir 10 is also provided with a liquid level sensing mechanism (not shown) which, when the level of beverage therein falls below a predetermined value, actuates the solenoid valve 50 via a timing mechanism (not shown). The timing mechanism produces cyclic movements of the solenoid valve 50 between its first and second position thus producing corresponding pumping strokes of the pistons 46 and 54 of the metering pump. Once the level of the beverage in the reservoir 10 reaches a predetermined maximum value, the liquid level sensing means (not shown) de-activates the solenoid operated valve 50.

It will be appreciated that utilising water pressure as the source of power for the metering pump simplifies the construction thereof and makes the pump capable of being easily disconnected from the dispensing apparatus when it requires cleaning.

Referring now to Figures 5 to 9 of the drawings, in a second embodiment a dispensing apparatus for dispensing a beverage formed of a mixture of fruit juice concentrate and water comprises a reservoir 110 for containing the mixed beverage. The reservoir 110 is provided with an external lining 112 formed of an insulating material such as polystyrene or the like.

A flow pipe 114 connects the reservoir 110 to an electrically driven pump 116. The pump 116 is connected by a further portion of the flow pipe 114 to a heat exchanger 118 formed by a cooling coil (not shown) which is mounted in a cooling bath (not shown). A conventional refrigeration system indicated generally at 122 which includes a compressor (not shown), a fan (not shown), a condenser 128, and a refrigeration coil (not shown) is provided to effect cooling of water in the cooling bath of the heat exchanger 118.

The flow pipe 114 extends from the cooling coil in the heat exchanger 118 to one or more dispensing valves or taps 132. The dispensing valves or taps 132, of which only one is shown in the drawings, draw the beverage directly from the flow pipe 114 and dispense the beverage when the valve or tap 132 is opened. When the valve or tap 132 is closed, the beverage supplied thereto through the flow pipe 114 is returned, in the case of the valve or tap 132 shown, to a return pipe 134 which extends parallel to the flow pipe 114 and is connected to the reservoir 110.

It will be realised that other forms of refrigeration systems could be utilised on the above described system modified to, for example, locate the heat exchanger 118 in the return pipe 134 without departing from the scope of this invention.

It will be appreciated that the dispensing valve or tap 132 thus constitutes part of the beverage supply circuit and beverage is not retained in a stagnant condition in said valve or tap.

The flow pipe 114 and the return pipe 134 are enclosed within a layer of insulating material 136 to ensure that the beverage during its passage through the flow pipe 114

and the return pipe 134 is kept at the lowest possible temperature which in order to inhibit bacteriological growth should be below 40 degrees Fahrenheit.

In addition, the pump 116 continuously circulates the beverage from the reservoir 110 through the flow pipe 114 via the heat exchanger 118 and returns the beverage to the reservoir 110 via the return pipe 134 so that the beverage is not left in a stagnant condition and this again inhibits bacteriological growth.

A restriction (not shown) having an adjustable aperture is formed in the return pipe 134 adjacent to or at its point of connection to the reservoir 110, or alternatively, the size of the return pipe 134 is selected so that the pressure of the beverage in the flow pipe 114 created by the pump 116 can either be adjusted or is arranged to be sufficient to provide adequate flow through the or each dispensing tap 132.

A concentrate container 140 is mounted in the reservoir 110 and is connected to a metering pump indicated generally at 142. The pump 142 comprises a first chamber 144 having a piston 146 slidably mounted therein and movable against the action of a spring 148. The lower portion of the first chamber 144 of the pump 142 is connected via a solenoid-operated valve 150 to a mains water supply 166 so that in one position of the valve 150 water is supplied under pressure through the valve 150 to the chamber 144 to move the piston 146 against the action of the spring 148 to the position shown in Figure 7 of the drawings.

The pump 142 is also provided with a second chamber 152 having a piston 154 which is a closed sliding fit mounted therein. The piston 154 is drivably connected to the piston 146 and the lower portion of the second chamber 152 is connected via a non-return valve 158 to the concentrate container 140.

When the piston 146 is moved against the action of the spring 148 to the position shown in Figure 7 of the drawings, concentrate is drawn from the container 140 into the second chamber 152 via the non-return valve 158.

