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(54) **A fan coil air conditioning system, a fan coil unit, and a method of controlling a fan coil air conditioning system**

(57) According to a first aspect of the invention there is provided a fan coil air conditioning system 1 comprises at least one fan coil unit 3, the fan coil unit 3 comprising a heat exchanger 9, at least one fan 19, a return air inlet 15 and a conditioned air outlet 17 for connection to a conditioned air delivery duct 5 in a building. The heat exchanger 9 comprises a cooling water connection 11A for connecting to a source of cooling water, and a heating water connection 13A for connecting to a source of heating water. The cooling water connection 11A and the heating water connection 13A are each provided with a respective motorised regulating flow valve 21, 23. The fan 19 is operative to draw air from the air inlet 15, through the heat exchanger 9 to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger 9, and to pump the conditioned air through the conditioned air outlet 17. The system 1 further comprises an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the air returning to the fan coil unit 3, and fluid temperature sensors 29 operative to generate fluid temperature signals indicative of the temperature of the fluids at the heat exchanger 2. The system 1 further comprises a controller operative to receive the air temperature signal and the fluid temperature signals, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet 17 in question. The controller subsequently generates a valve control signal to control the motorised flow valves 21, 23 in dependence upon the fluid temperature, air temperature and duty sig-

nals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger 9, match the conditioned air duty required.

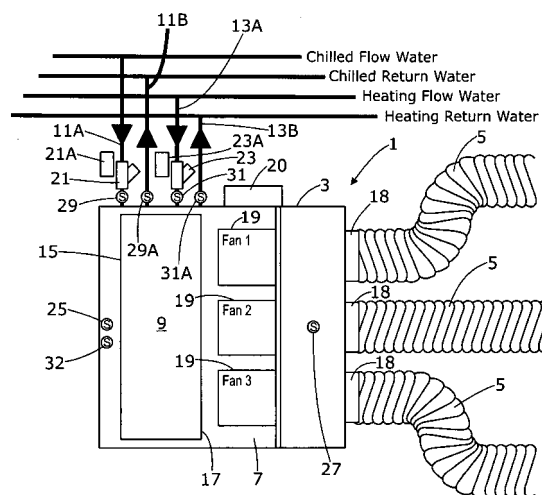


Fig. 1

Description

[0001] The present invention relates to a fan coil air conditioning system, a fan coil unit and a method of controlling a fan coil air conditioning system.

[0002] Fan coil air conditioning systems are found in many buildings, and particularly, but not exclusively, in larger commercial buildings such as office blocks for example. Such a system typically comprises a number of individual fan coil units. The system could comprise two or three individual fan coil units through to a few thousand individual units. These fan coil units are distributed around the building, are usually installed above the false ceiling, and each provide air conditioning to the particular area of the building in which they are located. The air conditioning demand in different areas will vary, and fan coil units typically come in a number of fixed sizes. Thus, once on site, each fan coil unit will be tuned to provide the exact amount of heating and cooling required for its location. The heating or cooling provided is controlled by the supply of heating or cooling water to a heat exchanger in the fan coil unit through which the air passes.

[0003] This site based tuning requires that, fan coil unit by fan coil unit, the air volume required from the fans in each unit is set and the heating and cooling water quantities are set - this process is called commissioning. On any building, commissioning is a substantial and lengthy task, carried out by specialists as the building approaches handover to the building client.

[0004] The purpose behind fan coil commissioning is to set each fan coil unit to provide its design performance without over-performing or compromising/starving any other fan coil unit or part of the system.

[0005] A fan coil unit is designed to provide cooling and heating. The fan coil unit incorporates a controller to blend those effects so that the required temperature in all areas served by the fan coil units is maintained.

[0006] The heat exchanger of a fan coil unit is typically in the form of copper coils through which the temperature controlled water passes. Sometimes there is only a cooling coil, sometimes only a heating coil and sometimes (most often) both.

[0007] Fan coils units also incorporate fans that move air through the unit. These pull air from the conditioned space, pass it over the heat exchanger coil(s) and then return it to the conditioned space. As the air passes over the coil(s) it is conditioned by acquiring or losing heat, the conditioned air then being delivered through ducts to the required area of the building. The amount of heat acquired or lost is governed by the amount of hot or cold water passing through the coil(s) and this is in turn controlled by a 'modulating control valve' under the command of the fan coil controller. On a fan coil unit that is designed to provide both heating and cooling, there will be two modulating control valves, one to control the cooling water flow, the other the heating water flow.

