March 30, 1948. B. J. ZAPART ET AL 2,438,594

EVAPORATIVE COOLER

Filed Jan. 11, 1946

Fig. 1

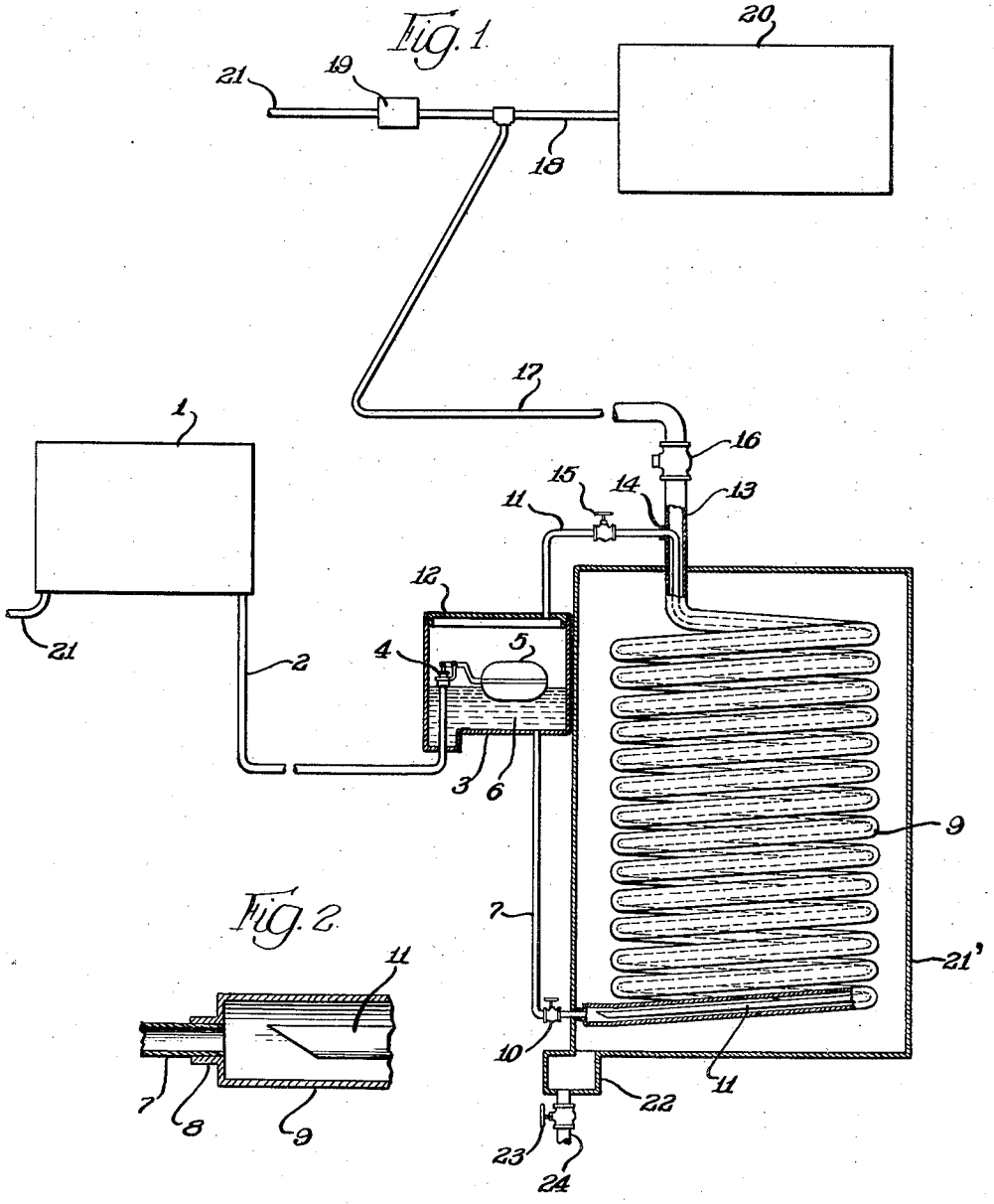


Fig. 2

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Patented Mar. 30, 1948 2,438,594

UNITED STATES PATENT OFFICE

2,438,594

EVAPORATIVE COOLER

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Application January 11, 1946, Serial No. 640,548

4 Claims. (Cl. 62—169)

1

Reference is hereby made to our co-pending application for "Refrigerating device" filed August 24, 1945, Serial No. 612,426. In that application we have disclosed a device into which a liquid refrigerant is fed into a coil, wherein a degree of vacuum is maintained by the suction engendered by an engine, which ultimately consumes the refrigerant vapors created in the coil during the refrigerating process. We have disclosed in said application means for injecting air into the lower end of the coil to mix with the refrigerant therein to enhance its vaporization.

