Dec. 18, 1934. W. A. OWEN 1,984,758

EVAPORATING DEVICE FOR REFRIGERATING SYSTEMS

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Fig. 1.

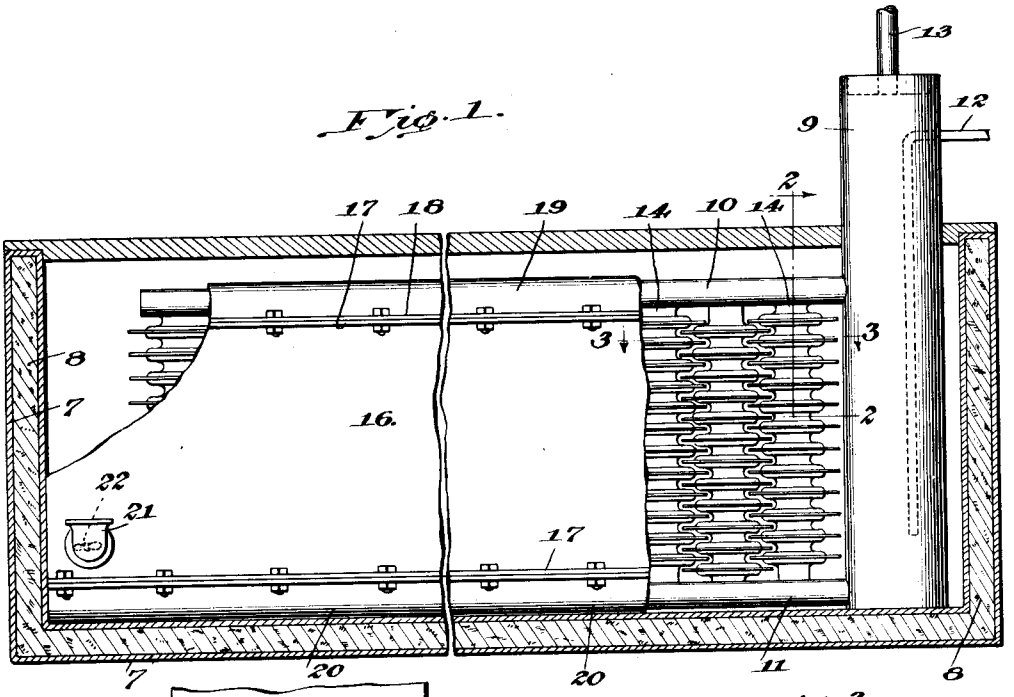
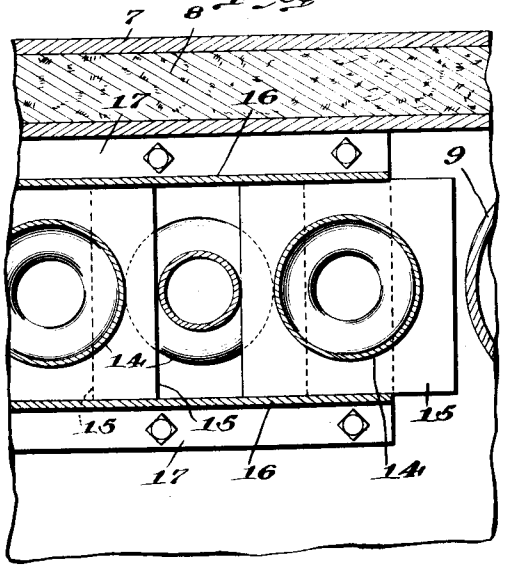


Fig. 3.



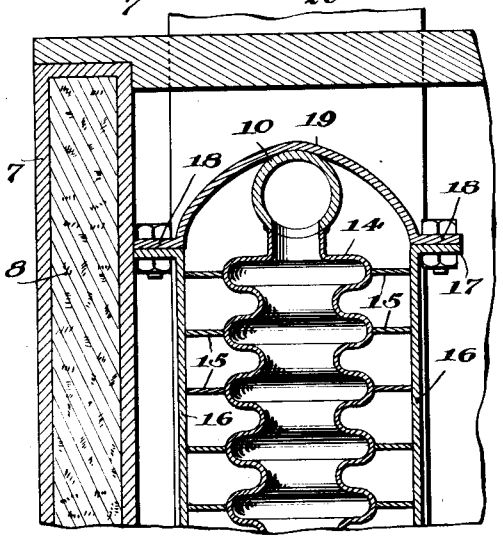


Fig. 2.

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Fig. 4.

