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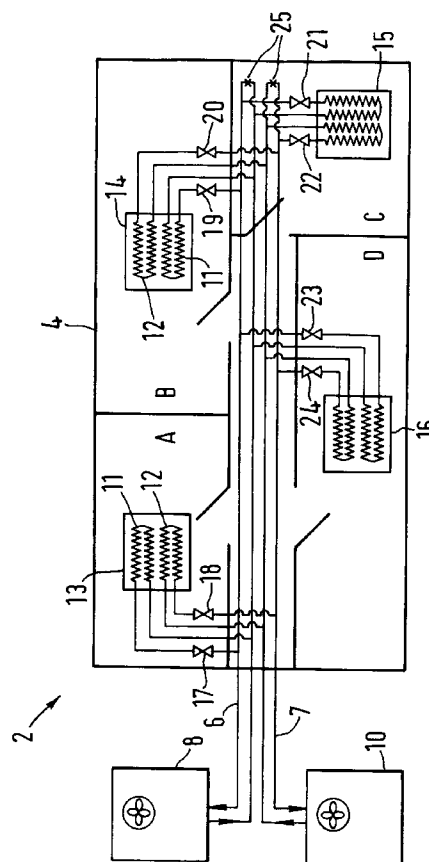
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(54) **Heating and cooling system and pump therefor**

(57) A system (2) for heating and/or cooling a plurality of separate locations in a building (4) comprising two heat-transfer circuits (6,7), each circuit (6,7) adapted to circulate a heat transfer medium from a heat source and/or a heat sink to a heat exchanger in each location, wherein the first heat-transfer circuit is able to supply the net cooling requirement of the heat exchangers and the second heat-transfer circuit is able to supply the net heating requirement of the heat exchangers during periods of conflicting requirements, and wherein both heat-transfer circuits (6,7) are able to supply the overall cooling requirement and the overall heating requirement of all the heat exchangers is described.

Also described is a heat pump unit (28) comprising a circuit (30) containing a heat-transfer medium which connects two or more primary heat exchangers (31,32), each heat exchanger being able to exchange heat with an associated heat-transfer circuit, with one or more compressors (34) between the primary heat exchangers (31) and one or more secondary heat exchangers (32) adapted to alter if necessary the temperature of the heat-transfer medium in the circuit, suitable for use with the system for heating and/or cooling also described herein.

**FIG.1**

Description

This invention relates to a heating and cooling system for a multizonal building, and a heat pump unit therefor.

In a multizonal building, e.g. an office block, the heating or cooling requirement in each room is usually different. Some people like their offices warmer or cooler than others. To overcome the need for separate heating and cooling systems, combined heating and cooling systems have been developed, e.g. WO93/03311.

The apparatus of WO93/03311 comprises a central heat pump connected to remote units which can supply either heating or cooling, depending on what is requested in each room. However, should only one room request cooling, the heat pump has to be set to cooling, and local electric heaters in each unit are required to accommodate local heating requirements until the system can switch to heating, which is less energy efficient. There is a need for a system which can cope with different heating and cooling requests simultaneously as well as overall heating and cooling.

Thus, according to a first aspect of the present invention, there is provided a system for heating and cooling a plurality of separate locations in a building comprising two heat-transfer circuits, each circuit adapted to circulate a heat transfer medium from a heat source and/or a heat sink to a heat exchanger in each location, wherein the first heat-transfer circuit is able to supply the net cooling requirement of the heat exchangers and the second heat-transfer circuit is able to supply the net heating requirement of the heat exchangers during periods of conflicting requirements, and wherein both heat-transfer circuits are able to supply the overall cooling requirement and the overall heating requirement of all the heat exchangers.

During periods of conflicting requirements, i.e. when some of the locations request heating and some request cooling, the heat exchangers in those locations requiring cooling are supplied by the first heat-transfer circuit, whilst the heat exchangers in those locations requiring heating are supplied by the second heat-transfer circuit. When there are only a number of cooling requests (i.e. no heating requests and thus no conflicting requirements), but the first heat-transfer circuit cannot fulfil all the cooling requests, then the second heat-transfer circuit is able to switch to a cooling configuration to support the first heat-transfer circuit. The combined cooling capacity of both heat-transfer circuits is designed to be sufficient to supply the overall cooling requirement of all the locations simultaneously (to a predetermined amount), e.g. on a hot summer's day. Vice versa, when there are only a number of heating requests and thus no conflicting requirements, and the second heat-transfer circuit cannot fulfil all the heating requests, the first heat-transfer circuit is switched to a heating configuration to support the second heat-transfer circuit. The combined heating capacity of both transfer circuits

is designed to be sufficient to supply the overall heating requirement of all the locations simultaneously (to a predetermined amount), e.g. on a cold winter's morning.

