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Cleland

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(54) **TABLE TOP REFRIGERATED BEVERAGE DISPENSER**

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Related U.S. Patent Documents

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Issued: **Nov. 20, 2007**
Appl. No.: **10/984,234**
Filed: **Nov. 8, 2004**

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(63) Continuation-in-part of application No. 10/705,774, filed on Nov. 10, 2003, now abandoned.

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F25B 41/04 (2006.01)
F25B 49/00 (2006.01)

(52) **U.S. Cl.** **62/196.1**; 62/224; 62/394; 62/513

(58) **Field of Classification Search** 62/151, 62/155, 196.1, 196.3, 196.4, 197, 200, 217, 62/224, 225, 277, 278, 389, 394, 395, 396, 62/210, 228.5
See application file for complete search history.

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(57) **ABSTRACT**

A self-contained beverage chilling apparatus including a refrigerant cooling system comprising a refrigerant reservoir in a fluid communication with a cold plate, a refrigerator accumulator, a compressor and a refrigerant condenser mounted within a housing unit. The housing unit further included beverage inlet means in fluid communication with the cooling system cold plate, and beverage dispenser means in fluid communication with the cold plate wherein the beverage to be dispensed is chilled to a desired temperature as it passes through the cold plate to the beverage dispensing means.

9 Claims, 9 Drawing Sheets

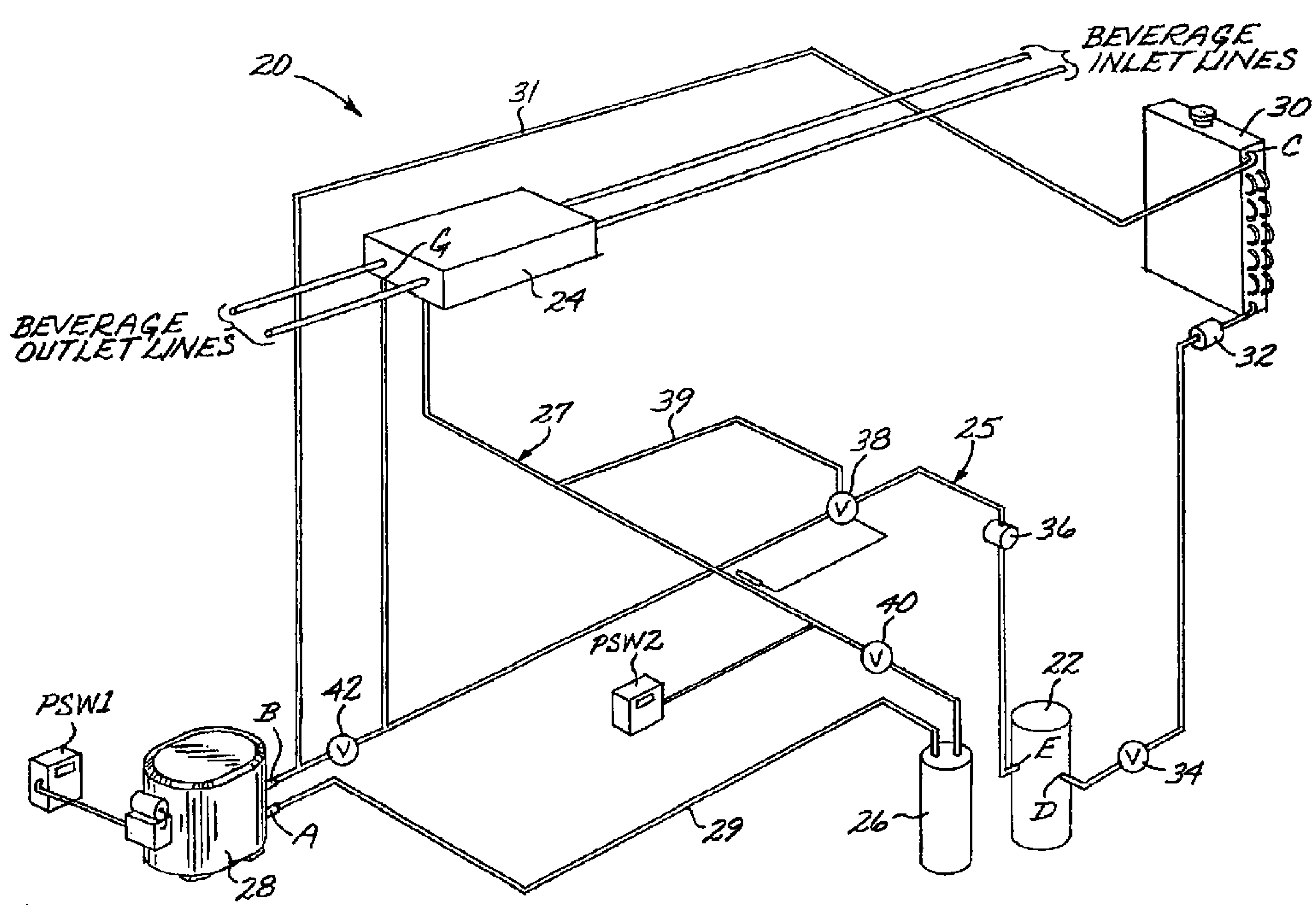
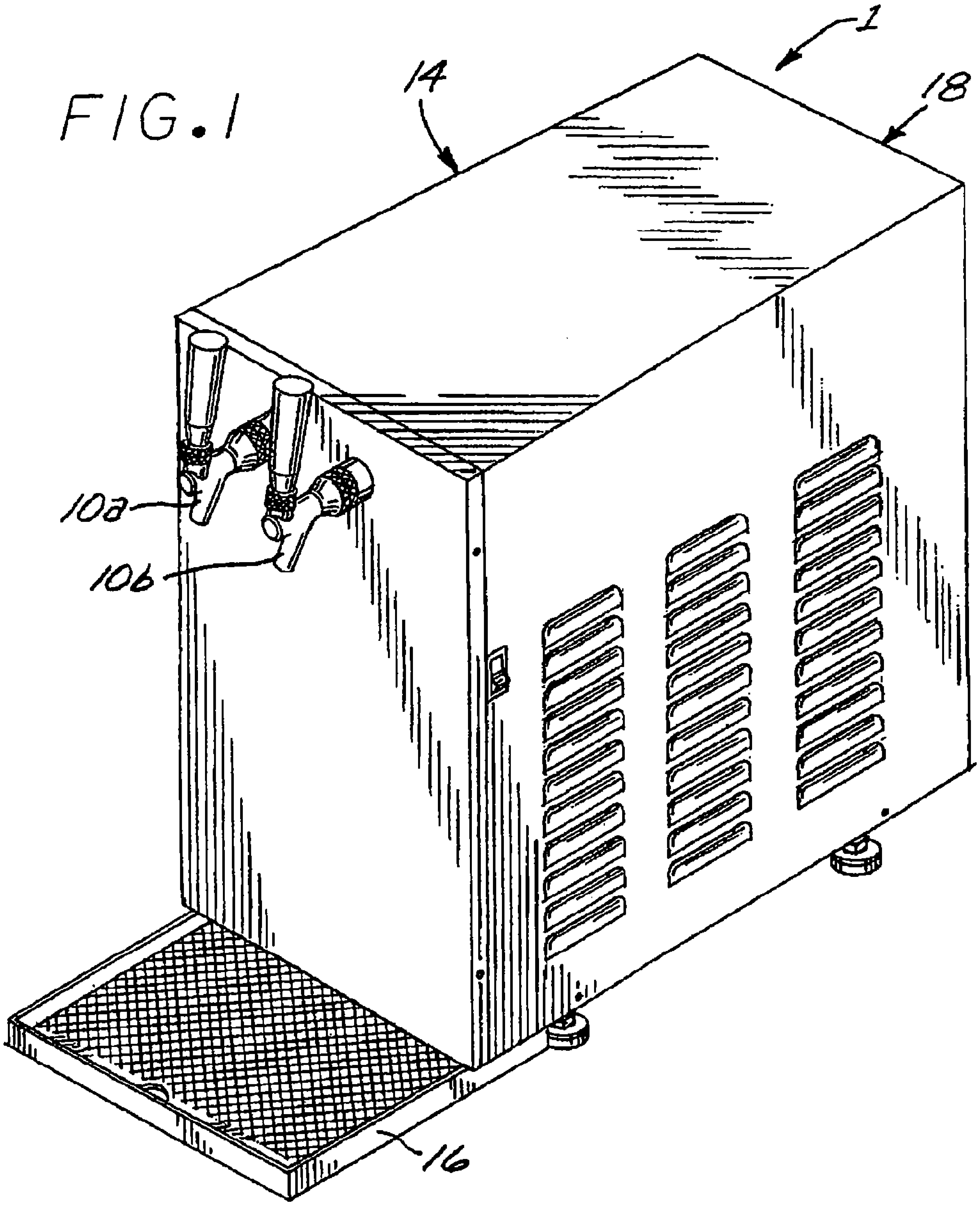