The solenoid-operated valve 150 is then moved to a second position disconnecting the chamber 144 from the water supply and allowing water therein to flow via the valve 150 to an outlet 160 leading to the reservoir 110 as the piston 146 moves downwardly under the action of the spring 148. The interconnection of the piston 146 to the piston 154 produces corresponding movement of the piston 154 to discharge the concentrate in the chamber 152 via a non-return valve 162 through the outlet 160 into the reservoir 110.

It will again be appreciated that the ratio of the mixture of concentrate to water is determined by the ratio of the cross-sectional areas of the chambers 152 and 144 and thus the pump 142 supplies a mixture having a consistent ratio of concentrate to water irrespective of the length of travel of the pistons 146 and 154. In addition, it will be appreciated that if this ratio of the mixture is to be changed it would be possible to replace the pump 142 with an alternative pump having different ratios of cross-sectional areas of the chambers therein.

The reservoir 110 is also provided with a liquid level sensing mechanism (not shown) which, when the level of beverage therein falls below a predetermined value, actuates the solenoid 150 via a timing mechanism (not shown). The timing mechanism produces cyclic movements of the solenoid valve 150 thus producing corresponding pumping strokes of the pistons 146 and 154 of the metering pump 142. Once the level of the beverage in the reservoir 110 reaches a predetermined maximum value, the liquid level sensing

means (not shown) de-activates the solenoid-operated valve 150.

The dispensing apparatus is mounted within a housing 170 which is provided with a fold down flap 172. The reservoir 110 is provided with self-sealing quick release couplings 174 to enable the reservoir 110 to be disconnected from the flow pipe 114, the return pipe 134 and the mains water supply 166.

The reservoir 110 is provided on its base with a roller bearing 176 and a similar roller bearing 176 is provided on the internal surface of the flap 172 to enable the reservoir 110 to be moved slidably out of the housing to either the position shown in Figure 7 of the drawings, in which it is partially removed to facilitate replenishment of the concentrate in the concentrate container 140, or to be completely removed from the housing 170 to either facilitate cleaning of the reservoir 110 or replacement thereof with a new reservoir.

It will be appreciated that the roller bearings 176 can be replaced by other types of friction reducing slides or alternatively, the reservoir 110 can be formed as an integral part of a sliding tray or sliding drawer formed in the housing.

The quick release coupling connectors 174 each consist of male and female portions 178 and 180 respectively and it is preferable for the female portion 180 to be mounted on the reservoir 110.

The male portion 178 of the connector 174 includes a spring loaded valve member 182 which is urged by the spring on to a seat to effect sealing thereof when the connector is in the disconnected condition. A rod 184 extends from the valve member 182 and is adapted to engage a spring loaded ball in the female portion 180

of the connector 174 when the male and female portions 178 and 180 are in their connected condition. The rod 184 not only lifts the spring loaded ball 186 of the female portion 180 off its seat but also lifts the valve member 182 of the male portion 178 off its associated seat so that liquid can flow through the coupling connector 174 in this connected condition.

The self sealing nature of the connectors 174 enables the reservoir 110 to be removed from the housing 170 even when the reservoir is wholly or partially full so that cleaning of the dispensing apparatus can be carried out at any desired period of time without wastage of beverage which is already in the reservoir 110.

The open top of the reservoir 110 is provided with a close fitting lid (not shown) to inhibit the ingress of any extraneous matter.

In order to facilitate cleaning of the dispensing apparatus, a separate cleaning container (not shown) of similar construction to the reservoir 110 is inserted after the reservoir 110 has been removed. The cleaning container is divided by a partition extending upwardly from the base into two separate compartments which are respectively connected to the flow pipe 114 and the return pipe 134 by the connectors 174. The compartment which is connected to the flow pipe 114 has a cleaning fluid provided therein and after insertion of the cleaning container into the housing 170, the apparatus is operated so that the cleaning fluid is pumped through the flow pipe and then returned through the return pipe 134 into the other compartment of the cleaning container.

If continued circulation of a cleaning fluid through the dispensing apparatus is required both compartments of the cleaning container are filled with

cleaning fluid and the partition is arranged so that it does not extend to the full height of the cleaning container so that as fluid is withdrawn through the flow pipe 114 from one compartment and is returned to the other compartment of the container through the return pipe 134, the liquid can flow over the top of the partition so that continuous circulation of the cleaning fluid can be maintained.