[0008] The fan coil control strategy will continually monitor the temperature of the area concerned and mod-

ulate the position of the heating and cooling modulating control valves accordingly to provide sufficient water volume to satisfy the demand at anytime. It should be noted that the heating and cooling valves are never open at the same time.

[0009] Beyond these 'modulating control valves' but still local to the fan coil, there is generally another valve called a 'regulating valve' or a 'double regulating valve'. These limit the maximum amount of water available to each unit; again one valve being provided for the heating coil and one for the cooling coil. The reason this adjustment is necessary is because it stops fan coil units close to the source of heating and cooling water, stealing water which might be required further away on the system. It also stops one or other fan coil unit over performing, ie providing too much heating or cooling effect.

[0010] It should be noted here that the modulating control valves and the regulating valves come in a number of different styles and combinations.

[0011] The maximum design water flow rates (one for heating and one for cooling) for each fan coil are calculated such that each fan coil can only provide the duty it was selected to provide, but no more. The duty is the amount of heating or cooling effect the unit was selected to provide for the area in which it is installed. The cooling duty will be sufficient to counter/offset all the calculated heat gains in the summer months (EG heat acquired from solar effects, people and machines) and the heating duty will be sufficient to cover all the heating losses in the winter months (EG heat lost through the fabric of the building to the outside).

[0012] When a building has been commissioned, this means that, amongst many other things, these water flow rates will have been measured at each fan coil unit, the regulating valves at each fan coil unit adjusted and set, and then the whole system proved to the client.

[0013] Water flow rate measurement is currently achieved by a pressure differential orifice plate (one per temperature control coil) connected to a manometer. The water passing through the orifice plate (and therefore on to the fan coil unit) presents a pressure drop across the plate, the more water the higher the pressure drop observed. Cross referencing to the orifice plate manufacturer's graphs will give the flow rate for any given pressure differential read (within a range).

[0014] The orifice plates come in a number of different styles and are sometimes combined with the modulating control valves and the regulating valves.

[0015] The water flow rate has been used historically because it is evidence that the fan coil unit is receiving sufficient heated and/or cooled water to provide the heating and/or cooling duty the designer wanted in that area of the building.

[0016] There are many types and combinations of modulating valve, regulating valve and orifice plates. To set, check or reset the flow rate values nonetheless always requires a physical visit to the fan coil unit or units in question.

[0017] Presently, a commissioning person physically visits every fan coil unit and measures the pressure differential, manually via the orifice plate, uses this to determine the water flow rate via the manufacturer's information, and then adjusts the regulating valve as necessary to provide the required water flow and consequently the required duty.

[0018] This process is very laborious and time consuming, especially if relatively large numbers of fan coil units are provided. For example, the process may take several weeks. Access to some of the fan coil units can also typically be relatively restricted. The commissioning process is therefore also relatively expensive.

[0019] The present invention stems from some work in trying to alleviate these problems.

[0020] According to a first aspect of the invention there is provided a fan coil air conditioning system comprising at least one fan coil unit, the fan coil unit comprising a heat exchanger, at least one fan, a return air inlet and a conditioned air outlet for connection to a conditioned air delivery duct in a building, the heat exchanger comprising a cooling water connection for connecting to a source of cooling water, and a heating water connection for connecting to a source of heating water, the cooling water connection and the heating water connection each being provided with a respective motorised regulating flow valve, the fan being operative to draw air from the air inlet, through the heat exchanger to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger, and to pump the conditioned air through the conditioned air outlet, the system further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the air returning to the fan coil unit, and fluid temperature sensors operative to generate fluid temperature signals indicative of the temperature of the fluids at the heat exchanger, the system further comprising a controller operative to receive the air temperature signal and the fluid temperature signals, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet in question, the controller being operative to subsequently generate a valve control signal to control the motorised flow valves in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger, match the conditioned air duty required.

[0021] A humidity sensor is preferably provided operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit.

[0022] Preferably the air temperature sensor comprises a sensor at the air inlet operative to measure the temperature of the air returning to the fan coil unit from the building. Preferably the air temperature sensor comprises a sensor at the conditioned air outlet operative to measure the temperature of the conditioned air leaving the fan coil unit to the building.

[0023] Preferably the fluid temperature sensors comprise sensors at the cooling water connections operative to measure the temperature of the cooling water flow to and return from the cooling heat exchanger, and further comprise sensors at the heating water connections operative to measure the temperature of the heating water flow to and return from the heating heat exchanger.

[0024] The controller may comprise a remote controller and a fan coil unit controller, the remote controller being operative to form a data connection with the or each fan coil unit controller. The controller may alternatively comprise a fan coil unit controller on the fan coil unit itself.