FIG. 1



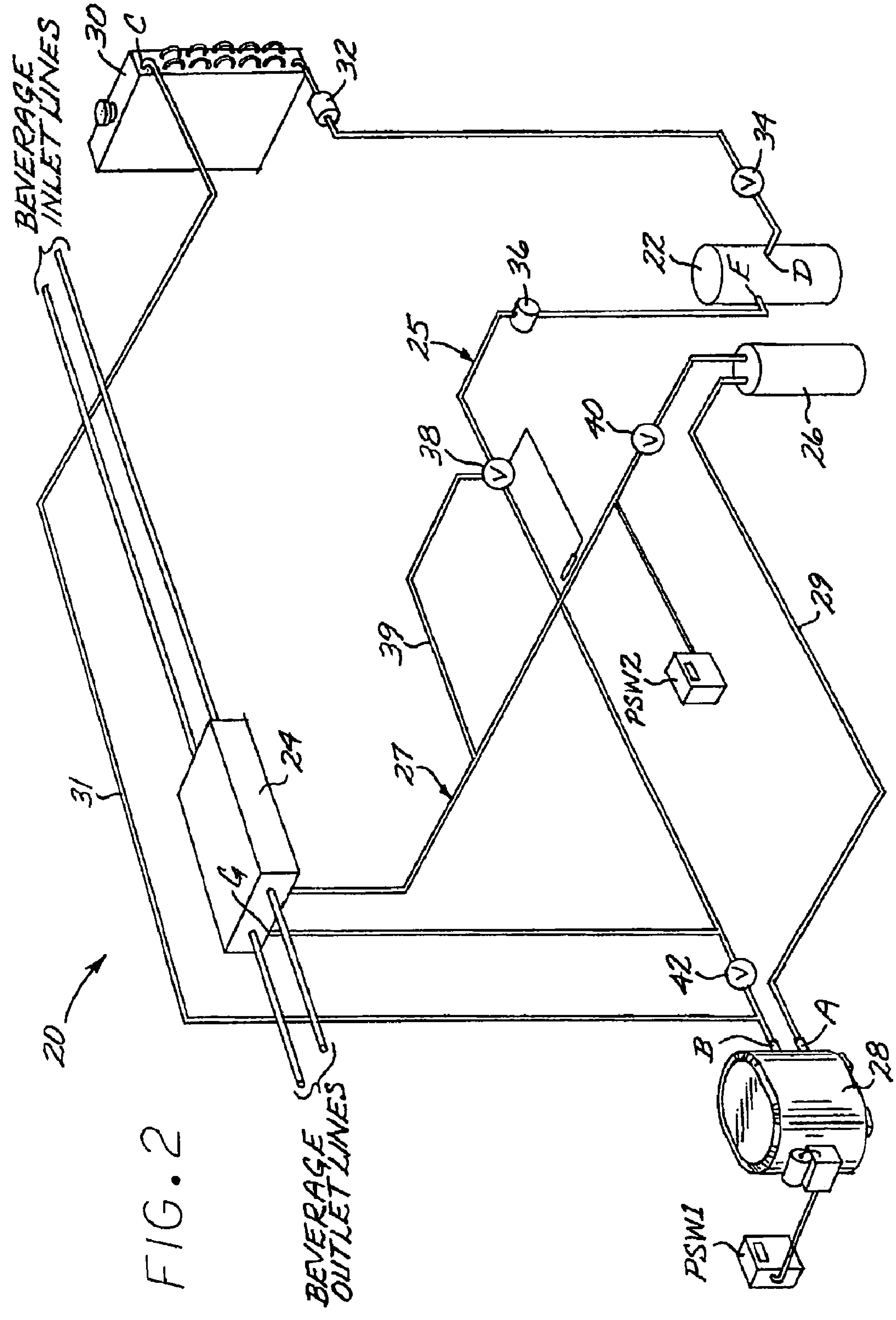

BEVERAGE INLET LINES
30
C
32
34
22
E
D
36
25
38
40
26
39
29
PSW2
24
27
31
G
42
A
B
28
20
BEVERAGE OUTLET LINES
PSW1

FIG. 2

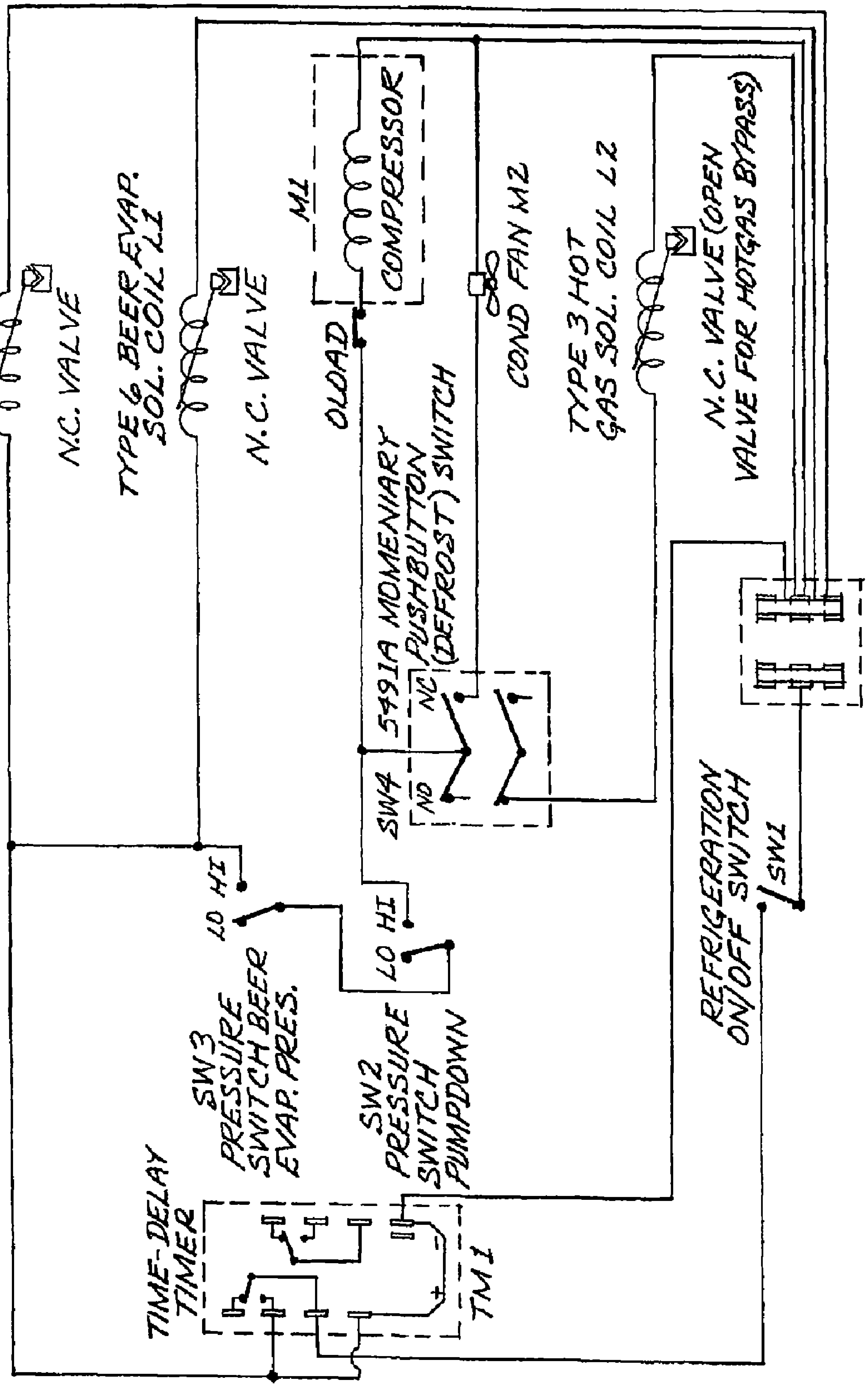

TYPE 3 LIQ. LINE SOL. COIL L1
N.C. VALVE
TYPE 6 BEER EVAP. SOL. COIL L1
N.C. VALVE
M1
COMPRESSOR
OLOAD
COND FAN M2
TYPE 3 HOT GAS SOL. COIL L2
N.C. VALVE (OPEN VALVE FOR HOTGAS BYPASS)
5491A MOMENIARY PUSHBUTTON (DEFROST) SWITCH
NC
NO
SW4
LO HI
LO HI
SW3 PRESSURE SWITCH BEER EVAP. PRES.
SW2 PRESSURE SWITCH PUMPDOWN
TIME-DELAY TIMER
TM1
REFRIGERATION ON/OFF SWITCH
SW1

