

Description**Field of the Invention**

This invention relates to modular refrigeration systems and relates particularly to such refrigeration systems for use in air conditioning installations.

Air conditioning installations for modern buildings, such as large office structures, shopping complexes, warehouses and the like, conventionally comprise air treatment units to which water or other heat exchange fluid is pumped whereby air is cooled (in summer) or heated (in winter) and circulated to the areas to be conditioned. The heat exchange fluid for cooling is generally circulated through an evaporator/chiller of a refrigeration system which removes heat from the fluid. The heat is given up to a second heat exchange fluid which circulates passed the condenser of the refrigeration system. The second heat exchange fluid may also comprise water or other liquid or may comprise air in an air cooled or evaporative cooler system. Such systems may also be designed to operate on reverse cycle and act as heat pumps to heat the air to be conditioned. The refrigeration system will, of course, have cooling/ heating capacity appropriate to the capacity of the air conditioning installation.

Background of the Invention

For high capacity installations, as may be incorporated in office and apartment blocks, a refrigeration system of high output is necessary to be able to handle the maximum load expected. In practice, such high output refrigeration systems tend to be more prone to breakdown and failure than do lower output refrigeration units. Such breakdowns and failures often leave the building in which the system is installed without any air conditioning until the breakdown or failure is remedied. In high capacity systems, breakdowns and failures can often take days and, sometimes, weeks to repair.

Further, in the design and construction of many modern building structures, provision is made for the expansion of the building structure, that is, the building is constructed in a number of stages spread over a period of time. Because of the difficulty in expanding a predesigned air conditioning system, it is generally necessary to design and install the system to have the air conditioning capacity for the completed building structure. This means, therefore, that the system is running, inefficiently, at less than full load capacity until such time as all building stages are completed.

In other instances, building structures are extended after the initial design and construction, and

such extensions often require the air conditioning system for the initial building structure to be completely replaced with a new system to be able to handle the load of the extended building structure.

Background Art

Australian Patent Specification 218,986 in the name of Alden Irving McFarlan discloses an air conditioning system for buildings having areas which require heating and cooling, the system incorporating separate air treating units for each of the different areas. The system described incorporates a number of individual refrigeration units comprising separate compressors, evaporators and condensers. These can be automatically and individually controlled for starting, stopping and unloading of the compressors to maintain high efficiency of operation at less than peak loads. However, the condensers for each refrigeration unit are connected in series as are the water circuits of the evaporator chillers thus requiring each refrigeration unit to have individual design criteria in accordance with the variation in temperature of the water circulating through the individual, series connected condensers and evaporator/ chillers.

It is desirable to provide an improved refrigeration system which obviates the disadvantages of the known systems.

It is also desirable to provide an improved refrigeration system which allows the design and construction of an air conditioning system for a building or like structure, which air conditioning system is less prone to breakdown and failure than known air conditioning systems.

It is also desirable to provide an improved refrigeration system particularly for air conditioning and in which a breakdown or failure of part of the refrigeration system does not prevent operation of the air conditioning plant.

It is further desirable to provide an improved air conditioning system using discrete refrigeration units which can be removed, repaired and/or replaced without major disruption of the operation of the air conditioning system. FR-A-2258596 discloses a refrigeration unit having two substantially identical refrigeration circuits, several such units being able to be connected to fluid supply and return pipes by individual fluid connections. The refrigeration units of FR-A-2258596 are essentially independent and when several such units are used in combination, the individual units remain independent and thus able to be removed or replaced without affecting the others, each unit having separate fluid connections and power supply.

In contrast the present invention provides modular refrigeration units having integrated fluid head-

er pipes and, in a preferred embodiment, an integrated electrical supply.