[0025] Preferably the system comprises a plurality of fan coil units.

[0026] Preferably each fan coil unit is provided with a unique identification, a signal indicative of the identification being provided to the controller.

[0027] According to a second aspect of the invention there is provided a fan coil unit comprising a heat exchanger, at least one fan, a return air inlet and a conditioned air outlet for connection to a conditioned air delivery duct in a building, the heat exchanger comprising a cooling water connection for connecting to a source of cooling water, and a heating water connection for connecting to a source of heating water, the cooling water connection and the heating water connection each being provided with a respective motorised regulating flow valve, the fan being operative to draw air from the air inlet, through the heat exchanger to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger, and to pump the conditioned air through the conditioned air outlet, the fan coil unit further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the air returning to the fan coil unit, and fluid temperature sensors operative to generate a fluid temperature signals indicative of the temperatures of the water at the heat exchangers, the fan coil unit further comprising a fan coil controller operative to receive the air temperature signal and the fluid temperature signal, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet in question, the controller being operative to subsequently generate a valve control signal to control the motorised flow valves in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger, match the conditioned air duty required.

[0028] A humidity sensor is preferably provided operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit.

[0029] According to a third aspect of the invention there is provided an electronic controller arranged to control the fan coil air-conditioning system of the first aspect of the invention.

[0030] The electronic controller may be mounted on the fan coil unit, or may be remote from the fan coil unit and connected thereto via a suitable data connection. The data connection may be a wired or wireless connection.

[0031] The controller may comprise an electronic data processor comprising software arranged to enable the data processor to control the fan coil air conditioning system.

[0032] The controller may comprise an electronic data processor comprising hardware arranged to enable the data processor to control the fan coil air conditioning system.

[0033] According to a fourth aspect of the invention there is provided a method of controlling a fan coil air conditioning system comprising at least one fan coil unit, the fan coil unit comprising a heat exchanger, at least one fan, a return air inlet and a conditioned air outlet for connection to a conditioned air delivery duct in a building, the heat exchanger comprising a cooling water connection for connecting to a source of cooling water, and a heating water connection for connecting to a source of heating water, the cooling water connection and the heating water connection each being provided with a respective motorised regulating flow valve, the fan being operative to draw air from the air inlet, through the heat exchanger to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger, and to pump the conditioned air through the conditioned air outlet, the system further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the returning to the fan coil unit, and fluid temperature sensors operative to generate fluid temperature signals indicative of the temperature of the fluids at the heat exchanger, the system further comprising a controller, the method comprising steps of using the controller:

to receive the air temperature signal and the fluid temperature signals, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet in question, and

to subsequently generate a valve control signal to control the motorised flow valves in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger, match the conditioned air duty required.

[0034] A humidity sensor is preferably provided, operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit.

[0035] Other aspects of the present invention may include any combination of the features or limitations referred to herein.

[0036] The present invention may be carried into prac-

tice in various ways, but embodiments will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic of a fan coil air conditioning system in accordance with the present invention, comprising a single fan coil unit; and

Figure 2 is a schematic of the system of Figure 1 comprising a plurality of fan coil units.

[0037] Referring to the figures, a fan coil air conditioning system 1 comprises a plurality of fan coil units 3 each having fluid connections to temperature controlled water, and being connected to conditioned air delivery ducts 5, each duct 5 leading from the fan coil unit 3 to an area of the building where conditioned air is required. The ducts 5 can lead to the same or different areas as required, and any number of ducts 5 can be connected to a given fan coil unit 3 as required. In this example each fan coil unit 3 is connected to three ducts 5.

[0038] Each fan coil unit 3 comprises a usually oblong housing 7 in which a heat exchanger 9 comprising two temperature control coils are provided. One coil is connected to a source of chilled water via a chilled water inlet 11A and a chilled water return 11B, whilst the other coil is connected to a source of heated water via a heated water inlet 13A and a heated water return 13B. The heat exchanger 9 further comprises a return air inlet 15 and an air outlet 17, the air inlet 15 receiving return air (unconditioned air) from the building.

[0039] Each fan coil unit 3 further comprises three fans 19, the fans 19 being positioned between the heat exchanger air outlet 17 and the ducts 5. The fans 19 are operative to draw air through the air inlet 15, across the temperature control coils, and out of the fan coil unit 3 via conditioned air outlets 18 connected to the ducts 5.

[0040] A fan coil unit controller 20 is provided to control the heat exchange coil 9 and the fans 19.