FIG. 3

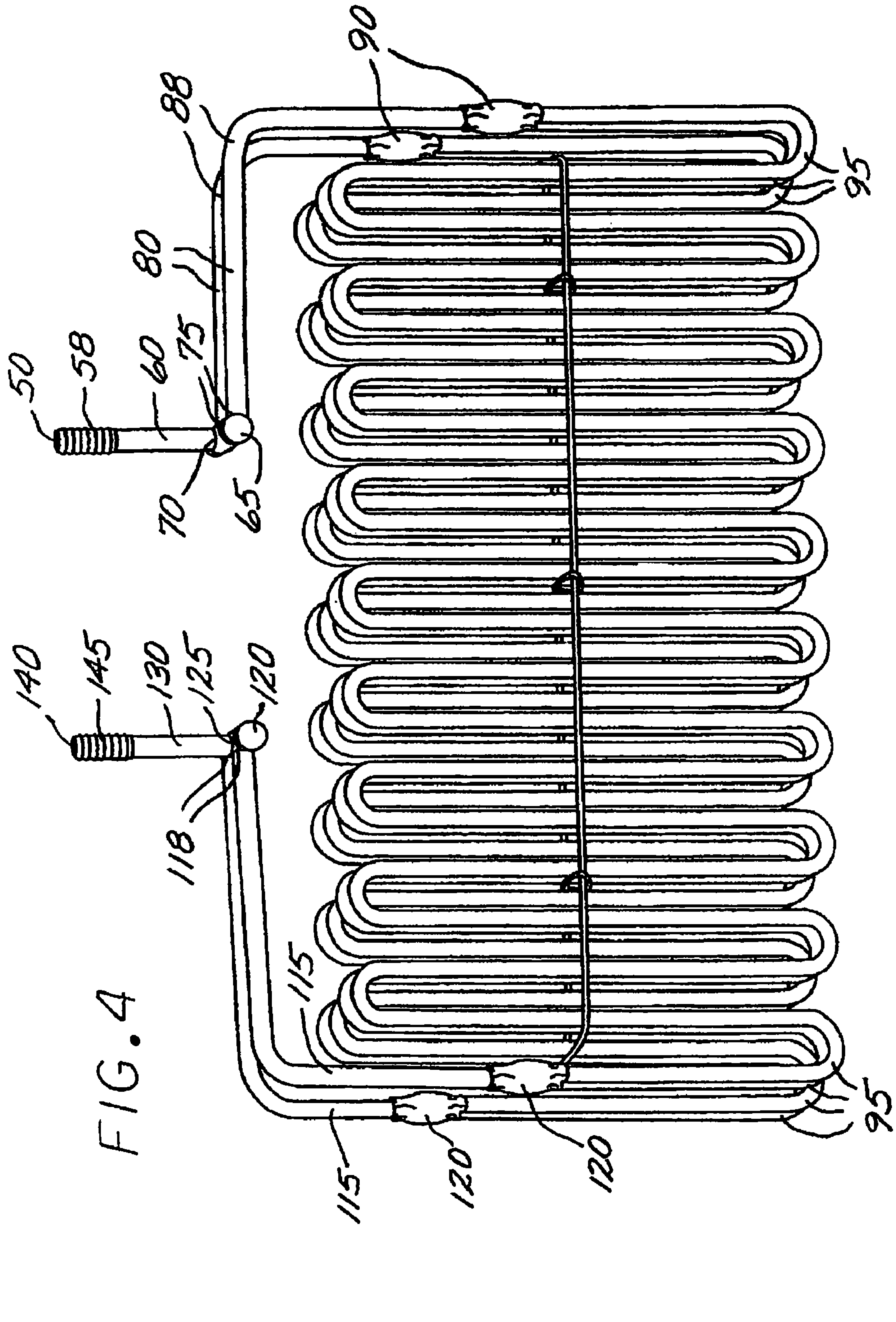

50
58
60
75
70
65
80
88
90
90
95
140
145
130
125
120
118
115
115
120
120
95

FIG. 4

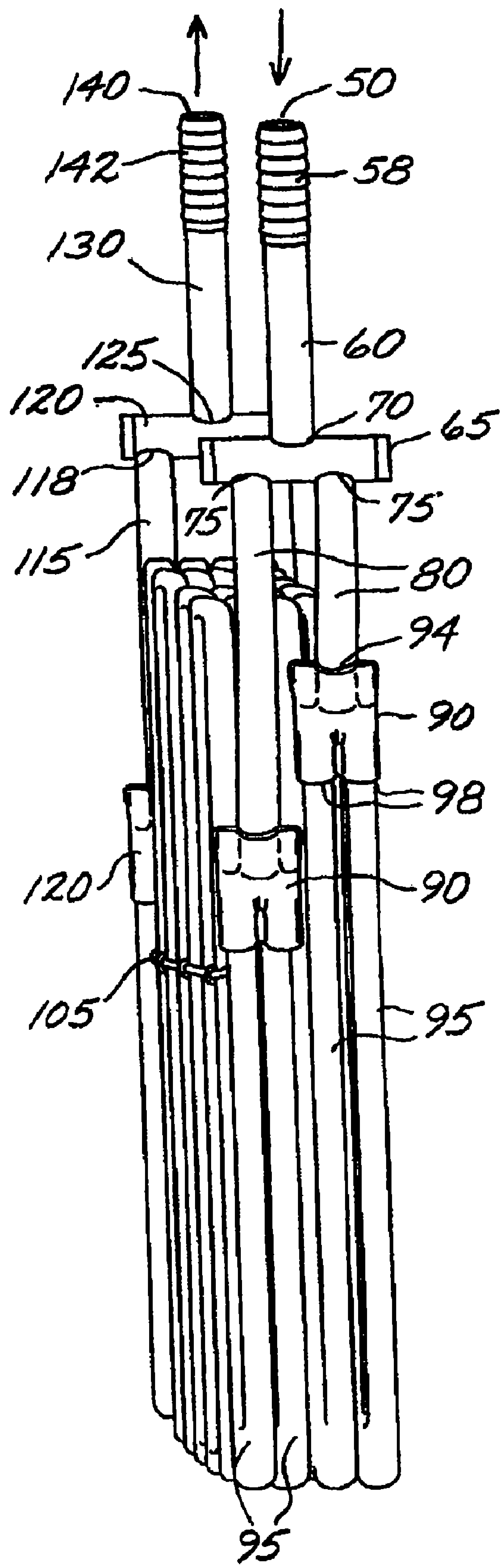

140
50
142
58
130
60
125
120
70
65
118
75
75
115
80
94
90
98
120
90
105
95
95

FIG. 5

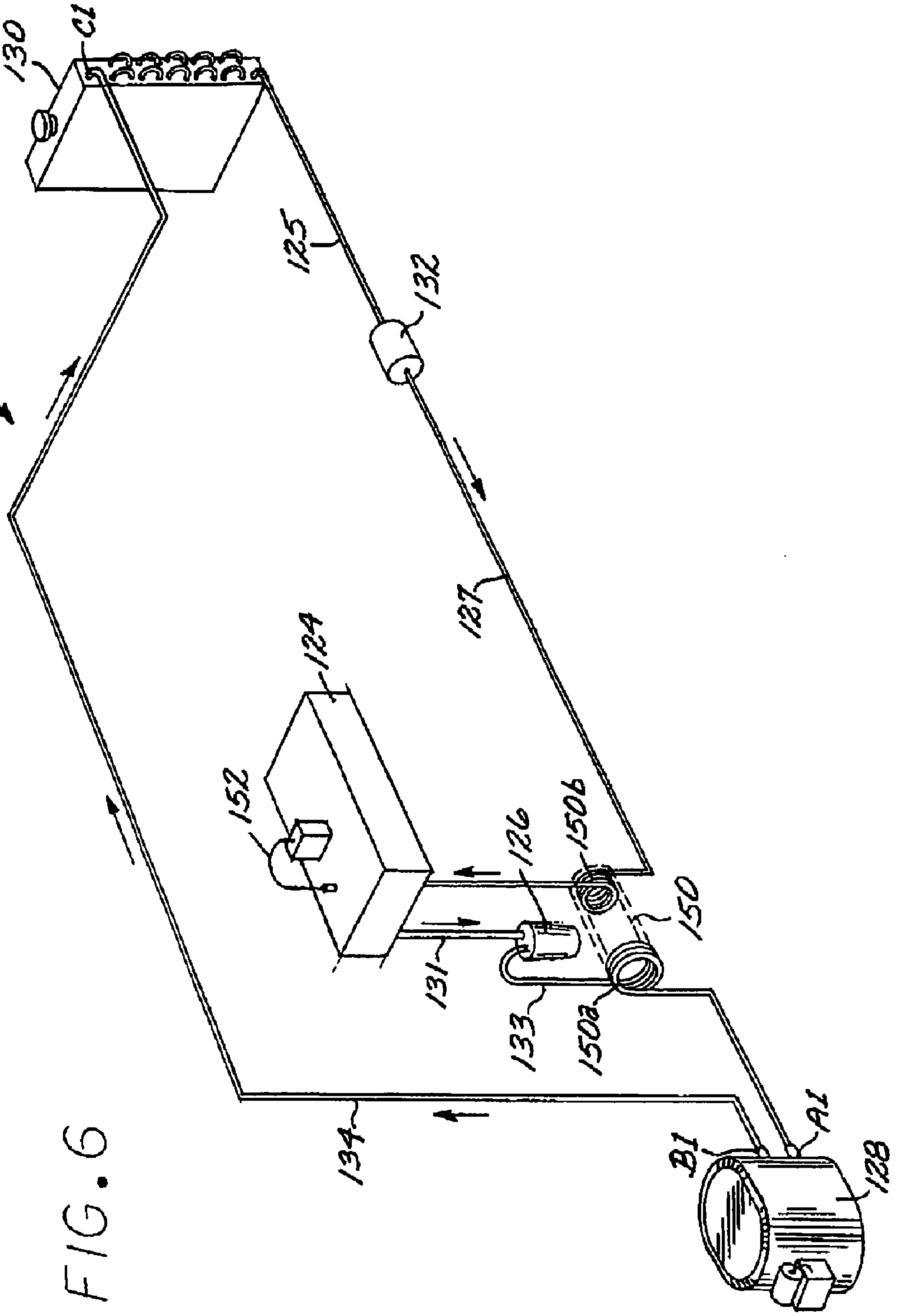

100
130
C1
125
132
127
124
152
126
150b
150
131
133
150a
134
A1
B1
128

FIG. 6

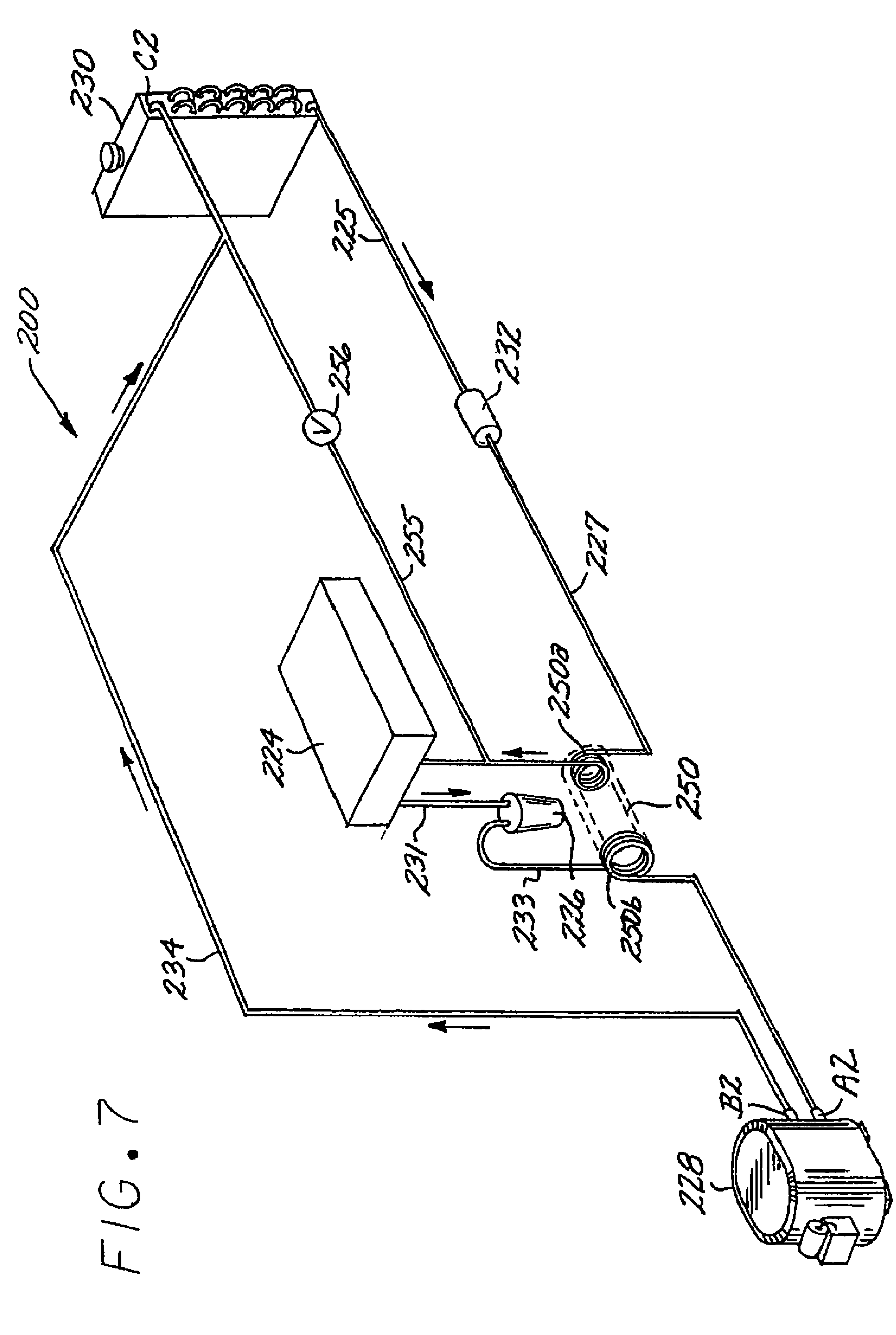

200
230
C2
225
232
256
255
227
224
250a
250
231
233
226
250b
234
228
B2
A2

FIG. 7

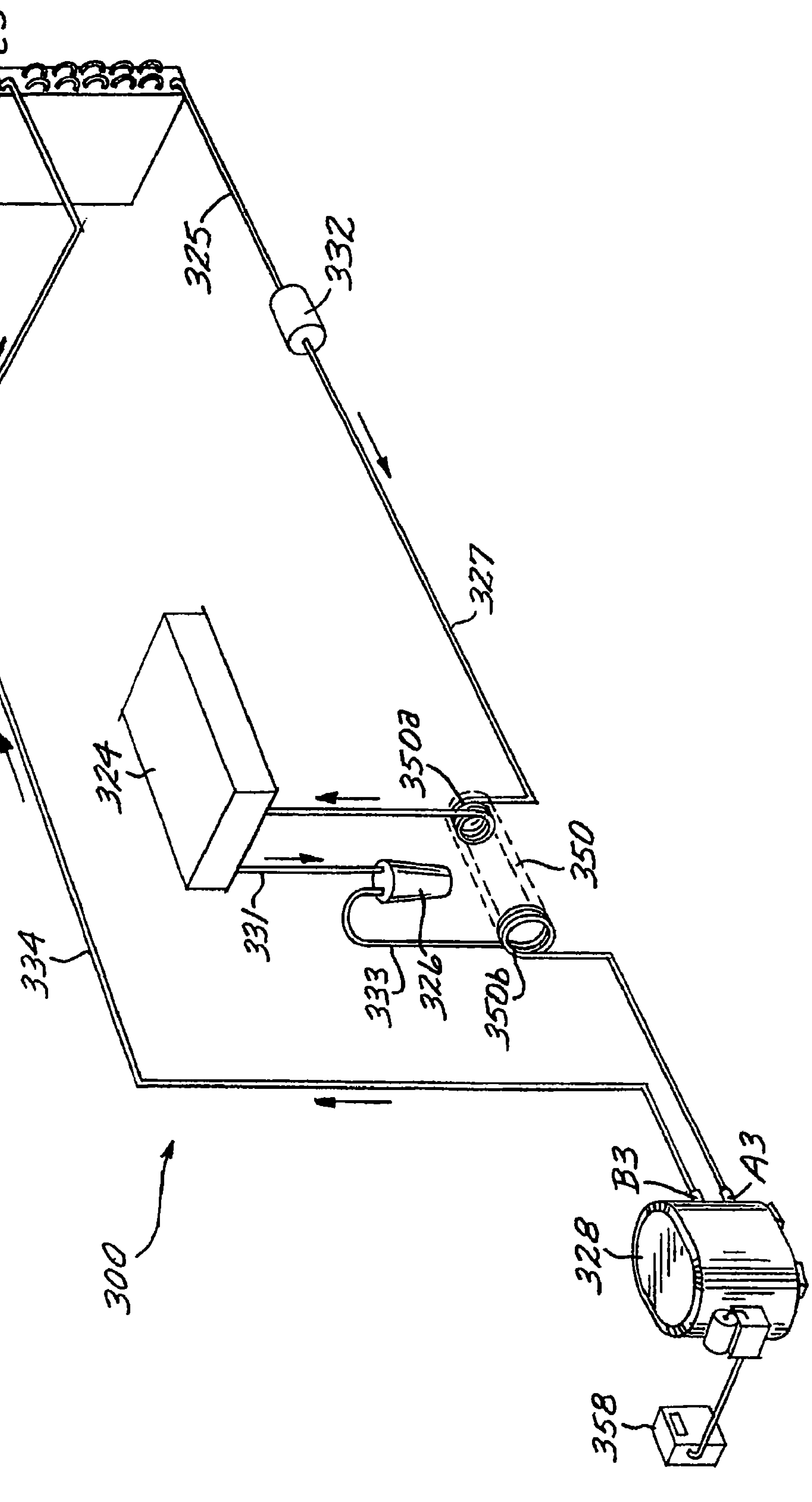

330
C3
325
332
327
324
350a
350
331
326
333
350b
334
B3
A3
328
300
358

FIG. 8

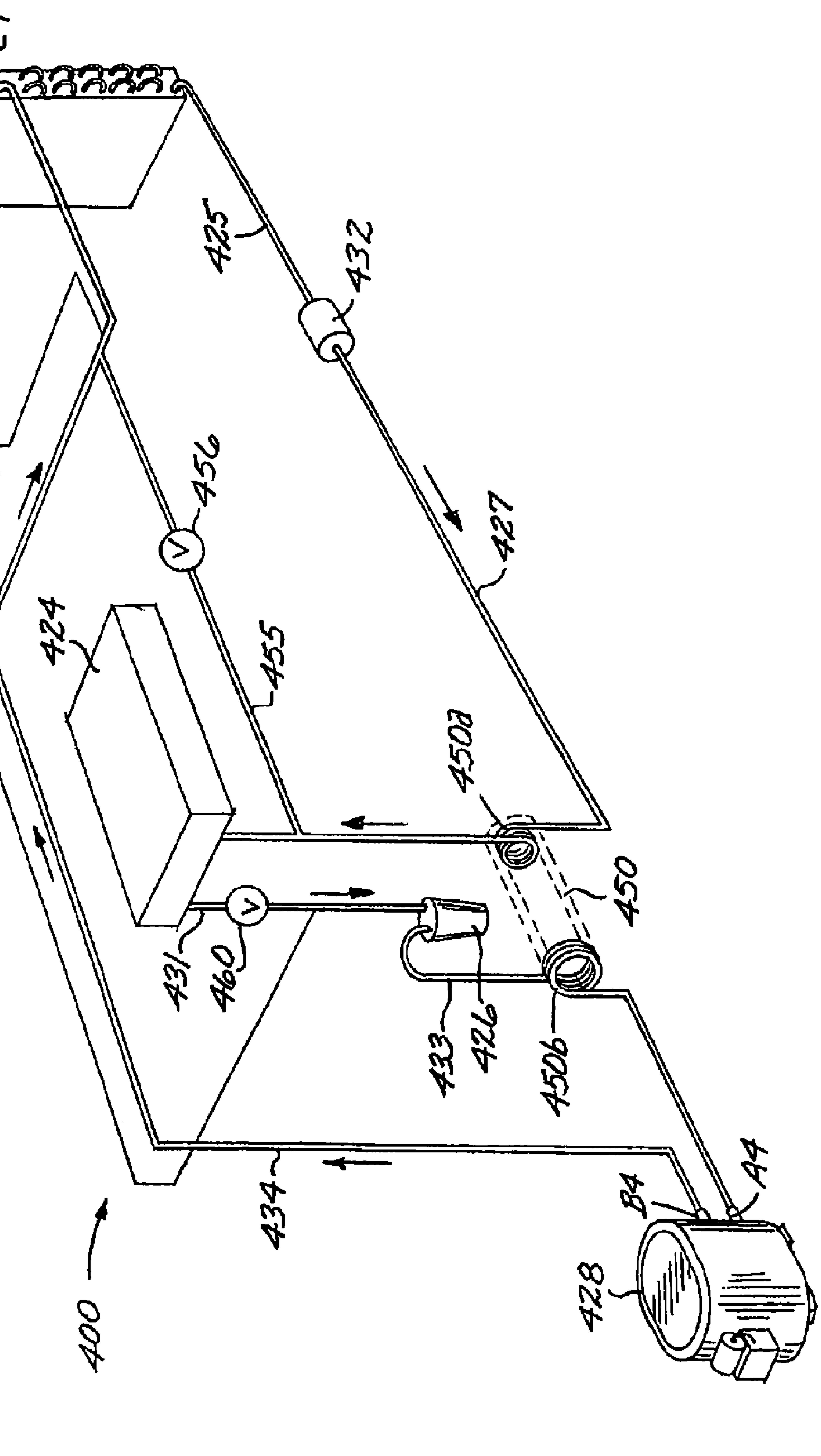

430
C4
462
425
432
456
427
424
455
450a
450
431
460
426
433
450b
434
B4
A4
428
400

FIG. 9

TABLE TOP REFRIGERATED BEVERAGE DISPENSER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

RELATED APPLICATIONS

This application is a continuation-in-part application of pending application Ser. No. 10/705,774 filed on Nov. 10, 2003 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related generally to beverage dispensing systems employing a cooling subsystem, and more particularly to a self-contained, table top beverage dispenser incorporating a refrigerant-chilled cold plate for cooling the beverage.

2. Description of Related Art

In a large number of restaurants, taverns, pubs, and clubs where beer is sold at a bar, beer kegs are stored in a cold room where they can be maintained at a reduced temperature along with other perishable food items and beverages. These cold rooms are typically maintained at a temperature of approximately 40° F. The beer is conducted from the cold rooms to serving towers at the bar through plastic tubes or beer lines that extend within a thermally insulated jacket, or trunk line. The distance between the cold room and the tower can be as little as fifteen feet and as great as two hundred feet, depending on the layout of the particular establishment. To move the beer through the lines, such systems require a pressurization subsystem that forces the beer from the cold room down the length of beer line to the beer tower for dispensing. The pressurization subsystem introduces a gas such as nitrogen or carbon dioxide into the beverage, pressurizing the beverage to enable it to be pumped through the beer lines.

As the beer is communicated from the cold room to the dispensing tower, it gains heat from the ambient atmosphere and warms to a temperature above the original 40° F. Even enveloped in the thermally insulated trunk line, traveling seventy five feet the beer in the trunk line can result in a beer temperature increase of 8° F. at the end of the trunk line. Thus, where the length of the beer lines from the cold room to the dispensing towers is not minimal, the beer dispensing system will traditionally include one or more refrigerated glycol chillers that incorporate glycol re-circulating lines of plastic tubing that extend within the thermally insulated trunk line carrying the beer lines. The presence of the glycol recirculation lines can reduce the warming of the beer by five to six degrees, resulting in an end temperature as low as 42° F., or a two degree rise from cold room to the end of the trunk line.

