

July 6, 1937.

G. F. ZELLHOEFER

2,085,937

ABSORPTION REFRIGERATING APPARATUS

Filed Dec. 2, 1935

2 Sheets-Sheet 1

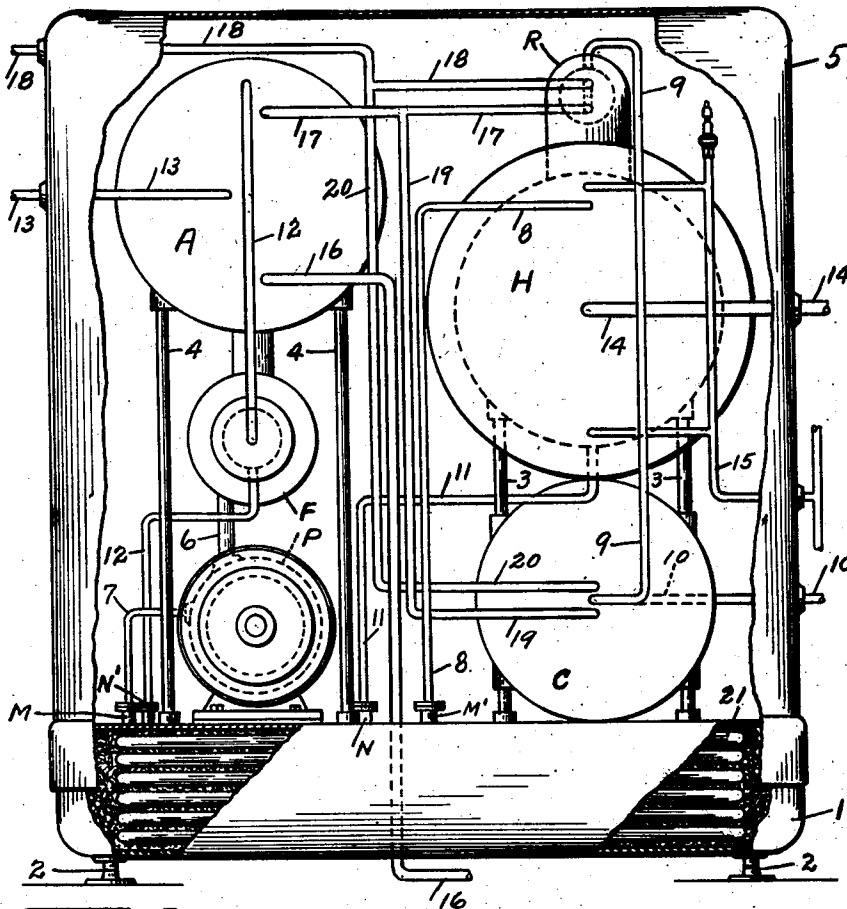


FIG. 7

INVENTOR.
GLENN F. ZELLHOEFER

BY *Langdon Morn*

ATTORNEY.

July 6, 1937.

