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PRECOOLER WITH INTERNAL FINS

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FIG. 1.

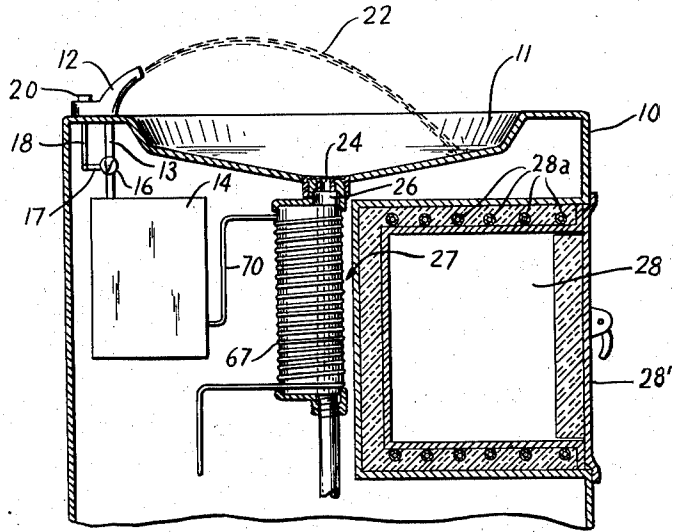


FIG. 2.

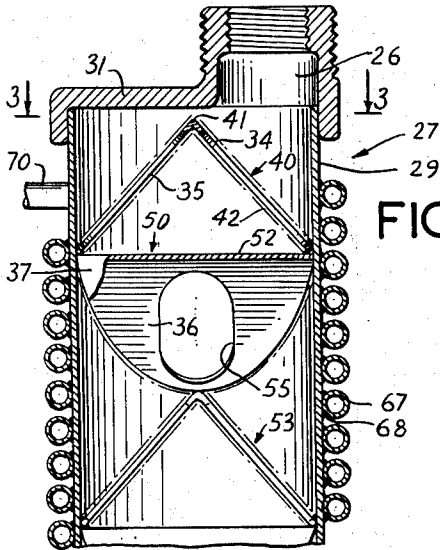
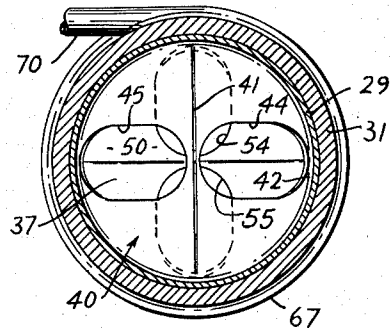
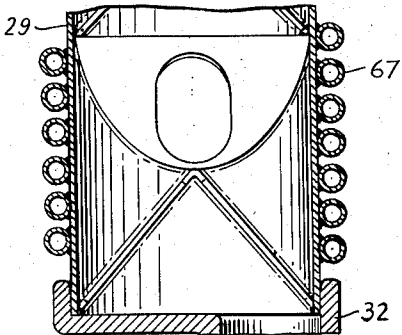


FIG. 3.



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PRECOOLER WITH INTERNAL FINS

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8 Claims. (Cl. 62-141)

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This invention relates to pre-coolers that are used in water coolers which pass water through a refrigeration unit and then discharge any unused cold water through a waste drain. A common type of such apparatus is a bubbler drinking fountain.

A substantial economy in refrigeration cost is obtained by using the waste water to cool the water that is coming from the water main or other source to the refrigeration unit of the apparatus. The pre-cooler comprises a heat exchanger through which the cold waste water and the warm or supply water flow in opposite directions to obtain the maximum heat transfer by the familiar principle of counter flow.

It is an object of this invention to provide an improved water cooler in which cold waste water is utilized to cool the incoming water flowing to the refrigeration unit.

Another object of the invention is to provide an improved pre-cooler in which adequate heat exchange takes place without providing the extensive surfaces and large apparatus that has formerly been used for the purpose.

One feature of this invention relates to a pre-cooler construction in which the water stream passing through the pre-cooler is broken up and deflected by fins that serve both as heat exchange surfaces and as baffles for agitating the water and causing flow of the water into contact with other heat exchanging surfaces that are in more direct thermal relation with the cold water. Such agitation causes a more rapid transfer of heat to the cold water in a surrounding conduit and thus obtains the heat transfer in apparatus of smaller size than has formerly been necessary. Other features of the invention relate to a construction and combination of parts that makes the invention economical to manufacture.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views,

Figure 1 is a sectional view, largely diagrammatic, showing a bubbler drinking fountain embodying this invention,

Figure 2 is an enlarged fragmentary sectional view through the pre-cooler of the drinking fountain shown in Figure 1,

Figure 3 is a sectional view taken on the line 3-3 of Figure 2.

