

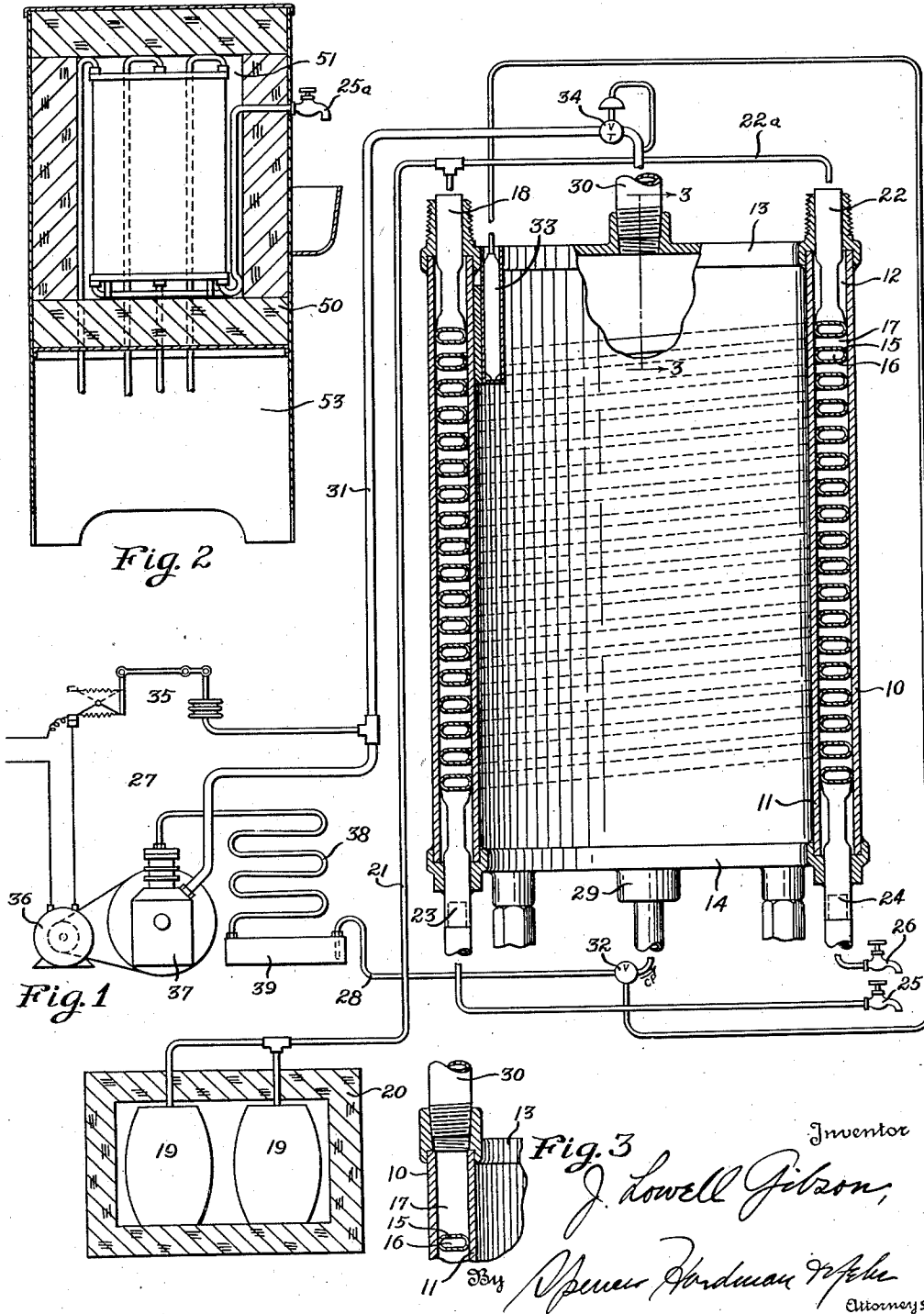
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REFRIGERATING APPARATUS

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REFRIGERATING APPARATUS

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This invention relates to refrigeration and more particularly to a liquid cooler.

It is an object of this invention to provide a cooler for liquids which may be easily and economically manufactured and which is extremely efficient in its operation.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a view showing my improved cooler with parts shown diagrammatically and with parts shown in vertical cross section;

Fig. 2 is a vertical cross sectional view, somewhat diagrammatic, of a cabinet in which my cooler may be installed; and

Fig. 3 is a cross sectional view taken along the lines 3—3 of Figure 1.