Thus the system of the present invention allows the overall heating and cooling requirement of a number of locations, e.g. rooms in an office block, to be accommodated by two cooling or two heating circuits, whilst conflicting requirements from different locations can be accommodated by having one circuit that is generally the main or 'primary' cooling circuit, and one circuit that is generally the main or 'primary' heating circuit. By utilising sizing techniques, the total range of heating and cooling requirements for a building can be satisfied by the system.

Where the overall cooling requirement can be supplied by the first heat-transfer circuit alone (e.g. in a cool climate), the second heat-transfer circuit need not be changeable to a cooling configuration and need only be supplied by a heat source. Vice versa, where the overall heating requirement can be supplied by the second heat-transfer circuit alone, (e.g. in a hot climate), the first heat-transfer circuit need only be supplied by a heat sink. In temperate climates, each heat-transfer circuit will usually be interchangeably supplied by a heat source and a heat sink.

Each heat-transfer circuit may be connected to the same heat exchanger in each location, e.g. a single coil connectable to either or both circuits by valve arrangements. Preferably each heat-transfer circuit is connected to a separate heat exchanger in each location, and each such heat exchanger is a coil. More preferably, in each location, the heat exchangers of each circuit are housed in one unit, i.e. so that only one unit need be installed in each location. The two such heat exchangers in each location may also be so arranged as to form a seemingly 'single coil' having split capacity. The heat exchanger(s) may be in any suitable part of each location, e.g. on the wall or on the ceiling of a room.

According to one embodiment of the present invention, the heat source and/or heat sink for each heat-transfer circuit is a heat pump. The heat pumps are changeable between supplying heating and cooling so that each heat-transfer circuit can have a heating or a cooling configuration. By having two changeable but independent heat pumps which can either support each other or operate differently from each other, the present invention reduces the size of system required whilst still providing independent heating/cooling to each location, and has the environmental benefits of reduced energy usage by the heat pumps. This reduces capital costs and running costs.

According to a second aspect of the present invention, there is provided a heat pump unit comprising a circuit containing a heat-transfer medium which connects two or more primary heat exchangers, each heat exchanger being able to exchange heat with an associated heat-transfer circuit, with one or more compressors between the primary heat exchangers and one or more

secondary heat exchangers adapted to alter if necessary the temperature of the heat-transfer medium in the circuit.

Any excess or waste heating capacity from one associated heat-transfer circuit can therefore be transferred or recovered to another associated circuit for use therein, e.g. the heat of the returning heat-transfer medium of a cooling circuit could be transferred into a heating circuit. This reduces running costs.

The heat pump unit is suitable for use with any system requiring two or more primary heat exchangers, e.g. cooling machinery and using the extracted heat to heat the workplace. The heat pump unit is suitable for use with a heating and cooling system having separate and independent heating and cooling circuits, to both of which are connected a heat exchanger(s), for example, a system wherein a single coil which can be supplied with either heating or cooling from the respective circuits using a suitable valve arrangement. In this system, the first primary heat exchanger of the heat pump unit preferably supplies the cooling circuit and the second primary heat exchanger preferably supplies the heating circuit. Each circuit is independent and it is the heat exchanger in each location which is altered. The use of the heat pump unit with this system may provide a more constant flow rate around the unit.

The heat pump unit is also suitable for use with the system for heating and/or cooling hereinbefore described wherein a heat pump unit having two primary heat exchangers could act as the heat sources and/or heat sinks for the two heat-transfer circuits. Preferably, the first heat-transfer circuit (primary cooling circuit) is supplied by the first primary heat exchanger (or "primary cooling exchanger"), and the second heat-transfer circuit (primary heating circuit) is supplied by the second primary heat exchanger (or "primary heating exchanger"). With respect to the direction of flow of the heat-transfer medium in the heat pump unit circuit, the order of the circuit is preferably the primary cooling exchanger, a secondary heat exchanger, a compressor, the primary heating exchanger, and then a second secondary heat exchanger,

More preferably, when the heat pump unit is used with the system for heating and cooling hereinbefore described, all cooling requirements are supplied by the primary cooling exchanger located before the compressor, and all heating requirements are supplied by the primary heating exchanger located after the compressor. During periods of conflicting heating and cooling requests, the cooling is supplied by the primary cooling exchanger whilst the heating is supplied by the primary heating exchanger. During periods when there are only heating or only cooling requests and where these requests cannot be fulfilled by either the primary heating circuit or the primary cooling circuit respectively, the required heating or cooling is supplied by the relevant primary heat exchanger to the relevant primary heat-transfer circuit, and the heat-transfer medium in that circuit may then be di-

vided between both primary heat-transfer circuits by a reversible connection thereinbetween. When there are conflicting requests for heating and cooling, the inter-connection between the primary circuits is closed so that each circuit can operate independently.

The secondary heat exchanger(s) are preferably fan heaters/coolers which have variable control. Preferably the heat pump unit uses two or more secondary heat exchangers.

