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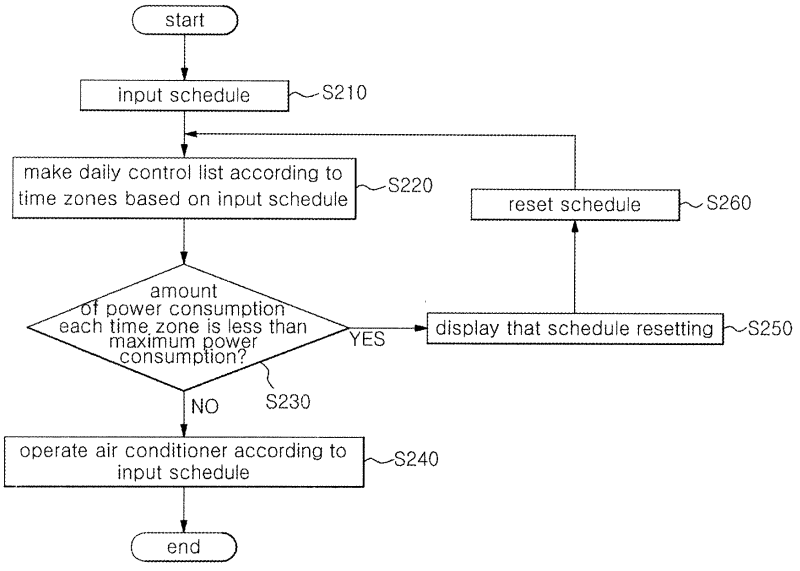
(54) Air conditioner and method for controlling the same

(57) Disclosed are an air conditioner and a method for controlling the same, and more particularly to an air conditioner and a method for controlling the same, capable of maintaining an amount of power consumption of the air conditioner to a level less than an amount of allowable maximum power consumption in a multi-type air conditioner including a plurality of indoor units.

In an air conditioner and a method for controlling the same, the amount of power consumption is calculated according to time zones based on input schedule information, and the calculated amount of power consumption is compared with the maximum power consumption. If a time zone exists in which the calculated amount of power consumption excesses the maximum power consumption, the air conditioner is in an off-state, but require the input of schedule information so as to operate under the maximum power consumption without additionally employing a peak power control unit. In addition, the operational schedule of the air conditioner is able to be variously preset by the user, without being restricted to reduce the amount of power consumption.

Fig. 5



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2007-155, filed on January 02, 2007, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the invention

[0002] The present invention relates to an air conditioner and a method for controlling the same, and more particularly to an air conditioner and a method for controlling the same, capable of maintaining an amount of power consumption of the air conditioner to a level less than an amount of allowable maximum power consumption in a multi-type air conditioner including a plurality of indoor units.

2. Description of the Prior Art

[0003] In general, an air conditioner is used for cooling or heating a room. In detail, the air conditioner performs the coding/heating operation by circulating liquid-phase refrigerant between an indoor unit and an outdoor unit to absorb ambient heat when the refrigerant is evaporated and emit heat when the refrigerant is liquefied.

[0004] A typical air conditioner has one outdoor unit and one indoor unit. However, recently, needs of a user increase for a multi system air conditioner that performs the cooling or heating operation in places in which a plurality of separated spaces exist, such as a school, a company, or a hospital, by connecting a plurality of indoor units having various shapes and capacities to one or more outdoor units.

[0005] Since such a multi-type air conditioner requires high power consumption, the multi-type air conditioner includes a peak power control unit in order to manage power such that an amount of power consumption of the air conditioner does not exceed the maximum power consumption, which is established by the contract with an electric supply company, for a predetermined period of time (e.g., 15 minutes) in a peak time causing the great amount of power consumption.

[0006] If power is supplied to the conventional multi-type air conditioner, a power consumption measurement unit detects instantaneous power and analyzes the detected power data so that the peak power control unit of the conventional multi-type air conditioner determines whether the amount of power consumption for 15 minutes exceeds the maximum power consumption. If it is expected from the determination result that the amount of power consumption for 15 minutes exceeds the maximum power consumption, the peak power control unit sequentially stops the operation of indoor units to be controlled among a plurality indoor units, or operates the indoor units in a low-power operation mode, thereby preventing the total amount of power consumption of the air conditioner for 15 minutes from exceeding the maximum power consumption.