A liquid cooler embodying features of my invention preferably embodies a metallic structure forming vertically spirally or circuitously arranged passageways in thermal contact with each other, one of the passageways being for liquid to be cooled and the other for refrigerant, these fluids flowing in counter direction to each other. Thus the cooler may take the form of two nested metallic tubes 10 and 11 having a space 12 between them sealed at the ends, for example, by means of metallic rings 13 and 14 soldered or brazed to the tubes and in which various fluid flow connections are made. A pipe 15 is circuitously arranged in the space 12, preferably in the form of a vertical spiral. This pipe is made of copper and is preferably flattened and contacts with both tubes to form two circuitous or spiral passageways inside and outside of said pipe. This pipe may be tinned on the inside and/or the outside. One of these passageways is for liquid to be cooled and the other is for refrigerant. In the form now preferred, the passageway for liquid to be cooled is inside the pipe 15 and is indicated at 16. The passageway for refrigerant is on the outside of pipe 15 and is indicated at 17. An inlet for liquid to be cooled takes the form of a connection 18 passing through ring 13 and is connected to a source of liquid to be cooled such as one or more beer kegs 19 placed in a refrigerated compartment 20 and connected by the pipe 21 with the inlet 18. If desired, and as shown, more than one pipe may be used spirally arranged in the space 12. Such pipes may have their coils interspaced and under such circumstances the

other pipe may be connected by an inlet 22 similar to the inlet 18 with the same or a different source of liquid to be cooled, such as to a supply of a different grade of beer or to a supply of water. Thus the pipe 22a may be connected to pipe 21 or to a different source of supply. The pipe or pipes 15 have liquid outlets 23 and 24 in the ring 14 and are connected to faucets 25 and 26 through which the cooled liquids are discharged.

Volatile refrigerant is introduced into the passageway 17, preferably in a flow direction counter to the flow of the liquid to be cooled. Thus a refrigerant liquefying unit 27 has its liquid refrigerant line 28 connected to a refrigerant inlet 29 in the ring 14 which discharges into the lower end of the passageway 17. The vaporized refrigerant leaves the passageway 17 through a refrigerant suction outlet 30 passing through the ring 13 and is connected by the refrigerant suction line 31 with the refrigerant liquefying unit 27.

Automatic controls are provided. Thus an automatic expansion valve 32 is connected to the lower end of the refrigerant passageway 17 preferably adjacent the inlet 29 and is calibrated to feed liquid refrigerant whenever the pressure in passageway 17 falls below a predetermined limit except when thermally throttled. A thermally responsive element, such as bulb 33, is placed in thermal exchange relationship with the liquid inlet 18 or 22 and in thermal exchange relationship with refrigerant near outlet 30 and controls the flow of refrigerant through the valve 32. This bulb 33, which is thus responsive to the liquid refrigerant level in the passageway 17 throttles valve 32 when the liquid refrigerant attains the proper level and thus prevents the spilling over of the refrigerant into the line 31. On the other hand, the flow of warm liquid into the inlet 18 or 22 warms the bulb 33 and thus tends to open the valve 32 for the flow of refrigerant when needed. A pressure limiting valve 34 is placed adjacent the outlet 30. This valve 34 prevents the refrigerant liquefying unit from reducing the pressure in the passageway 17 below the vapor pressure temperature of the refrigerant corresponding to the freezing temperature of the liquid to be cooled. It is of the type which gradually throttles more and more as the pressure drops in passageway 17 until it closes entirely before liquid can be frozen in passageway 16. An automatic control for the refrigerant liquefying unit 27 is provided which is responsive to conditions in the cooler.

Thus a pressure responsive switch 35 is connected to the suction line 31 between the valve 34 and the unit 27. The switch 35 tends to stop the motor 36 of the unit 27 when the pressure in the pipe 31 falls to a predetermined limit after valve 34 has closed, and tends to start the motor when the pressure rises to a predetermined limit after the valve 34 has opened. The motor 36 drives a compressor 37 of the unit 27 to which the pipe 31 is connected. The compressor 37 discharges into a condenser 38 of the unit 27 which is provided with a liquid refrigerant receiver 39 to which the pipe 28 is connected.

From the above it will be seen that the valve 32, with its bulb 33, tends to maintain the refrigerant passageway 17 in a flooded condition. When liquid to be cooled flows through the passageway 16, it opens valve 32 and simultaneously the liquid refrigerant, flowing into the passageway 17 volatilizing a portion thereof thereby opening valve 34 and increasing the pressure in the suction line 31 to the limit at which the motor 36 is started. The volatilized refrigerant is thus reliquefied and it is returned for reuse in the cooler. The unit 27 thus operates in response to conditions in the cooler through the control of switch 35.