Summary of the Invention

According to the present invention there is provided a refrigeration system for transferring heat from one fluid to another comprising a plurality of substantially identical modular refrigeration units adapted to be assembled together to form a system assembly, each unit having a housing for at least one refrigeration circuit including a compressor means, evaporator means and condenser means, a first fluid flow passage means for flow of a first fluid in heat exchange relation with the evaporator means, a second fluid flow passage means for flow of a second fluid in heat exchange relation with the condenser means, means for conveying the first fluid to the first fluid flow passage means and second fluid supply means to supply the second fluid to the second fluid flow passage means characterized in that said means for conveying the first fluid to the first fluid flow passage means comprises a pair of header pipes extending across the unit, and in fluid communication with the first fluid flow passage means, releasable connecting means interconnecting adjacent ends of header pipes of adjacent units whereby the interconnected header pipes form unitary first fluid supply and return manifolds for the assembly with the evaporator means of each unit connected in parallel.

Each modular unit preferably has an evaporator circuit in the housing and separated from a condenser circuit in the housing. With this arrangement, the housing defines one passage for the flow of heat exchange fluid in heat exchange relation with the evaporator circuit and a second passage for flow of a second heat exchange fluid in heat exchange relation with the condenser circuit.

The headers are provided on or incorporated in the housing to convey heat exchange fluid to and from the flow passages in the housing. The headers of each housing are adapted to be connected to headers of the or each adjacent unit.

Preferably, the control means is operative to cause progressive actuation of the units in sequence in response to increasing load demand, the sequence of actuation being automatically changed at periodic intervals whereby to substantially equalize usage of all units over a prolonged period. In a particularly preferred embodiment, one of the modular units is designated a master unit and is provided with electric control means to which other, slave units are connected whereby operation of all units is controlled by the master unit. The control means so arranged that, in the event of a failure of one of the modular units, that unit is electrically

disconnected from service and an appropriate alarm indication is given. For this purpose, each modular unit is provided with appropriate sensors to monitor operation of the respective units.

Each modular housing has sides which abut opposed sides of adjacent units, the header means of abutted units being interconnected to form common manifolds for supply and return of the respective heat exchange fluids. Each unit preferably comprises two refrigerant compressors with separate condenser and evaporator circuits. The modular housing houses both evaporators in one compartment which defines a single flow passage for the first heat exchange fluid. The modular housing of each unit also houses both condensers in a second compartment which defines a single flow passage for the second heat exchange fluid.

Each said header means comprises a fluid supply pipe and a fluid return pipe communicating with the respective flow passages, the supply and return pipes of each unit having connection means for coupling two respective pipes of adjacent units.

Description of the Drawings

Figure 1 is a perspective view of a plurality of interconnected modular refrigeration units in accordance with the present invention.

Figure 2 is a part cut-away perspective view of one modular refrigeration unit in accordance with the invention.

Figure 3 is a part sectional, side elevational view of the modular unit of Figure 2.

Figure 4 is a front elevational view, with the front panel removed, of the modular unit of Figure 2.

Figure 5 is a cross-sectional plan view of several interconnected modular units in accordance with the invention, and

Figure 6 is a side elevational, part cross-sectional view of a further embodiment of the invention.

Description of the Preferred Embodiments

With reference to Figure 1, a refrigeration system for use in an air conditioning installation, particularly a high capacity installation, comprises a series of modules 12 arranged in face-to-face relation. As shown in Figures 2 to 5, each module comprises a housing 14 on which is mounted two sealed unit refrigeration compressors 16. The housing 14 is formed of a bottom wall 42, side walls 41, a front wall 38, a rear wall 39 and a top wall 43. The housing 14 is divided into two compartments 19 and 21 separated by the partition 22. Compart-

ment 19 contains a pair of evaporator coils 17, one for each compressor 16, and compartment 21 contains two condenser coils 18. An appropriate refrigerant expansion device (not shown) is connected between the respective evaporator and condenser of each refrigeration circuit, in a known manner. The compartments 19 and 21 define separate fluid flow passages which serve to carry separate flows of heat exchange fluid, for example water, in heat exchange relation with the evaporator coils 17 and the condenser coils 18.

Baffles, shown generally at 20, act to direct the flow of heat exchange fluid into intimate contact with the evaporator coils 17 while similar baffles 25 in compartment 21 act in a similar manner with regard to the condenser fluid flow.

The heat exchange fluid, i.e. water, which is to be cooled by the evaporator coils 17, is supplied to the compartment 19 by a header pipe 23 mounted on the front wall 38 of the housing 14 by bracket 24. The header pipe 23 has an opening 26 which communicates with an inlet tube 27 extending from the compartment 19.