[0007] However, according to the conventional scheme, since the peak power control unit must be additionally provided, manufacturing costs may increase. In addition, if a user excessively excludes the indoor units by mistake when setting the indoor units to be controlled, the maximum power consumption may be exceeded only through the operation of the indoor units excluded from the control.

[0008] In addition, if most indoor units to be controlled are in an off-state or a low-power operation mode according to the operational conditions, power consumption cannot be reduced any more even when it is expected that the amount of power consumption of the air conditioner exceeds the maximum power consumption.

[0009] Further, when considering the characteristics of the multi-type air conditioner, which is generally operated for a predetermined period of time according to operational schedule preset by the user, that is, the user does not individually control the indoor unit whenever using the multi-type air conditioner, if the amount of power consumption is controlled by the conventional peak power control unit, the schedule function for the indoor units to be controlled may be disregarded. For this reason, the heating/cooling operation may not be properly performed in a space having such indoor units.

SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention has been made to solve above-mentioned problems occurring in the prior art, and an object of the present invention is to provide an air conditioner and a method for controlling the same, capable of maintaining an amount of power consumption of the air conditioner to a level less than maximum power consumption without additionally employing a conventional peak-power control unit in the air conditioner having a plurality of indoor units and being operated through a schedule function.

[0011] Another object of the present invention is to provide an air conditioner and a method for controlling the same,

capable of preventing an operational schedule preset by a user from being unnecessarily restricted in order to maintain the amount of power consumption to a level less than maximum power consumption.

[0012] In order to accomplish these objects, according to an aspect of the present invention, there is provided an air conditioner including a plurality of indoor units, an input module for inputting a schedule, which is an operational condition for the indoor units according to time, and a controller for previously calculating an amount of power consumption of the air conditioner based on the input schedule and comparing the amount of power consumption with allowable maximum power consumption to control an operation of the air conditioner according to the comparison result.

[0013] In addition, at least one schedule is inputted into the input module, and the schedule includes a number, an operating time, an operating mode, and a fan speed of the indoor unit.

[0014] The operating mode includes a cooling mode, a heating mode, and a wind blowing mode, and the fan speed includes a high speed, a mid speed, and a low speed.

[0015] The controller divides a day into a plurality of time zones, and calculates an amount of power consumption according to the time zones.

[0016] The air conditioner further includes a storage module for storing power consumption of each indoor unit according to the operating mode and the fan speed, wherein the controller searches the storage module to detect power consumption of the indoor unit corresponding to the input schedule and calculates an amount of power consumption by using the power consumption and the operation time of the indoor unit.

[0017] The controller operates the air conditioner according to the input schedule if there is no time zone representing the amount of the power consumption exceeding maximum power consumption.

[0018] The air conditioner includes a display module for allowing a user to reset the schedule, wherein the controller controls the display module to allow the user to reset the schedule without operating the air conditioner if there is a time zone representing the amount of power consumption exceeding the maximum power consumption.

[0019] According to another aspect of the present invention, there is provided a method for controlling an air conditioner including a plurality of indoor units, the method comprising the steps of (1) previously calculating an amount of power consumption of the air conditioner based on a schedule, which is an operational condition for the indoor units according to time, if the schedule is input, and (2) comparing the amount of power consumption with allowable maximum power consumption, thereby controlling an operation of the air conditioner according to the comparison result.

[0020] At least one schedule is input in step (1), and the schedule includes a number, an operating time, an operating mode, and a fan speed of the indoor unit.

[0021] The operating mode includes a cooling mode, a heating mode, and a wind blowing mode, and the fan speed includes a high speed, a mid speed, and a low speed.

[0022] A day is divided into a plurality of time zones in step (1), and an amount of power consumption is calculated according to the time zones.

[0023] The air conditioner includes a storage module for storing power consumption of the indoor unit according to the operating mode and the fan speed, power consumption of the indoor unit corresponding to the schedule input in step (1) is searched from the storage module, and an amount of power consumption is calculated by using the power consumption and the operation time of the indoor unit.