This liquid cooler may be used in any suitable location. For example, it may be placed in a cabinet 50 having an insulated space 51 through which a connection with the discharge faucet or faucets 25a is provided. If desired, the refrigerant liquefying unit may be placed in the space 53, although it is to be understood that the unit may be placed at a remote point from the cabinet 50.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A liquid cooler comprising nested tubes, a ring in sealing engagement with said tubes at one end, sealing means at the other end of said tubes, said ring having flanges engaging the sides of said tubes, a pipe circuitously arranged in the space between said tubes forming fluid flow circuitous passageways inside and outside said pipe, a refrigerant liquefying unit connected to one of said passageways in volatile refrigerant flow relationship therethrough and a source of liquid to be cooled connected to the other of said passageways.

2. A liquid cooler comprising nested vertically arranged tubes with a space between them sealed at the ends, a pipe spirally arranged in the space between said tubes forming fluid flow spiral passageways inside and outside said pipe, a connection into one of said passageways at the upper end of said tubes adapted to be connected to a source of liquid to be cooled and a discharge connection for cooled liquid at the other end of said passageway, a refrigerant liquefying unit having liquid refrigerant discharge means connected to the lower end of the other of said passageways and vaporized refrigerant suction means connected to the upper end of said last named passageway.

3. A liquid cooler comprising nested vertically arranged tubes with a space between them sealed at the ends, a pipe circuitously arranged in the space between said tubes forming fluid flow circuitous passageways inside and outside said pipe, a connection into the upper end of one of said

passageways adapted to be connected to a source of liquid to be cooled and a discharge connection for cooled liquid at the other end of said passageway, a refrigerant liquefying unit having liquid refrigerant discharge means connected to the lower end of the other of said passageways and vaporized refrigerant suction means connected to the other end of said last named passageway, the liquid to be cooled and the refrigerant flowing in counter directions in said cooler, an automatic expansion valve in said liquid refrigerant discharge means, and a thermostatic element at the upper end of said tubes modifying said valve.

4. A liquid cooler comprising vertically disposed nested tubes with a space between them sealed at the ends, a pipe circuitously arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space, one of said passageways being a refrigerant passageway and the other of said passageways being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into one end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connected to the upper end of said refrigerant passageway, a refrigerant liquefying unit connected to said valve and suction outlet, and a thermostatic element at the end away from said valve and modifying said valve.

5. A liquid cooler comprising nested tubes with a space between them sealed at the ends, a pipe circuitously arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space one of said passageways being a refrigerant passageway and the other of said passageways being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into one end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to one end of said refrigerant passageway and a refrigerant suction outlet connected to the other end of said refrigerant passageway, a refrigerant liquefying unit connected to said valve and suction outlet and a pressure limiting valve between said suction outlet and said refrigerant liquefying unit.

6. A liquid cooler comprising nested tubes with a space between them sealed at the ends, a pipe circuitously arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space one of said passageways being a refrigerant passageway and the other of said passageways being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into one end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to one end of said refrigerant passageway and a refrigerant suction outlet connected to the other end of said refrigerant passageway, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit and an automatic control for said refrigerant liquefying unit responsive to refrigerant pressure between said pressure limiting valve and said refrigerant liquefying unit.

7. A liquid cooler comprising vertically nested

tubes with a space between them sealed at the ends, a pipe spirally arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space, one of said passageways being a refrigerant passageway and the other passageway being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into the upper end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connected to the upper end of said refrigerant passageway, a thermostatic bulb adjacent said inlet connection and controlling said automatic expansion valve, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit, and an automatic control for said unit responsive to refrigerant pressure between said pressure limiting valve and said unit.

8. A liquid cooler comprising a metallic structure forming vertically spirally arranged passageways in thermal contact with each other, one of said passageways being a refrigerant passageway and the other passageway being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into the upper end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connection to the upper end of said refrigerant passageway, a thermostatic bulb adjacent said inlet connection and controlling said automatic expansion valve, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit, and an automatic control for said unit responsive to refrigerant pressure between said pressure limiting valve and said unit.

9. A liquid cooler comprising a metallic structure forming vertically spirally arranged passageways in thermal contact with each other, one of said passageways being a refrigerant passageway and the other passageway being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into the upper end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connected to the upper end of said refrigerant passageway, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit, and an automatic control for said unit responsive to refrigerant pressure between said pressure limiting valve and said unit.

10. A liquid cooler comprising nested tubes with a space between them sealed at the ends, a pipe circuitously arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space one of said passageways being a refrigerant passageway and the other of said passageways being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into one end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to one end of said refrigerant passageway and a refrigerant

suction outlet connected to the other end of said refrigerant passageway, said liquid to be cooled and refrigerant flowing in counter-current, a thermally responsive member located adjacent said suction outlet and said inlet connection from a source of liquid and controlling said automatic expansion valve and a refrigerant liquefying unit connected to said valve and suction outlet.