Cooled water is taken from compartment 19 through the lower header pipe 28 on the front wall 38 of the housing 14. The lower header pipe 28 has an opening 29, similar to opening 26, which communicates with an outlet tube 31.

Header pipes 32 and 33 are mounted on the rear wall 39 of the housing 14 on brackets 30 and communicate with the compartment 21 by similar openings and tubes 34 and 36, respectively. The header pipe 33 conveys cooling water to the condenser coils 18 in compartment 21, the cooling water being removed through the header pipe 32.

Each of the header pipes 23, 28, 32 and 33 are of a length enabling end-to-end connection with corresponding header pipes of adjacent modules 12 to form a common series of fluid manifolds. A coupling generally indicated at 35, such as that known by the trade mark VICTAULIC, is used to form fluid tight connections between the pipe ends. End caps 40 are used to seal the ends of the header pipes of the last module 12 of the assembly while appropriate fluid supply and return lines (not shown) are connected to the header pipes of the first module 12.

Pipes 37 for conveying refrigerant between the compressors 16, condenser and evaporator coils 18, 17, respectively, extend down and through the front and rear walls 38 and 39 of the housing 14 to the respective coils.

The side walls 41 on each side of the housing 14 are removable to give access to the compartments 19 and 21. The side walls are sealed against the housing bottom wall 42, the top wall 43 on which the compressors 16 are mounted, the partition 22 and the front and rear walls 38 and 39 to

ensure that the compartments 19 and 21 are fluid tight. It will be appreciated, however, that the evaporator coils 17 and the chiller water flow passages can be incorporated in a series of heat exchange plates which define the separate passageways for the respective fluids, thus obviating the need to provide a fluid tight compartment. Such plates are known in the art and are not described herein in detail.

The top wall 43 of the housing 14 has mounted along the rear edge thereof an electrical bus bar 46 to which the compressors 16 are electrically connected. The bus bar 46 has appropriate connections 47 at each end to enable the bus bars of adjacent units to be interconnected to provide continuity of electrical power supply to each unit.

Although the compressors 16 mounted on the top wall 43 of the housing 14 may be exposed, it is preferred that a top cover 51 is provided over the compressors 16. The top cover 51 is removable without removing the respective module 12 from the assembly to facilitate service and maintenance. Removable front and rear cover plates 56 and 57, respectively, are also provided on the housing 14.

As described above, each module 12 comprises a separate refrigeration unit comprising two refrigeration circuits. The refrigeration circuits of each unit are, essentially, independent of those of each of the other modules, with each circuit including its own control means in order to deactuate the refrigeration unit in the event of an overload or other malfunction occurring in that unit. The control means includes an electrical control panel 48 mounted on the top wall 43 of the housing 14. The control panel 48 receives signals from sensors (not shown) associated with operation of the refrigeration units and transmits those signals through electrical connections 44 on the front of the housing 14 to a master control panel located on one of the modules 12 in the system, preferably an end module 12A. The master control panel houses the electrical control circuits for the control of the assembly of the modules 12 in accordance with the desired operation or control of the air conditioning installation whereby the cooling effect of the system (or the heating effect if the refrigeration units are acting in a reverse cycle mode) meets the instantaneous requirements of the air conditioning installation. Under part load conditions, the control circuits are operative to actuate only one or some of the modules 12 (depending on the load) with other units being brought into operation as the load increases. Advantageously, the control circuits are operative to automatically switch, at predetermined intervals, the order in which the modules 12 are brought into operation in order to substantially equalize the usage of the individual modules over a prolonged period of time. The control circuits may

include memory circuits which maintain a constant record of the hours of operation of each module 12, the information being used to ensure substantial equalization of usage of the individual modules over a period of time.

A simple microprocessor can be used to control the progressive switching functions and to match operation of the refrigeration system to the load requirements of the air conditioning installation to which the system is connected.

