PATENT SPECIFICATION

639,414

Date of Application and filing Complete Specification: July 10, 1947.

No. 18377/47.

Application made in United States of America on July 13, 1946.

Complete Specification Published June 28, 1950.

Index at acceptance:—Classes 29, G1(c: h: n: o), G5(e: n); and 64(iii), S5d2.

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. 15376/47 (Serial No. 639,413) and in co-pending Application No. 18379/47 (Serial No. 639,416) there are disclosed and claimed an absorption refrigeration system and a control arrangement therefor in which the present invention may be readily included. It will be understood, of course, the present invention is not limited to its use in connection with the absorption refriger. ation system or the control arrangement therefor described in the co-pending applications above referred to but may be embodied in any type of continuous cycle absorption refrigeration system in which it is desired to obtain satisfactory operation of the system at higher concentrations of solution in the generator.

A main object of the present invention is to provide a continuous cycle absorption regrigeration system including a control arrangement adapted to permit satisfactory operation of the system at higher concentrations of solution in the generator than is customary during normal operation of the system.

A continuous cycle absorption refrigeration system according to the invention comprises in combination an absorber, an evaporator, a generator and a condenser, a line for supplying weak solution from the absorber to the generator, a second line for supplying strong solution from the generator to the absorber, heat exchange means disposed in said lines for placing solutions passing therethrough in heat exchange relation, said heat exchange means including a casing member and a coil member having sections of the coil disposed in series extending through the casing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arranged for the flow of weak solution therethrough in an opposite direction, and means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system by rendering at least one of the coil sections ineffective for substantial heat transfer.

The term "weak solution" is used herein to define a solution containing a large amount of refrigerant so that the solution is weak in absorbing properties. The term "strong solution" defines a solution which is relatively deficient in refrigerant and consequently a solution which possesses enhanced properties of refrigerant absorption.

The means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system may comprise a bypass line connecting the first line with a section of the coil, a valve in said bypass line, and a second valve in said first line, opening of said first valve and closing of said second valve opening the bypass and rendering such section of the coil ineffective for substantial heat transfer.

As hereafter more fully explained a pump may be employed for withdrawing weak solution from the absorber and for supplying the weak solution through said first line to the generator, and an ejector adapted to receive strong solution from the generator through the second line and to supply the strong solution to the absorber.

The present invention also comprises a heat exchanger for use in a continuous cycle absorption refrigeration system as above referred to, including a casing member and a coil member having sections of the coil disposed in series through the cas-

[Price 2/-]

ing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arranged for the passage of weak solution therethrough, and means for rendering at least one of the coil sections ineffective for substantial heat transfer.

Various combinations of refrigerant and absorbent may be used in the system described. A solution consisting of lithium bromide and water is highly satisfactory. Other salt solutions may be used if desired in the system. When the system is operated at high temperature (above freezing temperature) a solution of lithium chloride and water or a solution of sodium hydroxide and water, for example, may be used. When the system is used to obtain low temperature, ammonia, for example, may be employed as a refrigerant.

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 diagrammatic drawing.

Referring to the drawing, 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 second shell 5 includes a generator 6 disposed at the bottom thereof and a condenser 7 disposed in the upper portion of shell 5.

Weak solution is withdrawn from absorber 3 by pump 8 through line 9 and is forwarded to the generator 6 through line 10, line 11 forming a continuation of line 10, heat exchanger 12 as hereinafter described, and line 13. Strong solution is withdrawn from generator 6 through line 14, overflow arrangement 15, line 16, heat exchanger 12, line 17 to ejector 18 which forwards strong solution through line 19 to spray arrangement 20 adapted to spray the solution over the tubes 21 or absorber 3.

Heat exchange member 12 is disposed in position to place weak solution passing from the absorber to the generator and strong solution passing from the generator to the absorber in heat exchange relation with one another to permit operation of the system at higher efficiency. Under some conditions, it is desirable to operate the system at higher concentrations of solution leaving the generator than is customary during normal operation of the system. For this purpose, a bypass line 22 is provided connecting line 11 with a desired loop 23 of the heat exchanger 12. A manually operated valve 24 is disposed in line 22. A similar valve 25 may be disposed in line 11 as shown. It will be understood, of course, valves 24 and 25 may be automatically actuated by any suitable means. When it is desired to bypass or to cut out some portion of the heat exchanger surface, valve 24 may be opened and valve 25 throttled or closed thus permitting weak solution to flow through line 22 to bypass a portion of the heat exchanger surface as shown. Strong solution then leaving the heat exchanger is at a higher temperature which will permit operation at a higher concentration of solution leaving the generator without danger of approaching the freezing line.

