PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Refrigeration Systems

We, CARRIER ENGINEERING COMPANY LIMITED, a Company incorporated under the laws of Great Britain, of 24, Buckingham Gate, London, S.W.1, England, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to refrigeration systems.

In co-pending application No. 18376/47 (Serial No. 639,413) and in co-pending application No. 18379/47 (Serial No. 639,416) there are disclosed an absorption refrigeration system and a control arrangement therefor which may be readily modified to provide dual temperatures. While the present invention is not limited to its use in connection with the absorption refrigeration system described in such co-pending applications, above referred to, but may be embodied in other types of continuous cycle absorption refrigeration systems, it will be understood that it is preferred to employ the present invention in connection with an absorption refrigeration system of the kind described in such co-pending applications.

The chief object of the present invention is to provide a continuous cycle absorption refrigeration system capable of providing air attemperating or cooling mediums at different temperatures in which the temperatures of the mediums so provided may be controlled independently of one another

A continuous cycle absorption refrigeration system according to the invention, comprises in combination a generator, a condenser, an absorber and an evaporator, means for controlling operation of said system, a primary heat exchanger bypassed from the main circuit comprising generator, condenser, absorber and evaporator, means for circulating cooled medium from the evaporator to the primary heat exchanger and thence back to the evaporator, a secondary heat exchanger disposed in an area to be air-conditioned, a heat exchanger member in said evaporator adapted to dispose air-attemperating medium for use in said secondary heat exchanger in heat exchange relation with the cooled medium in said evaporator, and means for supplying air-attemperating medium to said secondary heat exchanger through said heat exchange member in the evaporator.

Means may be provided for controlling the temperature of cooled medium circulated to the primary heat exchanger, together with means for controlling the temperature of attemperating medium circulated to the secondary heat exchanger independently of said first means.

Means may be provided for bypassing attemperating medium about said heat exchange member, and for regulating the proportion of attemperating medium passing through said heat exchange member.

The regulating means may comprise a valve disposed in the path of the attemperating medium, a control member for regulating said valve and means for actuating said control member in response to the temperature of attemperating medium passing to the secondary heat exchanger.

A bypass may extend about the secondary heat exchanger, and a valve may be disposed in said bypass to regulate the quantity of attemperating medium passing through the secondary heat exchanger in response to the temperature of the area in which said secondary heat exchanger is disposed.

In order that the invention may be more clearly understood reference will now be made to a preferred embodiment thereof in an absorption refrigeration system arranged as illustrated in the accompanying diagrammatical drawings.

generator 7 disposed at the bottom thereof and a condenser 8 disposed in the upper

Figure 1 is a diagrammatical view illustrating the operation of the absorption refrigeration system; and

Figure 2 is a fragmentary diagrammatical view of the absorption system illustrating the manner in which dual temperatures are obtained.

In the drawings, like reference designate the same or similar parts.

Referring to the drawings, there is shown a horizontally extending shell 2 having an absorber 3 disposed at the bottom thereof, and an evaporator 4 disposed in the upper portion of the shell; a heat exchange member, such as a coil 5, is disposed in evaporator 4, as hereinafter explained. A second shell 6 includes a portion of shell 6. Weak solution, i.e., a generator 7 disposed at the bottom thereof and a condenser 8 disposed in the upper solution containing a large amount of refrigerant so that the solution is weak in absorbing properties, is withdrawn from absorber 3 by pump 9 through line 10 and is forwarded to generator 7 through line 11, heat exchanger 12 and line 13. Strong solution, i.e., a solution which is relatively deficient in refrigerant and consequently possesses enhanced properties of refrigerant absorption, is withdrawn from generator 7 through line 14, line 15, heat exchanger 12, line 16 to ejector 17 which forwards strong solution through line 18 to spray arrangement 19 adapted to spray the solution over the tubes of absorber 3.

A pump 20 passes cooling or condensing water through line 21 to the tubes of absorber 3. Cooling water after its passage through the tubes of absorber 3 is directed through line 22 to the tubes of condenser 8.

Chilled water leaves evaporator 4 through line 23 and is circulated by pump 24 through a primary heat exchanger 25 disposed preferably in a central station air conditioning system and is adapted to attemperate or cool air passing through the central station. Cooled water after its passage through heat exchanger 25 is returned through line 26 to evaporator 4 and is flash-cooled in the evaporator to attain the required temperature, the cooled water refrigerant passing in heat exchange relation with coil 5 and again being circulated through primary heat exchanger 25.