The drinking fountain shown in Figure 1 comprises a housing 10 having a top wall in which

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there is a basin 11. A fountain fitting 12, attached to the top wall of the housing at one side of the basin 11, is supplied with water through a pipe 13 leading from a refrigeration unit 14. The flow of water through the pipe 13 is controlled by a valve 16 which has a bias toward closed position, and which is opened by a lever 17 connected to the lower end of a push rod 18. This push rod 18 is actuated by depressing a button 20 which opens the valve to supply water to the fountain fitting 12.

A stream of cold water 22 from the fountain fitting 12 strikes the bottom of the basin 11 at different regions depending upon how much the valve 16 is opened. The basin 11 has a sloping bottom so that water striking the basin at any location runs down to a waste water drain 24. This drain opens into an inlet 26 at the top of a pre-cooler 27.

There is a refrigerated compartment 28 in the housing 10 for holding food or drinks. This compartment is closed by an insulated door 28' and the refrigerating coil for the compartment 28 is shown diagrammatically by tubing 28a. The pre-cooler of this invention, being smaller than those previously required, leaves more space available within the cabinet for a food or drink compartment.

The pre-cooler 27 comprises a length of metal tubing 29, which is preferably round, and which is closed at its opposite ends by upper and lower end fittings 31 and 32, respectively. The metal tubing 29, therefore, comprises a wall of a chamber. The end fittings 31 and 32 are soldered to the ends of this wall 29. The diameter of the inlet 26 is substantially smaller than that of the chamber enclosed by the wall 29 and the end fittings 31 and 32. The diameter of the inlet 26 is preferably less than one-half of the inside diameter of the chamber so that a solid stream of water flowing through the inlet 26 can be dispersed into a broken-up and discontinuous flow in the chamber.

Within the chamber of the pre-cooler there are fins 34, 35, 36 and 37. The fins 34 and 35 comprise the opposite sides of a fin element 40 which is made of sheet metal bent along a ridge 41 so that the fins 34 and 35 slope downwardly, preferably at an angle of substantially 45°, from the center ridge 41 toward opposite sides of the chamber. The fin element 40 is originally shaped so that when it is bent to the desired angle along the ridge 41, the periphery of the fin element is adjacent the inside surface of the wall 29 along the entire periphery of the fin element, and the

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fins are attached to the wall 29 by solder 42 which forms fillets along the entire peripheral edge of the fin element 40.

There are openings 44 and 45 (Fig. 3) through the fins 34 and 35, respectively. It is a feature of the construction that these openings 44 and 45 extend from a region near the ridge 41 to the fillet provided by the solder 42. By having these openings extend all the way down to the fillets provided by the solder, the construction provides drainage that prevents the accumulation of water in what would otherwise be a pocket between the lower portion of each fin and the side wall 29 of the pre-cooler. Any such pockets in which water could accumulate would decrease the efficiency of the pre-cooler because the improved results of the pre-cooler are obtained by keeping the water continually in motion and by constantly bringing different particles of water into contact with the side wall 29.

Some heat is conducted through the wall 29 and soldered fillets 42 to the fins so that the water receives heat from the fins, but the transfer of heat through the wall 29 to cold water on the other side of the wall is even more direct. The fins 36 and 37 comprise the sloping sides of a fin element 50 which is of identical construction with the fin element 40. The ridge 52 of the fin element 50, however, is preferably disposed at a phase angle to the axis of the chamber which is at 90° to the phase angle of the ridge 41. The next fin element 53 below the fin element 50 is disposed at the same phase angle to the chamber axis as the fin element 40.

In the construction shown, each successive fin element is located with its ridge at a phase angle to the chamber axis which differs by 90° from the phase angle of the next fin elements above and below it. It will be understood that the successive fin elements can be arranged at other phase angles with relation to one another, the purpose of the construction being merely to locate the openings through the successive fins so that most of the cross section of each opening is located above a surface area of the next adjacent fin below.

In order to make it possible to remove obstructions which may become lodged in the pre-cooler, the openings through the fins are shaped so that a portion of each opening over-lies a portion of the corresponding openings in the fins below. This is illustrated in Figure 3 where the upper portion of the opening 44 over-lies a part of openings 54 and 55 of the fin element 50, while the upper portion of the opening 45 over-lies portions of the openings 54 and 55 on the other side of the center ridge 41.