The invention disclosed in the present application has the same objects in view as that in the said co-pending application, namely the provision of a suitable mechanism, including a coil set intermediately of a source of refrigerant, such as gasoline tank, and an engine, such as an engine in an automobile, truck, locomotive, etc., into which the vapors engendered in the coil are sucked into and consumed, and wherein the engine due to its inherent property maintains a vacuum for sucking into the coil air to mix with the refrigerant therein for the purpose of bringing about vaporization of the refrigerant in the coil.

A still further object of the present invention is to pre-cool the air injected into the coil to bring about more efficient cooling of the coil.

A still further object of the present invention is to provide a pipe substantially centrally of the coil, and running substantially throughout its entire length, through which air is sucked due to the operation of the engine, for pre-cooling the air as it leaves the pipe and is injected into the refrigerant for the purpose of mixing therewith, at the lower end of the coil.

A still further object of the present invention is the provision of a tank, in the device of the character hereinabove described, into which liquid refrigerant is fed from the source thereof and maintained in proper amount and level by suitable valve, with air supplying pipe connecting therewith for the purpose of permitting escape of any fumes engendered in said tank due to the vaporization of the refrigerant therein, and feeding thereof together with air into the coil.

Another object of the present invention is the provision of a refrigeration method wherein liquid refrigerant is maintained under vacuum to bring about the vaporization thereof, with air injected into the refrigerant to mix therewith for enhancing the vaporization thereof, and pre-cooling the air before its injection.

2

With the above general objects in view and others that will appear as the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawing and pointed out in the appended claims.

In the drawing forming a part of this application:

Fig. 1 is a plan view, partly in section, of the present device, on a vertical plane, diagrammatically showing the relative position thereof with respect to a source of refrigerant, such as gasoline tank in a motor vehicle and an engine thereof; and

Fig. 2 is an enlarged longitudinal cross-sectional view of the lower end of a refrigerating coil with the refrigerant supply pipe connecting therewith, and with an air pipe, the latter in elevation, in an operative position therewithin.

Referring in detail to the present drawing there is shown tank 1, which may be a gasoline tank in a motor vehicle or similar conveyance, such as truck, locomotive, etc., and which tank constitutes the source of refrigerant in connection with the present device. Refrigerant supply pipe 2, connecting with the lower end of said tank 1, passes through the bottom of refrigerant distribution tank 3, and within a suitable distance from the bottom of the latter tank connects with float valve 4 which is actuated by float 5. Said float 5 floats upon the surface of gasoline 6 or other suitable liquid refrigerant, such as benzene, kerosene or any other which is suitable for use as a motive source in an engine or fuel in a furnace. The gasoline, or other liquid refrigerant is supplied into said distribution tank 3 by means of said pipe 2, and spills itself into said tank through valve 4.

Connecting with the bottom of tank 3 is a refrigerant feeding pipe 7, the opposite end of which is rigidly engaged, either threadedly or otherwise, by a reduced collar 8, integrally formed with coil pipe 9. Intermediately of its ends, said refrigerant feeding pipe 7 is provided with valve 10, by means of which the amount of refrigerant supplied into coil 9 is regulated, or if desired the same may be completely shut off by closing the same.

Air feeding pipe 11, which is of a diameter suitably smaller than that of coil 9 connects by one of its ends with the upper end of distribution tank 3 or with lid 12, as is shown, and enters coil 9 at its upper vertical end 13, as at 14, and from that point is positioned substantially cen-

trally of said coil 9, and coextensive with its length, except that at the lower end thereof it terminates short of collar 8. Thus, said pipe 11 is concentrically positioned with respect to coil 9, and in a spaced relation therewith. Intermediately of distribution tank 3 and pipe 13 said air supply pipe 11 is provided with bleeder valve 15 through which air is supplied into said pipe 11. The lower end of coil 9 and pipe 11 are at an incline, for the purpose which will be hereinafter stated.

Pipe 13 has check valve 16. Connecting with said pipe 13, which is the upper continuation of coil 9, is pipe 17, the latter connecting with manifold 18, and intermediately of carburetor 19 and engine 20. Through pipe 21, the latter connecting with tank 1 and carburetor 19, gasoline is fed into carburetor 19. Mixture of air and gasoline vapors passes from carburetor 19 through manifold 18 into engine 20, where it is used as a motive power in the usual manner.

Through lid 12 access may be had into distribution tank 3 for regulating float valve 4.

