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R. B. P. CRAWFORD

2,200,442

FLUID COOLING

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Fig. 1.

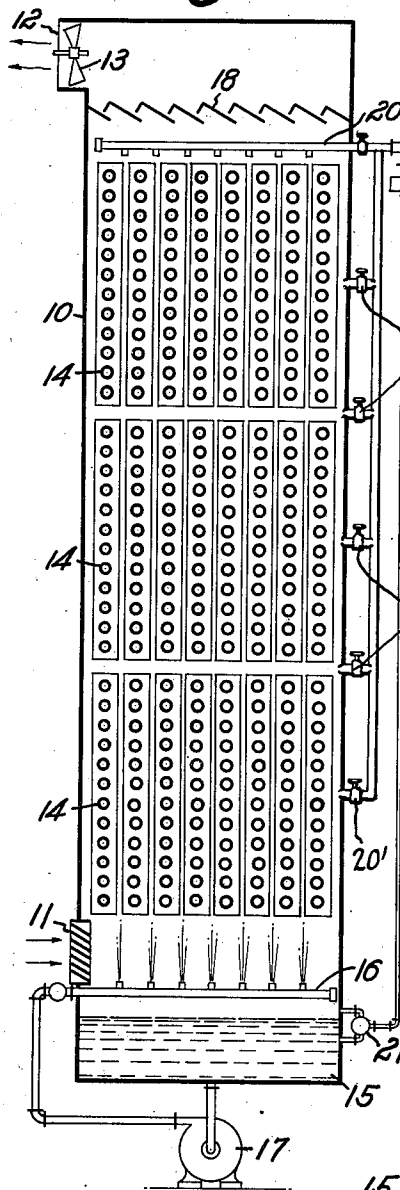


Fig. 2.

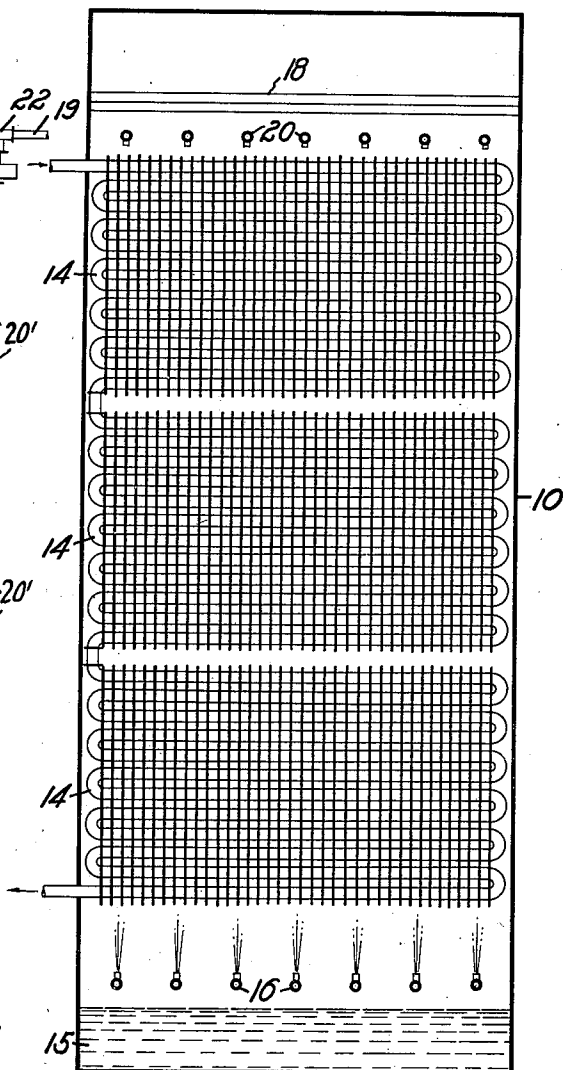
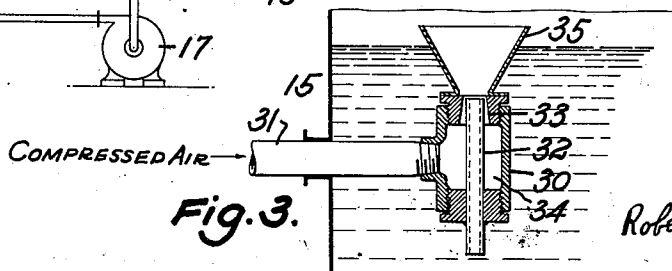


Fig. 3.



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FLUID COOLING

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2 Claims. (Cl. 62-156)

This invention relates to the cooling of fluids by the evaporative cooling effect of a stream of water in contact with a stream of air.

A principal object of the invention is the provision of a fluid cooling device of enhanced efficiency.

A further object of the invention is the cooling of a fluid by the evaporative cooling effect of concurrent streams of air and water.