Because of the fact that the downwardly sloping fins constantly deflect the broken-up water stream away from the center axis of the pre-cooler, and the additional fact that the diameter of the pre-cooler is much larger than the diameter of the inlet, substantially no water escapes directly through the over-lapping portions of the openings 44, 45, 54, 55, etc., in the fin elements.

The center clearance through the pre-cooler, provided by the overlapping openings of the successive fin elements, permits tweezers or a hook or other instrument to be inserted into the pre-cooler to remove any foreign body that becomes lodged between any of the fin elements, no matter at what level in the pre-cooler the foreign body may be located.

The warm water on its way to the refrigeration

unit travels through a conduit in heat exchange relation with the outside of the wall 29. This conduit, in the construction shown, comprises a helical coil of metal tubing 67, which is preferably made of copper. The tubing 67 is secured to the wall 29 by solder 68 which forms fillets that increase the section of metal through which heat flows from the tubing 67 into the wall 29 of the pre-cooler. The lower end of the tubing 67 is connected with a water main, or other source of water, and the upper end of the tubing 67 has a connection 70 leading to the water inlet of the refrigeration unit 14.

In the manufacture of the apparatus, the fin elements are stacked in the metal tubing 29, one above the other, and the helical metal tubing 67 is placed around the outside of the metal tubing 29. The parts are then fluxed and the entire unit is dipped in molten solder. In this way the fin elements and all of the convolutions of the tubing 67 are soldered to the metal tubing or wall 29 at the same time, and the surfaces of the wall 29 are covered with a thin layer of solder.

The preferred embodiment of the invention has been illustrated and described, but changes and modifications can be made, and some features of the invention can be used alone or in different combinations without departing from the invention as defined in the claims.

I claim as my invention:

1. In a water cooler of the type including a refrigeration unit, a supply pipe through which water is delivered to the refrigeration unit, and a drain for waste water, the combination with said drain of a pre-cooler through which the water from the drain is discharged, said pre-cooler comprising a cylindrical chamber having a helical conduit in heat-exchange relationship with the outside wall of the pre-cooler, the upper end of said helical coil being connected with the supply pipe to the refrigerating unit, and the lower end of said helical conduit being connected with a water main, a plurality of fin elements located in the pre-cooler and connected with the inside wall of the pre-cooler, each of said fin elements comprising a metal member having a bend providing a high ridge across the fin element and fins sloping downward on both sides of said ridge, said fins sloping downward to the sides of the pre-cooler, and said fins having openings therein in staggered relation with one another so that the surfaces of successive fins extend under the openings in the respective fins above them for the drainage of water through each fin into contact with the surface of the fin immediately below it.

2. In a water cooler of the type having a housing with a basin and a waste water drain from the basin, and having within the housing a refrigeration unit and a refrigeration compartment that is closed by a door and in which food and drinks can be stored, the combination with said housing of a pre-cooler located within the housing in position to receive water from said drain, a chamber within the pre-cooler through which the waste water runs, fin elements within the chamber and attached to a wall of the chamber around the peripheral edges of said fin elements, each of said fin elements comprising a metal member having a bend providing a high ridge across the fin element and fins sloping downward on both sides of said ridge, said fins having openings therein which are in staggered relation in successive fins so that the surfaces of successive fins extend under the openings in the

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respective fins above them, and said fins having sloping surfaces for diverting the water toward the wall of the chamber, the cross section of said chamber being substantially larger than the cross section of the opening through which waste water from said drain enters the chamber so that the waste water is broken up into small masses of water that are agitated and further divided as they drop through the pre-cooler by gravity against the sloping surfaces of successive fins, and at least some of the openings in the fins being located in position to drain water from the space between the wall of the chamber and the lowermost portions of the fins, and a conduit in heat exchanging relation with the outside of the wall of the chamber of the pre-cooler, said conduit having an upper end that connects with the water inlet of the refrigeration unit and having a connection at its lower end for communication with a water main or other source of water.

3. In a water cooler of the type having a refrigeration unit and a waste drain through which unused refrigerated water is discharged to a sewer, the combination with said drain of a pre-cooler having a wall enclosing a chamber through which water flows from the waste drain, a conduit around the outside of the wall and through which water flows to the refrigeration unit in a direction counter to the flow of water through said chamber, fin elements within the chamber connected with the chamber wall, each of said fin elements comprising a metal member having a bend providing a high ridge across the fin element and fins sloping downward on both sides of said ridge, and the fins on opposite sides of the ridge sloping toward opposite sides of the chamber for directing water into contact with the wall of the chamber, and said fins having openings therein in staggered relation with one another, so that the surfaces of successive fins extend under the openings in the respective fins above them, said openings extending substantially to the lowest regions of the respective fins so as to prevent the accumulation of water between the chamber wall and the lowest regions of the respective fins, the successive fins in the chamber sloping in different directions so as to compel the water to follow a tortuous path in contact with different fins that keep deflecting the water toward the wall of the chamber for heat exchanging relation with the wall.