Coil 9 may be enclosed within housing 21', which may be provided with suitable openings through which cool air may be blown out by suitable means into the interior of a motor vehicle, a truck body, passenger or refrigerated freight car, or the like. If the device is used as a home refrigerating unit, in which engine 20 may be substituted for a furnace, wherein the refrigerant is burned for heating purposes, housing 21' may be the walls for the refrigerating unit.

The bottom of housing 21' may be provided with reservoir 22, within which water may collect, when ice formed on coil 9 melts on de-frosting of the device. Through check valve 23 in pipe 24 water may pass outwardly of said reservoir 22.

As to the operation of the device, coil 9 is filled with gasoline, or other liquid refrigerant, through pipe 7 and valve 10, from distribution tank 3, to the normal level of that of gasoline in said tank 3. As the gasoline is periodically consumed in said coil 9 due to the vaporization thereof, float 5 will periodically be brought to a lower level for actuating float valve 4, thereby renewing the supply of the gasoline in said tank 3.

Due to the normal operation of engine 20, a furnace or other appliance, vacuum is maintained in pipe 17 and in the upper end 13 of coil 9, as well as in coil 9, through check valve 16. Due to said vacuum an amount of air is constantly sucked into coil 9 through pipe 11, air leaving said pipe 11 through its lower open end. The lower end of coil 9 is at an incline for the purpose of enhancing the rise of air in coil 9 as it leaves said pipe 11. Valve 15 permits the intake of air from the outside into said pipe 11, and the amount of air taken may be regulated by regulating said valve 15. Any fumes gathering in the upper end of tank 3 due to the normal vaporization of gasoline therein, escape through said pipe 11 by being sucked thereinto, together with the air through valve 15 by the vacuum engendered in pipe 13 and coil 9 through pipe 17 and manifold 18, by the action of engine 20.

Check valve 16 acts to maintain a comparatively uniform degree of vacuum in pipe 13 and coil 9. During varied cycles of the operation of engine 20 the degree of vacuum in manifold 18 and pipe 17 may vary. During intervals in the operation of engine 20 the degree of vacuum in pipe 17 and manifold 18 may not be sufficient to overcome valve 16 for opening the same. Thus, during those intervals check valve 16 remains

closed, without affecting the degree of vacuum in pipe 13 and coil 9 engendered therein during preceding cycle of the operation of the engine when the same was sufficient to open valve 16. When suction upon check valve 16 is sufficient to open the same, the mixture of air and vapor gas generated in coil 9 and pipe 13 will be sucked in through said check valve 16 and into pipe 17, from which the same will pass into manifold 18 and then to engine 20 to be utilized therein as a motive power along with the air and gas mixture from carburetor 19.

It will be seen that due to the fact that air supply pipe 11 throughout its major length is immersed in the gasoline in coil 9, the air passing therethrough into coil 9 becomes pre-cooled, thereby hastening the vaporization of the refrigerant in coil 9 and accelerating the cooling of coil 9 during the initial stages of the operation of the device, as it reduces the time required for the exchange of temperatures of the air and the refrigerant. During the advanced stages of the operation of the device the use of the pre-cooled air adds to the efficiency of vaporization of the refrigerant in coil 9 in that it eliminates mixing of air and refrigerant of extremely varied temperatures and consequent too fast vaporization of the latter.

If tank 1 is positioned on the same level as coil 9, so that refrigerant in coil 9 does not overflow beyond the upper end thereof, distribution tank 3 may be entirely eliminated. At least the latter will not be an essential element of the device if the level of the refrigerant in tank 1 coincides with the horizontal plane substantially with the upper end of coil 9. When distribution tank 3 is eliminated, in that event supply pipe 2 may directly connect with collar 8, as in that event feeding pipe 7 would be unnecessary.

It is further observed that lid 12 is closely fitted within the upper end of tank 3, thereby forming a seal therewith. Due to the action of vacuum in coil 9 and pipe 13, vacuum will be maintained in tank 3 through said pipe 11. Therefore, when valve 4 is open the vacuum in tank 3 will suck gasoline into said tank 3 through pipe 2. Thus, the flow of gasoline through valve 4 into tank 3 will be assured, regardless of the relative positions of tanks 1 and 3.

The lower end of pipe 11 is tapered, as seen in the drawing, for facilitating entry of air therethrough into coil 9.

It is understood that we do not desire to limit the refrigerant to gasoline as obviously other refrigerants, such as ammonia water may be used, and since ammonia water cannot be used as a motive power for an engine, the vapors thereof, after leaving coil 9, may be consumed in a furnace when engine 20 is substitued thereby.

While there is described herein a preferred embodiment of the present invention, it is nevertheless to be understood that minor changes may be made therein without departing from the spirit and scope of the invention as claimed.