The heat pump unit of the present invention has a number of advantages. The heat pump unit may only require the use of one compressor, thus saving energy over the use of separate heat pumps. It allows heat created by any primary 'cooling' exchanger to be transferred to any primary 'heating' exchanger. Moreover, the degree to which heat from any primary cooling exchanger is transferred to any primary heating exchanger, which depends on the size and balance of the requirements of the heat-transfer circuits being supplied therefrom and/or the heat exchanger(s) in each location (i.e. the size and balance of heating and cooling requests being received from the locations in a building), can be controlled by varying the speed of the compressor or the stages of the compression, and any excess cooling or heating required or to be dissipated from the circuit can be provided by the secondary heat exchangers. The amount of prime energy needed to work the compressor and the secondary heat exchange(s) could be considerably reduced over the use of two separate heat pumps by co-ordinating these features.

Preferably, the heat sources and heat sinks, e.g. heat pumps or heat pump unit described herein, are located outside the building. Also preferably, the heat transfer medium in the primary heat-transfer circuits is water or glycol or any other environmentally acceptable (e.g. non-ozone depleting) fluid medium. The use of e.g. non-ozone depleting mediums instead of known ozone depleting refrigerants in living and working environments is becoming increasingly desirable. Mediums such as "CFC's" (Chlorofluoro-hydrocarbons) are no longer desired in heating and cooling systems in buildings for environmental reasons.

The total capacity required for the heat exchanger (s) in each location depends upon the overall heating and cooling requirements. Where two heat exchangers are used in each location, the percentage split of this capacity between the two heat exchangers depends upon the maximum net heating and cooling requirements during periods of conflicting requirements or the individual capacity required in each location. The requirements can depend on the size and type of each location, and also the use of each location. The heat loss and heat gain of each location and the total building, in addition to the net heat loss or gain during periods of conflicting requirements, can be calculated and charts therefor produced. For example, for a relatively modern office building in the UK, the capacity is preferably split 70:30.

Moreover, where the capacity split of the two heat exchangers is different, i.e. not 50:50, the decision as to which sized heat exchanger is connected to which circuit in each location can also be determined from the aforesaid charts. Some locations may require the greater capacity heat exchanger to be connected to the primary cooling circuit and the smaller capacity heat exchanger to be connected to the primary heating circuit, whilst other locations may require the opposite. Where the two heat exchangers in each location are housed in one unit (including the seemingly single coil), the unit as such is preferably connectable either way round to the heat-transfer circuits. This simplifies manufacture and installation time and costs. The 70:30 split capacity unit is considered to cover at least the majority of multizonal building heating and cooling requirements in the UK.

Operation of the system of the present invention is preferably controlled automatically e.g. by a central control means. In each location there is preferably a control for setting the desired temperature therein and a monitor to determine the local environmental temperature, to which the central control acts in response.

According to a third aspect of the present invention there is provided a method for heating and cooling a plurality of separate locations in a building having two heat-transfer circuits, each circuit adapted to circulate a heat-transfer medium from a heat source and a heat sink to a heat exchanger in each location, wherein the first heat-transfer circuit is able to supply the net cooling requirement of the heat exchangers and the second heat-transfer circuit is able to supply the net heating requirement of the heat exchangers during periods of conflicting requirements, and wherein both heat-transfer circuits are able to supply the overall cooling requirement and the overall heating requirement of all the heat exchangers.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying schematic drawings, in which:

Fig. 1 is a plan of a system for heating and cooling according to the present invention;

Fig. 2 is a plan of a heat pump unit according to another aspect of the present invention; and

Fig. 3 is a plan of the heat pump of Fig. 2 with a second system for heating and cooling.

Referring to the drawings, Fig. 1 shows a system 2 for heating and cooling a plurality of independent locations, rooms A, B, C and D, in a building 4. The system 2 comprises two heat-transfer circuits 6,7. Each circuit 6,7 is adapted to circulate a heat transfer medium, e.g. water, from a heat pump, 8,10 respectively, to separate heat exchanging coils 11,12 respectively in each of rooms A, B, C and D. Circuit 6 is the primary cooling circuit and circuit 7 is the primary heating circuit. The coils 11,12 of each circuit 6,7 are housed in units 13, 14, 15 and 16, in the rooms A, B, C, D respectively, and they are located close to each other to form a seemingly sin-

gle coil with split capacity. The primary cooling transfer circuit 6 is able to supply the net cooling requirement of the primary cooling coils 11 during periods of conflicting requirements, and the primary heating circuit 7 is able to supply the net heating requirement to the primary heating coils 12 also during periods of conflicting requirements. However both circuits 6,7 are able to supply the overall cooling requirement and overall heating requirement of all the coils 11,12 when required. The heat sources/sinks for the circuits 6,7 are reverse cycle air-to-water heat pumps 8,10 respectively.