Referring now to Figures 10 to 12 of the drawings, in a third embodiment dispensing apparatus for dispensing a pre-mixed beverage comprises a flexible collapsible container 200 which is connected via a single pipe 202 containing a non-return valve 204 and a T-shaped junction 206 to a fluid circuit of the apparatus. The fluid circuit and the remainder of the apparatus is substantially identical to the beverage dispensing apparatus previously described with reference to Figures 5 to 9 of the drawings but a bleed valve 208 is mounted in the return pipe portion of the fluid circuit to enable the fluid circuit to be completely filled with the beverage which is to be dispensed.

The container 200 is of the disposable type, which once the beverage therein has been used, is then removed and replaced with a new full container.

The bleed valve 208 consists of a spring loaded valve member 210 which in the normal position shown in Figure 11 of the drawings allows fluid to flow therethrough through the return pipe. When the valve member 210 is manually moved against the action of the spring to the position shown in Figure 12 of the drawings, fluid is withdrawn from the flow pipe to bleed or vent the fluid circuit.

It will be appreciated that the non-return valve 204 allows fluid to flow from the container 200 into

the fluid circuit but prevents the return flow of fluid from the fluid circuit when the apparatus is in operation and the bleed valve 208 enables the fluid circuit to be fully filled with liquid when a container 200 is first mounted thereon. In addition, a self-sealing quick release connector is provided between the container 200 and the pipe 202 to enable the container 200 to be removed even if the container 200 is still partially full of beverage.

In a modification, additional cooling of the product in the reservoir 110 or container 200 is provided by effecting cooling of the reservoir 110 or container 200 itself by utilising the heat exchanger 118 or locating part of the fluid circuit in the housing 170 adjacent to the reservoir 110 or container 200.

In a further modification, the fluid circuit and the components associated therewith are arranged, when the reservoir 110 or container 200 are empty, the pump 116 switched off and the or each tap 132 is or are opened, to be self-draining to facilitate cleaning of the fluid circuit.

Additional, fluid circuits, product reservoirs, pumps and cooling coils may be provided to enable additional products to be dispensed.

It will also be appreciated that a vending machine having a coin or token operated mechanism for initiating the vending of a beverage can be constructed to include beverage dispensing apparatus according to the first second or third embodiment of this invention, the coin or token operated mechanism being arranged to operate the dispensing valve or tap 32 or 132 of the apparatus after a conventional cup dropping mechanism has placed a cup therebeneath.

Claims.

1. Apparatus for dispensing a beverage includes a fluid circuit comprising a flow pipe and a return pipe, pump means for continuously circulating the beverage around the fluid circuit, cooling means for cooling the beverage, and an outlet in the fluid circuit through which the beverage is dispensed.

2. Apparatus according to Claim 1, wherein the apparatus includes a reservoir for containing the beverage.

3. Apparatus according to Claim 2, for dispensing a beverage formed from a concentrate which is diluted with a dilutant, wherein a concentrate container is mounted in the beverage reservoir.

4. Apparatus according to Claim 3, wherein a metering pump is connected to the concentrate container for drawing concentrate therefrom and supplying the concentrate and the dilutant in a predetermined ratio to the beverage reservoir.

5. Apparatus for dispensing a beverage comprising fluid supply means, an outlet through which the beverage is dispensed, and a reservoir for containing the beverage, wherein the reservoir is connected to the apparatus by quick release coupling means to facilitate removal thereof.

6. Apparatus according to Claim 5, wherein the reservoir is slidably mounted on or forms part of a slidable tray or door of a housing for the apparatus to enable the reservoir to be wholly or partially removed from the apparatus.

7. Apparatus according to Claim 5 or Claim 6, wherein a cleaning tank of similar construction to the reservoir is provided so as to be capable of insertion into the apparatus after removal of the reservoir therefrom.

8. Apparatus according to Claim 7, wherein the cleaning tank is provided with two compartments, one compartment, which is to contain a cleaning fluid, being adapted to be connected by quick release coupling means to the flow pipe and the other compartment, which is to receive the cleaning fluid after circulation through the apparatus, being adapted to be connected by the quick release coupling means to the return pipe.

9. A metering pump for use in apparatus for dispensing a beverage formed of a concentrate and a dilutant comprising two chambers each having a piston mounted therein, the pistons in the two chambers being drivably connected together so that movement of the piston in one chamber under the action of the dilutant produces movement of the piston in the other chamber to draw concentrate from a concentrate container into said other chamber.