[0041] In accordance with the invention, each fan coil unit 3 comprises a pair of motorised regulating water flow control valves, one valve 21 being connected to the chilled water inlet 11A, the other valve 23 being connected to the heating water inlet 13A. The water flow control valves 21, 23 can alternatively be positioned on the chilled and heating water returns 11B, 13B. Each valve 21, 23 comprises a respective actuator 21A, 23A, these being controlled by the controller 20. Movement of the valves 21, 23 by actuators 21A, 23A using the controller 20 varies the flow rate of cooling or heated water into the heat exchanger 9 and thus conditions the temperature of air being drawn around the temperature control coils by the fans 19. The degree of conditioning of the air is also determined by the volume flow rate of air across the coils as determined by the speed of operation of the fans 19, this also being controlled by the controller 20.

[0042] Each fan coil unit 3 further comprises an air temperature sensor operative to generate an air temperature

signal indicative of the temperature of the air returning to the fan coil unit 3, a humidity sensor 32 operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit 3, and fluid temperature sensors operative to generate fluid temperature signals indicative of the temperatures of the fluids at the heat exchanger 9.

[0043] In this example, the air temperature sensor comprises an air inlet temperature sensor 25, and a conditioned air temperature sensor 27 located in the housing 7 between the fans 19 and ducts 5 at the conditioned air outlets 18.

[0044] The humidity sensor 32 is located adjacent the air inlet temperature sensor 25.

[0045] In this example the fluid temperature sensor comprises a cooling water flow temperature sensor 29, located adjacent the cooling water inlet valve 21, a cooling return water temperature sensor 29a located on the chilled water return pipework 11 B, a heating water flow temperature sensor 31 located adjacent the heating water inlet valve 23 and a return heating water sensor 31A located on the heated water return pipework 13B.

[0046] Each of these sensors 25 to 31 generates a respective fluid or air temperature signal that is received and processed by the controller 20.

[0047] The above described system 1 is arranged to enable every fan coil unit 3 in the system to be remotely interrogated for data that will, through calculation, quantify that an adequate design cooling/heating water flow rate is being provided to each unit 3 to provide the required conditioning to the air pumped by that unit 3, and if it is not, to remotely adjust the control valves 21, 23 such that it is. This reduces system commissioning times from what can be several weeks to several hours.

[0048] In contrast to the prior art system and associated commissioning described above, instead of measuring the cooling and heating water flow rate, the system 1 calculates the cooling and heating duties directly from the signals generated by the air temperature sensors, the humidity sensor 32 and the fluid temperature sensors. If those calculated duties are either too large or too small (an indication that the design water flow rates are either too large or too small), the system 1 adjusts the maximum design water flows to that unit 3 correcting the over performance or shortfall in performance.

[0049] The controller 20 uses this feedback to calculate the cooling and heating water flow rates and then, if required, automatically calculates corrections to the valve control positions for the valves 21, 23 of every fan coil 3 in the system 1.

[0050] So, the system 1 measures the air and water temperatures directly and then uses that sensor data to calculate the duty and, if necessary, to correct the regulating valves 21, 23 remotely.

[0051] Each fan coil unit 3, in this example, incorporates six temperature sensors 25, 27, 29, 29a, 31, 31a, and a humidity sensor 32.

[0052] These sensors measure:-

- The temperature of the air returning to the unit 3 from an area of the building - ie the temperature of the area of the building in question
- The humidity of the air returning to the unit 3 from an area of the building - ie the humidity of the area of the building in question
- The temperature of the conditioned air leaving the unit 3 having been cooled or heated by the heat exchanger 9
- The temperature of the cooling water going to the unit 3
- The temperature of the cooling water leaving the unit 3
- The temperature of the heating water going to the unit 3
- The temperature of the heating water leaving the unit 3.

[0053] During manufacture of each fan coil unit 3, its controller 20 is provided with the following information about the unit 3 it will be controlling:

- The fan coil unique unit reference number (ID). This is so that the system 1 can identify each individual fan coil unit 3
- The design cooling and heating duties - ie the maximum cooling and heating the unit 3 is required to provide when installed in the building
- The air volume the unit 3 is designed to circulate
- The calculated cooling water flow rate required to achieve the design cooling duty
- The calculated heating water flow rate required to achieve the design heating duty
- The design cooling and heating water flow temperatures
- The design entering (inlet) air conditions for both temperature, and humidity, (both in summer and winter)
- The design leaving (outlet) air temperatures, heating and cooling.

[0054] The system 1 operates in the following way. The operating steps described could be driven from any suitable device including (but not limited to) software stored on a (laptop) computer temporarily connected to the system 1, through any controller 20 on the system 1 via a suitable wired or wireless data connection, or it could be hard coded into each fan coil controller 20 and programmed to run once or on a regular basis, as required.

