July 7, 1953 A. Y. PREBLE ET AL 2,644,322

ATMOSPHERIC CONDENSER APPARATUS

Filed Aug. 26, 1949 2 Sheets-Sheet 1

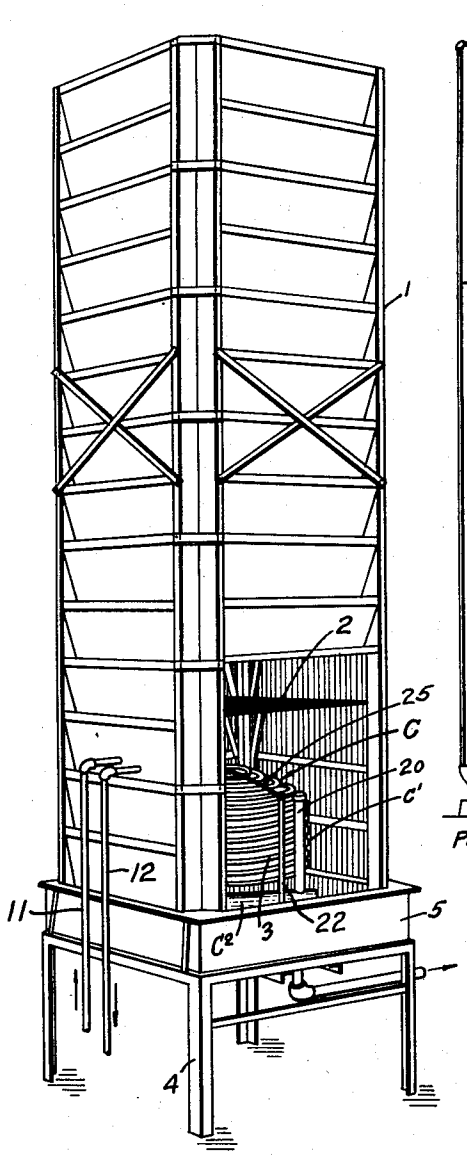


Fig. 1.

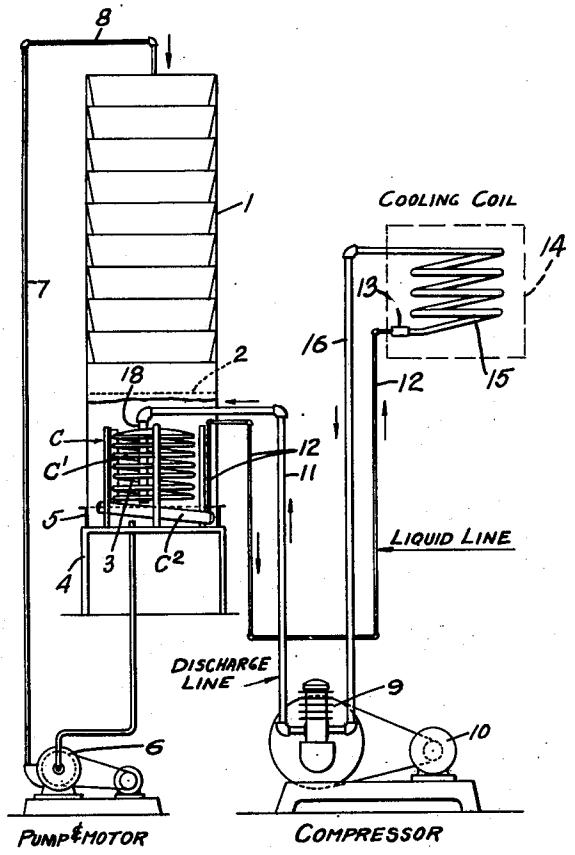


Fig. 2.

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Fig. 4.