The trunk lines may lead to a counter top supporting cabinetry such that their downstream ends terminate below the counter tops, where they connect with balance lines that extend from the down stream end of the trunk line to the delivery tubes adjacent the respective dispensing valve. In practice the beer flowing from the beer lines, through the balance lines and stainless steel tubes can be expected to further warm from 2° F. to 4° F. Accordingly, in the example above beer initially at 40° F. in the cold room is warmed to 42° F. at the downstream end of the trunk line, and further warmed to approximately 45° F. by the time it reaches the dispensing valve.

When beer is charged with a gas such as carbon dioxide to move the beer through the various lines, the gas is entrained or dissolved in the fluid and resides in a stable state for temperatures below or at approximately 30° F. That is, the gas does not bubble out of the fluid but is carried by the fluid and gives the beverage its distinctive effervescence when consumed. However, as the temperature of the beer rises above 30° F., absent an increase in pressure on the system, the gas gradually becomes increasingly unstable and begins to bubble or foam out of the flowing beer. Further warming of the beer increases the foaming effect as the gas bubbles coalesce and propagate downstream, and foaming is further exacerbated by disturbances in the beer such as the turbulence generated when the beer is dispensed from the dispensing valve. When beer is warmed to 45° F. or more, when exposed to normal ambient room pressure, the gas becomes so unstable and so much foam is generated when it is dispensed through the valves that it can often times cannot be served to patrons. As a result, the beer dispensed through the valve must be discarded as waste resulting in significant erosion of the owner's profit.

In the recent past, the purveyors of beer using systems such as that described above have resorted to the inclusion of jacketed heat exchangers in the beer distribution systems just prior to the dispensing valves to chill beer to a low temperature at the down stream end of the trunk lines. The heat exchangers are thermally insulated cast aluminum or aluminum alloy cold plates that incorporate stainless steel tubular beer conducting coils for communicating beer from the downstream end of the trunk lines to the upstream end of the balance lines. Within the cold plates next to the beer conducting coils are a series of coolant re-circulating coils used to remove heat from the beer in a heat exchanger relationship. Typically the coolant used in such systems has been glycol.

The chilled glycol carries heat away from the cold plate and the beer lines within the cold plate in a continuous manner to lower the temperature of the beer entering the balance lines. If the glycol is chilled to, for example, 28° or 29° F. where it enters the cold plate it can be expected that the beer flowing through the cold plate will be chilled to about 29° F. In such case, the beer as it leaves the cold plate will be conducted to the dispensing valve via the balance lines and will be dispensed at about 29° F. At this temperature, the generation of foam can be minimal if attention and care is applied when the delivery is carried out through the dispensing valve and profits can be preserved.