[0024] In step (2), the air conditioner is operated according to the input schedule if there is no time zone representing the amount of power consumption exceeding allowable maximum power consumption and a message for resetting the schedule is displayed without operating the air conditioner if there is a time zone representing the amount of the power consumption exceeding the maximum power consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram showing the structure of an air conditioner according to one embodiment of the present invention;

FIG. 2 is a block diagram showing the structure for controlling the operation of an air conditioner according to one embodiment of the present invention;

FIG. 3 is a view showing schedule setting information of an air conditioner according to one embodiment of the present invention;

FIG. 4 is a view showing a daily control list of an air conditioner according to one embodiment of the present invention; and

FIG.5 is a flowchart showing a control procedure of an air conditioner according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0027] FIG. 1 is a block diagram showing the structure of an air conditioner according to one embodiment of the present invention.

[0028] The air conditioner shown in FIG. 1 includes one outdoor unit 20 connected to an external power supply 10 and four indoor units 30a, 30b, 30c, and 30d connected to the outdoor unit 20, and the indoor units 30a, 30b, 30c, and 30d may have the same capacity or different capacities if necessary.

[0029] Although one outdoor unit 20 is provided as an example to realize the air conditioner according to the present embodiment, a plurality of outdoor units may be provided. In addition, according to another embodiment, the number of indoor units may be the same as or differ from the number of the indoor units 30a, 30c, 30c, and 30d according to the present embodiment.

[0030] In addition, if a user simultaneously inputs operational conditions of the indoor units 30a, 30b, 30c, and 30d for a predetermined period of time, the air conditioner shown in FIG. 1 has a schedule function of operating the indoor units 30a, 30b, 30c, and 30d according to the operating conditioners. In addition, if the indoor units 30a, 30b, 30c, and 30d have different capacities, the indoor units 30a, 30b, 30c, and 30d consume different amounts of power under the same operational condition.

[0031] FIG. 2 is a block diagram showing the structure for controlling the operation of the air conditioner according to the present invention.

[0032] If a user inputs information regarding operational schedules of the indoor units 30a, 30b, 30c, and 30d to an input module 110, a controller 100 delivers a control signal to an outdoor unit driving module 150 and an indoor unit driving module 160 in order to operate the air conditioner according to the input schedule using a timer 115 for measuring time.

[0033] The outdoor unit driving module 150 and the indoor unit driving module 160 drive the outdoor unit 20 and the indoor units 30a, 30b, 30c, and 30d according to the control signal.

[0034] At this time, if schedule information is input, the controller 100 allows a schedule managing module 120 accommodated therein to make a daily control list according to time zones based on the input schedule information before the operation of the air conditioner and then to calculate the total amount of power consumption of the air conditioner according to time zones by using information previously stored in a memory 130.

[0035] The schedule information includes information regarding the operational conditions of the indoor units 30a, 30b, 30c, and 30d according to time zones, and an example thereof is shown in FIG. 3.

[0036] A plurality of different-named schedules may be input according to the number of groups of the indoor units 30a, 30b, 30c, and 30d operating under the same condition, and the information regarding the operational conditions belonging to the schedules may be variously classified if necessary. For example, the information includes a valid period, a sequence number of an indoor unit, the operating time, the operating mode, a preset temperature, and a fan speed of the indoor unit corresponding to the schedule.

[0037] In this case, the operating time means a period of time during which each indoor unit is turned on/off, and the operating mode corresponds to one of a cooling mode, a heating mode, and a wind blowing mode. The fan speed includes one of high, mid, and low speeds.

[0038] FIG. 3 shows a case in which the first and second indoor units 30a and 30b are operated through the first schedule, and the third and fourth indoor units 30c and 30d are operated through the second schedule. In detail, FIG. 3 shows that the schedules are set such that the indoor units 30a, 30b, 30c, and 30d are operated through the first and second schedules to August 25, 2006 from July 26, 2006.

[0039] In addition, the schedules are preset such that the first and second indoor units 30a and 30b are operated at the high speed in the cooling mode for one hour between 13:00 and 14:00, and the third and fourth indoor units 30c and 30d are operated at a low speed in a cooling mode for nine hours between 09:00 and 18:00.