The modular construction described permits additional slave modules 12 to be added to the assembly in order to increase the capacity of the refrigeration system resulting from changes in load criteria of the air conditioning installation. In the event of a malfunction in one of the modules 12, that module may be shut down by the control circuits, while permitting continued operation of the other modules. Depending on the fault, the defective module may be repaired in situ while the system is in operation, or the defective module may be removed from the assembly for repair, a spare module being incorporated in the assembly to replace the removed, defective module or the assembly being permitted to operate without a replacement. Naturally, if a module is removed from the assembly for repair or maintenance, the header pipes 23, 28, 32 and 33 of the modules 12 on each side of that to be removed are connected together by temporary pipe connections to maintain the heat exchange fluid circuits. Similar temporary electrical connections are also made.

Referring to Figure 6, in this embodiment which uses a single compressor 16, the housing 14 has a single compartment 19 for the evaporator coil 17 while the condenser coil 18 is located in an air cooling chamber 52 located above the compressor 16. Fans 53 draw air through the chamber 52 to cool the finned condenser coil 18.

In some installations, an evaporative condenser is used and for this purpose water sprays 54 (shown in dotted lines) spray water over the condenser coil 18.

A refrigeration system formed in accordance with the present invention utilizing a number of modules 12 assembled together to form a single unit will have a reliability related to the reliability of the individual modules 12, which is substantially better than the reliability of a single refrigeration unit of equivalent output. The reliability is further enhanced, in accordance with the invention, by the continued operation of other modules of an assembly if one module is shut down for repair or maintenance. A system of increased capacity can be obtained in accordance with the invention simply by adding additional modules, as required, to take account of any increase in load resulting from a building extension or the like.

The use of header pipes to form common manifolds for supply and return of heat exchange fluid facilitates interconnection of the separate refrigeration units and allows modular construction of identical units which can be mass-produced for relatively less cost than fabricated units. The modular units are readily assembled into complete units of any desired capacity.

As indicated above, the refrigeration circuits may be adapted for reverse cycle operation, if desired.

It will be understood that the refrigeration system of the invention can be used for purposes other than air conditioning installations. Thus, the modular system is particularly useful for cool storage, cool rooms and freezer rooms in food processing and handling industries and in any other area requiring the use of relatively large capacity refrigeration.

Claims

1. A refrigeration system for transferring heat from one fluid to another comprising a plurality of substantially identical, modular refrigeration units (12) adapted to be assembled together to form a system assembly, each unit (12) having a housing (14) for at least one refrigeration circuit including a compressor means (16), evaporator means (17) and condenser means (18), a first fluid flow passage means for flow of a first fluid in heat exchange relation with the evaporator means (17), a second fluid flow passage means for flow of a second fluid in heat exchange relation with the condenser means (18), means for conveying the first fluid to the first fluid flow passage means and second fluid supply means to supply the second fluid to the second fluid flow passage means characterized in that said means for conveying the first fluid to the first fluid flow passage means comprises a pair of header pipes (23,28) extending across the unit, and in fluid communication with the first fluid flow passage means, releasable connecting means (35) interconnecting adjacent ends of header pipes of adjacent units whereby the interconnected header pipes (23,28) form unitary first fluid supply and return manifolds for the assembly with the evaporator means (17) of each unit (12) connected in parallel.
2. A refrigeration system according to claim 1 characterized in that a pair of second header pipe means (32,33) extends across each unit (12) and communicates with the second fluid



include memory circuits which maintain a constant record of the hours of operation of each module 12, the information being used to ensure substantial equalization of usage of the individual modules over a period of time.

A simple microprocessor can be used to control the progressive switching functions and to match operation of the refrigeration system to the load requirements of the air conditioning installation to which the system is connected.

The modular construction described permits additional slave modules 12 to be added to the assembly in order to increase the capacity of the refrigeration system resulting from changes in load criteria of the air conditioning installation. In the event of a malfunction in one of the modules 12, that module may be shut down by the control circuits, while permitting continued operation of the other modules. Depending on the fault, the defective module may be repaired in situ while the system is in operation, or the defective module may be removed from the assembly for repair, a spare module being incorporated in the assembly to replace the removed, defective module or the assembly being permitted to operate without a replacement. Naturally, if a module is removed from the assembly for repair or maintenance, the header pipes 23, 28, 32 and 33 of the modules 12 on each side of that to be removed are connected together by temporary pipe connections to maintain the heat exchange fluid circuits. Similar temporary electrical connections are also made.