A system such as that described above is disclosed in U.S. Pat. No. 5,694,787, entitled "Counter Top Beer Chilling Dispensing Tower," issued Dec. 9, 1997 and which the present inventor was a co-inventor. The '787 patent described a glycol recirculating coil unit or basket including elongate tubular glycol inlet and outlet tube sections having upstream ends connected to an upstream manifold and downstream ends connected to a downstream manifold.

Although the system disclosed in the '787 patent provided for a counter-top chilling and dispensing apparatus, it required the use of a glycol reservoir and glycol pump which take up significant space and require proper maintenance for efficient operation.

A need therefore exists for a tabletop chilled beverage dispensing system which is compact, easy to maintain and does not require the utilization of a glycol reservoir or pump.

SUMMARY OF THE INVENTION

The present invention is directed to a beverage dispensing system for dispensing chilled beverages comprising a housing with one or more beverage inlet connections extending from said housing and one or more beverage dispensers extending from said housing. A beverage cooling system is positioned within said housing, said cooling system comprising a reservoir containing a supply of refrigerant, a cold plate in fluid communication with said refrigerant reservoir wherein the refrigerant lines extend through said cold plate. The cooling system further includes an accumulator, a compressor, a refrigerant condenser and a thermal expansion valve positioned between said refrigerant reservoir and said cold plate to adjust the flow of refrigerant depending upon the temperature of the cold plate, wherein beverage lines extend between said beverage inlet connections and beverage dispensing outlets, said beverage lines passing through said cold plate in a heat exchange relationship with the refrigerant lines.

An electronic control system is provided for controlling the operation of the beverage cooling system. The electronic control system includes an on/off switch controlling the operation of the beverage dispenser, and a pressure switch controlling the operation of the compressor. A second pressure switch is provided for controlling the beverage evaporator coil, a liquid line coil and a time delay relay. A manual defrost switch is provided for operating a defrost line in the event the cold plate becomes frozen.

Alternate embodiments of the present invention may utilize a differing beverage cooling system wherein the system is controlled or monitored by a thermostatic control which monitors the temperature of the cold plate. Alternatively, flow of refrigerant to the cold plate may be controlled by means of a hot gas valve which diverts the flow of refrigerant from the cold plate or a pressure switch connected to the suction side of the compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the subject invention;

FIG. **2** is a diagram of the refrigerant cooling system of the subject invention;

FIG. **3** is a diagram of the electrical control system of the subject invention;

FIG. **4** is a front view of a beverage line coil basket used in the cold plate in one embodiment of the subject invention; and

FIG. **5** is an end view of the coil basket shown in FIG. **4**.