[0040] The daily control list made by the schedule managing module 120 based on the first and second schedules is representatively shown in FIG. 4.

[0041] Although power consumption may be calculated for a day relative to 24 time zones having a time interval of one hour as shown in FIG. 4, the time interval can be reduced or increased, if necessary. In addition, preferably, the operating time of an indoor unit having the shortest operating time from among the indoor units is set as the time interval in order to easily calculate power consumption.

[0042] In addition, the daily control list is identically employed every day during a predetermined period of time of employing the first and second schedules.

[0043] First, the list of indoor units to be controlled shows indoor units operated in each time zone according to the first and second schedules. All indoor units 30a, 30b, 30c, and 30d are operated between 13:00 and 14:00, and the third and fourth indoor units 30c and 30d are operated in remaining time zones except for the time zone between 13:00 and

14:00.

[0044] Meanwhile, the schedule managing module 120 calculates power consumption according to time zones by using information stored in the memory 130, and the memory 130 stores information regarding power consumption according the operating modes and the fan speeds of the indoor units 30a, 30b, 30c, and 30d.

[0045] The information stored in the memory 130 represents experimental values. The power consumption of the indoor units 30a, 30b, 30c, and 30d according to the operating mode and the fan speed is shown following tables 1 and 2. In addition, the unit of the power consumption is used as "watt (W)".

Table 1- power consumption in first and third indoor units

	High speed	Mid speed	Low speed
Cooling mode	100	80	60
Heating mode	150	130	110
Wind blowing mode	50	40	30

Table 2- power consumption in second and fourth indoor units

	High speed	Mid speed	Low speed
Cooling mode	120	100	80
Heating mode	200	170	140
Wind blowing mode	80	60	40

[0046] The power consumption (P1) of the air conditioner in remaining time zones except for the time zone between 13:00 and 14:00 is calculated in the order of the first, second, third, and fourth indoor units 30a, 30b, 30c, and 30d, and the power consumption (P1) is as follows.

$$\text{Power consumption (P1)} = 0 + 0 + 60 + 80 = 140[W]$$

[0047] In addition, the power consumption (P2) of the air conditioner in the time zone between 13:00 and 14:00 is calculated in the order of the first, second, third, and fourth indoor units 30a, 30b, 30c, and 30d, and the power consumption (P2) is as follows.

$$\text{Power consumption (P2)} = 100 + 120 + 60 + 80 = 360[W]$$

[0048] In this case, on the assumption that the established maximum power consumption is 180kWh for 15 minutes, the power consumption of the air conditioner must be less than 200W such that the air conditioner can maintain the amount of the power consumption to a level less than the maximum power consumption.

[0049] Accordingly, although the amount of power consumption of the air conditioner may be maintained to a level less than the maximum power consumption in the remaining time zones, the amount 324kWh of power consumption for 15 minutes may exceed the maximum power consumption in the time zone between 13:00 and 14:00.

[0050] In this case, the schedule managing module 120 indicates that schedule resetting is required in the time zone between 13:00 and 14:00 of the daily control list. Upon recognizing this, the controller 100 delivers a control signal to the display module 140 such that the display module 140 displays a message to allow a user to recognize the schedule resetting.

[0051] FIG. 5 is a flowchart showing a control procedure of the air conditioner according to one embodiment of the present invention.

[0052] If a user inputs an operational schedule of the indoor units 30a, 30b, 30c, and 30d through the input module 110 in order to operate the air conditioner according to desired schedule (step S210), the schedule managing module 120 of the controller 100 makes the daily control list according to time zones based on the input schedule as described above (step S220).

[0053] After step S220, the controller 100 determines whether the amount of power consumption in each time zone is less than the maximum power consumption (step S230). If the amount of the power consumption in each time zone is less than the maximum power consumption, the air conditioner is operated according to the input schedule (step S240).

[0054] Meanwhile, if the amount of power consumption exceeds the maximum power consumption in step S230, the controller 100 does not operate the air conditioner, but controls the display module 140 to display that schedule resetting is required with respect to a corresponding time zone (step S250). Accordingly, if the user resets schedule through the input module 110, the controller 100 performs step S220 (step S260).