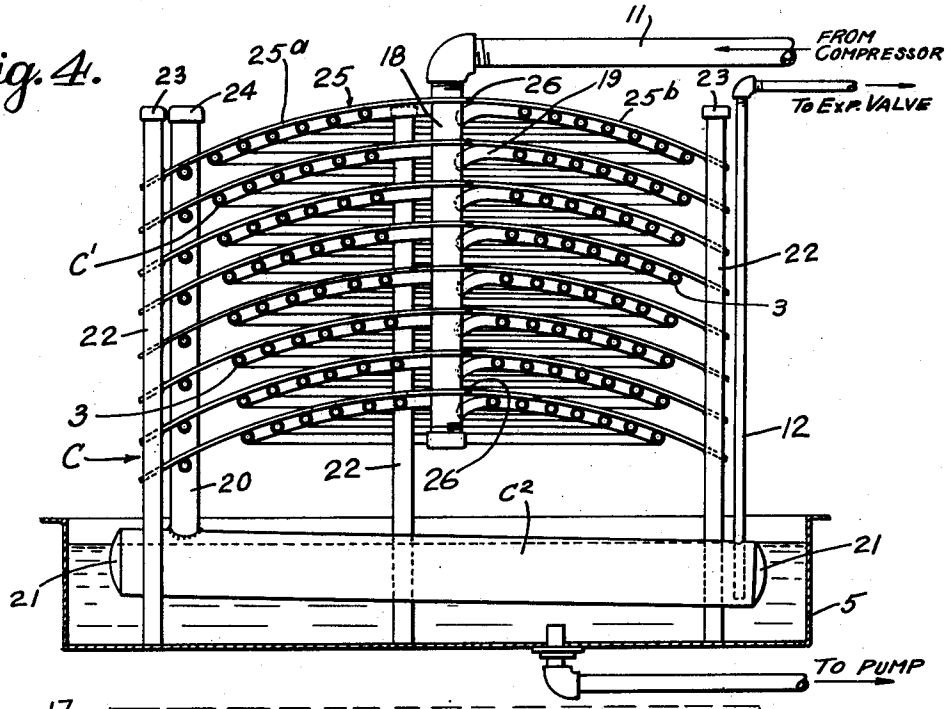
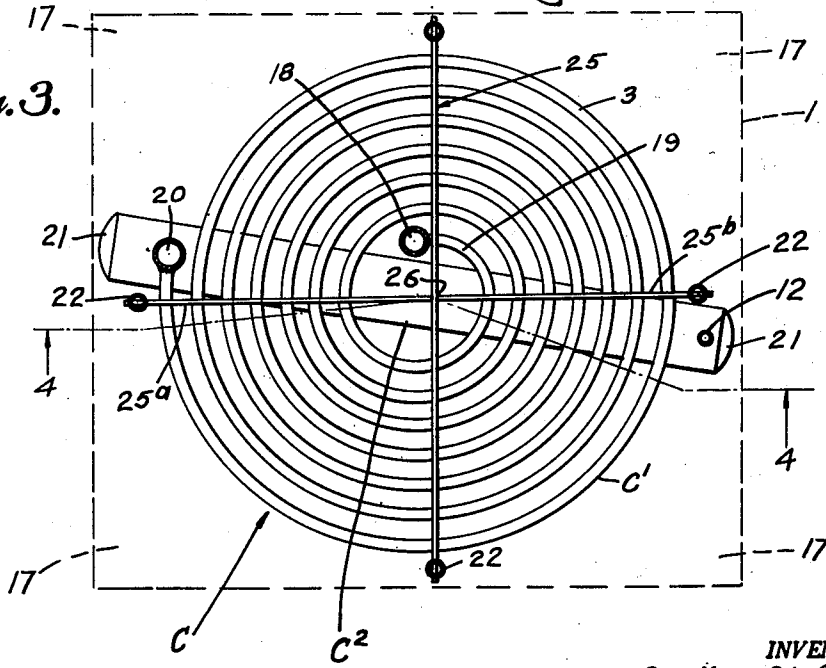


Fig. 3.



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ATMOSPHERIC CONDENSER APPARATUS

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4 Claims. (Cl. 62—154)

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This invention relates to condenser apparatus, and while the invention is capable of functioning in various situations, in the present specification it is described as applied to condenser apparatus associated with cooling towers in a type of condenser apparatus known as atmospheric condenser apparatus.

That type of apparatus usually employs a refrigerant that is compressed in a gaseous state and cooled until it becomes condensed to a liquid, and the cooled liquid is then permitted to pass through an expansion valve into a cooler or refrigerator from which the refrigerant carries off the heat.

It is a common practice to employ piping, or pipes in such apparatus, through which the condenser water flows, or is pumped in circulating it past the confined gaseous refrigerant and lifting it to the top of the cooling tower from which it descends in the atmosphere, thereby effecting considerable evaporation of the cascading water, which reduces its temperature sufficiently to enable it to operate effectively to cool and condense the gaseous refrigerant.

One of the objects of the invention is to provide a method of controlling the co-action of the cooling tower and the condenser unit that will result in developing a relatively lower temperature in the condensed refrigerant; and at the same time effecting a relative reduction in the horsepower required to effect the circulation of the condenser water.

Another object of the invention is to provide a condenser unit having features of construction that will eliminate any pockets in which the refrigerant can remain in the condenser pipes or coils, or the like, through which the gaseous refrigerant passes while having its heat extracted by the condenser water. To this end, a further object is to produce a condenser unit so constructed that the liquid of condensation of the refrigerant can flow by gravity through the pipes or coils of the condenser.

This is most advantageous, as it reduces the corrosive action to which the walls of the pipes or coils of the condenser are subjected.

Another object of the invention is to produce a condenser unit having characteristics that will enable it to be readily constructed completely of copper, and at a minimum of expense.