G. F. ZELLHOEFER

2,085,937

ABSORPTION REFRIGERATING APPARATUS

Filed Dec. 2, 1935

2 Sheets-Sheet 2

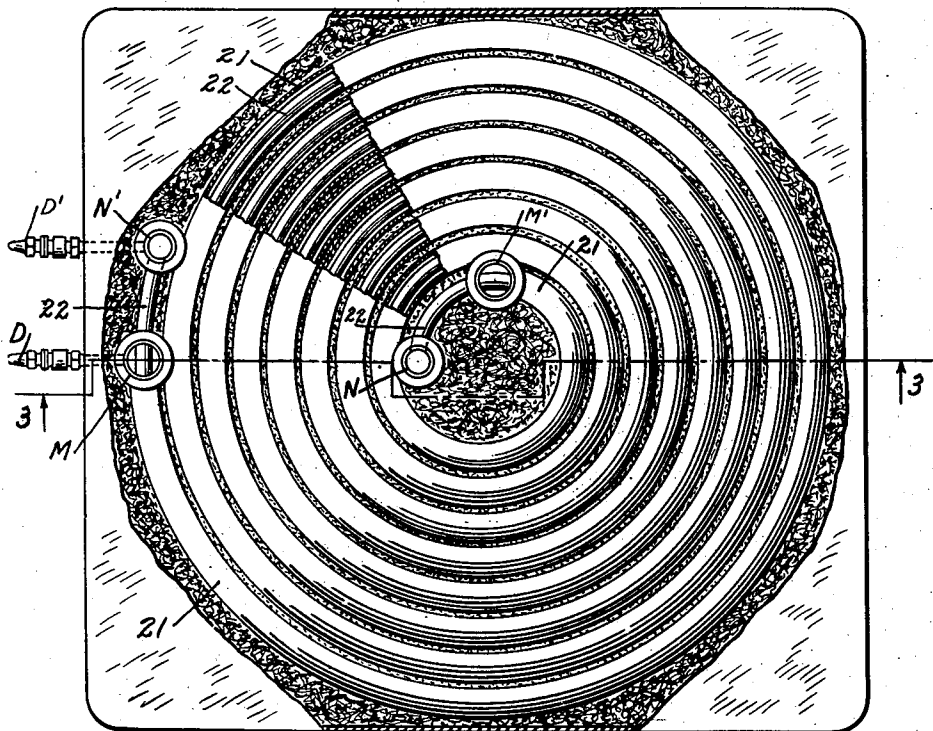


FIG. 2.

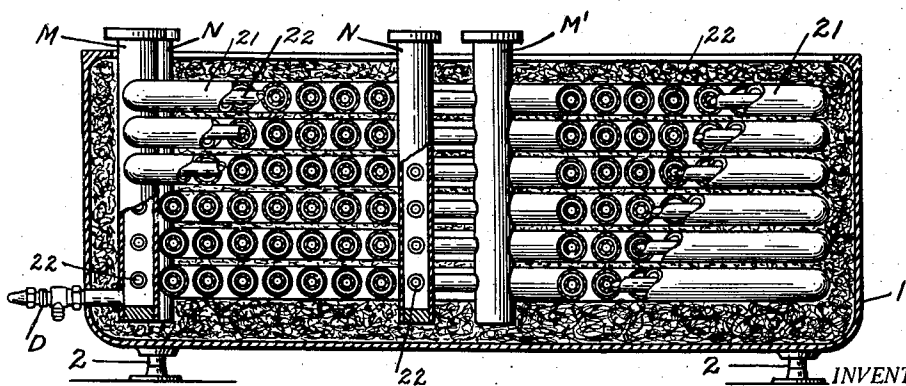


FIG. 3.

INVENTOR.
GLENN F. ZELLHOEFER

BY *Langdon M. Munn*

ATTORNEY.

UNITED STATES PATENT OFFICE

2,085,937

ABSORPTION REFRIGERATING APPARATUS

Glenn F. Zellhoefer, Bloomington, Ill.

Application December 2, 1935, Serial No. 52,468

4 Claims. (Cl. 62-119)

This invention relates to improvements in the absorption type of refrigerating apparatus and more particularly to an improved heat exchanger therefor.

Refrigerating apparatus employing a gaseous refrigerant and a liquid solvent therefor in which the gas is absorbed in the solvent to form a solution and the refrigerant freed from the solution in a heater or still is termed an absorption refrigerating apparatus. Such apparatus necessarily includes an absorber wherein the solution is formed, a heater or still wherein the gaseous refrigerant is boiled off or expelled from the solution, means transferring the solution from the absorber to the heater, a heat exchanger through which the heated solvent returns from the heater to the absorber and through which the solution passes on its way to the heater, a rectifier, a condenser and a cooling coil through which the gaseous refrigerant passes from the heater before being returned to the absorber.

It is an object of this invention to provide an improved heat exchanger for such a system. A system of this type is disclosed more in detail in this applicant's prior application Serial No. 736,232, filed July 20, 1934.

With this and other objects in view, reference is made to the accompanying sheets of drawings illustrating an embodiment of this invention with the understanding that minor changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 is a view in elevation of an apparatus of the class described, including an embodiment of the improved heat exchanger, with parts broken away and partly in section.

