July 21, 1936. M. M. LAWLER 2,048,661

COOLING OF AIR BY REFRIGERATION

Original Filed March 6, 1934

Fig. 1.

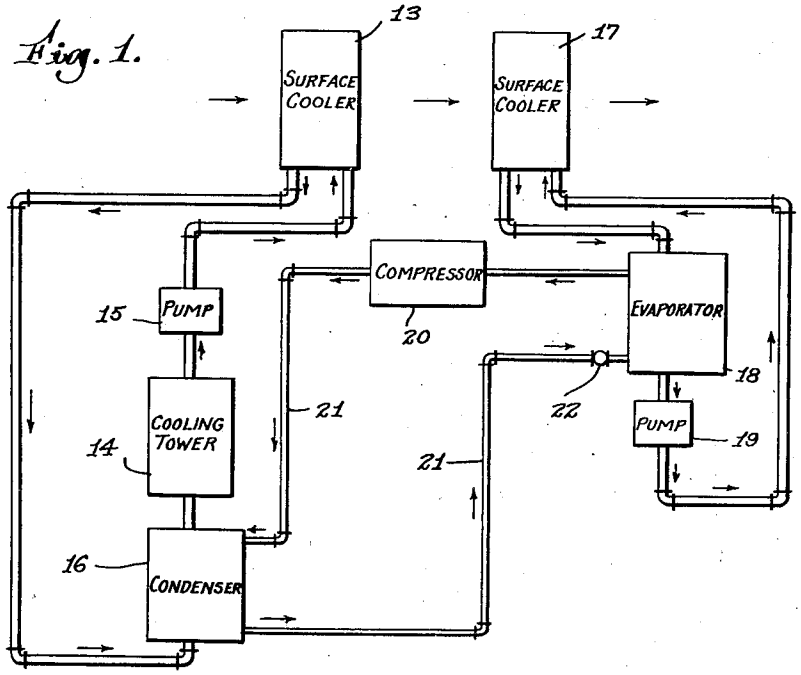
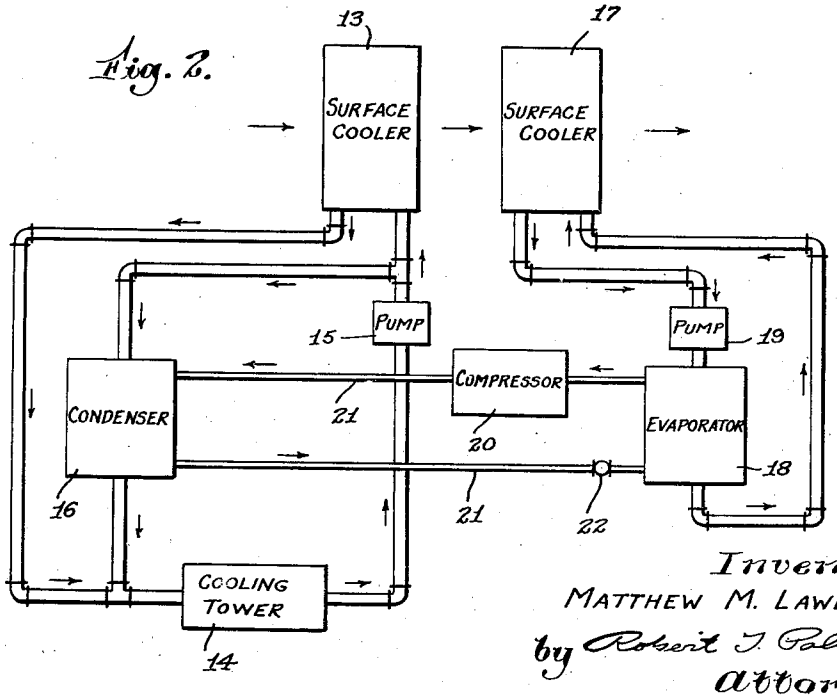


Fig. 2.



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COOLING OF AIR BY REFRIGERATION

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Original application March 6, 1934, Serial No. 714,219. Divided and this application July 26, 1935, Serial No. 33,224

3 Claims. (Cl. 62—129)

This invention relates to refrigeration systems for use in the conditioning of air and relates more particularly to the cooling of air with water, cooled through evaporative cooling, together with mechanical refrigeration.

This application is a division of my co-pending application, Serial No. 714,219, filed March 6, 1934 now Patent No. 2,018,453, granted October 22, 1935.

Possibly the greatest objection to the cooling of air in summer for air conditioning purposes is the high cost of refrigeration where the cooling is accomplished by some type of mechanical refrigeration. Mechanical refrigeration is necessary where well or lake water of sufficiently low temperature is not available.

In the western portion of the United States and in other areas where the Wet Bulb Temperature of the air is low, water may be cooled to a fairly low temperature by a cooling tower, and this cold water may be used to cool air for comfort purposes.

According to this invention, a refrigeration system for the cooling of air embodies apparatus for combined evaporative and mechanical cooling of water which is used for cooling the air. In one embodiment of the invention, extended surface cooling coils are used for cooling the air which is forced over the coils by a fan or blower. A cooling tower is provided and water, which is later circulated through the cooling coils, is first sprayed within the cooling tower, where it is cooled to a lower temperature. It is then passed through the evaporator of the refrigeration plant, where it is cooled an additional amount. It is then circulated through the extended surface cooling coils where its temperature is raised, and is next circulated through the condenser of the refrigeration plant where its temperature is raised an additional amount. From the condenser it is returned to the cooling tower where it is again sprayed. In this embodiment of the invention, there is one continuous water circuit which passes in series through the extended surface cooler, the condenser, cooling tower, and evaporator.