10. A metering pump according to Claim 9, wherein the piston in said one chamber is movable by the dilutant against the action of resilient means so that when the supply of dilutant is disconnected, the piston is moved by the resilient means to displace dilutant from said one chamber and produce corresponding movement of the piston in the other chamber to displace concentrate therefrom.

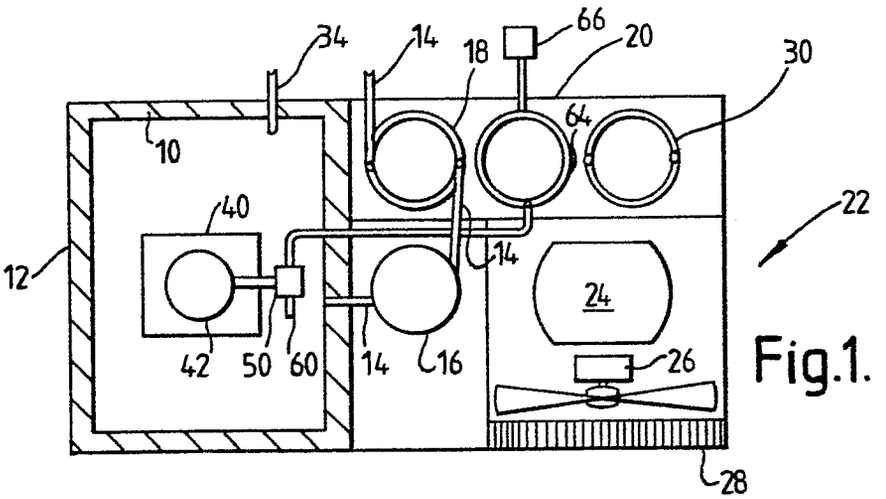



Fig.1.

Fig.2.

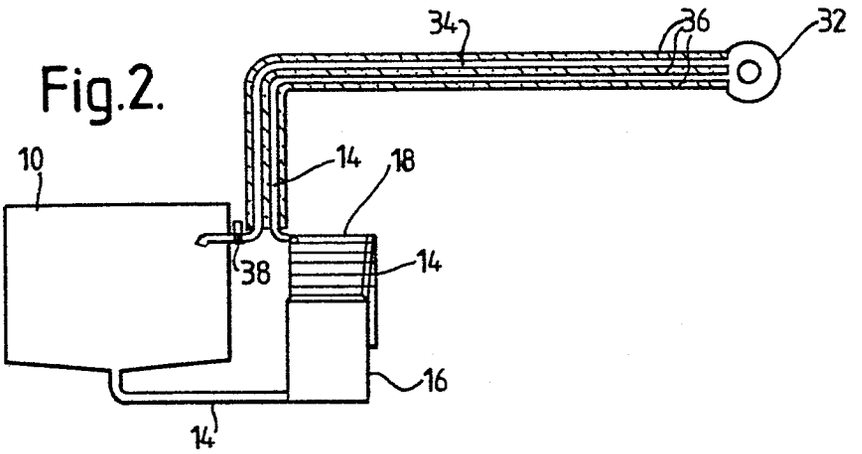



Fig.3.

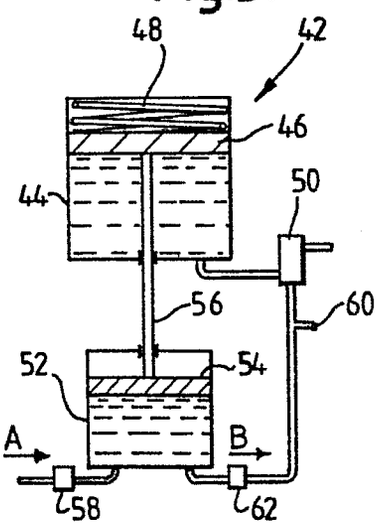
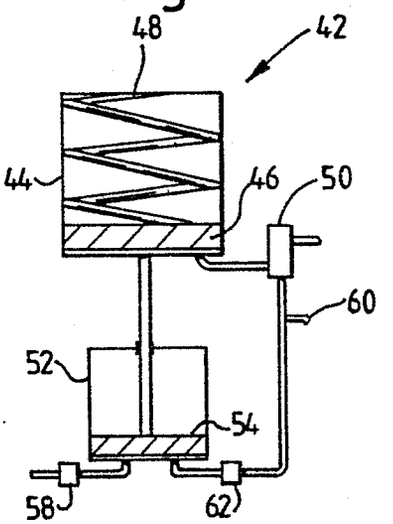



Fig.4.