Figure 2 is a detail top plan view of this improved heat exchanger with parts of the cover broken away and parts of the upper outer coils broken away to show the inner coils.

Figure 3 is a view in vertical section taken on the line 3-3, Figure 2, looking in the direction of the arrows, with parts shown in elevation.

In the form shown, the improved heat exchanger is enclosed in a rectangular casing 1, preferably supported upon adjustable feet 2 arranged adjacent each corner. The heater H and absorber A are supported upon legs 3 and 4 above the casing 1 with the condenser C arranged below the heater H and the rectifier R extending above the top of the heater, and with the float chamber casing F depending from the under side of the absorber and solution circulation pump P supported upon the casing therebelow. The apparatus above described is preferably encased with a cover 5 which may be supported upon the heat exchanger casing 1, as shown, or may embrace said casing and rest upon the floor.

Before describing in detail the improved heat

exchanger, it is customary in absorption refrigerating apparatus to circulate the solution through the outer coils of the heat exchanger to the heater and to circulate the solvent in the opposite direction from the heater through the inner coils of the heat exchanger and through a float valve before discharged into the absorber, said float valve being controlled by the amount of solution collected within the float valve casing communicating with the underside of the absorber, as disclosed in this applicant's said prior co-pending application. In the apparatus illustrated in Figure 1, the solution formed in the absorber A passes into the float chamber casing F and from there by pipe 6 to the intake of the solution pump P which discharges the solution through pipe 7 to a manifold M of the heat exchanger connected to the outer coils thereof, to be hereinafter described.

The pump P circulates the solution through the outer coils of the heat exchanger to a manifold M' from which it passes through pipe 8 to be discharged within the heater H. The gaseous refrigerant boiled off or expelled from the solution within the heater H passes through the rectifier R and by pipe 9 into the condenser C, and after passing through the condenser the refrigerant in liquid form is conducted through pipe 10 to the cooling coil, not shown. At the same time, the solvent resulting from the action of the heater upon the solution is conducted by pipe 11 from the heater to a manifold N connected to the inner coils of the heat exchanger, the other ends of which are connected to a manifold N' from which the solvent passes through pipe 12, through the float-controlled valve, not shown, to be discharged within the absorber A. The refrigerant vapor from the cooling coil is returned by pipe 13 to the absorber. Steam is supplied to the heater H through pipe 14 from a source of steam, not shown, with the condensate therefrom returned by pipe 15 to said source. Cooling water is supplied from the commercial line or a water tower, not shown, by pipe 16 to the absorber A, and from thence by pipe 17 to the rectifier, and after passing through the rectifier, is conducted by pipe 18 to the sewer or returned to the water tower, as the case may be. A pipe 19 branching from pipe 17 conducts cooling water to the condenser, which, after passing therethrough, is conducted by pipe 20 to join the pipe 18 leading from the rectifier R. This is the normal cycle of operation of the absorption refrigeration apparatus, illustrated in Figure 1 and described in said applicant's prior co-pending application.

It has been discovered that in an apparatus of the type just described which employs as a solvent monoethyl ether of diethylene glycol acetate, or a chemical of similar characteristics, and dichloro-

monofluoromethane, or a chemical of similar characteristics, as a refrigerant, as disclosed in applicant's prior co-pending application Serial No. 756,977, filed December 11, 1934, due to the characteristics of the specified solvent and refrigerant, the low side—or that part of the system including the cooling coil and absorber—may be pumped to a vacuum of 20" or more by closing the usual discharge valve into the cooling coil and continuing the operation of the circulating pump, and the liquid refrigerant may be drained from the condenser, thereby making it possible to remove the charge of solvent with the relatively small amount of refrigerant held in solution from the system or apparatus without any appreciable loss of refrigerant. In order to effect a gravity draining of said charge of solvent, an improved heat exchanger has been provided which possesses other advantages as well.

The improved heat exchanger is formed, as shown in Figures 2 and 3, of a plurality of horizontal rows of similar coils of pipes 21 arranged one above the other with each coil having the convolutions thereof lying in the same horizontal plane and each coil 21 containing therein a smaller pipe 22 spaced apart from the interior of each convolution. The outer ends of the outer coils 21 of each horizontal row are connected to a vertical manifold M and the inner ends of said coils 21 are connected to a vertical manifold M'.