FIG. **6** is a diagram view of an alternative configuration of the refrigerant cooling system of the subject invention.

FIG. **7** is a diagram view of a second alternative configuration of the refrigerant cooling system of the subject invention.

FIG. **8** is a diagram of a third alternative configuration of the refrigerant cooling system of the subject invention.

FIG. **9** is a diagram of a fourth alternative configuration of the refrigerant cooling system of the subject invention.

DETAILED DESCRIPTION OF THE INVENTION

The stand alone, self-contained beverage dispenser **1** of the present invention is shown in FIG. **1**. Although the subject invention will be described in the context of the beverage to be dispensed being beer, it is to be understood that the invention is not limited to the dispensing of beer. The dispenser of the subject invention may be utilized to chill and dispense any other beverage that may be desired. Beverage dispensing outlets **10**a and b extend out of the front end of housing **14**. The beverage dispensing outlets may be beer taps or other such dispensers known to those skilled in the art. A beverage spill tray **16** is positioned beneath the dispensing outlets **10**a and b.

Beverage dispenser **1** may be mounted on a counter-top or other support surface. Beverage inlet connections (not shown) are provided on the rear **18** of beverage dispenser **1**. The beverage dispenser **1** may be easily installed at the desired location. One need simply run the beverage lines from the beverage supply, i.e. beer keg, to the location for connection to the beverage dispenser unit.

A refrigerant cooling system **20** is contained within the housing **14** so as to provide a self-contained beverage dispenser which does not require a separate glycol chiller and pump as required in prior art systems.

The refrigerant cooling system **20** of the subject invention is shown in FIG. **2**. The cooling system **20** includes receiver **22** which acts as the reservoir for the refrigerant, which is in fluid communication with cold plate **24** via refrigerant line **25**. Refrigerant cooling lines extend through cold plate **24** to cool corresponding beverage lines which also extend through cold plate **24**. The cold plate utilized is a standard cold plate known to those skilled in the art wherein the beverage and refrigerant lines may be wound within the cold plate to increase the length of the lines positioned within said cold plate. The cooling system **20** also includes accumulator **26**, compressor **28** and refrigerant condenser **30**. As shown, refrigerant exits the cold plate **24** and flows to accumulator **26** via refrigerant line **27**. From the accumulator **26**, the refrigerant travels to the compressor **28** via refrigerant line **29**. The refrigerant flows from the compressor **28** to the condenser **30** via refrigerant line **31**.

The operation of the refrigerant system is described below, in connection with FIGS. **2** and **3**.

The refrigerant, in a preferred embodiment type **404**a is used, enters the compressor **28** at point A as a low pressure gas and is discharged from the compressor as a high pressure gas at point B. It then enters the top of the condenser **30** at point C.

The refrigerant is cooled in the condenser, exiting it as a high pressure liquid, and passes through a drier **32** (which retains unwanted scale, dirt and moisture) to the liquid line valve **34**, which is open whenever the cold plate **24** is warm enough to require cooling, as determined by a pressure switch PSW**2**.

The refrigerant, still in a high pressure liquid state, flows through the liquid line valve and enters the receiver tank **22**, which serves as a storage tank for the refrigerant at point D.

At point E, the refrigerant exits the receiver tank, passes through a sight glass **36** (where bubbles will be observed if the system is low on refrigerant) and encounters the thermal expansion valve **38**.

A pressure differential is provided across the thermal expansion valve. This valve includes a sensor bulb that measures the degree of superheat of the suction gas exiting the cold plate and expands or contracts to allow the flow of refrigerant to be varied according to need. The refrigerant leaving the thermal expansion valve will be in a low pressure liquid state.

At the thermal expansion valve **38** there is also a small equalizer tube **39** connected to the outlet of the cold plate **24**. The equalizer tube **38** helps to equalize the pressure between the inlet and outlet side of the cold plate **24**.

After passing through the thermal expansion valve **38**, the refrigerant enters the cold plate **24** at point G. As the liquid refrigerant enters the cold plate it is subjected to a much lower pressure due to the suction created by the compressor and the pressure drop across the expansion valve. Thus, the refrigerant tends to expand and evaporate. In doing so, the liquid refrigerant absorbs energy (heat) from beverage lines within the cold plate **24**.

The low pressure gas leaving the cold plate **24** encounters the evaporator valve **40**, whose function is to trap refrigerant in the cold plate, thus helping to keep the cold plate cold while it is absorbing heat from the beverage, i.e. beer in a preferred embodiment. From the evaporator valve **40**, the gas passes into the accumulator **26**, which prevents any slugs of liquid refrigerant from passing directly into the compressor, and continues back to the compressor **28**.

The thermal expansion valve **38** mentioned above is used instead of a capillary tube in order to provide improved response to the cooling needs of the cold plate **24**.

The electrical control system **50** is illustrated in FIG. **3**. Refrigeration on/off switch SW**1** provides power to the entire system by manually depressing the switch. Pressure switch SW**2** monitors the refrigerant pressure in the compressor and cycles of the compressor and condenser fan (not shown) when the pressure drops to a predetermined level, 15 psi in a preferred embodiment, and cycles the compressor and fan back on when the pressure reaches a second predetermined level, 30 psi in a preferred embodiment. The pressure switch PSW**2** normally will be set to monitor refrigerant pressure with a range in the low pressure side of the compressor and cycles off the compressor and condenser fan (not shown) when refrigerant pressure drops to approximately 10 to 20 psi and cycles the compressor back on at approximately 25 to 30 psi. Pressure switch SW**3** monitors refrigerant pressure in the beverage cold plate. When the pressure drops to a predetermined level, approximately 62-65 psi in a preferred embodiment, pressure switch SW**3** cycles off the beverage evaporator coil, liquid line solenoid coil and time delay relay TM-**1**. When the refrigerant pressure rises to a second predetermined level, approximately 72-75 psi in a preferred embodiment, the switch SW**3** cycles on the beverage (beer) evaporator solenoid coil, liquid line solenoid and the time delay relay TM-**1**. A push-button defrost switch SW**4** is provided to cycle on the hot gas solenoid and cycle off the condenser fan to deliver hot gas to the cold plate should the cold plate become frozen.

Pressure switch SW**3** responds to the cold plate **24** temperature by reading the pressure of the refrigerant as it is discharged from the cold plate. When the cold plate becomes warm enough the liquid line valve and the evaporator valve open, thereby allowing refrigerant to flow throughout the system. When the cold plate becomes cool enough these valves will close, trapping most refrigerant in the system but allowing gaseous refrigerant to pump from the accumulator into the compressor. Pumping from the accumulator into the compressor extends the life of the compressor by preventing it from having to start against a high pressure differential.

The time delay relay TM-**1** causes the liquid line valve and the evaporator valve to remain open for about 10 seconds after the pressure switch SW**3** tells them to close. It allows some time for the system to stabilize and prevents short cycling of the compressor.

As shown in FIG. **2**, defrost valve **42** is installed between the compressor discharge tube and the cold plate inlet. A manually operated momentary switch SW**4** may be deployed to open the defrost valve, which allows high pressure gas from the compressor to be pumped into the cold plate to thaw it, should it freeze up. To prevent damaging the system, the switch should not be held on for more than two minutes.

The refrigerated beverage system described herein is capable of producing 16 ounce draws on a continual basis at a dispensing of temperature of approximately 29° F. based upon a beverage (beer) inlet temperature of 60° F. and ambient room temperature of 70° F.

An alternative configuration of the refrigerant coolant system is shown in FIG. **6**. In this embodiment a thermostatic control is provided for controlling the temperature of the liquid being chilled through the cold plate.

The refrigerant cooling system **100** of this embodiment includes refrigerant condenser **130**, drier **132**, cold plate **124**, accumulator **126**, heat exchanger **150** and compressor **128**. The refrigerant condenser **130** is in fluid communication with cold plate **124** by means of refrigerant line **125** and capillary line **127**. As with the embodiment shown in FIG. **2**, refrigerant exits cold plate **124** and travels to accumulator **126** by means of refrigerant line **131**. The cooling system **100** shown in FIG. **6** is a critical charge type system utilizing just enough refrigerant to fill the system.

As with the prior embodiment, the refrigerant, preferably type **404**a, enters the compressor **128** at point A_1 as a low pressure gas and is discharged from the compressor as a high pressure gas at point B_1. It then enters the condenser at point C_1. Compressor **128** is in fluid communication with condenser **130** by means of refrigerant line **134**.

The operation of this embodiment of the cooling system is similar to the system described in connection with FIG. **2**. Refrigerant is cooled in condenser **130** and exits the condenser as a high pressure liquid, passing through drier **132**. From drier **132** the refrigerant flows through capillary line **127** to heat exchanger **150** and from heat exchanger **150** into cold plate **124**. As the refrigerant passes through cold plate **124** it cools the liquid flowing through the beverage lines (not shown). The refrigerant then exits the cold plate **124** and flows to the accumulator **126**, through heat exchanger **150** and on through to the compressor **128**. By passing the refrigerant through heat exchanger **150** as it flows from accumulator **126** to compressor **128** one avoids excess liquid build up in compressor **128**.