A pump 26 passes cooling or condensing water through line 27 to the tubes 21 of absorber 3. Cooling water after its passage through the tubes of absorber 3 is directed through line 28 to the tubes 29 of condenser 7.

Chilled water leaves the evaporator through line 30 and is circulated to the heat exchange coil (not shown) of an air conditioning system, for example, by means of pump 31. The chilled water is returned from the air conditioning system through line 32 and is sprayed by means of spray arrangement 33 in the evaporator 4. Pressure in shell 2 is such that the water sprayed therein is flash cooled. The vapour passes downward to be absorbed by the solution in absorber 3 while the cooled water remains in evaporator 4 and may be withdrawn therefrom, as described above, through line 30. Line 34 serves to forward condensate from condenser 7 to evaporator 4. A precooler arrangement 35 may be provided in line 34 so that the condensate forwarded to the evaporator is maintained at a desired temperature.

Any suitable purge arrangement 36 may be provided to withdraw non-condensible gases from the absorber and the condenser.

A valve 37 is disposed in line 10 to throttle the volume of weak solution passing to generator 6 and ejector 18. Valve 37 is actuated by thermostat control 38 responsive to the temperature of chilled water leaving evaporator 4 as registered by bulb 39 disposed in or adjacent line 30. A valve 40 in steam line 40^1 determines the volume of steam passing into the tubes of generator 6. Valve 40 is actuated by control 41 responsive to the temperature of strong solution leaving the generator as registered by bulb 42 placed in or adjacent to line 14. A valve 43 placed in the cooling water line serves to control the volume of cooling water passing through the tubes of absorber 3 and condenser 7. Valve 43 is actuated by control 44 in response to the temperature of condensate leaving condenser 7 by means of bulb

45 placed in or adjacent condensate line 34.

The control arrangement so described is disclosed and claimed in said co-pending Application No. 18379/47 and reference is made to the specification of such application for a more complete description of the arrangement and the manner in which it controls operation of the absorption refrigeration system disclosed in the co-pending application above referred to. The present invention is concerned primarily with the provision of means enabling operation of an absorption refrigeration system of this type at higher concentrations of solutions leaving the generator than is customary during the normal operation of said system.

In operation, assuming that it is desired to operate the system at higher concentrations of solution leaving the generator, a portion of heat exchange member 12 may be bypassed as already described. To bypass a portion of the heat exchange surface, valve 24 may be opened and valve 25 throttled or closed, permitting weak solution to flow through line 22 to loop 23 of heat exchanger 12 without passing through the complete heat exchange surface. Solution then leaving the heat exchanger is at a higher temperature which will permit operation of the system at a higher concentration of solution leaving the generator.

The control arrangement provided by the present invention permits operation of the generator of an absorption refrigeration system at higher concentrations of solution without danger of crystallisation of the solution. Such arrangement may be embodied in an absorption refrigeration system of the type described at minor expense and serves effectively to provide desired variations in concentration of solution leaving the generator in accordance with conditions encountered in certain uses.

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 an absorber, an evaporator, a generator and a condenser, a line for supplying weak solution from the absorber to the generator, a second line for supplying strong solution from the generator to the absorber, heat exchange means disposed in said lines for placing solutions passing therethrough in heat exchange relation, said heat exchange means including a casing member and a coil member having sections of the coil disposed in series extending through the casing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arrranged for the flow of weak solution therethrough in an opposite direction, and means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system by rendering at least one of the coil sections ineffective for substantial heat transfer.

2. A refrigeration system according to Claim 1, in which the means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system comprises a bypass line connecting the first line with a section of the coil, a valve in said bypass line, and a second valve in said first line, opening of said first valve and closing of said second valve opening the bypass and rendering such section of the coil ineffective for substantial heat transfer.