Suitable controls are provided to regulate the operation of the system. Valve 27 controlled by thermostat 28 actuated in response to a bulb 29 disposed in or in contact with line 23 regulates the flow of solution through the system. Valve 30 disposed in steam line 31 and controlled by thermostat 32 actuated by bulb 33 disposed in or adjacent line 14 regulates the quantity of steam passing through the tubes of generator 7. Valve 34, disposed in condensing water line 35, controlled by thermostat 36 actuated by means of a bulb 37 disposed in or in contact with condensate line 38 regulates the flow of cooling or condensing water through the tubes of the absorber 3 and condenser 8. Suitable means are provided, of course, to purge the absorber and condenser of non-condensible gases and to return condensate from condenser 8 to evaporator 4.

The absorption refrigeration system so described is disclosed and claimed in the co-pending applications above referred to and reference is made to such applications for a more complete description of the arrangement and the manner in which such system functions. The present invention is concerned primarily with an improvement in such system whereby the system may function to provide dual temperatures of attemperating medium.

Referring to Figure 2, there is illustrated suitable means for providing dual temperatures from a single absorption refrigeration machine of the type described. Attemperating medium is circulated by pump 39 through line 40 to coil 5 disposed in evaporator 4; flash-cooled medium, i.e., water, in evaporator 4 is disposed in heat exchange relation with coil 5 and serves to cool attemperating medium passing therethrough. Line 41 connects coil 5 with a plurality of secondary heat exchangers 42 disposed in areas to be conditioned. Such secondary heat exchangers 42 may comprise a portion of an air-conditioning system such as is described in co-pending application No. 4533/46 (Serial No. [ ]) in which air from the area being conditioned is induced into an induction unit disposed in the area by the discharge of primary conditioned air at high velocity in the unit. The induced air passes through secondary heat exchanger 42 and is cooled to a desired temperature in accordance with the requirements of the individual area being conditioned. 641,712

Attemperating medium after passage through secondary heat exchangers 42 is returned through line 43 to pump 39 and is again passed through coil 5 and again cooled.

It will be appreciated in most cases it is desirable that cooled water passing to primary heat exchanger 25 be at a different temperature than attemperating medium passing to secondary heat exchangers 42. Water is flash-cooled in evaporator 4 to a desired temperature

and, passing in heat exchange relation with coil 5, cools attemperating medium therein to substantially the same temperature. A three-way mixing valve 44 is disposed in line 41 to regulate the flow of attemperating medium therethrough. Valve 44 is controlled by a thermostat 45 which is actuated by a bulb 46 disposed in or in contact with line 41, and a bypass 47 connects line 40 with valve 44.

Assume it is desired to maintain attemperating medium passing to secondary heat exchangers 42 at a temperature of 50°F., bulb 46 in response to the temperature of attemperating medium in line 41 actuates thermostat 45 to control valve 44 to regulate the quantity of medium passing through coil 5 and through bypass 47. In other words, a portion of attemperating medium returning from secondary heat exchangers 42 is cooled while a second portion is not changed in temperature, the proportions of the two streams of attemperating medium being regulated to attain a desired final temperature of attemperating medium for supply to the secondary heat exchangers. If desired, a throttling valve shown in dotted outline may be disposed in bypass 47 as a substitute for valve 44. While such valve is not as satisfactory as valve 44 it will permit adequate operation of the system.

In order to regulate the quantity of medium passing through each secondary heat exchanger 42, a suitable bypass 48 is provided extending from line 41 to line 43. A valve 49 is disposed in bypass 48; valve 49 may be regulated in response to the temperature of the area being conditioned to determine the quantity of cooled attemperating medium passing through each heat exchanger 42 in accordance with the requirements of each individual area. If desired, bypass 48 and valve 49 may be eliminated, a suitable throttling valve, for example, the valve disclosed in United States Reissue patent No. 22,685, granted October 30, 1945, being placed in line 41 and serving to throttle the flow of conditioning medium to a heat exchanger 42 in accordance with the requirements of the area in which it is disposed.

In operation, the absorption refrigeration system functions to provide chilled water at a predetermined temperature, such chilled water being circulated through a primary heat exchanger 25 in heat exchange relation with air to be conditioned. After passage through heat exchanger 25, the chilled water is returned to evaporator 4 and is flash-cooled in evaporator 4 to a predetermined temperature. The cooled water in evaporator 4 passes in heat exchange relation with attemperating medium flowing through coil 5 in evaporator 4 and serves to cool such medium to a desired temperature, again being withdrawn from the evaporator 4 by pump 24 and circulated through primary heat exchanger 25.