As shown in FIG. **6**, heat exchanger **150** is comprised of coil **150**b formed in capillary line **127** and coil **150**a formed in refrigerant line **133**. Coils **150**a and **150**b are positioned together in a heat exchange relationship. They may be joined together by soldering, the utilization of shrink wrap or other mechanical means known to those skilled in the art.

The operation of compressor **128** is controlled by thermostatic control **152** which is provided on cold plate **124**. Depending upon the desired temperature of the chilled beverage the thermostatic control **152** is set to a pre-determine temperature setting. By way of example, the refrigerant cooling system **100** of this embodiment may be used to produce chilled shots of an alcoholic beverage at 5° F. To produce chilled beverage at this temperature using type **404**a in the refrigerant the thermostatic control **152** would be set at to turn on the compressor when the temperature reached 7° F. and turn off the compressor when it reached 3° F., and the compressor pressure would be set at approximately 38 psi. When the thermostatic control senses a cold plate temperature of 7° F., (i.e. the cold plate is warming up) compressor **128** is activated resulting in the discharge of high pressure gas at point B, and the transmission of the refrigerant gas through refrigerant line **134** to condenser **130**. When the temperature of cold plate **124** reaches a predetermined temperature, such as 3° F., thermostatic control **152** causes compressor **128** to turn off. One skilled in the art will recognize that the system can be set to differing on and off temperatures depending upon the beverage being chilled or how closely it is desired to maintain the beverage at a predetermined temperature.

Alternatively, rather then using a thermostatic control the temperature of the liquid being chilled can be controlled by means of monitoring the refrigerant hot gas pressure. The refrigerant coolant system monitoring the refrigerant hot gas pressure is shown in FIG. **7**.

The refrigerant cooling system **200** of this embodiment includes refrigerant condenser **230**, drier **232**, cold plate **224**, accumulator **226**, heat exchanger **250**, hot gas valve **256** and compressor **228**. The refrigerant condenser **230** is in fluid communication with cold plate **224** by means of refrigerant line **225** and capillary line **227**. As with the embodiment shown in FIG. **6**, the refrigerant exits cold plate **224** and travels to accumulator **226** by means of refrigerant line **231**.

As with the prior embodiment, the refrigerant, preferably type **404**a, enters the compressor **228** at point A_2 as a low pressure gas and is discharged from the compressor as a high pressure gas at point B_2. It then flows to condenser **230** by means of refrigerant line **234** and enters the condenser at point C_2.

The operation of this embodiment of the cooling system is similar to the system described in connection with FIG. **6**. Refrigerant is cooled in condenser **230** and exits the condenser as a high pressure liquid, passing through drier **232**. From drier **232** the refrigerant flows through capillary line **227** to heat exchanger **250** and from heat exchanger **250** into cold plate **224**. As the refrigerant passes through cold plate **224** it cools the liquid flowing through the beverage lines enclosed within the cold plate. The refrigerant then exits the cold plate **224** and flows to the accumulator **226**, through heat exchanger **250** and then to the compressor **228**.

As shown in FIG. **7**, bypass line **255** is provided between capillary tube **227** and refrigerant line **234**. Hot gas bypass valve **256** is provided in bypass line **255**. Depending upon the desired temperature of the chilled beverage as well as the freezing point of the beverage the hot gas valve **256** is set to a pre-determine pressure setting. By way of example, the refrigerant cooling system **200** of this embodiment may be used to produce chilled shots of an alcoholic beverage of 5° F., as well as chill a beverage such as beer to a temperature of 29° F. To produce chilled beverage at a temperature of 5° F. the hot gas valve **256** would be set at a back side pressure of approximately 250-270 psi. To produce chilled beverage at a temperature of approximately 29° F., the hot gas valve would be set at a back side pressure of approximately 150 psi. The cooling system **200** of this embodiment is a critical charge type system in which just enough refrigerant is provided to fill the system with the use of or need for a refrigerant reservoir. In operation, the cooling system operates continuously with refrigerant being continually circulated through the cold plate. This continuous operation could lead to a "freezing up" of the cold plate depending upon the beverage being chilled. This is avoided by the provision of the bypass valve **256** on bypass line **255**. Bypass valve **256** is set to open when the back side hot gas pressure reaches a certain predetermined pressure. When the hot gas back pressure reaches the pre-set level, hot gas valve **256** opens and the refrigerant is drawn through bypass line **255** back into the condenser **230** rather than through cold plate **224**. This prevents the cold plate from being cooled to a level which would cause the cold plate to freeze the beverage flowing through the beverage lines cast within the cold plate. When the temperature of the cold plate rises to a predetermined level, the change in hot gas back pressure will cause hot gas valve **256** to close. This, in turn, re-introduces the flow of refrigerant through the cold plate **224**.

Yet another refrigerant coolant system is shown in FIG. **8**. As shown in this embodiment the temperature of the liquid being chilled is controlled by monitoring the pressure on the suction side of the compressor.

The refrigerant cooling system **300** of this embodiment includes refrigerant condenser **330**, drier **332**, cold plate **324**, accumulator **326**, heat exchanger **350** and compressor **328**. The refrigerant condenser **330** is in fluid communication with cold plate **324** by means of refrigerant line **325** and capillary line **327**. As with the embodiment shown in FIG. **6**, refrigerant exits cold plate **324** and travels to accumulator **326** by means of refrigerant line **331**. From accumulator **326** the refrigerant flows through heat exchanger **350** to low pressure inlet A_3 on compressor **328**.

As with the prior embodiment, the refrigerant, preferably type **404**a, enters the compressor **328** at point A_3 as a low pressure gas and is discharged from the compressor as a high pressure gas at point B_3. It then enters the condenser at point C_3.

The operation of this embodiment of the cooling system is similar to the system described in connection with FIG. **6**. Refrigerant is cooled in condenser **330** and exits the condenser in a high pressure liquid, passing through drier **332**. From drier **332** the refrigerant flows through capillary line **327** to heat exchanger **350** and from heat exchange **350** into cold plate **324**. As this refrigerant passes through cold plate **324** it cools the liquid flowing through the beverage lines (not shown) enclosed within the cold plate. The refrigerant then exits the cold plate **324** and flows to the accumulator **326** then to the compressor **328**.

The operation of compressor **328** is controlled by pressure switch **358** which monitors the pressure on the suction side (A_3) of compressor **328**. Depending upon the desired temperature of the chilled beverage the pressure switch **358** is set to a pre-determine pressure setting. By way of example, the refrigerant cooling system **300** of this embodiment may be used to produce chilled shots of an alcoholic beverage of 5° F. To produce chilled beverage at this temperature the pressure switch **358** would be set at 39 psi. When the pressure of the refrigerant in gas line **331** on the suction side of the compressor reached 38 psi, switch **358** will turn off the compressor **328**. When the pressure reaches a predetermined level pressure switch **358** will turn on the compressor. To avoid unduly taxing the compressor one skilled in the art will know to set the pressure switch **358** to a predetermined pressure range which equates to a predetermined temperature range, by way of example ±2° F.

Finally, an additional embodiment of this refrigerant system is shown in FIG. **9**. This embodiment is similar to the embodiment shown in FIG. **7**. In this embodiment refrigerant cooling system **400** includes refrigerant condenser **430**, drier **432**, cold plate **424**, accumulator **426** and compressor **428**. The refrigerant condenser **430** is in fluid communication with cold plate **424** by means of refrigerant line **425**, drier **432** and capillary tube **427**. As with the prior embodiments, the refrigerant exits the cold plate **424** and travels to accumulator **426** by means of refrigerant line **431**. From accumulator **426** the refrigerant flows through heat exchanger **450** to compressor **428**. As shown in FIG. **9**, pressure regulator **460** is provided between cold plate **424** and accumulator **426**. Pressure regulator **460** is controlled by pressure control **462** which allows for adjustment of the system pressure settings to accommodate different beverage temperature settings.

As shown in FIG. **9**, bypass line **455** is provided between capillary tube **427** and refrigerant line **434**. Hot gas bypass valve **456** is provided in bypass line **455**. Depending upon the desired temperature of the chilled beverage the hot gas valve **456** is set to a pre-determine pressure setting. By way of example, the refrigerant cooling system **400** of this embodiment may be used to produce chilled shots of an alcoholic beverage of 5° F., as well as chill a beverage such as beer to a temperature of 29° F. To produce chilled beverage at a temperature of 5° F. the hot gas valve **456** would be set at a back side pressure of approximately 250-270 psi. To produce chilled beverage at a temperature of approximately 29° F., the hot gas valve would be set at a back side pressure of approximately 150 psi. The cooling system **400** of this embodiment is also a critical charge type system in which just enough refrigerant is provided to fill the system with the use of or need for a refrigerant reservoir. In operation, the cooling system operates continuously with refrigerant being continually circulated through the cold plate. As with the hot gas bypass valve system shown in FIG. **7**, the continuous operation of cooling system **400** could lead to a "freezing up" of the cold plate depending upon the beverage being chilled. This is avoided by the provision of bypass valve **456** on bypass line **455**. Bypass valve **456** is set to open when the back side hot gas pressure reaches a certain predetermined level. When the hot gas back pressure reaches the pre-set level hot gas valve **456** opens and the refrigerant is drawn through bypass line **455** back into the condenser **430** rather than through cold plate **424**. This prevents the cold plate from being cooled to a level which would cause the cold plate to freeze the beverage flowing through the beverage lines cast within the cold plate. When the temperature of the cool plate rises to a predetermined level, the change in hot gas back pressure will cause hot gas valve **456** to close. This, in turn, re-introduces the flow of refrigerant through the cold plate **424**. To provide greater accuracy or control over the temperature of the system in this embodiment pressure regulator **460** is provided between cold plate **424** and accumulator **426**. Pressure regulator **460** allows the operator to control the pressure of the refrigerant as it exits the cold plate which in turn more accurately controls the temperature of the cold plate and the beverage being chilled by the cold plate. By setting the pressure regulator **460** to a certain predetermined pressure one can control the length of time the refrigerant is retained within the cold plate **424** thereby either increasing or decreasing the time the refrigerant is in cooling engagement with the beverage. To increase the time pressure regulator **460** is set at a higher pressure and to decrease the time it is set at a lower pressure. An electronic pressure control unit **462** is provided whereby the operator can more easily set pressure regulator **460** as well as bypass valve **456**. Suitable pressure control units, such as those marketed by Alco, are known to those skilled in the art.