To illustrate the operation of the system 2 a spring day is taken as an example. At the beginning of the day, it is assumed that the rooms A-D are all cold, or at least below a pre-determined minimum temperature. In order to heat the rooms A-D quickly, both heat pumps 8,10 operate in a heating configuration to supply 100% heating to both circuits 6,7, and hence to the units 13-16; all valves 17-24 in the circuits 6,7 are open. In due course as the rooms A-D heat up and the occupants arrive, the temperature in e.g. room A is considered sufficient by the occupant or a temperature monitor in room A, and a signal is sent to stop the heating requirement to unit 13, whereupon valves 17,18 are closed. When the net heating requirement of the rooms A-D is below the heating capacity of the primary heating circuit 7, heating through the primary cooling circuit 6 is no longer required, and the first heat pump 8 may be stopped, and valves 17, 19, 21 and 23 closed. When one or more of the occupants or temperature monitors in the rooms A-D indicates to the central control that the temperature in that room is too high, the first heat pump 8 is set to a cooling operation. If, for example, room A requires cooling, valve 17 connected to the primary cooling circuit 6 is opened to provide the cooling requirement to the relevant heat exchanger 11. Thus room A can be cooled whilst room B is heated etc.

If during the day the net cooling requirement is greater than the primary cooling circuit 6 can supply, and there is no heating requirement requested (as may be the case due to the dynamics of the building), the second heat pump 10 is switched to a cooling operation to supply cooling through the primary heating circuit 7, and hence increase the overall cooling capacity of the system 2; all valves in those areas requiring cooling are opened. Later, when the occupant or temperature monitor in e.g. room C desires heat, the central control firstly determines whether there is any heating available. If so, i.e. at least the second pump 10 is in operation in the heating configuration, valve 22 is opened. If there is no heating available, the central control starts heat pump 10 in its heating operation and valve 22 is then opened.

At the end of each heat transfer circuit 6,7 is a flow bypass valve 25 which will guarantee flow of the mediums in circuits 6,7 at all times, independent of how many of the heat exchangers 11,12 are connected or isolated from each circuit 6,7. If necessary or desired more than one heat pump could be used to supply heating or cool-

ing to each of the circuits 6,7.

Fig. 2 shows a heat pump unit 28 comprising a circuit 30 connecting two primary heat exchangers 31,32 and a compressor 34 thereinbetween. The first primary heat exchanger 31 exchanges heat with a primary cooling circuit 37. The second primary heat exchanger 32 exchanges heat with a primary heating circuit 38. The circuit 30 includes two secondary heat exchangers 39,40. The primary circuits 37,38 are similar to circuits 6,7 in Fig. 1 and may be part of a heating and/or cooling system 2 as shown in Fig. 1 (wherein the primary heat exchangers 31,32 act as the heat sources and/or heat sinks).

The secondary heat exchangers 39,40 are fan coils which can either add heat to or dissipate heat from the heat transfer medium in the circuit 30. The speed of the fans is continuously variable, as is the speed of the compressor 34. Alternatively, the compressor 34 may operate in stages. The direction of flow of the heat transfer medium in the circuit 30 is shown by the arrow 42.

When the unit 28 is used with the system 2 as shown in Fig. 1, any or all cooling requirements are supplied by the first primary exchanger ("primary cooling exchanger") 31 and any or heating requirements are supplied by the second primary exchanger ("primary heating exchanger") 32. This is a suitable arrangement as the heat-transfer medium in the circuit 30 is hotter following compression by the compressor 34 than before compression. Between the primary circuits 37,38 are link pipes 43,44 so that the medium of either primary circuit 37,38 can be divided between the two circuits 37,38 when desired. Flow of the mediums in the primary circuits 37,38 and the pipes 43,44 is directed by valves 46-49.

The system 2 of Fig. 1 concerns the fulfilment of heating and cooling requests. The heat pump unit 28 can fulfil these requests as follows. When there are only cooling requests, cooling to the primary cooling circuit 37 is supplied by the primary cooling exchanger 31. The excess heat of the heat-transfer medium in circuit 30 is dissipated by the second fan coil 40. If the cooling requests are greater than can be fulfilled by the primary cooling circuit 37 and the heat exchangers in the relevant locations attached thereto, the medium of circuit 37 is divided between the primary circuits 37 and 38 (by opening valves 47 and 48 and closing valve 49) so that the heat exchangers in the relevant locations attached to the second primary circuit 38 can supply cooling as well. Thus the primary cooling exchanger 31 can fulfil the overall cooling requirement of the system 2.

When there are only heating requests, heating to the primary heating circuit 38 is supplied by primary heating exchanger 32. The heat required by the circuit 30 is supplied by the first fan coil 39. If the heating requests cannot be fulfilled by the primary heating circuit 38 and the heat exchangers in the relevant locations attached thereto, the medium of circuit 38 once heated by the primary heating exchanger 32 is divided between

the primary circuits 37 and 38 (by opening valves 47 and 48 and closing valve 46) so that the heat exchangers in the relevant locations attached to the first primary circuit 37 can supply heating as well. Thus the primary heating exchanger 32 can fulfil the overall heating requirement of the system 2. Where only the primary heating exchanger 32 is required, a 3-port valve 52 can be activated so that the medium in circuit 30 bypasses the primary cooling exchanger 31 through piping 53 to avoid possible freezing of the primary cooling exchanger 31.