Cooled attemperating medium is directed through coil 5 by pump 39, being cooled during such passage by the flash-cooled medium in the evaporator. It is desired to maintain a predetermined temperature of attemperating medium supplied to the secondary heat exchangers 42. For this purpose, valve 44, disposed in line 41 is actuated to regulate the proportions of attemperating medium directed through coil 5 to be cooled and the proportions of medium bypassing coil 5. Such streams of attemperating medium at different temperatures are mixed automatically to provide medium at a desired temperature for supply to secondary heat exchangers 42. After passage of attemperating medium through secondary heat exchangers 42, pump 39 again supplies such medium to be cooled in evaporator 4.

The above description contemplates operation of the system at substantially full load to provide attemperating medium to heat exchangers 42. It will be appreciated that frequently, under certain conditions of operation, as large a supply of medium at a temperature of say 50°F. is not required. At substantially full load, it is contemplated that medium returning from exchangers 42 will be raised in temperature to say 60°F. Suppose, for example, the load decreases so that medium returning to coil 5 is at a temperature of say 55°F. Under these circumstances, the difference between the temperature of the attemperating medium and the chilled water decreases, the bypass 47 is opened to a greater extent and the velocity of medium through coil 5 is reduced thus reducing the rate of heat transfer to provide medium at the desired temperature under conditions of partial load. When the load imposed upon the system at primary heat exchanger 25 decreases, the absorption machine then operates under partial load conditions as explained in the co-pending applications Nos. 18386/47 (Serial No. 639,413) and 18379/47 (Serial No. 639,[illegible]6) above referred to.

It will be observed that the present invention provides cooled medium, such as chilled water, at a predetermined temperature for passage through a primary heat exchanger and also provides attemperating medium, such as chilled water, at a different temperature for passage

through a plurality of secondary heat exchangers and the control of the temperatures so obtained independently of one another, further the temperatures of the two mediums may be varied as desired in order to supply the mediums at desired temperatures to the primary and secondary heat exchangers.

The present invention provides a single absorption refrigeration machine capable of supplying attemperating medium to a plurality of heat exchangers disposed in heat exchange relation with medium to be attemperated at different temperatures. The absorption sytem provided is inexpensive in initial cost and in operation; the equipment required to provide attemperating mediums at different temperatures does not increase the cost of the machine to a great extent and may be readily incorporated in the system at the place of manufacture.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A continuous cycle absorption refrigeration system, comprising in combination a generator, a condenser, an absorber and an evaporator, means for controlling operation of said system, a primary heat exchanger bypassed from the main circuit comprising generator, condenser, absorber and evaporator means for circulating cooled medium from the evaporator to the primary heat exchanger and thence back to the evaporator, a secondary heat exchanger disposed in an area to be air-conditioned, a heat exchange member in said evaporator adapted to dispose air-attemperating medium for use in said secondary heat exchanger in heat exchange relation with the cooled medium in said evaporator, and means for supplying air-attemperating medium to said secondary heat exchanger through said heat exchange member in the evaporator.

2. A refrigeration system according to Claim 1, in which the generator, condenser, absorber, and evaporator are disposed in a closed circuit, and the evaporator is adapted to flash cool medium conveyed thereto from the primary heat exchanger.

3. A refrigeration system according to Claim 1 or Claim 2, in which means are provided for controlling the temperature of cooled medium circulated to the primary heat exchanger and means are provided for controlling the temperature of attemperating medium circulated to the secondary heat exchanger independently of said first means.

4. A refrigeration system according to any of Claims 1 to 3, having means for bypassing attemperating medium about said heat exchange member and for regulating the proportion of attemperating medium passing through said heat exchange member.

5. A refrigeration system according to Claim 4 in which said regulating means comprise a valve disposed in the path of the attemperating medium, a control member for regulating said valve and means for actuating said control member in response to the temperature of attemperating medium passing to the secondary heat exchanger.

6. A refrigeration system according to Claim 5, having a supply line connecting said heat exchange member in the evaporator with the secondary heat exchanger, and a return line connecting the secondary heat exchanger with said heat exchange member, the bypass means comprising a bypass connecting the return line and the supply line and the regulating valve being disposed in said supply line so as to be capable of regulating the proportions of attemperating medium passing through the heat exchange member and the bypass in response to the temperature of attemperating medium passing to the secondary heat exchanger.