Referring to Figure 6, in this embodiment which uses a single compressor 16, the housing 14 has a single compartment 19 for the evaporator coil 17 while the condenser coil 18 is located in an air cooling chamber 52 located above the compressor 16. Fans 53 draw air through the chamber 52 to cool the finned condenser coil 18.

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The use of header pipes to form common manifolds for supply and return of heat exchange fluid facilitates interconnection of the separate refrigeration units and allows modular construction of identical units which can be mass-produced for relatively less cost than fabricated units. The modular units are readily assembled into complete units of any desired capacity.

As indicated above, the refrigeration circuits may be adapted for reverse cycle operation, if desired.

It will be understood that the refrigeration system of the invention can be used for purposes other than air conditioning installations. Thus, the modular system is particularly useful for cool storage, cool rooms and freezer rooms in food processing and handling industries and in any other area requiring the use of relatively large capacity refrigeration.

Claims

1. A refrigeration system for transferring heat from one fluid to another comprising a plurality of substantially identical, modular refrigeration units (12) adapted to be assembled together to form a system assembly, each unit (12) having a housing (14) for at least one refrigeration circuit including a compressor means (16), evaporator means (17) and condenser means (18), a first fluid flow passage means for flow of a first fluid in heat exchange relation with the evaporator means (17), a second fluid flow passage means for flow of a second fluid in heat exchange relation with the condenser means (18), means for conveying the first fluid to the first fluid flow passage means and second fluid supply means to supply the second fluid to the second fluid flow passage means characterized in that said means for conveying the first fluid to the first fluid flow passage means comprises a pair of header pipes (23,28) extending across the unit, and in fluid communication with the first fluid flow passage means, releasable connecting means (35) interconnecting adjacent ends of header pipes of adjacent units whereby the interconnected header pipes (23,28) form unitary first fluid supply and return manifolds for the assembly with the evaporator means (17) of each unit (12) connected in parallel.
2. A refrigeration system according to claim 1 characterized in that a pair of second header pipe means (32,33) extends across each unit (12) and communicates with the second fluid

flow passage means for supply of said second fluid thereto.

3. A refrigeration system according to claim 1 or claim 2 characterized in that each modular unit (12) has two refrigeration circuits and said first flow passage directs said first fluid into heat exchange contact with the two evaporator means (17) of the two circuits.
4. A refrigeration system according to claim 3 characterized in that separate condenser means (18) of the two circuits of each unit (12) are connected in parallel in the second fluid flow passage means.
5. A refrigeration system according to any preceding claim characterized in that the first fluid is water.
6. A refrigeration system according to any preceding claim characterized in that the second fluid is air.
7. A refrigeration system according to claim 1 characterized in that a pair of compressors (16) are mounted on the housing (14) with refrigerant pipes passing through the housing wall to the evaporator means (17) and condenser means (18) of respective refrigeration circuits which are in heat exchange relation with the first and second fluids, respectively.
8. A refrigeration system according to claim 1 characterized in that said housing (14) comprises a first compartment (19) containing said evaporator means (17) and a second compartment (21) containing said condenser means (18).
9. A refrigeration system according to claim 1 characterized in that said pair of header pipes comprises a fluid supply pipe and a fluid return pipe connected by conduit means to the first fluid flow passage means, the supply and return pipes each being fitted with fluidtight releasable couplings (35) connecting the ends thereof to the respective supply and return pipes of adjacent units or to mains supply and return pipes in the case of an end unit of an assembly.
10. A refrigeration system according to any preceding claim wherein the second fluid is water.
11. A refrigeration system according to claim 1 wherein the compressor means (16) are electrically operated and said housing (14) carries

an electrical bus bar means with releasable connections to interconnect bus bar means of adjacent units of the assembly and thereby provide continuity of power supply to all units of the assembly.