Further objects of the invention will appear hereinafter.

The invention consists in the method to be presently described, and in the novel parts, and combinations of parts, all of which cooperate to produce an efficient condenser apparatus.

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A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Fig. 1 is a perspective illustrating the condenser unit at the bottom of a cooling tower, a side portion of which is broken away to display the unit.

Fig. 2 is a diagrammatic view showing the water cooling tower in elevation, with its side broken away to expose the condenser unit. The other parts in this view diagrammatically illustrate other parts of the apparatus.

Fig. 3 is a plan illustrating a single coil that confines the refrigerant, and illustrates the headers of the unit to which the ends of the coil are connected.

Fig. 4 is an ideal section about on the line 4—4 of Fig. 3. This view further illustrates the manner in which the coils are disposed, and illustrates some features of the unit that adapt it to be fabricated of copper.

In practicing our method of condensing a gaseous refrigerant, we continuously circulate condenser water past the coils of the condenser unit, and this circulation is effected in such a way that a considerable portion of the circulating water fails to come in contact with the coils; a considerable portion of the water, however, passes in contact with the coils, and all of the water that passes the coils is collected beyond the coils, in the present instance, below the coils in the collecting basin. The water is then withdrawn from the basin, and after being cooled, in the present instance, in an atmospheric cooling tower, it is re-circulated past the coils. The water that does not come in contact with the coils, of course has a considerably lower temperature when it reaches the collecting basin, than the water that passes against coils. The result of this is that the water in the collecting basin will have a temperature that is relatively lower as compared with a circulating system in which all of the water comes in contact with the coils. By establishing a relatively lower temperature in the basin, the condensing effect of this water on a partially submerged drum that receives the liquid of condensation from the coils, becomes increased.

The apparatus that we prefer to employ in practicing this invention, and which also is of our invention, will now be described.

Referring particularly to Figs. 1 and 2, 1 indicates a water cooling tower of any conventional type, constructed so that when water is per-

mitted to drip down, or cascade on its sides, the water will become cooled due principally to evaporation from its own mass. Near the bottom of this tower, means is provided for dispersing the water over the entire horizontal cross-sectional area of the tower, and for this purpose we may employ a screen 2 such as is commonly employed in towers of this type. From the screen the water drips down and a considerable portion of it passes against coils 3 of the condenser unit C, which unit includes a body portion C' composed of a bank of the coils, and a depressed drum C^2 that receives the liquid of condensation from the coils. The tower 1 as illustrated in Figs. 1 and 2, is supported upon a stand or table 4, the upper portion of which carries a basin or shallow tank 5 on the bottom of which the lower end of the tower rests. In the operation of the apparatus a bath of the cooling water is maintained at a substantially fixed level by means of a float control valve (not illustrated) connected to an inlet pipe that delivers water into the basin.

The water that collects in the basin 5 is continuously withdrawn and re-circulated by any means such as a centrifugal pump 6, the discharge side of which is connected to an uptake pipe 7 with an extension 8 at its upper end that delivers the water onto the upper end of the tower, from which point the tower automatically distributes the water to the series of louvers where it drips down through the atmosphere.

The relatively warm refrigerant gas is delivered from a compressor 9 driven by a suitable motor 10, through a pipe 11, and the liquid of condensation from the drum C^2 is forced through a pipe line 12 to an expansion valve 13 that delivers the refrigerant liquid under considerable pressure into a cooler 14, the casing of which is illustrated in dotted lines in Fig. 2. From the cooler coil system 15 the refrigerant in gaseous form, then passes back on the pipe 16 to the intake side of the compressor.

Referring now particularly to Figs. 3 and 4, it will be noted that the tower illustrated is of substantially square form. This is the usual form in plan of a cooling tower such as illustrated. This satisfies the requirement of our invention, that the cross-section of the tower is preferably polygonal, although it would be possible to employ a tower of circular section, so long as the cross-sectional area of the tower is considerably greater than the area of the condenser C as viewed in plan. It will be noted that by reason of the fact that the condenser is of substantially circular form, at the four corners of the tower, spaces 17 are formed, through which a considerable portion of the cooling water will fall, which water will fail to make contact with the coils 3 of the condenser. However, a considerable portion of the cascading water will pass over the outer surface of the coils 3 and exert efficient condensing effect on the gaseous refrigerant within the coils.

In accordance with our invention, we prefer to construct the condenser unit C so that its interior through which the refrigerant passes, is substantially devoid of pockets in which the liquid refrigerant could stand when the apparatus has been shut down, and we also prefer to employ features of construction for the condenser, that enable it to be readily constructed entirely of copper, which metal is highly resistant to the corrosive action of important refrigerants. The construction that we prefer to employ, provides a skeleton type framing that enables the coils to be readily supported in a bank, one above the other. In addition to this, the coils are so disposed and formed that as the gas liquefies within the same, it will flow by gravity down the coils. In this way the coils continuously free themselves of all liquid of condensation within them.