[0055] The steps described below are based on a remote laptop computer being used to initiate the process.

[0056] The fan coil units 3 in the system 1 are connected together to form a data network such that commands and status reports can be sent to or retrieved from the controller 20 of each fan coil unit 3.

[0057] The laptop is connected to the data network of fan coil units 3 and so can send and receive data to and from as many fan coil units 3 as are connected by the

network; this could be two, it could be 2000 for example.

[0058] The steps are run twice, once for cooling and once for heating. The heating and cooling procedures can be executed in either order or interlaced. For each, the laptop software first sends a command to all fan coil units 3 to enter a commissioning mode. This is instructing the units 3 to temporarily exit any variable fan speed strategy that they might normally operate and, after a brief diagnostic routine, go to design fan speed and opening either the cooling or heating regulating valve 21, 23 to the position that has been predefined as letting the design water flow rate through to the unit 3. This setting position, under normal operation, would mean that the unit 3 was providing its maximum design cooling, or heating, duty.

[0059] The laptop software polls each unit 3 in turn and requests that each send back the following information (the following description describes a cooling water flow rate checking routine, the heating is the same but uses the heating values in place of the cooling):

- The unique fan coil unit reference number (ID)
- The design cooling duties (ie the maximum cooling duties the unit 3 is designed to provide)
- The design air volume the unit 3 is designed to circulate
- The actual cooling water flow and return temperatures, from sensors 29 and 29a
- The actual return air temperature going to the fan coil unit 3, from sensor 25
- The actual relative humidity of the air going to the fan coil unit 3, from sensor 32
- The actual conditioned air temperature leaving the fan coil unit 3, from sensor 27.

[0060] This polling routine, automatically contacts every unit 3 and it takes only a few seconds per set of data. By way of example, 250 fan coil units 3 could take five to six minutes depending on network speeds. This allows any interested party to confirm the performance of every fan coil unit 3 in the fan coil system 1, whereas the previous manual process could take many weeks. Constrained by time, the prior art manual process would therefore often have to be limited to a representative selection of fan coils 3 within a fan coil system 1.

[0061] The software then uses the signals indicative of the air temperature and humidity into the unit 3, the air temperature out of the unit 3 and the air volume the unit 3 is designed to circulate to determine the cooling performance of the unit 3 at that point in time, the 'as now' duty.

[0062] It should be noted that the duty (at commissioning time) is not likely to match the design duty because while a building is being commissioned the water temperatures and the building air temperatures are most often not at their final design values. So, to determine if the unit 3 would be meeting the design duty if the air and water were correct, the 'as now' duty may need to be corrected to compensate for the water and air tempera-

tures at their 'as now' values not being as per the original design.

[0063] After a settling delay, the software checks the 'as now' duty and corrects it to allow for the differences between the 'as now' water, air and humidity values and the respective design values. Having corrected the 'as now' duty, a signal is generated indicative of the corrected calculated duty and the software compares this to the required design duty and generates a duty correction signal indicative of the amount by which the corrected calculated duty differs from the design duty. The duty correction signal is a measure of how much the cooling water inlet regulating valve 21 needs adjusting such that the corrected calculated duty matches the design duty. The software uses the duty correction signal to generate a valve correction signal used by the controller 20 to adjust the current cooling regulating valve 21 position such that the correct cooling water flow rate is provided to the heat exchange cooling coil. This process is often automatically repeated to refine and then confirm the adjustments.

[0064] The system 1 is pre-programmed with the relevant design values that will provide the correct amount of cooling and heating energy to the un-conditioned air. These values are then transposed by the fan coil controller 20 into a cooling and heating valve position at which the respective valve will, within acceptable tolerances, only allow the programmed maximum water to flow. This ensures that the unit 3 is permitted to provide the correct amount of cooling/heating, but no more and that it does not steal system water from fan coil units 3 further on in the system 1.

[0065] A problem is that the valve position is only ever exactly the same in a precise laboratory condition. As soon as one uses a fan coil unit 3 on site in a building with the associated variations and vagaries of the site pipe-work leading to each valve 21, 23, the theoretical valve position may no longer be correct. Therefore, depending upon the site pipe-work condition, each valve 21, 23 will likely require fine tuning as per the described method.

[0066] The above described system 1 performs the commissioning task remotely and automatically and therefore comparatively very quickly. At the end of the commissioning routine described, all the relevant data, including confirmation that the unit has 'passed' its commissioning tests can be sent to the laptop for examination and/or printing for record purposes. The commissioning function can be reconfirmed as often as the building occupier / designer might want. So this could be on a monthly or bi-annual basis for example, and could account for the different seasons.