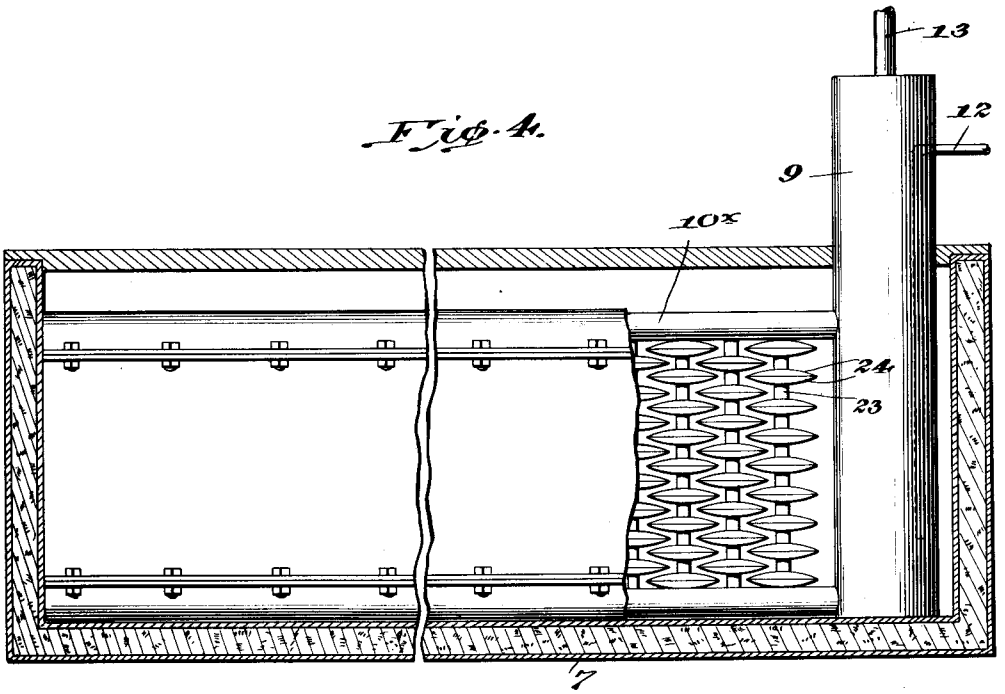


Fig. 5.

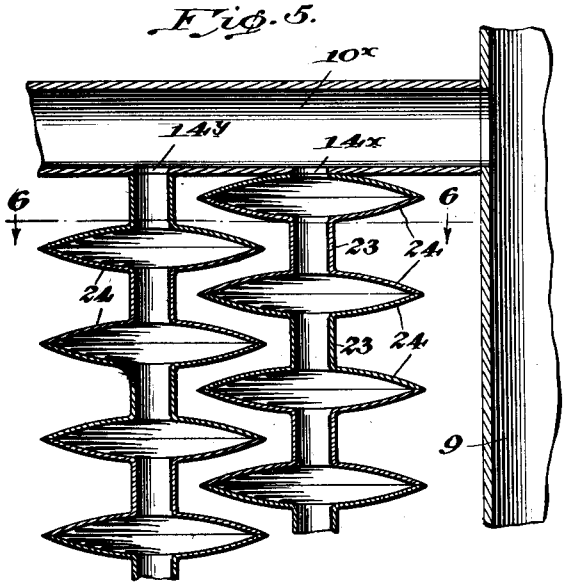
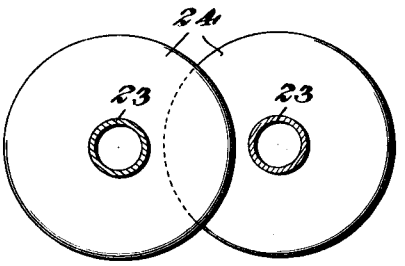


Fig. 6.



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UNITED STATES PATENT OFFICE

1,984,758

EVAPORATING DEVICE FOR REFRIGERATING SYSTEMS

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Application October 14, 1933, Serial No. 693,636

5 Claims. (Cl. 62—141)

My invention relates to improvements in evaporating devices for refrigerating systems, and it consists in the combinations, arrangements and constructions herein described and claimed.

An object of my invention is to provide an evaporator for use with a volatile refrigerant, such as anhydrous ammonia, so constructed that the vapor evolved has a comparatively free path to the vapor discharge pipe, thereby distinguishing from other devices in which the vapor is frictionally held by contact with the walls of the evaporator, thus slowing up the rate and rendering the device inefficient.

A further object of the invention is to provide an evaporator having parts so arranged that the resistance to the flow of the medium from which the heat is being abstracted in the evaporation of the volatile liquid, is reduced to a minimum, thus accelerating the rate of heat exchange and adding to the efficiency of the device.

