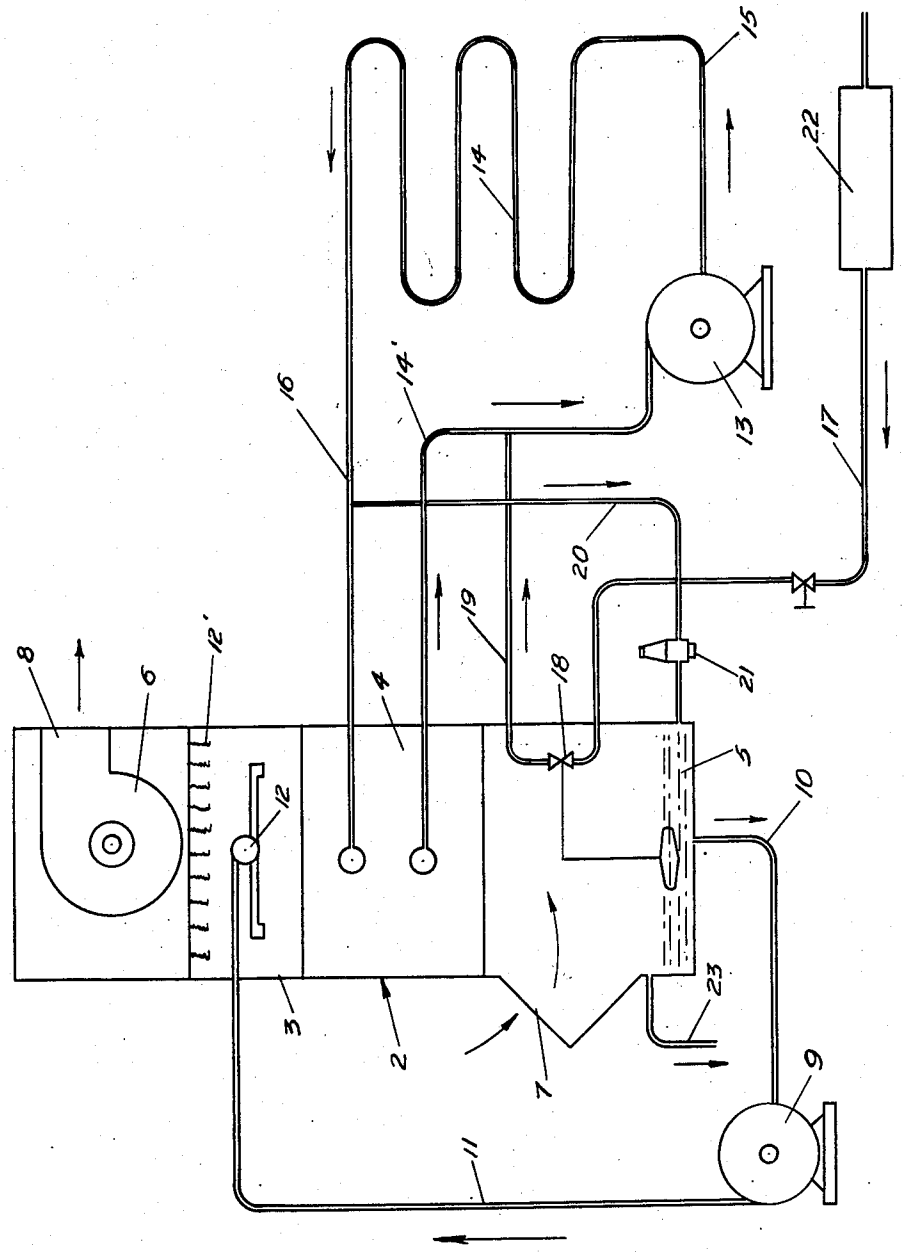
March 16, 1954 D. H. GOLD 2,672,033

EVAPORATIVE WATER COOLER ARRANGEMENT

Filed Aug. 18, 1951




*INVENTOR.*

BY David H. Gold
Herman Seid
Atty.

Patented Mar. 16, 1954 2,672,033

# UNITED STATES PATENT OFFICE

2,672,033

## EVAPORATIVE WATER COOLER ARRANGEMENT

David H. Gold, Liverpool, N. Y., assignor to Carrier Corporation, Syracuse, N. Y., a corporation of Delaware

Application August 18, 1951, Serial No. 242,484

7 Claims. (Cl. 62—155)

1

This invention relates to an evaporative water cooler arrangement and more particularly to an evaporative cooler arrangement in which the capacity of the cooler is increased by utilizing the cooling factor available in makeup water.

An evaporative cooler functions by passing a liquid to be cooled such as heated water through a coil in heat exchange relation with air drawn over the coil and with water sprayed over the coil, the sprayed water which is not evaporated returning to a sump in the bottom of the cooler and again being sprayed over the coil. It is necessary, of course, to replenish the supply of water in the sump as it is utilized and for this purpose the sump is connected to a source of supply of so called "make-up" water or water supplied to the sump to assure that a desired volume is present to spray over the surfaces of the coil. Generally, to prevent concentration of minerals in the sump, an overflow is provided to drain continuously a minor portion of the water in the sump. Such coolers are well-known in the industry.