[0067] Furthermore buildings have only previously been designed with one set of design conditions in mind, ie the chilled water will be X°C flow and Y°C return, the desired building condition will be Z°C etc. This is partly because, changing any of those values means that some of the fan coil unit settings, particularly the water flow rates, will no longer be valid, requiring a manual com-

missioning process to be repeated.

[0068] Because changing or resetting the water flow rates with the above described system 1 is an operation which can be done automatically, remotely and regularly, this gives opportunities for building designers to change the various design parameters, possibly water temperatures, either as the external environment changes throughout the year or because people with different needs move around within the building. The system 1 can therefore be programmed to recognise these changes and 'auto adapt'.

[0069] In some instances some of the sensors, particularly the return water and humidity sensors 29a, 31a and 32 can be omitted from the system. This may be possible if a calculated estimation of some of the data values was acceptable.

Claims

1. A fan coil air conditioning system (1) comprising at least one fan coil unit (3), the fan coil unit (3) comprising a heat exchanger (9), at least one fan (19), a return air inlet (15) and a conditioned air outlet (17) for connection to a conditioned air delivery duct (5) in a building, the heat exchanger (9) comprising a cooling water connection (11A) for connecting to a source of cooling water, and a heating water connection (13A) for connecting to a source of heating water, the cooling water connection (11A) and the heating water connection (13A) each being provided with a respective motorised regulating flow valve (21, 23), the fan (19) being operative to draw air from the air inlet (15), through the heat exchanger (9) to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger (9), and to pump the conditioned air through the conditioned air outlet (17), the system (1) further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the air returning to the fan coil unit (3), and fluid temperature sensors (29) operative to generate fluid temperature signals indicative of the temperature of the fluids at the heat exchanger (9), the system (1) further comprising a controller (20) operative to receive the air temperature signal and the fluid temperature signals, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet (17) in question, the controller (20) being operative to subsequently generate a valve control signal to control the motorised flow valves (21, 23) in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger (9), match the conditioned air duty required.
2. The fan coil air conditioning system (1) of claim 1 wherein a humidity sensor (32) is provided operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit (3).
3. The fan coil air conditioning (1) system of claim 1 or claim 2 wherein the air temperature sensor comprises a sensor at the air inlet (15) operative to measure the temperature of the air returning to the fan coil unit (3) from the building.
4. The fan coil air conditioning system (1) of any one of the preceding claims wherein the air temperature sensor comprises a sensor at the conditioned air outlet (17) operative to measure the temperature of the conditioned air leaving the fan coil unit (3) to the building.
5. The fan coil air conditioning system (1) of any one of the preceding claims wherein the fluid temperature sensors (29) comprise sensors at the cooling water connection (11A) operative to measure the temperature of the cooling water flow to and return from the heat exchanger (9), and further comprise sensors at the heating water connection (13A) operative to measure the temperature of the heating water flow to and return from the heat exchanger (9).
6. The fan coil air conditioning system (1) of any one of the preceding claims wherein the controller comprises a remote controller and a fan coil unit controller, the remote controller being operative to form a data connection with the or each fan coil unit controller.
7. The fan coil air conditioning system (1) of any one of claims 1 to 5 wherein the controller (20) comprises a fan coil unit controller on the fan coil unit (3) itself.
8. The fan coil air conditioning system (1) of any one of the preceding claims comprising a plurality of fan coil units (3).
9. The fan coil air conditioning system (1) of claim 8 wherein each fan coil unit (3) is provided with a unique identification, a signal indicative of the identification being provided to the controller (20).
10. A fan coil unit (3) comprising a heat exchanger (9), at least one fan (19), a return air inlet (15) and a conditioned air outlet (17) for connection to a conditioned air delivery duct (5) in a building, the heat exchanger (9) comprising a cooling water connection (11A) for connecting to a source of cooling water, and a heating water connection (13A) for connecting to a source of heating water, the cooling water connection (11A) and the heating water connection (13A) each being provided with a respective motor-

ised regulating flow valve (21, 23), the fan (19) being operative to draw air from the air inlet (15), through the heat exchanger (9) to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger (9), and to pump the conditioned air through the conditioned air outlet (17), the fan coil unit (3) further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the air returning to the fan coil unit (3), and fluid temperature sensors (29) operative to generate fluid temperature signals indicative of the temperatures of the water at the heat exchanger (9), the fan coil unit (3) further comprising a fan coil controller (20) operative to receive the air temperature signal and the fluid temperature signal, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet (17) in question, the controller (20) being operative to subsequently generate a valve control signal to control the motorised flow valves (21, 23) in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger (9), match the conditioned air duty required.