[0055] As described above, when a user inputs schedule information, the air conditioner according to the present invention determines whether the maximum power consumption is exceeded according to time zones. If a time zone of exceeding the maximum power consumption exists, the air conditioner is not operated, but schedule resetting is required. Accordingly, the operation of the air conditioner is previously prevented even when the user makes a schedule by mistake such that the amount of power consumption is exceeded in a specific time zone.

[0056] The air conditioner according to the present invention can operate under the maximum power consumption without additionally employing a peak power control unit. In addition, the operational schedule of the air conditioner can be variously preset by the user, without being restricted to reduce the amount of power consumption.

[0057] As described above, in an air conditioner and a method for controlling the same according to the present invention, the amount of power consumption is calculated according to time zones based on input schedule information, and the calculated amount of power consumption is compared with the maximum power consumption. If a time zone exists in which the calculated amount of power consumption excesses the maximum power consumption, the air conditioner does not operate, but require the input of schedule information so as to operate under the maximum power consumption without additionally employing a peak power control unit. In addition, according to the present invention, the operational schedule of the air conditioner can be variously preset by the user, without being restricted to reduce the amount of power consumption.

[0058] Although exemplary embodiments of the present invention has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. An air conditioner comprising:

   a plurality of indoor units;
   an input module for inputting a schedule, which is an operational condition for the indoor units according to time; and
   a controller for previously calculating an amount of power consumption of the air conditioner based on the input schedule and comparing the amount of power consumption with allowable maximum power consumption to control an operation of the air conditioner according to the comparison result.

2. The air conditioner as claimed in claim 1, wherein at least one schedule is inputted into the input module, and the schedule includes a number, an operating time, an operating mode, and a fan speed of the indoor unit.

3. The air conditioner as claimed in claim 2, wherein the operating mode includes a cooling mode, a heating mode, and a wind blowing mode, and the fan speed includes a high speed, a mid speed, and a low speed.

4. The air conditioner as claimed in claim 3, wherein the controller divides a day into a plurality of time zones, and calculates an amount of power consumption according to the time zones.

5. The air conditioner as claimed in claim 4, further comprising a storage module for storing power consumption of each indoor unit according to the operating mode and the fan speed, wherein the controller searches the storage module to detect power consumption of the indoor unit corresponding to the input schedule and calculates an amount of power consumption by using the power consumption and the operation time of the indoor unit.

6. The air conditioner as claimed in claim 5, wherein the controller operates the air conditioner according to the input schedule if there is no time zone representing the amount of the power consumption exceeding maximum power consumption.

7. The air conditioner as claimed in claim 6, further comprising a display module for allowing a user to reset the schedule,

wherein the controller controls the display module to allow the user to reset the schedule without operating the air conditioner if there is a time zone representing the amount of power consumption exceeding the maximum power consumption.

8. A method for controlling an air conditioner including a plurality of indoor units, the method comprising the steps of:

(1) previously calculating an amount of power consumption of the air conditioner based on a schedule, which is an operational condition for the indoor units according to time, if the schedule is input; and
(2) comparing the amount of power consumption with allowable maximum power consumption, thereby controlling an operation of the air conditioner according to the comparison result.

9. The method as claimed in claim 8, wherein at least one schedule is input in step (1), and the schedule includes a number, an operating time, an operating mode, and a fan speed of the indoor unit.

10. The method as claimed in claim 9, wherein the operating mode includes a cooling mode, a heating mode, and a wind blowing mode, and the fan speed includes a high speed, a mid speed, and a low speed.

11. The method as claimed in claim 10, wherein a day is divided into a plurality of time zones in step (1), and an amount of power consumption is calculated according to the time zones.

12. The method as claimed in claim 11, wherein the air conditioner includes a storage module for storing power consumption of the indoor unit according to the operating mode and the fan speed, power consumption of the indoor unit corresponding to the schedule input in step (1) is searched from the storage module, and an amount of power consumption is calculated by using the power consumption and the operation time of the indoor unit.

13. The method as claimed in claim 12, wherein, in step (2), the air conditioner is operated according to the input schedule if there is no time zone representing the amount of power consumption exceeding allowable maximum power consumption and a message for resetting the schedule is displayed without operating the air conditioner if there is a time zone representing the amount of the power consumption exceeding the maximum power consumption.