The invention broadly comprises flowing a fluid to be cooled in countercurrent heat exchange relation with concurrent contacting streams of air and water. It is, of course, to be understood that any gas of low solubility in water may be used in place of air, and that the air or other gas must have a relative humidity below the saturation point at the temperature to which the fluid is to be cooled.

An advantageous form of apparatus comprises a conduit providing a stream of the fluid to be cooled flowing in a generally downward direction and means for providing upward streams of air and water in contact with the outside of said conduit.

The invention will be more particularly described for the purpose of illustration with reference to the accompanying drawing showing typical apparatus embodying the principles of the invention.

In the drawing,

Fig. 1 is a sectional elevation of apparatus embodying the principles of the invention;

Fig. 2 is a sectional elevation taken at right angles to the section of Fig. 1; and

Fig. 3 is a fragmentary detail showing a spray device particularly adapted for use in the invention.

In the apparatus shown in Figs. 1 and 2, 10 is a casing having an air inlet 11 and an air outlet 12 in which a fan 13 is diagrammatically indicated. The fluid to be cooled, such as a refrigerant liquid or vapor, is passed downwardly through the banks of finned pipe coils 14. It is particularly desirable that the coils 14 be arranged so that both pipes and fins are uniformly vertically aligned from top to bottom to reduce obstructions to the upward flow of air and water.

At the bottom of the casing is a sump 15 for the collection of cooling water which flows back down over the pipes, and a series of spray nozzles 16 positioned to throw streams of water upwardly through the casing between adjacent rows of pipes 14, the nozzles being fed from sump 15 by means of pump 17.

Spray eliminators 18 are advantageously provided at the upper end of the apparatus.

The nozzles and pump should be selected to provide a spray with force sufficient, in combination with the carrying power of the updraft of air, to carry a portion of the spray as far as the uppermost passes of coils 14, and it is desirable that the amount of water sprayed should be sufficiently in excess of the amount evaporated into the air stream so that the coils and fins are always covered by a film of returning water, whereby the heat exchange efficiency of the operation is greatly increased.

Since the air entering at 11 is at its highest evaporative capacity, as soon as the operation has reached an equilibrium, the lowest air and water temperatures will be established at the bottom of the coil at a point approaching the wet bulb temperature of the entering air and a temperature gradient will be established upward through the apparatus approaching the temperature of the entering fluid in coils 15.

To compensate for the water carried off by evaporation into the air stream and any unavoidable spray loss, make-up water is fed from a source of supply 19 to sprays 20. This make-up is advantageously controlled through constant level control 21 actuating valve 22. Since in operation the water in sump 15 will be at approximately the lowest temperature in the apparatus and the available make-up water will, in general, be higher in temperature, the efficiency of the operation is substantially increased by supplying the make-up water at that section of the apparatus where the equilibrium temperature is approximately that of the make-up water. In the drawing, the make-up water is shown as being supplied at the top. In case its temperature is lower than the temperatures at the top of the apparatus, it should be supplied at a lower level of corresponding temperature, for example, by spraying it in laterally through nozzles 20' in a horizontal row along the side of the apparatus.

An air velocity of at least 1000 feet per minute through the body of the apparatus is desirable. This may be reduced to 500 feet per minute or less above the coils to assist in the elimination of spray. The air paths upward through the apparatus should be substantially smooth, straight and unbroken, but the heat exchange surfaces should be so positioned as to insure turbulent flow and maximum heat transfer, for example, by maintaining gaps of not over one-quarter inch between adjacent heat transfer surfaces in the air stream spaces.

The effectiveness of the apparatus may be increased by increasing the directivity of the spray members and the fineness of subdivision produced by these members or both. A suitable spray device is shown in detail in Fig. 3. It comprises a hollow body portion 30 supplied with compressed air through pipe 31. Water inlet 32 opens at its bottom end in sump 15 and at its upper end in an annular outlet 33 from the compressed air chamber 34. The upper opening of water inlet 32 is below the level of the water in sump 15 and is advantageously surrounded by a shield 35.

I claim:

1. A method of cooling fluids which comprises passing the fluid in countercurrent heat exchange relation with contacting upward streams of air and water, and supplying an amount of water equivalent to the amount evaporated by the air stream at a point in the stream of water where

the temperature of the stream is approximately the temperature of the water supplied.

2. Apparatus for cooling fluids comprising a conduit providing a vertical path of flow for a fluid, means for establishing fluid flow downwardly through said conduit, means for establishing an upward flow of air in contact with the walls of said conduit, means for supplying a stream of water to said flow of air adjacent the lower end of said conduit, a reservoir for receiving excess of water supplied to said flow of air, means for drawing water from said reservoir for supplying to said flow of air, and means for supplying make-up water to said flow of air at a point where the established wet bulb temperature is approximately the same as the temperature of the make-up water.

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