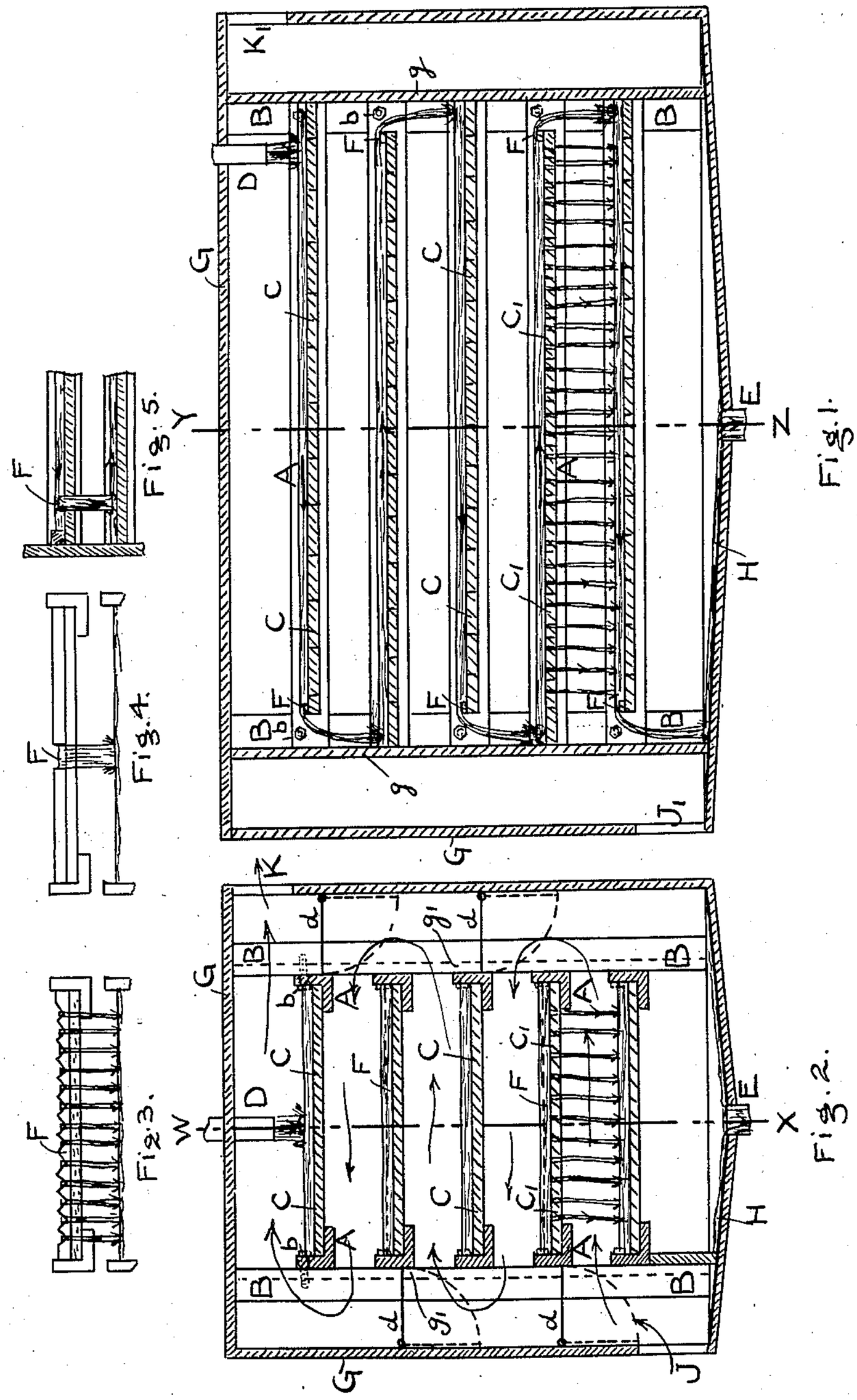
No. 813,066. PATENTED FEB. 20, 1906.

G. T. VOORHEES.

AIR AND LIQUID COOLING APPARATUS.

APPLICATION FILED JUNE 6, 1903.



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AIR AND LIQUID COOLING APPARATUS.