Fig. 1

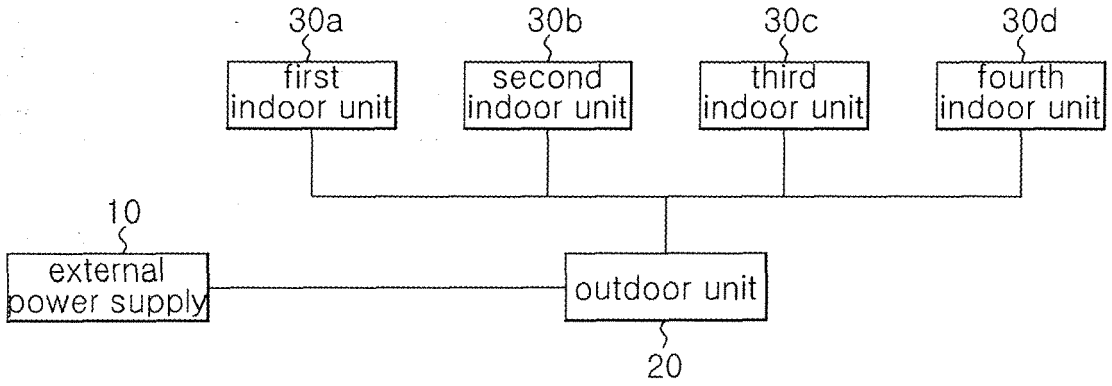

30a
30b
30c
30d
first indoor unit
second indoor unit
third indoor unit
fourth indoor unit
10
external power supply
outdoor unit
20

Fig. 2

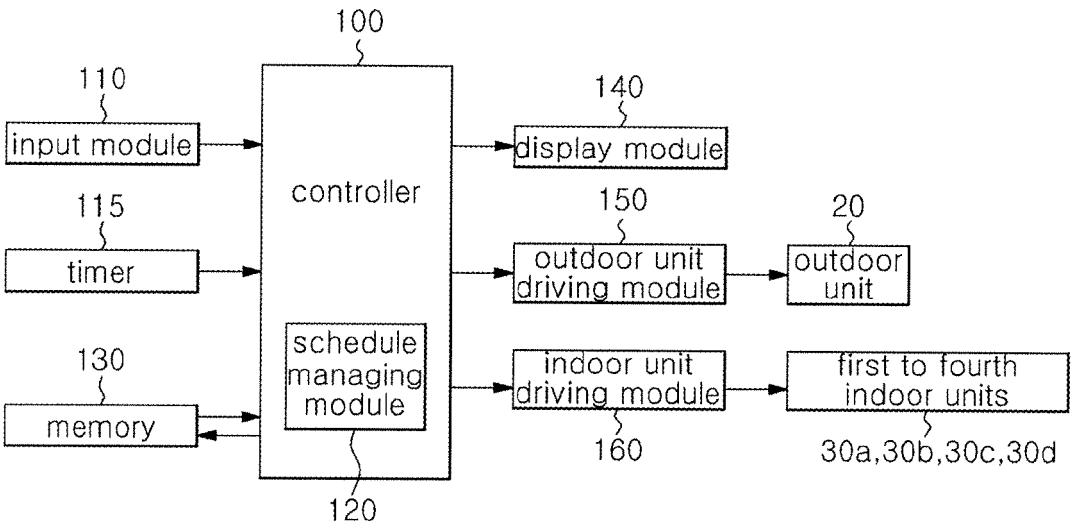

100
110
input module
115
timer
130
memory
controller
schedule managing module
120
140
display module
150
outdoor unit driving module
20
outdoor unit
indoor unit driving module
160
first to fourth indoor units
30a,30b,30c,30d