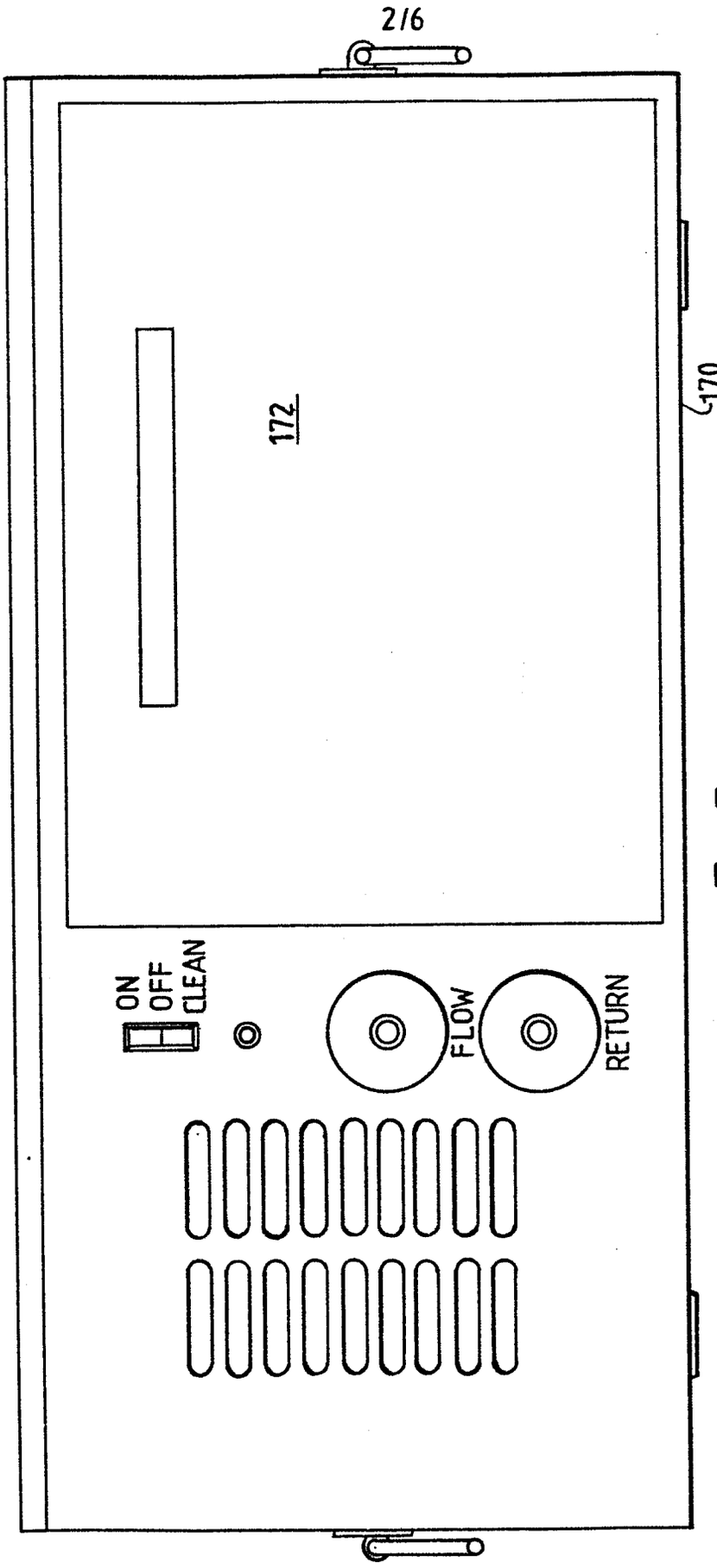



Fig.5.