4. The structure described in claim 3 in which the openings through the successive fins are of such shapes that at least a portion of the openings through the different fins overlap the corresponding openings through other fins that are disposed in a different direction so that there is an unobstructed passage through the center region of the chamber for access to foreign material that may become lodged in the chamber.

5. A pre-cooler comprising a chamber through which waste water runs from a drain and a conduit surrounding a side wall of the chamber for the counter flow of water from a supply source to a refrigeration unit, fins within the chamber in spaced relation one above the other and disposed at a slope for deflecting water into contact with the side wall of the chamber, an inlet pipe through which the waste water is introduced into the upper end of the chamber, said inlet pipe having a cross section substantially smaller than the open cross section of the chamber so that a solid column of water moving through the inlet is broken up into groups of deflected particles within the chamber, the suc-

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cessive fins within the chamber having openings therein disposed with a portion of each opening in line with a portion of the next opening above it in a direction parallel to the chamber axis so that there is an open space extending straight through the chamber, and with a solid portion of each successive fin under another portion of the opening in the fin above it.

6. A pre-cooler for the counter flow of cold waste water in heat exchanging relation with a stream of warmer water moving to a refrigeration unit, said pre-cooler comprising a tubular wall connected with end walls to form a chamber, a helical coil surrounding the outside of the tubular wall and connected to the outside of the wall by solder which provides fillets for increasing the area of metal through which heat is conducted from the coil to the tubular wall of the chamber, a plurality of fin elements stacked one above the other within the chamber, each of the fin elements comprising a metal member having a substantial right angle providing a high ridge bend across its mid portion and from which fins slope downward on opposite sides of the ridge, said fins being shaped to contact with the inside wall of the tubular element around the entire periphery of the fin element, the peripheral edge of each fin element being connected to the tubular element by solder that forms fillets between the fin element and the chamber wall, each successive fin element being disposed with its high ridge at a phase angle about the axis of the chamber differing by about 90° from the phase angle of the next succeeding fin element and having at least one opening in each of the downwardly sloping sides of the fin elements, said openings extending on both sides of each fin element substantially to the fillet provided by the solder along the lowest peripheral portions of the fin element, and said openings extending upward to regions near the ridge of the fin element and being shaped to leave a portion of each opening in an overlapping relation with the corresponding openings of the next successive fin element so that there are openings extending straight through the pre-cooler near the axis of the pre-cooler chamber and at the regions where the successive fin elements have their highest elevations, and an inlet through which water flows into a pre-cooler, said inlet having a cross section of a diameter less than one-half the internal diameter of the chamber in the pre-cooler so that a solid stream of water flowing through the inlet is broken up into particles by the fins in the pre-cooler.

7. In apparatus of the type that supplies refrigerated water and that has a drain for waste water, the combination with said drain of a pre-cooler, said pre-cooler having a wall enclosing a chamber through which the waste water passes, a conduit for the passage of supply water to a refrigerating unit beyond the pre-cooler in a direction opposite to the direction of flow of the cold waste water through the pre-cooler, said conduit being outside of the wall of the pre-cooler and in heat-exchanging relation with the wall, fin elements within the chamber connected to the wall, each of said fin elements comprising a metal member having a bend providing a high ridge across the fin element and fins sloping downward on both sides of said ridge, successive fin elements having their ridges at different phase angles with respect to a longitudinal axis through the chamber so that the fins of successive elements slope in different directions, said

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8. In apparatus of the type that supplies refrigerated water and that has a drain for waste water, the combination with said drain of a pre-cooler, said pre-cooler having a wall enclosing a chamber through which the waste water passes, a conduit for the passage of the supply water to a refrigerating unit along the pre-cooler in a direction opposite to the direction of flow of the cold waste water through the pre-cooler, said conduit being outside of the wall of the pre-cooler and in heat-exchanging relation with the wall, a plurality of fin elements located one above the other in the chamber and connected with the wall of the chamber, each of said fin elements comprising a metal member having a bend providing a high ridge across the fin element and fins sloping downward on both sides of said ridge, each successive fin element having its ridge at a phase angle to the pre-cooler axis

which differs by substantially 90° from the phase angle of the next adjacent fin element and each fin element having its fin extending down into contact with the ridge of the fin element below it, and each of said fins having openings therein through which water drops into contact with the next fin below.

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