11. A liquid cooler comprising vertically nested tubes with a space between them sealed at the ends, a pipe spirally arranged in said space forming fluid flow passageways inside and outside said pipe and extending along said space, one of said passageways being a refrigerant passageway and the other passageway being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into the upper end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connected to the upper end of said refrigerant passageway, a thermostatic bulb adjacent said suction outlet and controlling said automatic expansion valve, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit, and an automatic control for said unit responsive to refrigerant pressure between said pressure limiting valve and said unit.

12. A liquid cooler comprising a metallic structure forming vertically spirally arranged passageways in thermal contact with each other, one of said passageways being a refrigerant passageway and the other passageway being a liquid to be cooled passageway, an inlet connection from a source of liquid to be cooled into the upper end of said liquid to be cooled passageway and a discharge from the other end of said passageway, an automatic expansion valve connected to the lower end of said refrigerant passageway and a refrigerant suction outlet connected to the upper end of said refrigerant passageway, a thermostatic bulb adjacent said suction outlet and controlling said automatic expansion valve, a refrigerant liquefying unit connected to said valve and suction outlet, a pressure limiting valve between said suction outlet and said refrigerant liquefying unit, and an automatic control for said unit responsive to refrigerant pressure between said pressure limiting valve and said unit.

13. A liquid cooler comprising nested continuously longitudinally straight walled tubes, rings at both ends of said tubes having flanges in sealing engagement with the ends of said tubes, a pipe circuitously arranged in the space between said tubes forming fluid flow circuitous passageways inside and outside said pipe, a refrigerant liquefying unit connected to one of said passageways in volatile refrigerant flow relationship therethrough and a source of liquid to be cooled connected to the other of said passageways.

14. A liquid cooler comprising nested continuously longitudinally straight walled tubes, rings at both ends of said tubes having flanges in sealing engagement with the ends of said tubes, a pipe circuitously arranged in the space between said tubes forming fluid flow circuitous passageways inside and outside said pipe, a refrigerant liquefying unit connected to one of said passageways in volatile refrigerant flow relationship and a source of liquid to be cooled connected to the other of said passageways, said pipe passing through both of said rings.

15. A liquid cooler comprising walls forming coaxial spiral refrigerant and liquid to be cooled, passageways of substantially the same diameter of convolution in thermal exchange relationship, a connection between a source of liquid and said liquid to be cooled passageway at one end of said cooler, and a liquid discharge connection with said passageway at the other end of said cooler, a refrigerant liquefying unit, a liquid refrigerant connection between said unit and said refrigerant passageway at the last named end of said cooler, an automatic expansion valve in said connection, an expanded refrigerant connection between the other end of said refrigerant passageway at said first named end of said cooler and said refrigerant liquefying unit, and a thermostatic element at said first named end in thermal contact with both of said passageways modifying said automatic expansion valve.
- 20 16. A liquid cooler comprising walls forming coaxial spiral refrigerant and liquid to be cooled passageways in thermal exchange relationship, a connection between a source of liquid and said liquid to be cooled passageway at one end of said cooler, and a liquid discharge connection with said passageway at the other end of said cooler, a refrigerant liquefying unit, a liquid refrigerant connection between said unit and said refrigerant passageway at the last named end of said cooler, an automatic expansion valve in said connection, an expanded refrigerant connection between the other end of said refrigerant passageway at said first named end of said cooler and said refrigerant liquefying unit, and a thermostatic element at said first named end in thermal contact with

said liquid to be cooled passageway modifying said automatic expansion valve.

17. A liquid cooler comprising walls forming coaxial circuitous refrigerant and liquid to be cooled passageways in thermal exchange relationship, a connection between a source of liquid and said liquid to be cooled passageway at one end of said cooler, and a liquid discharge connection with said passageway at the other end of said cooler, a refrigerant liquefying unit, a liquid refrigerant connection between said unit and said refrigerant passageway at the last named end of said cooler, an automatic expansion valve in said connection, an expanded refrigerant connection between the other end of said refrigerant passageway at said first named end of said cooler and said refrigerant liquefying unit, and a thermostatic element at said first named end in thermal contact with both of said passageways modifying said automatic expansion valve.

18. A liquid cooler comprising nested tubes sealed together to form a longitudinally extending annular passageway between said tubes, a pipe circuitously arranged in the space between said tubes forming fluid flow circuitous passageways inside and outside said pipe, a refrigerant expansion valve adjacent one end of one of said passageways and an evaporated refrigerant outlet at the other end of said passageway, a refrigerant liquefying unit connected in refrigerant flow relationship with said expansion valve and said refrigerant outlet, a source of liquid to be cooled connected to one end of the other of said passageways, and a liquid discharge outlet at the other end of said last named passageway.

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