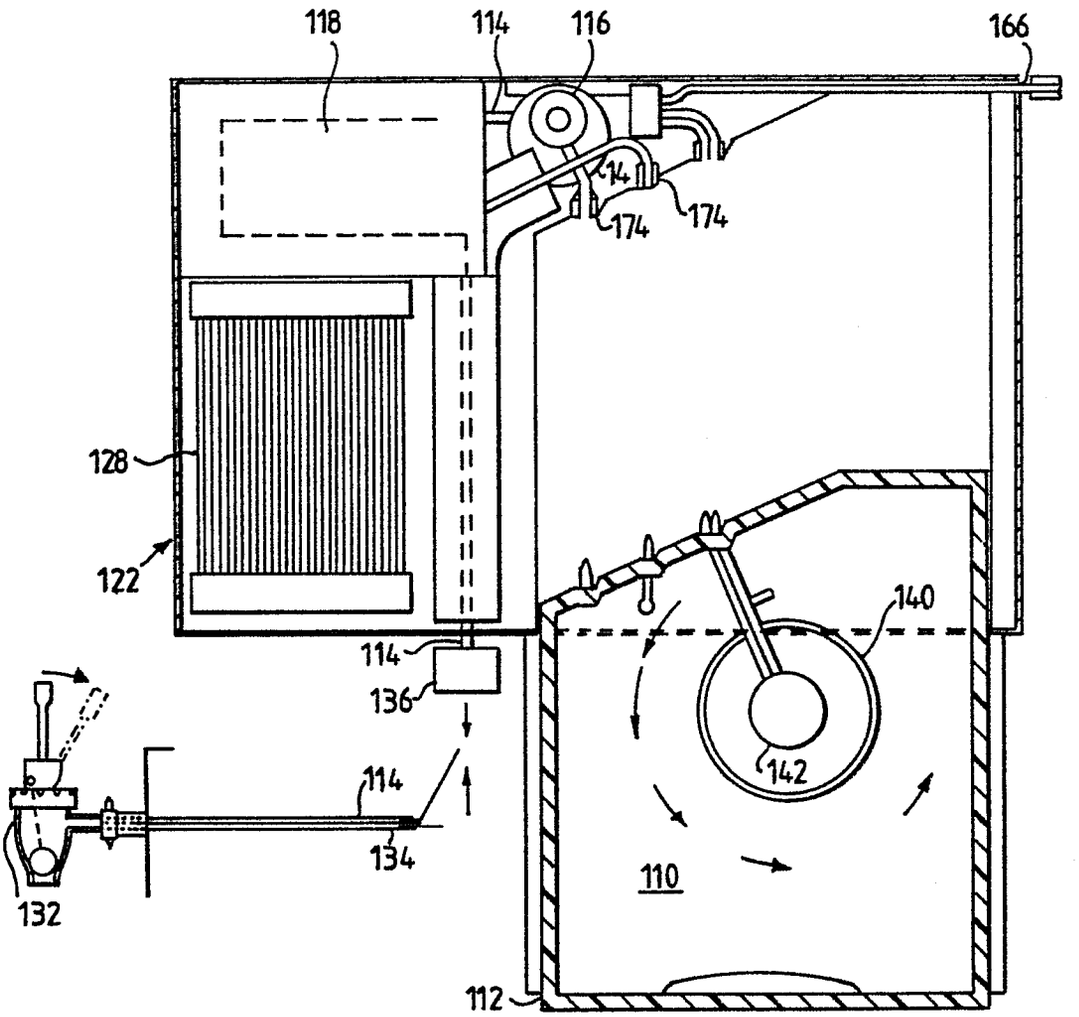

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Fig.6.