The inner ends of the smaller inner pipes 22 in each row are extended through vertical manifold M' and are connected to a vertical manifold N and the outer ends of the pipes 22 are extended through the vertical manifold M and are connected to a vertical manifold N'. The superimposed double coils of pipes 21 and 22 are mounted within the rectangular casing 1 and the space between the coils and between the coils and casing is preferably packed with a desirable insulation material.

The manifold M connected with the outer ends of the outer pipe 21 of each coil in each row is provided with a drain cock D extending from the bottom thereof and projecting through the casing, as shown in Figure 3, and the manifold N' connected with the outer ends of the smaller inner pipes 22 in each row is also provided with a similar drain cock D' extending from the bottom thereof and projecting through the casing 1, as shown in Figure 2.

The improved heat exchanger being contained within the casing 1 which supports the other parts of the apparatus thereabove with the manifold M connected by the pipe 7 to the discharge side of the solution pump P and the manifold M' is connected through pipes 22, manifold N, and pipe 11 to the lower portion of the interior of the heater H. After the liquid refrigerant has been drained from the condenser, the pump stopped, and the vacuum broken by opening the usual purging valves in the heater and absorber, the solvent remaining in the system may be drained therefrom through the drain cocks D and D'. To recharge, a partial vacuum is pulled upon the system through a purging valve and the chemicals introduced in the usual manner. The peculiar construction of the heat exchanger prevents the formation of liquid traps that would pocket air when the vacuum is pulled prior to recharging, and likewise eliminates the necessity of additional valves in the system.

The heat exchanger, constructed as disclosed herein, not only provides a compact unit but also a most efficient one as the hot solvent from the heater H enters the inner ends of the small coils 22 from the manifold N and passes through the embracing convolutions toward the periphery to the outer manifold N' with a negligible loss of heat with relation to the small amount of insulation. Furthermore, due to the low pressure differential between the high side, or that portion of the system including the heater, rectifier and condenser, and the low side of an absorption refrigerating apparatus employing the chemicals specified herein, it is essential to reduce the pressure drop through the heat exchanger to the minimum possible for a given size tube, which is accomplished by this improved heat exchanger and which carries more solution for a given pressure drop through a coil of given length and diameter than a coil of equal length and diameter wound on a constant diameter or one using return bends.

From a manufacturing standpoint, not only is a heat exchanger unit constructed in accordance with this invention less costly than the conventional commercial form, but also allows the ready connection of units one above the other for apparatus of a wider range of capacity than the standard single unit.

What I claim is:

1. In an absorption refrigeration apparatus including an absorber, a solution circulating pump, a heater and a condenser, the combination with a unit heat exchanger including a plurality of horizontal rows of coiled pipes arranged within an enclosed rectangular base supporting all of the first-named elements above the upper surface of the base.

2. The structure of claim 1, wherein each coil includes a smaller enclosed pipe, and wherein the outer ends of the larger coils are connected through the top of the base to the solution pump, the outer ends of the smaller pipes are connected through the top of the base to the absorber with the inner ends of the larger pipes connected through the top of the base to the upper portion of the heater, and the inner ends of the smaller pipes connected through the top of the base to the lower portion of the heater.

3. The structure of claim 1, wherein each coil includes a smaller enclosed pipe, and wherein the outer ends of the larger coils are connected through the top of the base to the solution pump, the outer ends of the smaller pipes are connected through the top of the base to the absorber with the inner ends of the larger pipes connected through the top of the base to the upper portion of the heater and the inner ends of the smaller pipes connected through the top of the base to the lower portion of the heater, and wherein the outer ends of the larger and smaller pipes are each provided with a drain cock extending through the side wall of the base whereby the system may be drained by gravity.

4. In an absorption refrigeration apparatus, an enclosed rectangular casing, an absorber, a solution circulating pump, a heater and a condenser all mounted above and upon the top of said casing as a base, and a heat exchanger arranged within said casing having connections passing through the top of said casing to the said elements supported thereabove.

GLENN F. ZELLHOEFER.