In Figs. 3 and 4, we illustrate a preferred embodiment of the condenser unit.

The piping 11 that carries the compressed gaseous refrigerant from the compressor, delivers the same into a substantially vertical header 18 that is preferably disposed toward the interior of the condenser unit and near the vertical geometrical axis of the coils (see Fig. 3). In accordance with our invention, the pipes or coils lead off from the header and incline in a downward direction from the header, so that all liquid of condensation will gravitate down these pipes. In the present instance, the individual coils 3 are disposed in a bank, one above the other. The innermost wrap 19 of each coil is brazed to the edge of its opening from the header 18. The successive wraps of each coil are disposed in a spiral which is also a helix, by reason of the fact that the outer wraps of the coil are successively more depressed than the next inner wraps. At the lower and outer end of each coil, it is brazed to the edge of its opening into an outer header 20, which header is also in substantially vertical position, and the lower end of this header is brazed to its opening into the drum C^2 already referred to.

As indicated in Fig. 4, the drum C^2 illustrated, is of cylindrical form, with convex dished heads 21, and it is disposed in the basin 5 with its axis slightly inclined to the horizontal. It is preferably not completely submerged or immersed in the water bath within the basin; this operates to prevent any possibility that water of condensation in the drum would extend up in the outer header 20 to a point above its connections to any of the lower coils, thereby insuring that they will always freely deliver any liquid of condensation within them into the header.

The bank of coils, in the present instance, is supported on four stanchions or legs 22 which are preferably formed of stout copper tubing, the upper ends of which are soldered or brazed to receive caps 23, respectively, that close their upper ends.

The upper end of the header 20 is also soldered or brazed and provided with a similar cap 24.

The individual coils are supported from above by a rudimentary frame 25 which, in the present instance, is illustrated as composed of two crossed bow-form bars 25*a* and 25*b*. These bars cross each other near the geometrical axis of the bank of coils, at which points 26 they are brazed together. The outer ends of the bow-form bars 25*a* and 25*b* are inserted through openings formed through the walls of the legs 22, and for this purpose two openings are formed in the tubular walls of the legs, that are out of line with each other, the innermost opening being slightly elevated. After the ends of the bowed bars are brazed through these openings, they are brazed to the edges of the openings, either on the inner sides of the legs toward the axis of the back, or on the outer sides, or at both of these points.

As indicated in Fig. 4, the outlet pipe 12 that leads the liquid refrigerant under pressure from the drum C^2, preferably extends down to a low level in the lower end of the drum, to insure that it will always get the refrigerant in liquid form.

In Fig. 4 the inner ends of the coils where they are attached to the header 18, are illustrated

as though they are slightly bent down. This feature is of a diagrammatic character, and is employed so as to enable the drawing to be more easily read. As a matter of fact, the point of attachment of the inner end of each coil, is elevated above any other part of the coil.

It will be evident that the features of the construction described for the condenser unit, admirably adapt it to be formed of copper.

Among the advantages of this condenser apparatus, are that the initial cost is relatively low, as compared with other apparatus of the same capacity. It is substantially unnecessary to perform cleaning operations except at long intervals. The operating cost is low, and the period of usefulness of the condenser unit is increased due to the fact that it is unnecessary to employ any cleaning acids within it; and no electrolysis or rust will appear in the unit as sometimes occurs with condenser units employing iron piping and steel drums or headers.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

We claim as our invention:

1. In condenser apparatus for operation in a water cooled system, the combination of a plurality of condenser coils disposed in spirals about a substantially vertical axis, and forming a bank, said coils having adjacent relatively elevated inlet ends, adjacent the axis of said coils, and having adjacent relatively depressed outlet ends, an inlet header, disposed adjacent said axis connected to said elevated ends of the spiral coils, for supplying the vapors under pressure thereto, to be condensed in the same, so that the liquid

of condensation flows down by gravity through the coils, an outlet header disposed adjacent the perimeter of said bank connected to the outlet ends of said coils, a receiver connected to the lower end of said outlet header, means for spraying said coils with air cooled water to accelerate the condensing effect, said receiver having an outlet connection for delivering the liquid under pressure to an expansion valve of a cooler.

2. Condenser apparatus according to claim 1, and including a basin in which the drip water collects in contact with the receiver.

3. Condenser apparatus according to claim 1, including a plurality of oppositely disposed supporting legs spaced circumferentially around the peripheries of said coils, and transversely disposed bows connecting the opposite legs and supporting said coils.

4. A condenser according to claim 1, in which the said bows and coils are of copper, with the bows located above the coils respectively and brazed to the same.

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