A further object of the invention is to provide an evaporator having a relatively large conducting surface so arranged as to permit free flow of the brine or other liquid in which it is immersed.

A further object of the invention is to provide a device in which the contraction or expansion, due to the variations of temperature, will have little or no effect, as far as the opening of joints is concerned, thus providing for a minimum need for shut-downs for repairs or replacements.

A further object is to provide an evaporator which is relatively cheap to build while at the same time affording an efficient refrigerating means of durability.

Other objects and advantages will appear in the following specification and the novel features of the invention will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings forming part of this application, in which:

Figure 1 is a sectional view partly in side elevation showing one embodiment of the invention.

Figure 2 is an enlarged section on the line 2—2 of Fig. 1.

Figure 3 is an enlarged section on the line 3—3 of Fig. 1.

Figure 4 is a side elevation partly in section of a modified form of the device.

Figure 5 is an enlarged sectional view of a portion of the device shown in Fig. 4, and,

Figure 6 is a sectional view on the line 6—6 of Fig. 5.

The invention set forth herein is of the general type disclosed in the patent to Shipley, 1,718,313 of June 25, 1929. It is designed to be an improvement over the device shown in said patent, as will be pointed out hereinafter.

Referring now particularly to the drawings I have shown a tank 7, the bottom and sides of which are preferably double-walled and are insulated by a layer of cork 8 or other suitable insulating material. At one end of this tank is a vertical drum 9 which serves as a receiver suction trap. An upper header 10 communicates with this drum near the top of the tank while a lower header 11 communicates with the drum near the bottom of the latter. A feed line for a refrigerant such as liquid ammonia is indicated at 12, while the suction line leading from the drum is indicated at 13.

Extending between the upper and lower headers 10 and 11 respectively, is a series of evaporating elements in the form of fluted tubes. One of these tubes is shown at 14 in Fig. 2. It will be observed that the tube has alternately arranged portions of larger diameter with intervening portions of smaller diameter. This gives to the tube a fluted or corrugated appearance. On those portions of larger diameter are outwardly extending metal fins 15, these fins affording additional conducting surfaces by means of which the heat is abstracted from the surrounding medium in vaporizing the ammonia. The tubes, as will be seen from Fig. 1, are arranged in a row. The row of tubes has on each side thereof an enclosing casing having side walls 16. These are flanged as shown at 17 and are bolted to flanges 18 of a curved cover portion 19. At the bottom there is a bottom portion 20 which is similar to the portion 19 and which is bolted to the sides 16 in precisely the same manner as that shown in Fig. 1.

Attention is called to the arrangement of the adjacent tubes. As will be seen from Fig. 1 the fins of one tube are disposed on each side of a portion of larger diameter of the adjacent tube, the fins entering the space between adjacent portions of larger diameter, i. e., they extend toward the portions of smaller diameter of the adjacent tube. This permits of a close assemblage of the tubes without interfering with the circulation.

The side walls 16 which, together with the top 19 and the bottom 20 form an enclosing casing about the row of tubes, terminate short of the header 9 and, as will be seen from Fig. 1, the side walls extend to the opposite end of the tank. In one of the side walls I have shown an intake 21 having a propeller 22 so disposed as to cause a

circulation of the brine or other refrigerating medium from left to right in Fig. 1 under and over the fins 15 and around the tubes 14. Since the side walls 16 terminate short of the opposite end of the tank the liquid will come out at the right end into the tank and a continuous flow will be maintained as long as the propeller 22 is operated.

The flow of the warmer liquid, such as brine in contact with the tubes which are of course made of highly conductive metal, causes the rapid evaporation of the ammonia. Consider the cross section of the tube shown in Fig. 2. When the vapor is evolved, it has a free passage direct to the header. If a vapor bubble should be generated at the sides of the tube as a great many of them will be, the shape of the tube will cause the bubble to be freed almost instantly, and to be projected into the central portion of the tube, and there will be a stream of bubbles of vapor constantly ascending the center of the tube with no contacting surfaces for causing friction of these bubbles and hence no retarding action, as distinguished from those constructions in which the liquid medium can only be vaporized by the passage of the vapor through the multiplicity of narrow tubes.

Where there is adhesion of the bubbles of vapor, the friction caused by moving against the walls of the tubes will cause a checking effect which will prevent rapid evaporation and hence will lower the efficiency of the device.