No. 813,066. Specification of Letters Patent. Patented Feb. 20, 1906.

Application filed June 5, 1903. Serial No. 160,153.

To all whom it may concern:

Be it known that I, GARDNER T. VOORHEES, a citizen of the United States of America, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Air and Liquid Cooling Apparatus, of which the following is a specification.

In existing apparatus for cooling air by contact with liquid-surfaces or cooling liquids by contact with air, such as water-towers and air-coolers, I have found numerous objections arising from the fact that the liquid presented its surface to the air by either flowing like rain through the air or flowing in a vertical or nearly vertical direction over surfaces, such as pipes, wood, cloth, sheet metal, &c. One of the objections is that the downward flow of the liquid due to gravitation is too rapid. If a number of these surfaces are supposed to have equal quantities of liquid flowing over them, the question of regulation of the flow of the liquid is extremely difficult. As a result, some of the surfaces get too much liquid over them and others do not get nearly enough. The liquid-surface is so variable that the work of cooling is variable also. Again, the downward flow of the liquid is so rapid that there is hardly time to do the required cooling before the liquid has left the surface.

In the process of artificial refrigeration it is becoming a well-known fact that the most successful way to cool rooms, buildings, cold-storage warehouses, theaters, packing-houses, &c., is to have the air cooled in a chamber outside of the room or space to be so cooled and to circulate the air so cooled in the space to be cooled. This air is circulated either by natural or artificial circulation. The earliest method of cooling this air was to pass it over coils of pipe that were cooled by cold brine or ammonia circulated in them. These pipes would accumulate much frost, and thereby obstruct the passage of air. Then it was discovered that if brine was allowed to trickle over the outer surfaces of these pipes it would keep the pipes free from frost and also keep the air drier than heretofore. This method is used extensively to-day; but owing to the great expense of the pipe-coils, their valves, and connections new methods are coming into use, whereby the pipes are done away with and vertical surfaces of cloth, boards, coke, sheet-iron, &c., are used to form surfaces on which to conduct the brine that has been previously cooled and that after passing over these surfaces is recooled and again passed over the surfaces. In order to regulate the flow of the brine with any degree of nicety, many regulating-valves must be governed which require resetting upon change in quantity of brine circulated or from stoppage due to foreign matter. These methods require great attention and much apparatus to regulate properly the flow over these surfaces.

Now the object of my invention is to provide means to overcome the difficulties presented by these methods

In the drawings illustrating my invention, Figure 1 is a longitudinal vertical section on line W X of Fig. 2. Fig. 2 is a cross vertical section on line Y Z of Fig. 1. Figs. 3 and 4 are end views showing modifications of weir. Fig. 5 is a part longitudinal vertical cross-section showing modifications of weir.

A A are horizontal longitudinal stringers, preferably angle-irons. These stringers are secured by bolts *b b* to supports B B. The latter are of any desired character and are here shown as four upright posts of wood. C C are strips of material, preferably wood, laid side by side and extending horizontally, having their ends supported by said stringers A A. They thus form tiers of horizontal floors C C and with the stringers form liquid-channels, which may be liquid-tight or not. If desired, these strips C may be perforated, forming perforated floors C′ C′.

D is a liquid-inlet discharging onto upper floor of the tiers of floors, while E is a liquid-outlet conducting the liquid away after it has passed over a lower floor.

F F are weirs, which may be the length of strips C, or they may be contracted, as in Fig. 4, or have serrated edges, as in Fig. 3, or may be replaced by a tube F, as in Fig. 5, or by any other suitable construction.

G is a housing for the floors, having a waterproof floor H and air inlets and outlets J′ and K′.

d d are dampers.

g g are end partitions, (see Fig. 1,) which may be removed and placed at *g′ g′* in Fig. 2, in which case air inlets and outlets would be located at J′ K′ in Fig. 1, instead of J and K in Fig. 2.