What we claim as new is:

1. In combination with a source of liquid refrigerant and an appliance wherein the refrigerant is normally consumed when converted into gas, a helical refrigerating device comprising a refrigerating coil, a conduit connecting said source with the one end of said coil, said conduit being adapted to constantly supply the refrigerant to said coil as the same is used up, a second conduit connecting the other end of said coil with said appliance, the appliance inducing

vacuum in said coil through said last named conduit for vaporizing the refrigerant in said coil, the generated vapor passing through said last named conduit into said appliance to be normally consumed therein, and an air pipe concentrically disposed within said coil and having one end thereof connected with the atmosphere, said air pipe being in a spaced relation with said coil and substantially coextensive with the length thereof, the vacuum induced in said coil by said appliance sucking in air from the other end of said air pipe to inject the same into and to mix with the refrigerant in the said coil for enhancing vaporization thereof, the air passing through said air pipe becoming pre-cooled before the injection thereof into the refrigerant.

2. In combination with a source of liquid refrigerant and an appliance wherein the refrigerant is normally consumed when converted into gas, a refrigerating device comprising a refrigerating coil, a conduit connecting said source with the one end of said coil, said conduit being adapted to constantly supply the refrigerant to said coil as the same is used up, a second conduit connecting the other end of said coil with said appliance, the appliance inducing vacuum in said coil through said last named conduit for vaporizing the refrigerant in said coil, the generated vapor passing through said last named conduit into said appliance to be normally consumed therein, an air pipe having one of its ends connected with the atmosphere and disposed substantially in a spaced relation with said coil and being substantially coextensive with the length thereof, the vacuum induced in said coil by said appliance sucking in air through the other end of said air pipe to inject the same into and to mix with the refrigerant in the said coil for enhancing vaporization thereof, the air passing through said pipe becoming pre-cooled before the injection thereof into the refrigerant, and an air intake valve disposed intermediate the ends of said air pipe.

3. In combination with a source of liquid refrigerant and an appliance wherein the refrigerant is normally consumed when converted into gas, a refrigerating device comprising a refrigerating coil, a tank, a conduit connecting said tank with said source, normally said conduit being closed, a feeding pipe connecting said tank with one end of said coil, a second conduit connecting the other end of said coil with said appliance, said appliance inducing vacuum in said coil through said last named conduit for vaporizing refrigerant in said coil, the vapor generated in said coil due to the vaporization of the refrigerant therein passing through said last named conduit into said appliance to be normally utilized therein, means periodically opening said first named conduit for renewing the refrigerant in said tank as the same is periodically consumed due to the vaporization thereof in said coil, and an air supplying pipe having an open

end connecting with the atmosphere and entering said coil at the end adjacent the juncture of said second named conduit with said coil, said air supplying pipe being in a spaced relation with said coil and substantially coextensive with the length thereof, the vacuum induced in said coil sucking in the air through the open end of said air supplying pipe and adjacent the other end of said coil for injecting the air into and mixing the same with the refrigerant in said coil for enhancing vaporization thereof, and means connecting said air supplying pipe adjacent its open end with said tank and above said refrigerant allowing the escape therethrough of any refrigerant vapors engendered therein.

4. In combination with a source of liquid refrigerant and an appliance wherein the refrigerant is normally consumed when converted into gas, a refrigerating device comprising a refrigerating coil, a tank, a conduit connecting said tank with said source, normally said conduit being closed, a feeding pipe connecting said tank with one end of said coil, a second conduit connecting the other end of said coil with said appliance, said appliance inducing vacuum in said coil through said last named conduit for vaporizing refrigerant in said coil, the vapor generated in said coil due to the vaporization of the refrigerant therein passing through said last named conduit into said appliance to be normally utilized therein, means periodically opening said first named conduit for renewing the refrigerant in said tank as the same is periodically consumed due to the vaporization thereof in said coil, an air supplying pipe disposed within said coil and having one of its ends connecting with the atmosphere said air supplying pipe being in a spaced relation with said coil and substantially coextensive with the length thereof, the vacuum induced in said coil being adapted to suck in the air through the other end of said air supplying pipe and adjacent the other end of said coil for injecting the air into and mixing the same with the refrigerant in said coil for enhancing vaporization thereof, and means connecting said air supplying pipe with said tank and above said refrigerant for allowing the escape therethrough of any refrigerant vapors engendered therein, and an air intake valve connecting with said air supplying pipe intermediate of said tank and said coil.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,157,409	Helfrecht	May 9, 1939
2,258,725	Wilkinson	Oct. 14, 1941