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(54) Method and apparatus for monitoring refrigerant-cycle systems

(57) A real-time monitoring system that monitors various aspects of the operation of a refrigerant-cycle system is described. In one embodiment, the system includes a processor that measures power provided to the refrigerant-cycle system and that gathers data from one or more sensors and uses the sensor data to calculate a figure of merit related to the efficiency of the system. In one embodiment, the sensors include one or more of the following sensors: a suction line temperature sensor, a suction line pressure sensor, a suction line flow sensor, a hot gas line temperature sensor, a hot gas line pressure sensor, a hot gas line flow sensor, a liquid line tempera-

ture sensor, a liquid line pressure sensor, a liquid line flow sensor. In one embodiment, the sensors include one or more of an evaporator air temperature input sensor, an evaporator air temperature output sensor, an evaporator airflow sensor, an evaporator air humidity sensor, and a differential pressure sensor. In one embodiment, the sensors include one or more of a condenser air temperature input sensor, a condenser air temperature output sensor, and a condenser air flow sensor, an evaporator air humidity sensor. In one embodiment, the sensors include one or more of an ambient air sensor and an ambient humidity sensor.

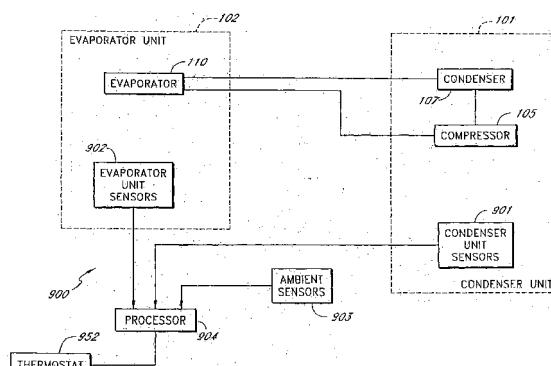


FIG. 9A



DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	US 4 948 040 A (KOBAYASHI TOYOHIRO [JP] ET AL) 14 August 1990 (1990-08-14) * the whole document * -----	1-4	INV. F24F11/00 F25B49/02
X	US 6 385 510 B1 (HOOG KLAUS D ET AL) 7 May 2002 (2002-05-07) * the whole document * -----	1-4	
X	US 2003/150926 A1 (ROSEN HOWARD B) 14 August 2003 (2003-08-14) * the whole document * -----	1-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			G01D F24F H04L G08C G05B F25B G05D
The present search report has been drawn up for all claims			
18	Place of search	Date of completion of the search	Examiner
	Munich	11 March 2008	Valenza, Davide
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			

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

see additional sheet(s)

The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4

Intelligent thermostat comprising a display and a processing system configured to receive sensor data from a condenser unit and an evaporator unit, said processing system configured to calculate an efficiency of a refrigerant-cycle system.

2. claim: 5

System for electrical load control comprising a remote monitoring system, and a thermostat and a data interface provided to said thermostat.

3. claim: 6

System for electrical load control comprising a remote monitoring system, a cooling system comprising an evaporator unit, and a data interface provided to said evaporator unit.

4. claim: 7

System for electrical load control comprising a remote monitoring system, a cooling system condenser unit, a compressor provided to said condenser unit, a data interface provided to said condenser unit.

5. claim: 8

System for electrical load control comprising a remote monitoring system, a cooling system comprising, an evaporator unit, a condenser unit, a thermostat, and one or more data interface devices provided to said cooling system.

6. claim: 9

Monitoring system for monitoring an evaporator of a refrigerant-cycle system, comprising a first temperature sensor, a second temperature sensor, one or more ambient sensors, an air flow sensor, and a processing system to calculate a performance criteria of the evaporator unit.

7. claim: 10



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

Monitoring system for monitoring an evaporator of a refrigerant-cycle system, comprising means for measuring one or more inputs to said evaporator, means for measuring one or more outputs from said evaporator, programmed data parameters related to said evaporator, and a processing system to calculate one or more performance criteria of the evaporator unit.

8. claim: 11

Monitoring system for monitoring a condenser of a refrigerant-cycle system, comprising means for measuring one or more inputs to said condenser, means for measuring one or more outputs from said condenser, programmed data parameters related to said evaporator, and a processing system to calculate one or more performance criteria of the condenser unit.

9. claim: 12

Monitoring system for monitoring an air filter in a forced-air heating or cooling system, comprising means for holding a filter element, means for measuring a pressure drop across the filter element, means for sending data to a processing system, and a processing system configured to calculate one or more performance criteria of the filter.

10. claim: 13

Monitoring system for monitoring an air filter in a forced-air heating or cooling system, comprising means for holding a filter element, means for measuring a light transmission through the filter element, means for sending data to a processing system, and a processing system configured to calculate one or more performance criteria of the filter.

11. claim: 14

Monitoring system for monitoring an air filter in a forced-air heating or cooling system, comprising a light source, a light sensor, and a processing system configured to calculate a performance criteria of the filter.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 07 6045

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-03-2008

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 4948040	A	14-08-1990		NONE		
US 6385510	B1	07-05-2002		NONE		
US 2003150926	A1	14-08-2003	US	2003150927 A1		14-08-2003