The chief object of the present invention is to provide an evaporative cooler arrangement in which the capacity of the cooler is increased 8% to 15% or more by utilizing makeup water for the cooler as a portion of the cooling water and by returning heated water to the cooler to be distributed over the coil therein.

A further object is to provide a novel cooler arrangement by adding cool makeup water to the coil water and by bleeding hot water into the sump.

A further object is to provide a method of operation of an evaporative liquid cooling arrangement which increases the capacity of the arrangement approximately 8% to 15% or more without increase in operating costs. Other objects of the invention will be readily perceived by reference to the following description.

This invention relates to an evaporative liquid cooling arrangement which comprises in combination a casing, a coil in said casing through which liquid to be cooled is passed, a sump in the casing, means for distributing water from the sump over the coil, means for directing air through the coil in heat exchange relation with liquid in the coil, a line for supplying cooled liquid from the coil to a place of use, a second line for supplying heated liquid from the place of use to the coil, means for circulating liquid through said lines, means for supplying makeup liquid in the first line and means for bleading a similar quantity of liquid from the second line to the sump.

2

This invention further relates to a method of operating an evaporative liquid cooling arrangement in which the steps consist in passing liquid to be cooled through the coil of an evaporative cooler, spraying water from the cooler sump over the exterior surface of the coil, directing air through the coil in heat exchange relation with liquid therein, forwarding the cooled liquid to a place of use, returning heated liquid from the place of use to the coil, adding cool makeup liquid to the cooled liquid being supplied to the place of use and bleeding a similar quantity of heated liquid from the system to the sump.

The attached drawing is a diagrammatic view of an evaporative cooler arrangement embodying the present invention.

Referring to the attached drawing, there is shown the evaporative cooler arrangement of the present invention. The arrangement comprises a cooler 2 including a casing 3 containing a coil 4, a sump 5 and a fan 6 to draw air through inlet 7 within casing 3 over coil 4 and to discharge the air through outlet 8. A pump 9 is provided to withdraw water from the sump 5 through line 10 and to forward such water through line 11 to a suitable spray 12' which distributes the water over coil 4. Eliminators 12 are provided in the casing to assure that drops of water are not discharged with the air after it has passed through coil 4.

A pump 13 is connected to coil 4 by line 14'. Pump 13 is connected by line 15 to a place of use such as the cooling jacket 14 of a diesel engine. The jacket 14 is connected to coil 4 by line 16. In effect, a closed circuit is provided including coil 4, pump 13 and the jacket of diesel engine 14. Pump 13 circulates cooling liquid through the circuit, the pump withdrawing cooled liquid from coil 4, passing the cooled liquid through the cooling jacket 14 and returning the heated liquid through line 16 to the coil 4 where it is again cooled by being placed in heat exchange relation with air drawn through the casing by fan 6 and by the sump water distributed over the exterior surface of coil 4 by sprays 12.

A source of supply of makeup water is provided which is connected to the arrangement by line 17. Passage of makeup water through line 17 is regulated by means of a float valve 18 placed in the sump 5, the float valve being connected to line 14' by line 19. Line 15 is connected to sump 5 by line 20, a pressure relief valve 21 being placed in line 20. If desired, a suitable member 22 may be provided in line 17 to treat the makeup water to eliminate hard-

ness. If desired, any suitable overflow 23 may be provided in sump 5 as hereinafter explained.

Considering the operation of the arrangement, fan 6 draws air through casing 3 in heat exchange relation with liquid passing through coil 4. At the same time, pump 9 circulates water to spray 12 which distributes the water over the exterior surface of coil 4. Pump 13 withdraws liquid from coil 4 and circulates the cooled liquid through cooling jacket 14 of a diesel engine or similar heat load, the heated water then returning to coil 4 to be again cooled. It will be appreciated some portion of the water distributed over the exterior surface of coil 4 is evaporated or carried away by the air directed through the casing. Accordingly, it is necessary to provide makeup water. Preferably, as discussed above, the makeup water is treated to remove its hardness by any suitable means. As the level in the sump falls, float valve 18 opens, permitting treated makeup water to pass to line 14' through lines 17 and 19, the makeup water added to the cooling liquid being directed by pump 13 through the cooling jacket 14. Since the addition of such makeup water in the closed circuit increases the pressure therein, the increase in pressure is reflected against pressure relief valve 21 moving such valve toward an open position and permitting a similar quantity of heated liquid to drain into sump 5.

It will be appreciated a desired amount of water continually overflows sump 5 through overflow line 23. Thus, the overflow is not hot water directly but is rather a mixture of the water in the sump and the hot water, so that a desired reduction in water hardness is obtained.

The cooling performance resulting from adding the coil makeup water to the coil water is the product of the quantity of makeup water and the temperature difference between the cool inlet makeup water temperature in line 19 and hot bleed off water temperature in line 20. Usually this is approximately 15% of the coil load.