3. A refrigeration system according to Claim 1 or Claim 2, characterised by a pump for withdrawing weak solution from the absorber and for supplying the weak solution through said first line to the generator, and an ejector adapted to receive strong solution from the generator through the second line and to supply the strong solution to the absorber.

4. A heat exchanger for use in a continuous cycle absorption refrigeration system according to any of Claims 1 to 3, including a casing member and a coil member having sections of the coil disposed in series through the casing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arranged for the passage of weak solution therethrough, and means for rendering at least one of the soil sections ineffective for substantial heat transfer.

5. A continuous cycle absorption refrigeration system according to Claim 1, arranged substantially as described with reference to the accompanying drawing.

6. A heat exchanger for use in a continuous cycle absorption refrigeration system, according to Claim 4, arranged substantially as described with reference to the accompanying drawing.

Dated this 8th day of July, 1947.
PAGE, WHITE & FARRER,
Chartered Patent Agents,
27, Chancery Lane, London, W.C.2,
Agents for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office by the Courier Press.—1950.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.

45 placed in or adjacent condensate line 34.

The control arrangement so described is disclosed and claimed in said co-pending Application No. 18379/47 and reference is made to the specification of such application for a more complete description of the arrangement and the manner in which it controls operation of the absorption refrigeration system disclosed in the co-pending application above referred to. The present invention is concerned primarily with the provision of means enabling operation of an absorption refrigeration system of this type at higher concentrations of solutions leaving the generator than is customary during the normal operation of said system.

In operation, assuming that it is desired to operate the system at higher concentrations of solution leaving the generator, a portion of heat exchange member 12 may be bypassed as already described. To bypass a portion of the heat exchange surface, valve 24 may be opened and valve 25 throttled or closed, permitting weak solution to flow through line 22 to loop 23 of heat exchanger 12 without passing through the complete heat exchange surface. Solution then leaving the heat exchanger is at a higher temperature which will permit operation of the system at a higher concentration of solution leaving the generator.

The control arrangement provided by the present invention permits operation of the generator of an absorption refrigeration system at higher concentrations of solution without danger of crystallisation of the solution. Such arrangement may be embodied in an absorption refrigeration system of the type described at minor expense and serves effectively to provide desired variations in concentration of solution leaving the generator in accordance with conditions encountered in certain uses.

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 an absorber, an evaporator, a generator and a condenser, a line for supplying weak solution from the absorber to the generator, a second line for supplying strong solution from the generator to the absorber, heat exchange means disposed in said lines for placing solutions passing therethrough in heat exchange relation, said heat exchange means including a casing member and a coil member having sections of the coil disposed in series extending through the casing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arrranged for the flow of weak solution therethrough in an opposite direction, and means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system by rendering at least one of the coil sections ineffective for substantial heat transfer.

2. A refrigeration system according to Claim 1, in which the means for operating the system at a concentration of solution leaving the generator greater than concentration of solution leaving the generator during normal operation of the system comprises a bypass line connecting the first line with a section of the coil, a valve in said bypass line, and a second valve in said first line, opening of said first valve and closing of said second valve opening the bypass and rendering such section of the coil ineffective for substantial heat transfer.

3. A refrigeration system according to Claim 1 or Claim 2, characterised by a pump for withdrawing weak solution from the absorber and for supplying the weak solution through said first line to the generator, and an ejector adapted to receive strong solution from the generator through the second line and to supply the strong solution to the absorber.

4. A heat exchanger for use in a continuous cycle absorption refrigeration system according to any of Claims 1 to 3, including a casing member and a coil member having sections of the coil disposed in series through the casing, one of said members being arranged for the flow of strong solution therethrough and the other of said members being arranged for the passage of weak solution therethrough, and means for rendering at least one of the soil sections ineffective for substantial heat transfer.

5. A continuous cycle absorption refrigeration system according to Claim 1, arranged substantially as described with reference to the accompanying drawing.

6. A heat exchanger for use in a continuous cycle absorption refrigeration system, according to Claim 4, arranged substantially as described with reference to the accompanying drawing.

Dated this 8th day of July, 1947.
PAGE, WHITE & FARRER,
Chartered Patent Agents,
27, Chancery Lane, London, W.C.2,
Agents for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office by the Courier Press.—1950.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.