12. A refrigeration system according to claim 1 characterized in that a control means is provided for the assembly for controlling operation of each unit of the assembly, said control means being operative to cause progressive actuation of the modular units (12) of the assembly in sequence in response to increasing load demand.
13. A refrigeration system according to claim 12 characterized in that said sequence of actuation of said modular units (12) is automatically changed at periodic intervals to substantially equalize use of all modular units over a predetermined period of time.
14. A refrigeration system according to claim 12 characterized in that said control means includes sensors on each modular unit (12) to sense an overload or malfunction thereof, and means to discontinue operation of any individual modular unit of an assembly in response to a sensed malfunction, or to activate a non-operational unit of an assembly in response to a sensed overload.

Revendications

1. Système de réfrigération pour transférer de la chaleur d'un fluide à un autre, comportant une pluralité de groupes de réfrigération modulaires (12) sensiblement identiques, conçus pour être assemblés ensemble pour donner un ensemble formant système, chaque groupe (12) comprenant un carter (14) pour au moins un circuit de réfrigération incluant des moyens formant compresseur (16), des moyens formant évaporateur (17) et des moyens formant condenseur (18), des moyens formant passage pour l'écoulement d'un premier fluide pour permettre l'écoulement d'un premier fluide en réalisant un échange de chaleur avec les moyens formant évaporateur (17), des moyens formant passage pour l'écoulement d'un second fluide pour permettre l'écoulement d'un second fluide en réalisant l'échange de chaleur avec les moyens formant condenseur (18), des moyens pour transporter le premier fluide dans les moyens formant passage pour l'écoulement du premier fluide, et des moyens d'amenée du second fluide pour amener le second



- fluide dans les moyens formant passage pour l'écoulement du second fluide, caractérisé par le fait que lesdits moyens prévus pour transporter le premier fluide dans les moyens formant passage pour l'écoulement du premier fluide comportent une paire de tubulures (23,28) qui s'étendent d'un côté à l'autre du groupe et qui sont en communication fluide avec les moyens formant passage pour l'écoulement du premier fluide, des moyens de raccordement amovibles (35) interconnectant des extrémités, voisines, des tubulures des groupes voisins, ce par quoi les tubulures interconnectées (23,28) forment des collecteurs, d'une pièce, d'amenée et de retour du premier fluide pour l'ensemble, les moyens formant évaporateur (17) de chaque groupe (12) étant reliés en parallèle.
2. Système de réfrigération selon la revendication 1, caractérisé par le fait qu'une paire de moyens formant secondes tubulures (32,33) s'étendent d'un côté à l'autre de chaque groupe (12) et communiquent avec les moyens formant passage pour l'écoulement du second fluide pour y amener ledit second fluide.
 3. Système de réfrigération selon la revendication 1 ou la revendication 2, caractérisé par le fait que chaque groupe modulaire (12) comporte deux circuits de réfrigération et par le fait que ledit passage d'écoulement du premier fluide envoie ledit premier fluide en contact, pour échange thermique, avec les deux moyens formant évaporateur (17) des deux circuits.
 4. Système de réfrigération selon la revendication 3, caractérisé par le fait que les moyens distincts formant condenseur, (18), des deux circuits de chaque groupe (12) sont reliés en parallèle dans les moyens formant passage pour l'écoulement du second fluide.
 5. Système de réfrigération selon l'une quelconque des revendications précédentes, caractérisé en ce que le premier fluide est l'eau.
 6. Système de réfrigération selon l'une quelconque des revendications précédentes, caractérisé en ce que le second fluide est l'air.
 7. Système de réfrigération selon la revendication 1, caractérisé par le fait qu'une paire de compresseurs (16) sont montés sur le carter (14), les conduites de réfrigérant passant à travers la paroi du carter pour arriver aux moyens formant évaporateur (17) et aux moyens formant condenseur (18) des circuits de réfrigération respectifs qui sont en relation, pour échange de chaleur, avec le premier et le second fluides, respectivement.
 8. Système de réfrigération selon la revendication 1, caractérisé par le fait que ledit carter (14) comporte un premier compartiment (19) contenant lesdits moyens formant évaporateur (17) et un second compartiment (21) contenant lesdits moyens formant condenseur (18).
 9. Système de réfrigération selon la revendication 1, caractérisé en ce que ladite paire de tubulures comporte une tubulure d'amenée du fluide et une tubulure de retour du fluide reliées, par des moyens formant conduit, aux moyens formant passage pour l'écoulement du premier fluide, des tubulures d'amenée et de retour étant chacune équipées de raccords amovibles (35), étanches au fluide, qui relient leurs extrémités aux tubulures respectives d'amenée et de retour des groupes voisins ou aux tubulures principales d'amenée et de retour, dans le cas d'un groupe d'extrémité d'un ensemble.
 10. Système de réfrigération selon l'une quelconque des revendications précédentes, dans lequel le second fluide est l'eau.
 11. Système de réfrigération selon la revendication 1, dans lequel les moyens formant compresseur (16) sont manoeuvrés électriquement et dans lequel ledit carter (14) porte un moyen formant barre omnibus électrique avec des connexions amovibles pour interconnecter les moyens formant barre omnibus des différents groupes de l'ensemble et assurer ainsi la continuité de l'alimentation puissance à tous les groupes de l'ensemble.
 12. Système de réfrigération selon la revendication 1, caractérisé par le fait que des moyens de commande sont prévus pour l'ensemble pour commander le fonctionnement de chaque groupe de l'ensemble, lesdits moyens de commande fonctionnant pour réaliser la mise en oeuvre progressive des groupes modulaires (12) de l'ensemble en séquence, en réponse à un accroissement de la demande de charge.
 13. Système de réfrigération selon la revendication 12, caractérisé par le fait que ladite séquence de mise en oeuvre desdits groupes modulaires (12) est automatiquement modifiée à intervalles périodiques pour égaliser sensiblement l'emploi de tous les groupes modulaires sur une période de temps prédéterminée.