The operation of the apparatus is as follows: The liquid flows from inlet D to upper floor C of apparatus, over this floor, its weir F, and down over successive floors and

weirs, and then out at liquid-outlet E. This liquid may, if desired, be made to flow in part through one or more perforated floors C′ C′. Air is caused to flow between the floors in contact with the flowing liquid. The air may flow, as indicated by the arrows in Fig. 2, entering at J and discharging at K, or it may flow in the opposite direction, or by lowering the dampers to the dotted partitions the air may pass in parallel through the spaces between the floors. In Fig. 2 the air flows across the direction of flow of the liquid, but the air may flow in the same or in the opposite directions to the flow of the liquid by using J′ and K′ as air inlets and outlets and removing partitions *g′ g′* and by boarding up the sides *g′ g′* and providing the necessary dampers, such as are shown in Fig. 2.

This apparatus may be used to cool and purify air or to cool a liquid.

As is well known, the relative humidity of the air, the temperature of the air, and the liquid and character of the liquid will determine whether the air is cooled and purified by contact with the liquid or whether the liquid is cooled by contact and evaporation with said air. The liquid may be water, brine, or the like and may contain absorbent chemicals that will dry the air or deprive it of its carbonic acid. Such a chemical, as lime, will absorb carbonic acid. Water or brine will also absorb it to a limited degree. The air may be caused to circulate by gravity or by means of a fan. Whenever the word "water" is used, I mean any liquid that can be used as a medium to be cooled by evaporation by the air. The air thus cooled may be used for various purposes and not again passed through the cooling-chamber, new or fresh air being continually supplied. The brine may be cooled by any desired means—for example, a brine-coil, ice, or any refrigerating-machine. Whenever the word "brine" is used, I mean any liquid that can be used as a medium to cool the air.

What I claim is—

1. A tier of horizontal liquid-channels formed of boards, and angle-irons which support the boards; the angle-irons extending the entire length of the liquid-channels in two tiers, the vertical legs of the angle-irons forming sides for the liquid-channels, while the horizontal legs form supports for the ends of the boards; upright supports for the angle-irons; a liquid-inlet to the upper liquid-channel and a liquid-outlet from the lower liquid-channel; liquid-outlets for the intermediate liquid-channels; a casing inclosing the liquid-channels, the two sides of the said casing being at a distance from the liquid-channels; an air-inlet to, and an air-outlet from, the casing; air-channels being thus formed by the liquid-channels and these two sides of the casing; all being so combined that liquid flowing through the liquid-channels will exchange heat with the air flowing through the air-channels.

2. A tier of horizontal liquid-channels formed of boards, whose edges abut, and angle-irons which support the boards; the angle-irons extending the entire length of the liquid-channels in two tiers, the vertical legs of the angle-irons forming sides for the liquid-channels, while the horizontal legs form supports for the ends of the boards; upright supports for the angle-irons; a liquid-inlet to the upper liquid-channel, and a liquid-outlet from the lower liquid-channel; dams at the ends of the liquid-channels; liquid-outlets for the intermediate liquid-channels; a casing inclosing the liquid-channels, the two sides of said casing being at a distance from the liquid-channels; an air-inlet to, and an air-outlet from, the casing; air-channels being thus formed by the liquid-channels and these two sides of the casing; all being so combined that the liquid flowing through the liquid-channels will exchange heat with the air flowing through the air-channels.

3. A tier of horizontal liquid-channels formed of boards, whose edges abut, and angle-irons which support the boards; the angle-irons extending the entire length of the liquid-channels in two tiers, the vertical legs of the angle-irons forming sides for the liquid-channels, while the horizontal legs form supports for the ends of the boards; upright supports for the angle-irons; a liquid-inlet to the upper liquid-channel, and a liquid-outlet from the lower liquid-channel; dams at the ends of the liquid-channels; liquid-outlets for the intermediate liquid-channels; a casing inclosing the liquid-channels, the two sides of said casing being at a distance from the liquid-channels; an air-inlet to, and an air-outlet from, the casing; air-channels being thus formed by the liquid-channels, and these two sides of the casing; dampers in the air-channels so arranged that air may be caused to flow through the air-channels either in series or in parallel; all being so combined that the liquid flowing through the liquid-channels will exchange heat with the air flowing through the air-channels.

In testimony whereof I affix my signature in presence of two witnesses.

GARDNER T. VOORHEES.

Witnesses:

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