In one embodiment of the invention, separate extended surface cooling coils are provided, the first set for the water which is cooled by evaporative cooling, and the second set for a refrigerant which is cooled mechanically. In this embodiment of the invention there are two cooling fluid circuits. The cold water, which is cooled in the cooling tower, passes in series through the cooling tower, the first set of extended surface cooling coils, and the condenser of the refrigeration plant. In the second circuit, the cooling water or other refrigerant passes in series through the evaporator and second surface cooler. The air to be cooled passes first over the surface cooler, which is supplied with water from the cooling tower, and next through the coils, which are cooled by mechanical refrigeration.

In another embodiment of the invention, two separate cooling circuits are provided through two separate sets of extended surface cooling coils. In the first set of coils, water cooled by evaporative cooling is circulated, the condenser and cooling coils being in parallel relationship rather than in series relationship, as employed in the second described embodiment. The advantage of this is that increased refrigeration effect is obtained through the provision of a larger cooling tower and condenser capacity.

An object of the invention is to cool air with water previously cooled by evaporative cooling.

Another object of the invention is to cool air by water cooled through evaporative cooling and by mechanical refrigeration.

Another object of the invention is to provide an air conditioning plant with evaporative cooling and cooling by mechanical refrigeration.

Other objects of the invention will be apparent from the following description taken in connection with drawing.

The invention will be described in connection with the drawing, of which:

Fig. 1 is a diagrammatic illustration of one embodiment of the invention embodying evaporative cooling and cooling with mechanical refrigeration, utilizing two sets of air cooling coils, water cooled by evaporative cooling passing through one set of coils, and water cooled by mechanical refrigeration passing through the second set of coils, and

Fig. 2 is a diagrammatic illustration of another embodiment of the invention, similar to that illustrated by Fig. 1, except that the condenser and surface cooler are arranged in parallel instead of in series.

In the embodiment of the invention illustrated by Fig. 1, two separate air cooling compartments are utilized. The first compartment 13 received water cooled by evaporative cooling, the circuit being from the cooling tower 14, pump 15, cooler 13, and condenser 16. The second cooler 17 is supplied with refrigeration produced by mechanical refrigeration, cold water from the evaporator 18 being circulated through coils in the cooler 17 by means of the pump 19. As the compressor 20 supplied refrigerant through the pipes 21 to the condenser 16, the refrigerant is cooled by con-

denser water and is expanded through the expansion valve 22 to the evaporator coils 18, through which the water is to be cooled in the refrigeration cycle is circulated.

In one installation, it was found that by adding the cooling coils through which the water, cooled by evaporative cooling, is circulated, the capacity of the refrigerating plant was reduced from 29 tons to 16½ tons, which reduced the equipment required and the operating expense.

The embodiment of the invention illustrated by Fig. 2 is similar to that of Fig. 1, except that the condenser and surface cooler are placed in parallel relationship instead of in series relationship. For this reason, the same reference characters are applied to Fig. 2 as are applied to corresponding apparatus of Fig. 1. The advantages and disadvantages of placing the surface cooler and condenser in series and parallel are that with the arrangement illustrated by Fig. 2, the surface cooler and condenser in parallel will require a larger condenser, a larger cooling tower, and a larger water circulatory system for the water cooled by evaporative cooling; the compressor displacement and the surface of the condenser coils may be reduced, and less power will be required to operate the refrigeration plant.

Another advantage of an air conditioning system according to the present invention, is that during several months of the year, that is, in the early summer and early fall, the desired cooling effect may be obtained by discontinuing the refrigerating plant and circulating water cooled by evaporative cooling through the cooling coils in the surface coolers. So, the compressor and its associated equipment is operated only during mid-summer, with the result that the total cost in producing the desired air cooling is comparatively low.

While the several embodiments of the invention have been described in connection with extended surface coils for cooling the air, it should be understood that the invention comprehends also the use of air washers, extended surface coolers having been referred to merely by way of illustration. The same cooling effect may be obtained with air washers as with surface coolers. With the latter, a somewhat lower relative humidity is obtained.

Whereas several embodiments of the invention have been described for the purpose of illustration, it should be understood that the invention is not limited to the details described, since many modifications may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. Air conditioning apparatus comprising a cooling compartment, a cooling tower, a second cooling compartment, a refrigeration plant, including a refrigerant condenser, for cooling the air passing through said second cooling compartment, and means for circulating water from said cooling tower through said condenser and through said first named cooling compartment.

2. Air conditioning apparatus comprising an air cooler, a cooling tower for the evaporative cooling of water, means for circulating cooled water from said tower through said cooler, a second air cooler, a refrigeration plant including a condenser and evaporator for supplying refrigerant to said second cooler, and means for circulating water from said cooling tower through said condenser.

3. Air conditioning apparatus comprising an air cooler, a cooling tower for the evaporative cooling of water, means for circulating a portion of the water from said tower through said cooler, a second cooler, a refrigeration plant including a condenser and evaporator for supplying refrigerant to said second cooler, and means for circulating another portion of the water from said cooling tower through said condenser.

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