11. The fan coil unit (3) of claim 10 wherein a humidity sensor (32) is provided operative to generate a signal indicative of the relative humidity of the air returning to the fan coil unit (3).
12. An electronic controller (20) arranged to control the fan coil air-conditioning system (1) of any one of claims 1 to 10.
13. A method of controlling a fan coil air conditioning system (1) comprising at least one fan coil unit (3), the fan coil unit (3) comprising a heat exchanger (9), at least one fan (19), a return air inlet (15) and a conditioned air outlet (17) for connection to a conditioned air delivery duct (5) in a building, the heat exchanger (9) comprising a cooling water connection (11A) for connecting to a source of cooling water, and a heating water connection (13A) for connecting to a source of heating water, the cooling water connection (11A) and the heating water connection (13A) each being provided with a respective motorised regulating flow valve (21, 23), the fan (19) being operative to draw air from the air inlet (15), through the heat exchanger (9) to condition the temperature of the air, the temperature being determined by the flow of cooling or heating water through the heat exchanger (9), and to pump the conditioned air through the conditioned air outlet (17), the system (1) further comprising an air temperature sensor operative to generate an air temperature signal indicative of the temperature of the returning to the fan coil unit (3),

and fluid temperature sensors (29) operative to generate fluid temperature signals indicative of the temperature of the fluids at the heat exchanger (9), the system (1) further comprising a controller (20), the method comprising steps of using the controller (20):

to receive the air temperature signal and the fluid temperature signals, and also a duty signal indicative of the temperature and volume flow rate of the conditioned air required for the conditioned air outlet (17) in question, and to subsequently generate a valve control signal to control the motorised flow valves (21, 23) in dependence upon the fluid temperature, air temperature and duty signals such that the flow rate of cooling and/or heating fluid and the flow rate of air through the heat exchanger (9), match the conditioned air duty required.

14. The method of claim 13 comprising steps of providing a humidity sensor (32), and generating a signal indicative of the relative humidity of the air returning to the fan coil unit (3).