7. A refrigeration system according to Claim 6, having a pump in said return line for circulating attemperating medium through said heat exchange member in heat exchange relation with cooled medium in the evaporator and for passing the attemperating medium through the secondary heat exchanger.

8. A refrigeration system according to Claim 6 or Claim 7 in which the regulating valve is located at the juncture of the bypass and supply line.

9. A refrigeration system according to any of Claims 6 to 8, in which a bypass extends about the secondary heat exchanger and connects the supply and return lines, and a valve is disposed in said secondary heat exchanger bypass to regulate the quantity of attemperating medium passing through the secondary heat exchanger in response to the temperature of the area in which said secondary heat exchanger is disposed.

10. A continuous cycle absorption refrigeration system according to Claim 1, adapted to function so as to provide dual temperatures of air-attemperating medium and arranged substantially as described with reference to the accompanying drawings.

through a plurality of secondary heat exchangers and the control of the temperatures so obtained independently of one another, further the temperatures of the two mediums may be varied as desired in order to supply the mediums at desired temperatures to the primary and secondary heat exchangers.

The present invention provides a single absorption refrigeration machine capable of supplying attemperating medium to a plurality of heat exchangers disposed in heat exchange relation with medium to be attemperated at different temperatures. The absorption sytem provided is inexpensive in initial cost and in operation; the equipment required to provide attemperating mediums at different temperatures does not increase the cost of the machine to a great extent and may be readily incorporated in the system at the place of manufacture.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A continuous cycle absorption refrigeration system, comprising in combination a generator, a condenser, an absorber and an evaporator, means for controlling operation of said system, a primary heat exchanger bypassed from the main circuit comprising generator, condenser, absorber and evaporator means for circulating cooled medium from the evaporator to the primary heat exchanger and thence back to the evaporator, a secondary heat exchanger disposed in an area to be air-conditioned, a heat exchange member in said evaporator adapted to dispose air-attemperating medium for use in said secondary heat exchanger in heat exchange relation with the cooled medium in said evaporator, and means for supplying air-attemperating medium to said secondary heat exchanger through said heat exchange member in the evaporator.

2. A refrigeration system according to Claim 1, in which the generator, condenser, absorber, and evaporator are disposed in a closed circuit, and the evaporator is adapted to flash cool medium conveyed thereto from the primary heat exchanger.

3. A refrigeration system according to Claim 1 or Claim 2, in which means are provided for controlling the temperature of cooled medium circulated to the primary heat exchanger and means are provided for controlling the temperature of attemperating medium circulated to the secondary heat exchanger independently of said first means.

4. A refrigeration system according to any of Claims 1 to 3, having means for bypassing attemperating medium about said heat exchange member and for regulating the proportion of attemperating medium passing through said heat exchange member.

5. A refrigeration system according to Claim 4 in which said regulating means comprise a valve disposed in the path of the attemperating medium, a control member for regulating said valve and means for actuating said control member in response to the temperature of attemperating medium passing to the secondary heat exchanger.

6. A refrigeration system according to Claim 5, having a supply line connecting said heat exchange member in the evaporator with the secondary heat exchanger, and a return line connecting the secondary heat exchanger with said heat exchange member, the bypass means comprising a bypass connecting the return line and the supply line and the regulating valve being disposed in said supply line so as to be capable of regulating the proportions of attemperating medium passing through the heat exchange member and the bypass in response to the temperature of attemperating medium passing to the secondary heat exchanger.

7. A refrigeration system according to Claim 6, having a pump in said return line for circulating attemperating medium through said heat exchange member in heat exchange relation with cooled medium in the evaporator and for passing the attemperating medium through the secondary heat exchanger.

8. A refrigeration system according to Claim 6 or Claim 7 in which the regulating valve is located at the juncture of the bypass and supply line.

9. A refrigeration system according to any of Claims 6 to 8, in which a bypass extends about the secondary heat exchanger and connects the supply and return lines, and a valve is disposed in said secondary heat exchanger bypass to regulate the quantity of attemperating medium passing through the secondary heat exchanger in response to the temperature of the area in which said secondary heat exchanger is disposed.

10. A continuous cycle absorption refrigeration system according to Claim 1, adapted to function so as to provide dual temperatures of air-attemperating medium and arranged substantially as described with reference to the accompanying drawings.

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