14. Système de réfrigération selon la revendication 12, caractérisé par le fait que lesdits moyens de commande comprennent des détecteurs sur chaque groupe modulaire (12) pour détecter une surcharge ou un mauvais fonctionnement de ce groupe, ainsi que des moyens pour interrompre le fonctionnement de tout groupe modulaire individuel d'un ensemble en réponse à la détection d'un mauvais fonctionnement, ou pour mettre en route un groupe, qui ne fonctionnait pas, d'un ensemble en réponse à la détection d'une surcharge.

Ansprüche

1. Kühltssystem zum Übertragen von Wärme von einem Fluid an ein anderes, mit einer Vielzahl von im wesentlichen identischen modularen Kühleinheiten (12), die zur Bildung eines Systemaufbaues zusammenfügbar sind, wobei jede Einheit (12) ein Gehäuse (14) für wenigstens einen Kühlkreis mit einem Kompressor (16), einem Verdampfer (17) und einem Kondensator (18), ferner ein erstes Fluiddurchflußmittel für den Durchfluß eines ersten Fluids unter Wärmeaustausch mit dem Verdampfer (17) und ein zweites Fluiddurchflußmittel für den Durchfluß eines zweiten Fluids unter Wärmeaustausch mit dem Kondensator (18), und ferner Mittel zum Fördern des ersten Fluids zum ersten Fluiddurchflußmittel und zweite Fluidzufuhrmittel zum Zuführen des zweiten Fluids zum zweiten Fluiddurchflußmittel aufweist, dadurch gekennzeichnet, daß die Mittel zum Fördern des ersten Fluids zum ersten Fluiddurchflußmittel ein Paar Sammelrohre (23,28), die sich längs der Einheit erstrecken und in Fluidverbindung mit dem ersten Fluiddurchflußmittel sind, und lösbare Verbindungsmittel (35), die benachbarte Enden der Sammelrohre benachbarter Einheiten miteinander verbinden, aufweisen, wodurch die miteinander verbundenen Sammelrohre (23,28) eine einheitliche erste Fluidzuführung und Rücklauf-Verteiler für den Aufbau unter Parallelschalten der Verdampfer (17) jeder Einheit (12) bilden.
2. Kühltssystem nach Anspruch 1, dadurch gekennzeichnet, daß ein Paar zweiter Sammelrohre (32,33) sich längs jeder Einheit (12) erstreckt und mit dem zweiten Fluiddurchflußmittel zum Zuführen des zweiten Fluids in Verbindung ist.
3. Kühltssystem nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß jede modulare Einheit (12) zwei Kühlkreisläufe aufweist und daß das

erste Fluiddurchflußmittel das erste Fluid in Wärmeaustauscherkontakt mit den zwei Verdampfern (17) der beiden Kreisläufe leitet.