When there are both heating and cooling requests, each primary circuit 37,38 operates independently, i.e. valves 47,48 are closed. As the cooling of the primary cooling circuit 37 will produce excess heat in the circuit 30, the heat pump circuit 30 can transfer this heat to the primary heating circuit 38. The degree to which this is done depends on the number and balance of the heating and cooling requests to be fulfilled. When the heating demand from the primary heating circuit 38 equals the heat produced by the cooling demand from the primary cooling circuit 37 plus any heat input from the compressor 34, then the circuit 30 is in effect "balanced" and the compressor 34 is only required to circulate the medium in circuit 30 at a rate which transfers this heat from the primary cooling exchanger 31 to the primary heating exchanger 32. The prime energy requirement of this could be very low. Where there is a greater cooling demand from the primary cooling circuit 32 than heating demand from the primary heating circuit 38, excess heat from the medium of the circuit 30 can be dissipated by the second fan coil 40. Where there is a greater heating demand than cooling demand, extra heat can be added to the medium of circuit 30 by the first fan coil 39.

The heat pump unit 28 is run by a control 54, which acts in response to sensors in or connected to the system 2. The control 54 controls either the speed of the compressor 34 or the stages of compression, so as to minimise the prime energy required to satisfy the demands of the primary circuits 37,38. Once the speed of the compressor 34 and/or the stages of compression are determined, the speed of the fans in the fan coils 39,40 are controlled, e.g. by closed loop pressure controls, to finely balance the unit 28. The control 54 also controls valve 52.

Circuit 30 includes a check valve 56 to prevent feed-back through the primary cooling exchanger 31 where the bypass piping 53 is in use. A thermostatic expansion valve control 58 is also present. If necessary or desired, more than one heat pump unit 28 could be used to supply heating and cooling to each of the primary circuits 37,38.

Fig. 3 shows the heat pump unit 28 of Fig. 2 in simplified form. Only the circuit 30, first and second primary heat exchangers 31,32 and the compressor 34 are shown. Fig. 3 also shows a second system for heating and cooling a plurality of separate locations in a building comprising a heating circuit 60 and a cooling circuit 62, the circuits 60,62 being supplied by the second and first

primary heat exchangers 32, 31 respectively of the heat pump unit 28. Each circuit 60, 62 can circulate a heat transfer medium, e.g. water, to single heat exchanging coils 64, 66, 68 in three locations A, B, C respectively. The coils 64, 66, 68 in each location are separately connectable to the heating and cooling circuits 60, 62 via 3-port entry valves 70 and 3-port exit valves 72.

When, e.g. location A requires heating, the valves 70 and 72 connect the coil 64 to the heating circuit 60. When location A requires cooling, coil 64 is connected to cooling circuit 62. Circuits 60, 62 always remain as heating and cooling circuits respectively. By using the heat pump unit 28 with this system, the flow rate around the unit circuit 30 could be more balanced than as occurs in Fig. 2.

The heat pump unit 28 could be used in any situation wherein heat from one location/apparatus etc., e.g. a moulding machine, can be recovered and used in another location/apparatus, e.g. to heat a room or heat a press.

Variations and modifications can be made without departing from the scope of the invention described above.