The addition of the heated liquid to the sump results in an increased spray temperature which is the resulting mixture temperature of the heated liquid and a quantity of sump water which is equal to the spray water quantity minus the heated liquid quanity. This resulting increase in spray water temperature brings about a decrease in the coil loading. This reduction in the heat removed from the coil equals approximately ⅓ of the heat increase in the makeup water. The temperature of the spray water leaving the coil is dependent only upon the leaving coil water temperature and is independent of the spray quantity, loading applied to the sprays, coil inlet liquid temperature and coil liquid quantity. A net gain in overall cooling is obtained equal to approximately ⅔ of the cooling performed by the addition of cooled water to the coil circuit. Such net increase in overall cooling capacity is obtained with no additional operating cost.

The present invention provides a simple arrangement for increasing the capacity of an evaporative cooler which does not increase operating costs. No problem of scaling exists in the cooling jacket since the makeup water is treated and in effect only passes through the water jacket once before it leaves through line 20 to the sump.

If desired, the makeup water may be added to the discharge side of pump 13 depending upon the pressure difference between the makeup water line and the coil circuit and whether the pump can handle higher head or higher quantity. If desired, when the additional capacity is not required, the makeup water may be added directly to the sump of the cooler. I have found that the pressure relief valve may be replaced by any suitable orifice. This is generally undesirable, however, since it requires individual sizing for each installation. In a system containing an open sump at the suction of pump 13, the treated makeup water may be supplied directly to such sump through a float valve in the sump, bleed water being supplied directly to the sump 5 in the unit through float valve 18.

While I have described a preferred embodiment of my invention, it will be understood my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In an evaporative liquid cooling arrangement, the combination of a casing, a coil in said casing through which liquid to be cooled is passed, a sump in the casing, means for distributing water from the sump over the coil, means for directing air through the coil in heat exchange relation with liquid in the coil, a line for supplying cooled liquid from the coil to a place of use, a second line for supplying heated liquid from the place of use to the coil, means for supplying makeup liquid directly to the first line, means for bleeding a similar quantity of liquid from the second line and control means for regulating the supply of makeup liquid to the first line and the quantity of liquid bled from the second line.

2. In an evaporative liquid cooling arrangement, the combination of a casing, a coil in said casing through which water to be cooled is passed, a sump in the casing, means for distributing water from the sump over the coil, means for directing air through the coil in heat exchange relation with liquid in the coil, a line for supplying cooled liquid from the coil to a place of use, a second line for supplying heated liquid from the place of use to the coil, a pump for circulating liquid through said lines, a line for supplying makeup liquid to the first line, a float valve in said line responsive to the level of water in the sump for supplying makeup liquid to the first line, a line connecting the sump with a second line, and a valve in said line responsive to pressure in the second line for bleeding a similar quantity of heated liquid from the second line to the sump.

3. An evaporative liquid cooling arrangement according to claim 2 in which the cooled liquid is supplied to the cooling jacket of a diesel engine, the makeup water being treated to remove its hardness before supply to the first line.

4. In the method of operation of an evaporative liquid cooling arrangement the steps which consist in passing liquid to be cooled through the coil of an evaporative cooler, spraying water from a sump in the cooler over the exterior surface of the coil, directing air through the coil in heat exchange relation with liquid therein, forwarding the cooled liquid to a place of use, returning heated liquid from the place of use to the coil, adding cool makeup water to the cooled liquid being supplied to the place of use and bleeding a similar quantity of heated liquid from the system to the sump.

5. In a method of operation of an evaporative liquid cooling arrangement the steps which consist in passing liquid to be cooled through the coil of an evaporative cooler, spraying water from a sump in the cooler over the exterior surface of the coil, directing air through coil in heat exchange

relation with liquid therein, forwarding the cooled liquid to a place of use, returning heated liquid from the place of use to the coil, adding cool makeup water to the cooled liquid being supplied to the place of use and bleeding heated liquid to the sump.

6. In the method of operation of an evaporative liquid cooling arrangement, the steps which consist in passing liquid to be cooled through the coil of an evaporative cooler, spraying water from a sump in the cooler over the exterior surface of the coil, directing air through the coil in heat exchange relation with liquid therein, forwarding the cool liquid to a place of use, returning heated liquid from the place of use to the coil, adding cool makeup water to the cooled liquid being supplied to the place of use, bleeding heated liquid to the sump and regulating the supply of makeup water in accordance with the level of water in the sump.



7. The method of operation of an evaporative liquid cooling arrangement according to claim 6 in which the quantity of heated liquid bled from the arrangement is regulated in accordance with the pressure therein.

DAVID H. GOLD.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,162,158 | Coey | June 13, 1939 |
| 2,221,530 | Strang | Nov. 12, 1940 |
| 2,251,261 | Coey | Aug. 5, 1941 |
| 2,387,364 | Terry | Oct. 23, 1945 |
| 2,557,333 | Zwack | June 19, 1951 |