4. Kühltssystem nach Anspruch 3, dadurch gekennzeichnet, daß die getrennten Kondensatoren (18) der beiden Kreisläufe jeder Einheit (12) im zweiten Fluiddurchflußmittel parallel miteinander verbunden sind.
5. Kühltssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das erste Fluid Wasser ist.
6. Kühltssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das zweite Fluid Luft ist.
7. Kühltssystem nach Anspruch 1, dadurch gekennzeichnet, daß ein Paar Kompressoren (16) am Gehäuse (14) befestigt sind, wobei Kühlrohre durch die Gehäusewand zum Verdampfer (17) und zum Kondensator (18) der betreffenden Kühlkreisläufe führen und in Wärmeaustauschverbindung mit dem ersten bzw. zweiten Fluid sind.
8. Kühltssystem nach Anspruch 1, dadurch gekennzeichnet, daß das Gehäuse (14) einen ersten Abschnitt (19), der den Verdampfer (17) enthält, und einen zweiten Abschnitt (21), der den Kondensator (18) enthält, aufweist.
9. Kühltssystem nach Anspruch 1, dadurch gekennzeichnet, daß das Paar Sammelrohre eine Fluidzufuhrleitung und eine Fluidrücklaufleitung aufweist, die durch Leitungen mit dem ersten Fluiddurchflußmittel verbunden ist, daß die Zuführ- und die Rücklaufleitung jeweils mit fluiddichten lösbaren Kupplungen (35) verbunden sind, die deren Enden mit der Zuführ- bzw. Rücklaufleitung benachbarter Einheiten oder mit einer Hauptzufuhrleitung und einer Hauptrücklaufleitung im Falle einer Endeinheit des Aufbaues verbinden.
10. Kühltssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das zweite Fluid Wasser ist.
11. Kühltssystem nach Anspruch 1, dadurch gekennzeichnet, daß der Kompressor (16) elektrisch betrieben ist und daß das Gehäuse (14) eine elektrische Sammelschiene mit lösbaren Verbindungen trägt, um die Sammelschienen benachbarter Einheiten des Aufbaues miteinander zu verbinden und dadurch eine durchgehende Spannungsversorgung zu allen Einheiten



des Aufbaues vorzusehen.

12. Kühlsystem nach Anspruch 1, dadurch gekennzeichnet, daß eine Steuervorrichtung für den Aufbau zum Steuern der Betätigung jeder Einheit vorgesehen ist und daß die Steuervorrichtung derart betreibbar ist, daß eine aufeinanderfolgende schrittweise Zuschaltung der modularen Einheiten (12) des Aufbaues bei Erhöhung der angeforderten Belastung bewirkt ist. 5 10
13. Kühlsystem nach Anspruch 12, dadurch gekennzeichnet, daß die Folge in der Zuschaltung der modularen Einheiten (12) sich in periodischen Intervallen automatisch ändert, um alle modularen Einheiten über eine bestimmte Zeitdauer hinweg im wesentlichen gleichmäßig zu verwenden. 15 20
14. Kühlsystem nach Anspruch 12, dadurch gekennzeichnet, daß die Steuervorrichtung an jeder modularen Einheit (12) Sensoren, um eine Überlast oder Fehlfunktion zu erfassen, und Mittel zum Unterbrechen des Betriebes jeder einzelnen modularen Einheit des Aufbaues aufgrund einer erfaßten Fehlfunktion oder zum Zuschalten einer sich nicht im Betrieb befindlichen Einheit des Aufbaues aufgrund einer erfaßten Überlast aufweist. 25 30



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