In another alternate embodiment of the invention, the cold plate disclosed in co-pending application Ser. No. 10/633,728, for Coil Basket having the same inventor as the subject invention may be utilized. The disclosure of application Ser. No. 10/633,728 is hereby incorporated by reference in its entirety.

As show in FIGS. **4** and **5**, this cold plate utilizes a beverage line coil basket having a plurality of clips or Y-connectors to take a single inlet line and separate it into a plurality of lines within the cold plate and then reduce the plurality of lines back down to a single outlet line. This allows for greater exposure of the beverage to the refrigerant lines within the cold plate to maximize the cooling effect of the cold plate on the beverage.

The beverage line circulation system shown in isolation in FIGS. **4** and **5** includes an inlet **50** formed with a connector portion **58** that connects to the beverage line. The inlet **50** further includes a straight pipe portion **60** leading to a cylindrical compartment **65** with a longitudinal axis traverse with the longitudinal axis of the straight pipe portion **60**. The cylindrical compartment **65** has an inlet **70** at a centered position on its top surface where the straight pipe portion **60** is welded, such that beverage conducted through the straight pipe portion **60** enters and fills the cylindrical compartment **65**. The cylindrical compartment **65** includes two outlets **75** on the bottom surface equally spaced from the central inlet location, and each outlet **75** is welded to an intermediate inlet tubing element **80** such that each intermediate inlet tubing element **80** receives an equal distribution of the beverage flow entering the cylindrical compartment **65**. Here, the internal diameter of each intermediate segment **80** is smaller compared with the inner diameter of the straight pipe section **65**, and the pair of intermediate segments **80** are preferably arranged in a parallel orientation having conforming curvatures forming an elbow section **88**. The transition from a single flow through the straight pipe **60** of the inlet **50** to the pair of intermediate segments **80** constitutes a first stage.

The two intermediate segments **80** at the end of the elbow **88** each terminate in a Y-connector or splitter clip **90** that further divides the flow in each intermediate segment **80** into two smaller, beverage tubes **95**. Again, the outlets **98** of the Y-connector **90** are spaced equal distant from the inlet **94** so as to equalize the flow between the two beverage tubes **95**. It may be necessary to stagger the location of the Y-connecters **90** in the vertical direction as shown in FIG. **5** in order to minimize the profile of the basket **10**, since the Y-connectors **90** have a width greater than the width of two beverage tubes **95**. Placing the two Y-connectors **90** at the same vertical location could unnecessarily widen the basket **10** at that point, so slightly staggering the position of the Y-connectors provides a more compact configuration. The creation of the four beverage lines **95** from the two intermediate segments **80** comprises the second stage.

The four beverage tubes **95** are preferably arranged substantially in a common plane as shown in FIG. **5**, and assimilate into the grouping of the refrigerant conducting tubes. Because the beverage flow has been reduced in two stages, each stage exactly doubling the lines of the previous stage, the resultant flows are equally balanced and each beverage (beer) line is subjected to the same heat exchanging conditions.

The four tubes **95** conducting the beverage converge into two intermediate outlet segments **115** in the same manner as that described for the inlet stage two. That is, two Y-connectors **120** each consolidate two beverage tubes **95** into an intermediate segment **115** having an inner diameter larger than the inner diameter of the heat exchanger tubes **95**. The two intermediate outlet segments **115** feed to a cylindrical compartment **120** along a bottom surface thereof, where the inlets **118** to the cylindrical compartment **120** are equally spaced from a centrally disposed outlet **125**. The outlet **125** feeds a single straight pipe section **130** leading to beverage outlet **140** of the cold plate with connector portion **142** that carries the end of a beverage line connecting the cold plate with beverage dispenses **10**a, b shown in FIG. **1**.

In describing the above beverage circulating system, the term Y-connector or splitter should be interpreted broadly as any fluid dividing member that has either one inlet line and two outlet lines, or two inlet lines and one outlet. Thus, the cylindrical compartments described with respect to the first stage division and consolidation should be considered Y-connectors for purposes of this application. Likewise, clips or other flow dividers that provide a 2 for 1 flow division or flow consolidation are also properly considered Y-connectors.

Each stage of the beverage flow subdivision is preferably accompanied by a reduction in the inner diameter of the downstream tubing, but in a preferred embodiment the cross-sectional area of the two downstream tubing is greater than the cross sectional area of the upstream tubing. This increase in the flow capacity of the downstream tubing results in a slowing of the fluid flow through the cold plate leading to more efficient heat exchange conditions. That is, the resident time for the beverage in the cold plate is increased and thus the efficiency of the heat exchange is improved when compared to faster moving beverage flow.

While the description above discloses two stages of beverage subdivision forming four discrete beverage tubes **95**, the present invention can be expanded to a third stage of subdivision wherein the four beverage tubes are replaced with four transitional tubes that each incorporate a Y-connector at a staggered position with respect to each other to yield eight individual beverage conducting tubes in a manner similar to that described above. Employing eight beverage lines increases the available contact area with the refrigerant conducting lines and can further slow the flow of beverage in the manner described above. However, machining smaller tubes can be more expensive and increase the overall cost of the cold plate. Further, because the walls of the tubing are minimized in the beverage portion of the basket to facilitate heat transfer, smaller tubes may be susceptible to crimping which can block flow and negatively impact heat transfer. Those skilled in the art will recognize that additional stages of subdivision can be provided to allow for additional beverage lines if desired. The ultimate number of beverage lines N can be characterized as N=2s, where S is the number of stresses and S is greater or equal to 2.

It is to be understood that the subject invention is not to be limited to the specific embodiment disclosed herein but is to be accorded the full breadth and scope of the appended claims.

I claim:

[1. A beverage dispensing cooling system for dispensing chilled beverages comprising:
- a refrigerant condenser;
- a cold plate;
- a heat exchanger;
- an accumulator;
- a compressor; and
- a bypass valve positioned within a bypass line positioned between the heat exchanger and the cold plate, wherein said cooling system is filled with a critical charge of refrigerant and further wherein said cooling system operates continuously with the refrigerant circulating through the system and wherein said bypass valve is set to a predetermined back pressure and upon aid pressure being reached said bypass valve opens and diverts the flow of refrigerant from the cold plate to the condenser.**]**

[2. The beverage dispensing cooling system of claim **1** further including a pressure regulator to control the pressure of the refrigerant as it exits the cold plate.**]**

[3. The beverage dispensing cooling system of claim **2** further including means for controlling said pressure regulator and said bypass valve.**]**

4. A beverage dispensing cooling system for dispensing chilled beverages comprising:
- *a refrigerant condenser;*
- *a beverage cooling unit;*
- *an accumulator;*
- *a compressor;*
- *a receiver tank;*
- *a pressure switch;*
- *an evaporator valve in fluid communication with the accumulator and the beverage cooling unit; and*
- *a line valve in fluid communication with the refrigerant condenser and the receiver tank;*
- *wherein the pressure switch monitors pressure of refrigerant between the beverage cooling unit and the accumulator, and the pressure switch causes the evaporator valve and the line valve to open and close in response to the monitored pressure, to control circulation of refrigerant within the cooling system.*

5. A beverage dispensing cooling system as defined in claim 4, wherein the system further comprises a time delay relay in communication with the evaporator valve and the line valve.

6. A beverage dispensing cooling system as defined in claim 4, wherein the system further comprises a defrost valve in between the compressor and the beverage cooling unit.

7. A beverage dispensing cooling system as defined in claim 6, wherein the system comprises a defrost switch which, when deployed, causes the defrost valve to open.

8. A beverage dispensing cooling system as defined in claim 7, wherein the defrost switch is a manually-operable switch.

9. A beverage dispensing cooling system as defined in claim 4, wherein the system further comprises a thermal expansion valve in between the receiver tank and the beverage cooling unit.

10. A beverage dispensing cooling system as defined in claim 4, wherein the system further comprises a compressor pressure switch in communication with the compressor, the compressor pressure switch causing the compressor to turn on and off as pressure of refrigerant flowing into the compressor falls and rises.

11. A beverage dispensing cooling system as defined in claim 4, wherein the cooling system is contained within a housing.

12. A beverage dispensing cooling system as defined in claim 4, wherein when the evaporator valve and the line valve close, gaseous refrigerant is pumped from the accumulator into the compressor until the compressor pressure switch shuts off the compressor.

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