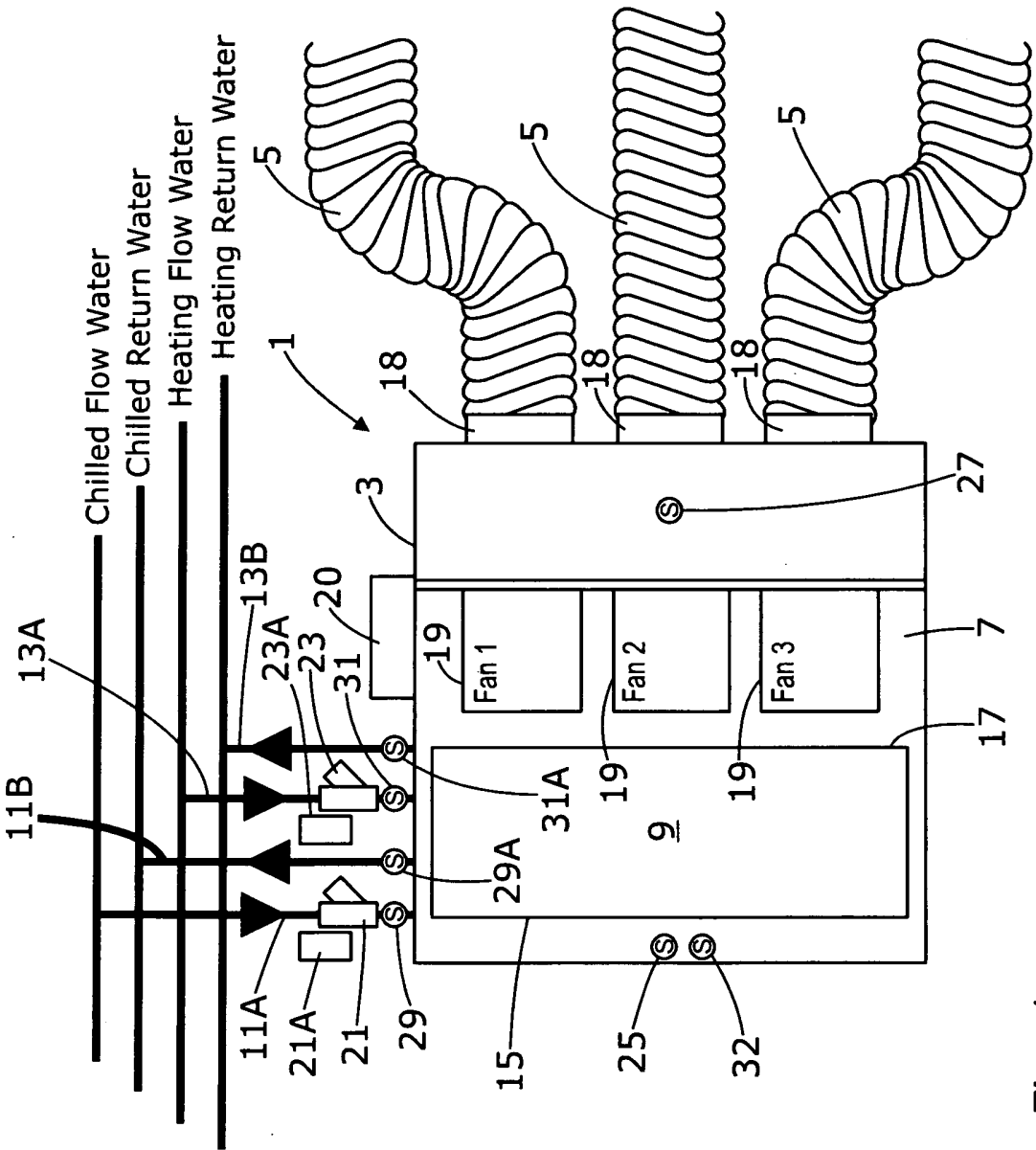


Fig. 1

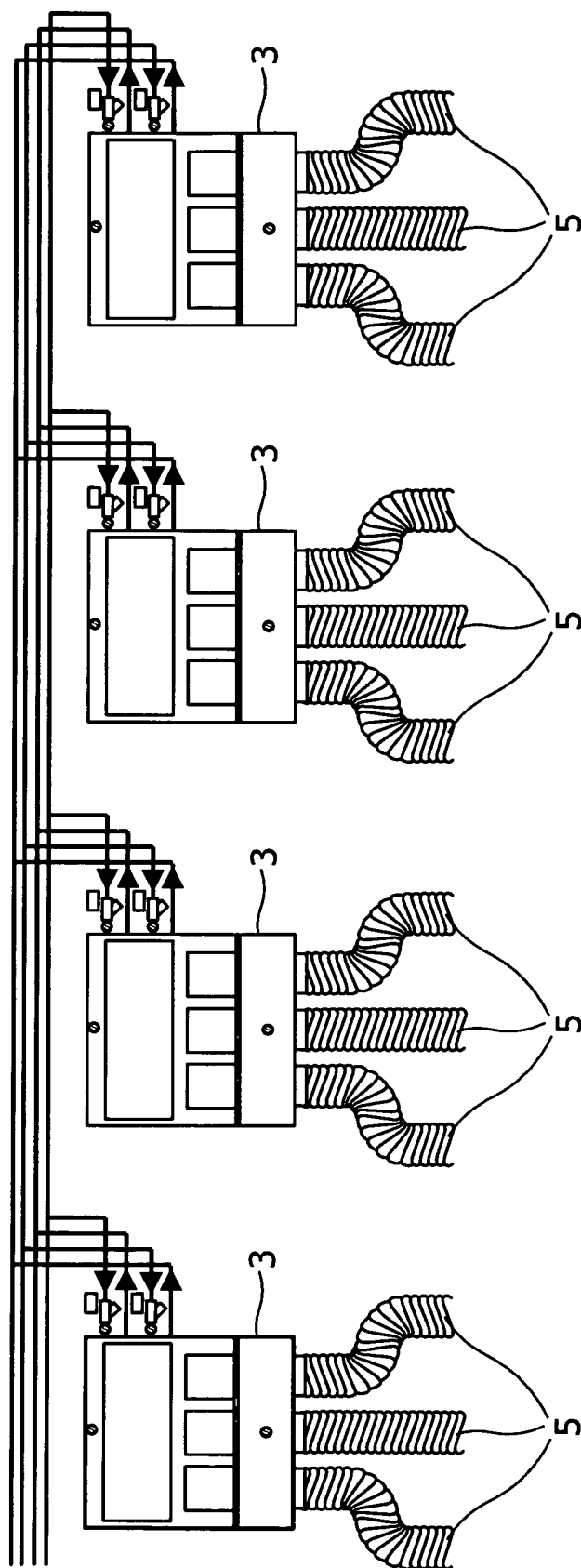


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2630

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search Munich		Date of completion of the search 12 June 2012	Examiner Decking, Oliver
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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The members are as contained in the European Patent Office EDP file on
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12-06-2012

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