The making of the tubes in the manner specified also obviates another difficulty which is experienced in devices of this type. Owing to the change of temperature evaporators of the type such as described in the present application and in Patent 1,718,313, expand and contract. In fact to employ a good heat conductor generally means employing a conductor whose coefficient of expansion is high. This often results in strained, broken or cracked joints from which the very volatile gas escapes. In the present instance the construction is on the bellows-type as will be seen from Fig. 2. If there is any expansion or contraction it will simply mean a very slight straightening out or bending of very small portions of the tube. In other devices where the major portion of the expansion comes at a joint, the device is apt to crack.

With the tubes arranged as described in Fig. 1 there is a substantially uniform flow of the brine past the tubes as distinguished from those constructions in which the tubes merely present rounded surfaces. In the present invention the tubes with their fins arranged parallel to the direction of flow constitute what might be called a stream-line construction that gives a minimum of resistance to the flow of the brine. Where a stream comes against the side of a cylindrical tube and has to divide and pass around it, there is a portion behind the tube which is in the nature of a partial vacuum and which causes eddy currents that tend to slow up and retard the main stream. As will be seen from Fig. 1 both the front and the rear sides of the tube (the front side meaning that side facing the oncoming stream and the rear side the opposite side which the stream is leaving) are so fashioned as to cleave the stream and to prevent these disturbing currents. The result is that there is an even flow of the brine over the tubes and a more uniform and rapid evaporation caused by a steady transfer of heat from the brine to the ammonia.

In Figs. 4, 5 and 6 I have shown a modified form in which the evaporating elements consist of tubes having a series of alternate large and small diameters as in the form shown in Figs. 1, 2 and 3, but which are formed without radiating fins.

Referring particularly to Fig. 5, it will be seen that the upper head 10*x* communicates with tubes which are made of a cylindrical portion such as that shown at 23, having integral dish shaped extensions 24 at each end thereof. The dish shaped extensions 24 of one section are welded or otherwise secured to the companion extensions, so that the result is a tube having double convex portions spaced apart and joined by cylindrical portions 23 of smaller diameter.

In this form of the device one tube 14*x* is disposed with relation to an adjacent tube 14*y* in such manner that the double convex portions overlap. Considering now that the stream of brine is coming from left to right in Fig. 5, it will be observed that it will be divided by converging edges of a portion of larger diameter and that before it leaves the opposite side of the tube it will have been brought into contact with the convex extension of an adjacent tube. This tends to facilitate the flow because the parts are so designed as to cause less friction.

In this form of the device, as in the one already described, there is the bellows arrangement which takes care of undue expansion through changes of temperature. There is also a central tube through which the vapor bubbles may readily pass, and in this form as in the one already described, if the bubbles are formed, for instance in the interior of the double convex portions, they will follow these portions only a short distance before they reach the upwardly extending stream of bubbles which moves through the central portions 23.

The device is highly efficient because of the fact that it has a relatively large surface over which the rapidly moving brine can pass, thus causing a rapid evaporation of the ammonia and the consequent lowering of the temperature of the brine.

I claim:

1. An evaporating device comprising an upper and a lower header, a plurality of tubes connecting said headers, means for causing a flow of fluid in a direction transverse to the longitudinal axes of the tubes, each of said tubes having spaced apart portions of greater and less diameter, being formed to cleave the stream of oncoming liquid and for preventing cross currents in the rear of the tube, thereby providing for a uniform flow.

2. An evaporating device comprising upper and lower headers, a series of tubes connecting said headers, said tubes having alternating portions of greater and less diameter, the portions of greater diameter being staggered with respect to the corresponding portions of adjacent tubes to provide for a closer association with the adjacent tubes, and means for causing a flow of fluid over the tubes in a general direction parallel to the headers.

3. An evaporating device comprising an upper and a lower header, a plurality of tubes connecting said headers, each of said tubes having spaced apart portions of greater diameter and intervening portions of lesser diameter, the portions of greater diameter having integrally extending fins and being offset with the corresponding portions of adjacent tubes whereby the fins of one tube will enter between the portions of greater diameter in adjacent tubes, thereby permitting a closer relation of the series of tubes.

4. An evaporating device comprising an upper and a lower header, a plurality of tubes connecting said headers, and means for causing a flow of fluid in a direction transverse to the longitudinal axis of the tubes, each of said tubes having spaced apart portions of greater and less diameter, the portions of greater diameter consisting of double convex plates joined at their edges in a common plane parallel to the direction of flow of the fluid.

5. An evaporating device comprising an upper and a lower header, a plurality of tubes connecting said headers, and means for causing a flow of fluid in a direction transverse to the longitudinal axis of the tubes, each of said tubes having spaced apart portions of greater and less diameter, the portions of greater diameter having outwardly projecting fins in a common plane parallel to the direction of the flow of fluid.

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