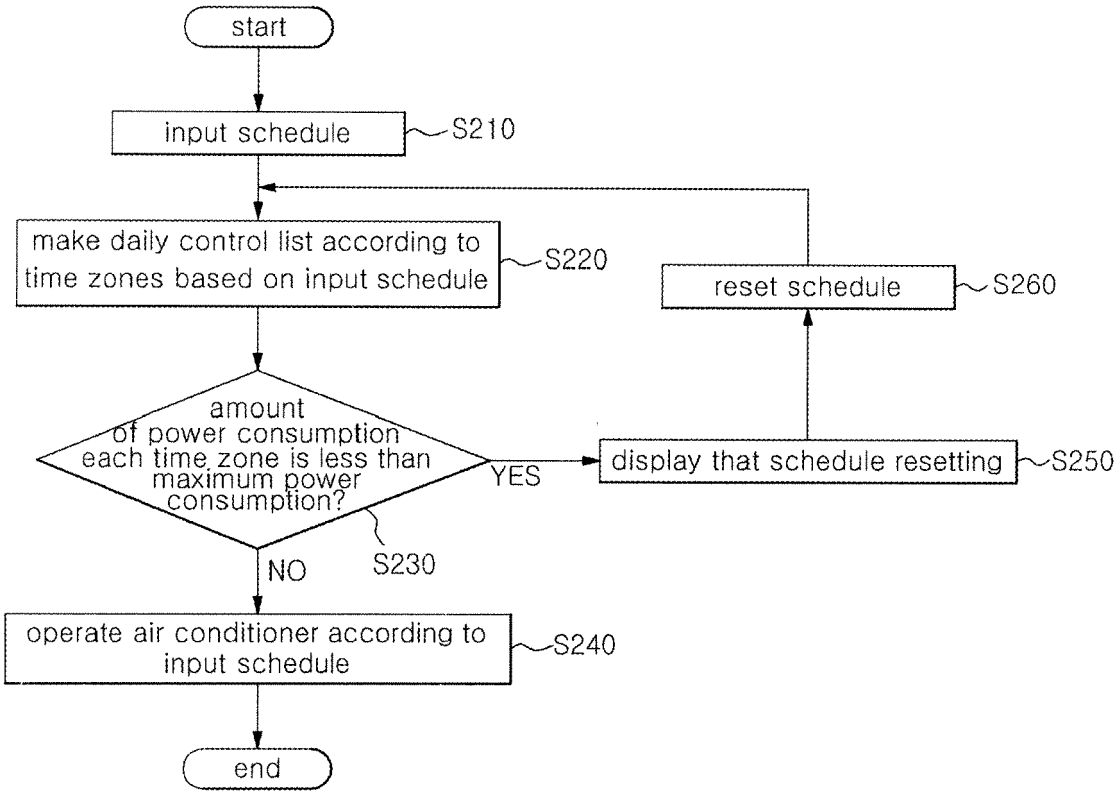
Fig. 3

schedule name	fist schedule	second schedule
period of time	2006/07/26 ~ 2006/08/25	2006/07/26 ~ 2006/08/25
indoor unit No	1, 2	3, 4
operating time interval	13:00 ~ 14:00	09:00 ~ 18:00
operating mode	cooling mode	cooling mode
fan speed	high speed	low speed

Fig. 4

time interval	list of controlled indoor unit	power consumption(W)	schedule resetting state
:	:	:	:
:	:	:	:
:	:	:	:
11:00 ~ 12:00	3,4	140	un-required
12:00 ~ 13:00	3,4	140	un-required
13:00 ~ 14:00	1,2,3,4	360	required
14:00 ~ 15:00	3,4	140	un-required
:	:	:	:
:	:	:	:
:	:	:	:

Fig. 5


start
input schedule
S210
make daily control list according to time zones based on input schedule
S220
amount of power consumption each time zone is less than maximum power consumption?
YES
NO
S230
display that schedule resetting
S250
reset schedule
S260
operate air conditioner according to input schedule
S240
end

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 10 8450

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X	US 2005/005621 A1 (JAYADEV TUMKUR S [US]) 13 January 2005 (2005-01-13) * paragraphs [0050] - [0057]; figures 3a,4 *	1,8	
X	US 2006/065750 A1 (FAIRLESS KEITH W [US]) 30 March 2006 (2006-03-30) * paragraphs [0064] - [0069]; figures 7,10 *	1,8	TECHNICAL FIELDS SEARCHED (IPC) F24F
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 March 2008	Valenza, Davide

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 10 8450

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14-03-2008

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