Claims

1. A system for heating and cooling a plurality of separate locations in a building comprising two heat-transfer circuits, each circuit adapted to circulate a heat transfer medium from a heat source and/or a heat sink to a heat exchanger in each location, wherein the first heat-transfer circuit is able to supply the net cooling requirement of the heat exchangers and the second heat-transfer circuit is able to supply the net heating requirement of the heat exchangers during periods of conflicting requirements, and wherein both heat-transfer circuits are able to supply the overall cooling requirement and the overall heating requirement of all the heat exchangers.
2. A system as claimed in Claim 1 wherein the heat source and/or heat sink for each heat-transfer circuit is a heat pump changeable between a heating and a cooling operation.
3. A system as claimed in Claim 1 or Claim 2 wherein the heat transfer medium in each circuit is water or glycol.
4. A system as claimed in any one of Claims 1 to 3 wherein each heat-transfer circuit is connected to the same heat exchanger in each location.
5. A system as claimed in any one of Claims 1 to 3 wherein each heat-transfer circuit is connected to a separate heat exchanger in each location.
6. A system as claimed in Claim 5 wherein the heat exchangers in each location are housed in one unit.
7. A system as claimed in Claim 6 wherein the heat exchangers in each location form a seemingly 'single coil' having split capacity.
8. A system as claimed in any one of Claims 5 to 7 wherein the percentage split between the heat exchangers in each location of the total capacity required depends upon the maximum net heating and cooling requirements during periods of conflicting requirements.
9. A system as claimed in Claim 8 wherein the ratio of the two capacities of the heat exchangers is 70:30.
10. A system as claimed in any one of Claims 6 to 9 wherein the unit is connectable either way round to the heat-transfer circuits.
11. A system as claimed in any one of the preceding Claims wherein the heat exchanger(s) are coils.
12. A system as claimed in any one of the preceding Claims wherein the system is controlled automatically by a central control means.
13. A system as claimed in any one of the preceding Claims wherein there is located in each location a local temperature setting control and a local temperature monitor.
14. A method for heating and cooling a plurality of separate locations in a building having two heat-transfer circuits, each circuit adapted to circulate a heat-transfer medium from a heat source and/or a heat sink to a heat exchanger in each location, wherein the first heat-transfer circuit is able to supply the net cooling requirement of the heat exchangers and the second heat-transfer circuit is able to supply the net heating requirement of the heat exchangers during periods of conflicting requirements, and wherein both heat-transfer circuits are able to supply the overall cooling requirement and the overall heating requirement of all the heat exchangers.
15. A heat pump unit comprising a circuit containing a heat-transfer medium which connects two or more primary heat exchangers, each heat exchanger being able to exchange heat with an associated heat-transfer circuit, with one or more compressors between the primary heat exchangers and one or more secondary heat exchangers adapted to alter if necessary the temperature of the heat-transfer medium in the circuit.
16. A heat pump unit as claimed in Claim 15 wherein

the unit has two primary heat exchangers and one compressor.

17. A heat pump unit as claimed in Claim 16 wherein the order of the circuit is: primary heat exchanger, secondary heat exchanger, compressor, second primary heat exchanger and second secondary heat exchanger. 5
18. A heat pump unit as claimed in any one of Claims 15 to 17 wherein the or each secondary heat exchanger is a variable control fan heater/cooler. 10
19. A heat pump unit as claimed in any one of Claims 15 to 18 wherein the circuit of the heat pump unit is controlled by varying the speed of the or each compressor or varying the stages of compression. 15
20. A heat pump unit as claimed in any one of Claims 15 to 19 adapted to recover heat from one or more locations or apparatus and supply the recovered heat to one or more further locations or apparatus. 20
21. A heat pump unit as claimed in Claim 20 adapted to supply a system for heating and cooling a plurality of separate locations. 25
22. A system as claimed in any one of Claims 1 to 13 wherein the heat pump unit as described in any one of Claims 15 to 21 supplies the heating and/or cooling requirements. 30
23. A system as claimed in Claim 22 wherein the heat-transfer circuits are reversibly interconnectable. 35
24. A system as claimed in any one of Claims 1 to 13, 22 and 23, wherein the heat sources and/or heat sinks are located outside the building. 40