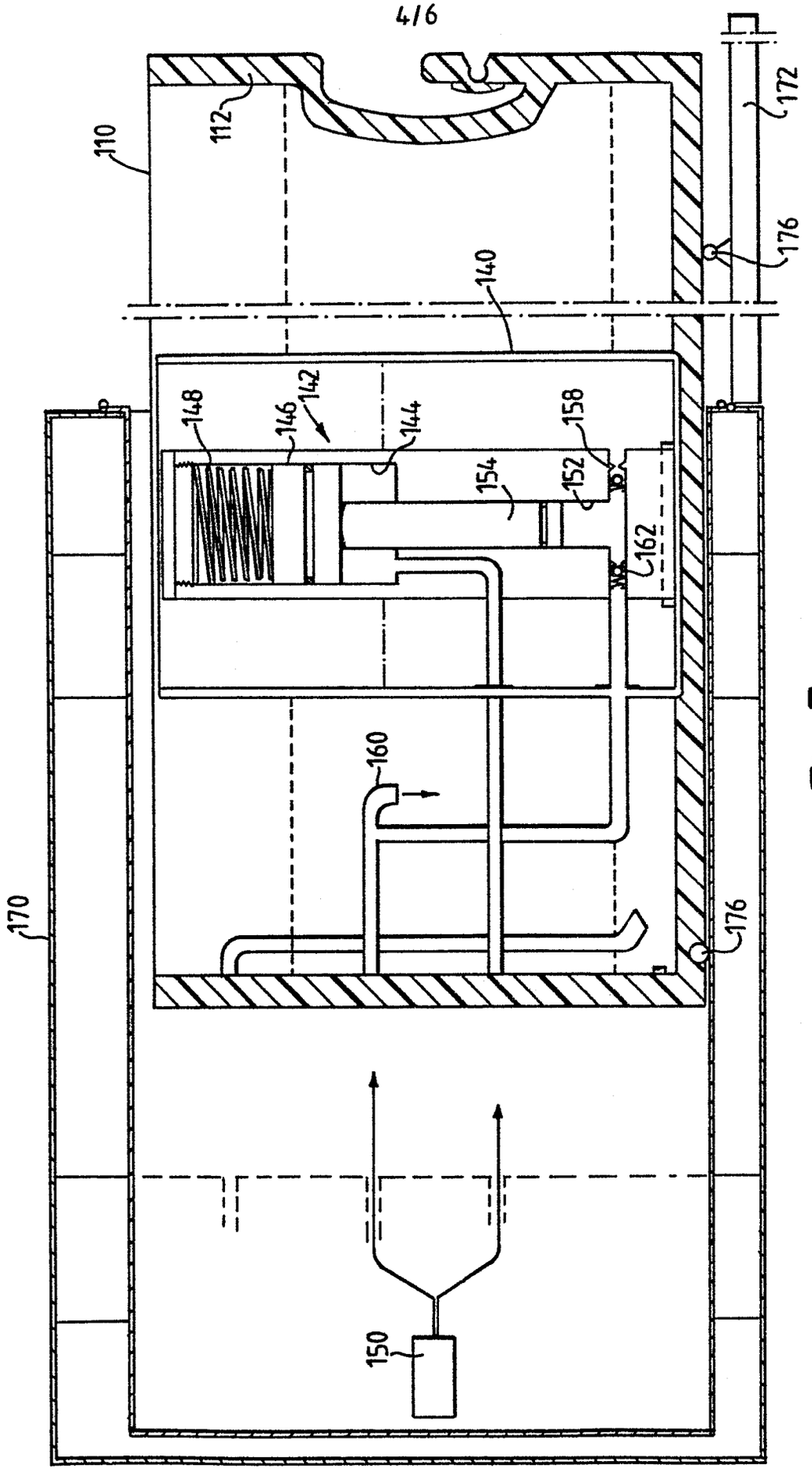
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Fig. 7.

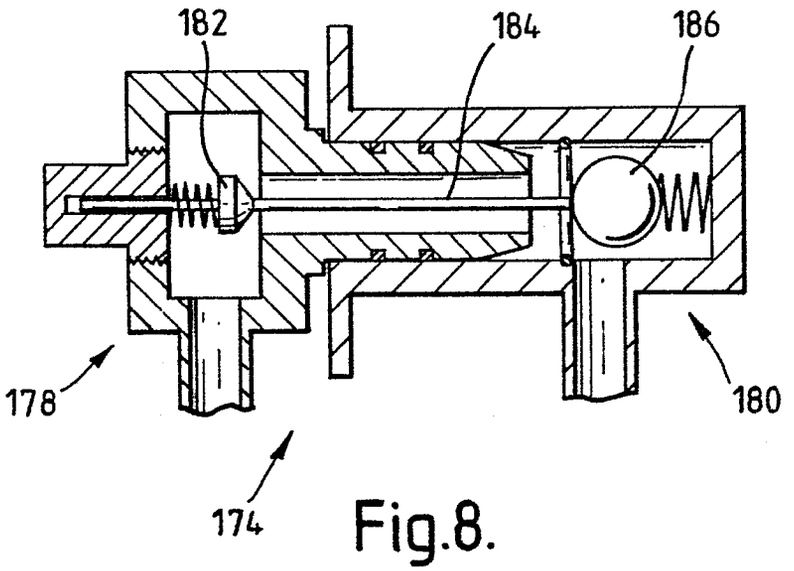


Fig.8.