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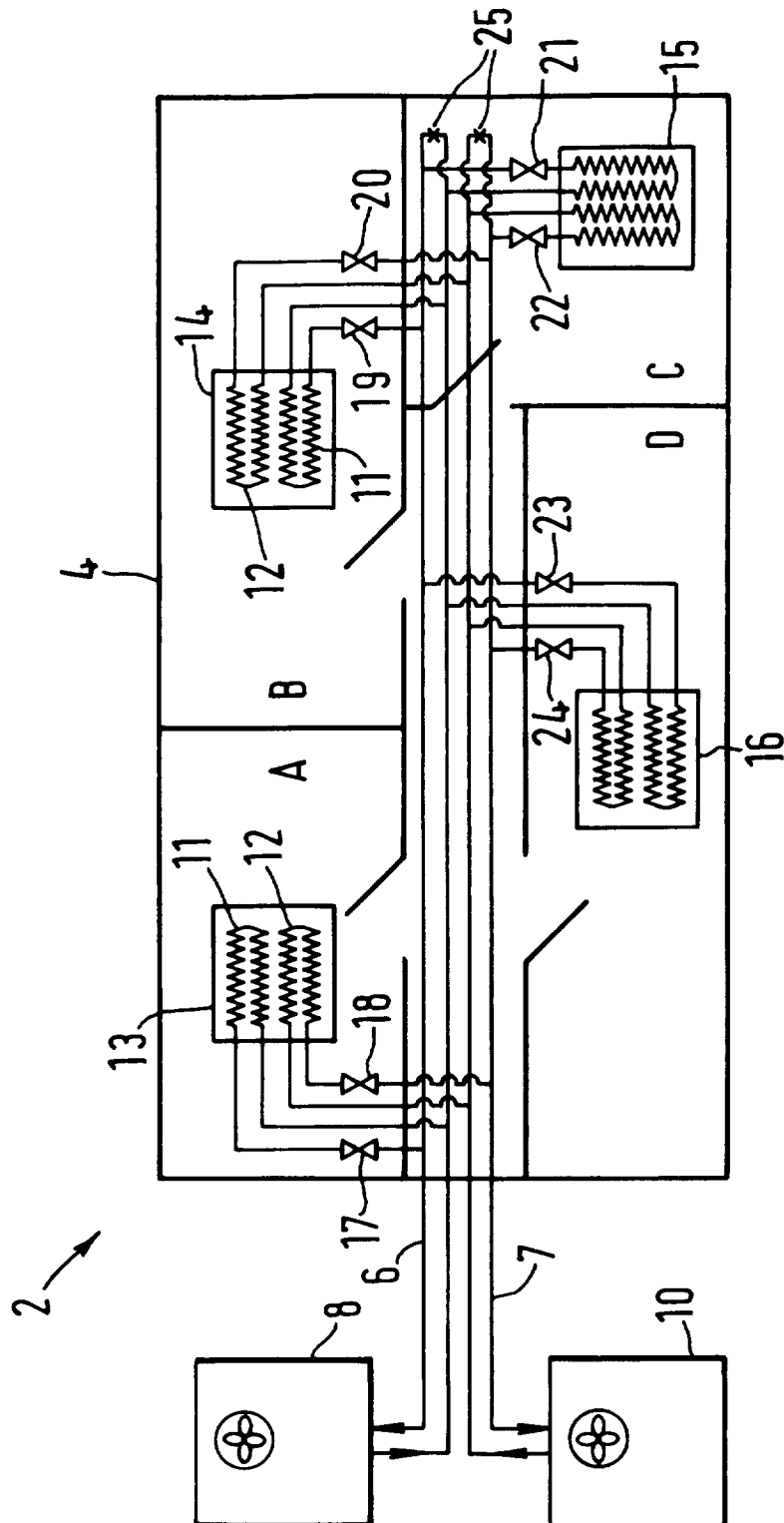
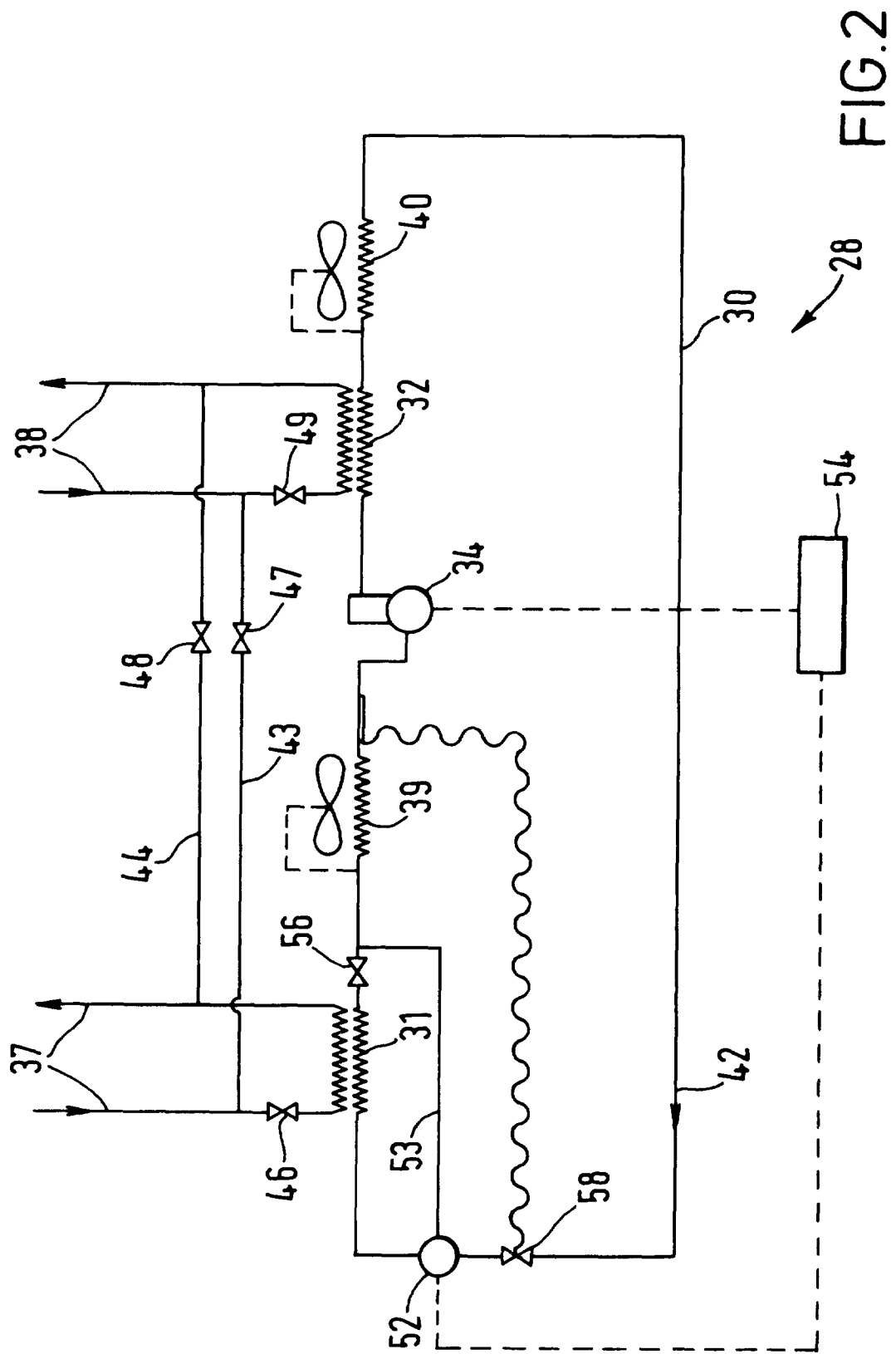


FIG.1



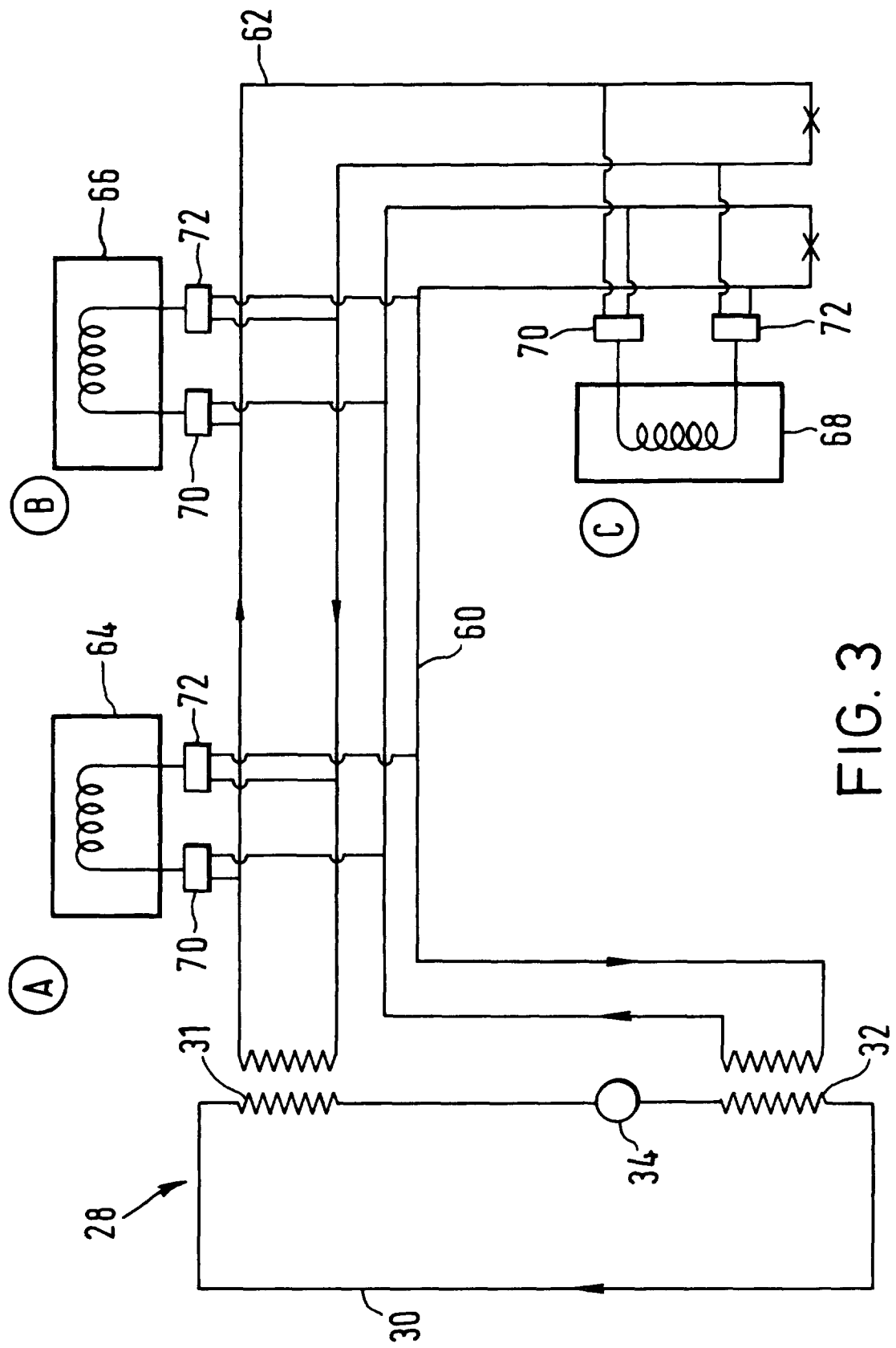


FIG. 3