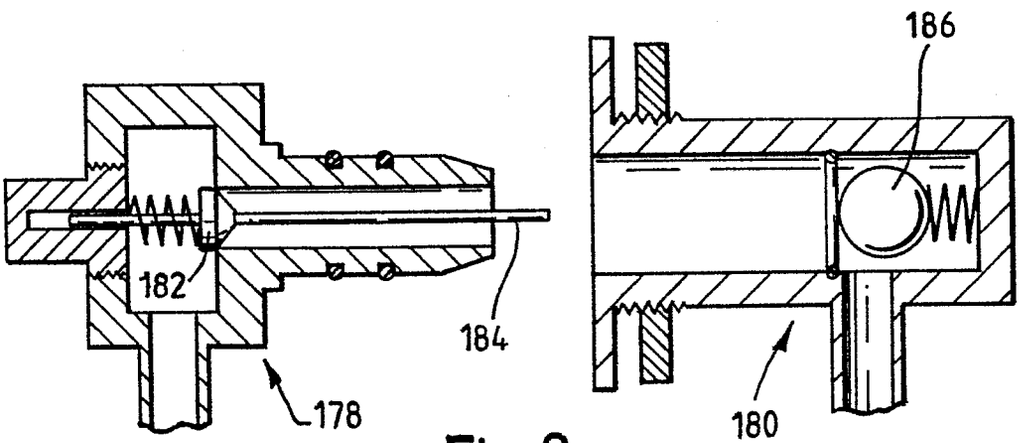


Fig.9.

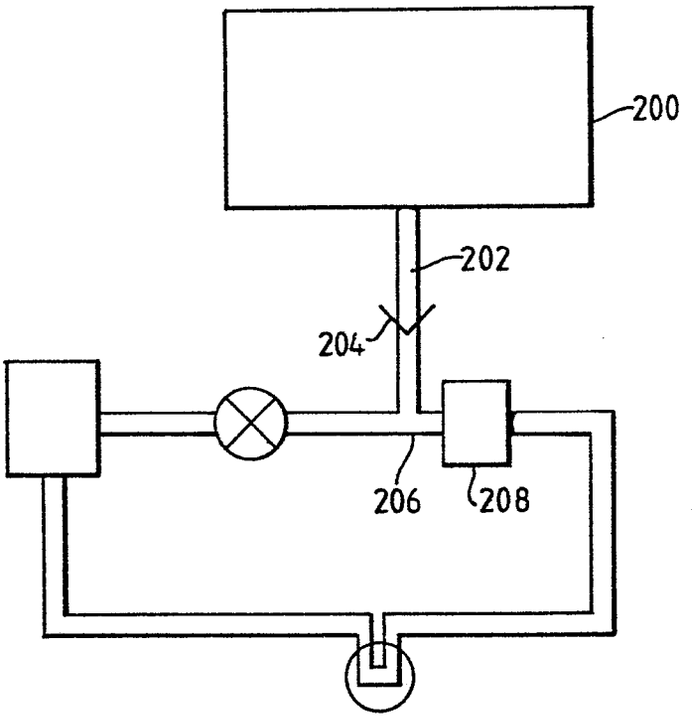


Fig.10.

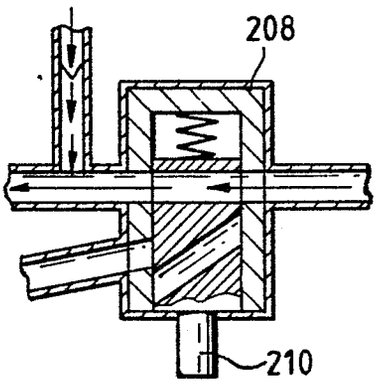


Fig.11.

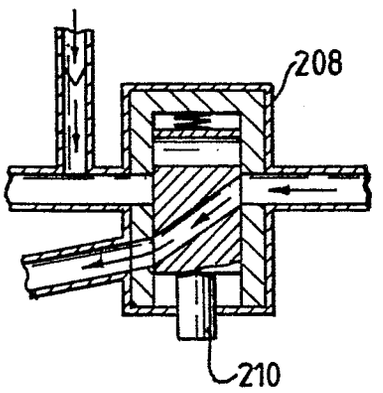


Fig.12.