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(54) A Heat Pump or Refrigerating System Monitoring Unit

(57) The present invention is related to a heat pump or refrigerating system monitoring unit comprising: a) a receiving unit for receiving measurement data; b) at least one pressure sensor for measuring a pressure value of a fluid present in the heat pump or refrigerating system; **characterized in that** the at least one pressure sensor communicates to the receiving unit via a wireless connection. Further, the present invention is directed to a heat pump or refrigerating system comprising such monitoring unit.

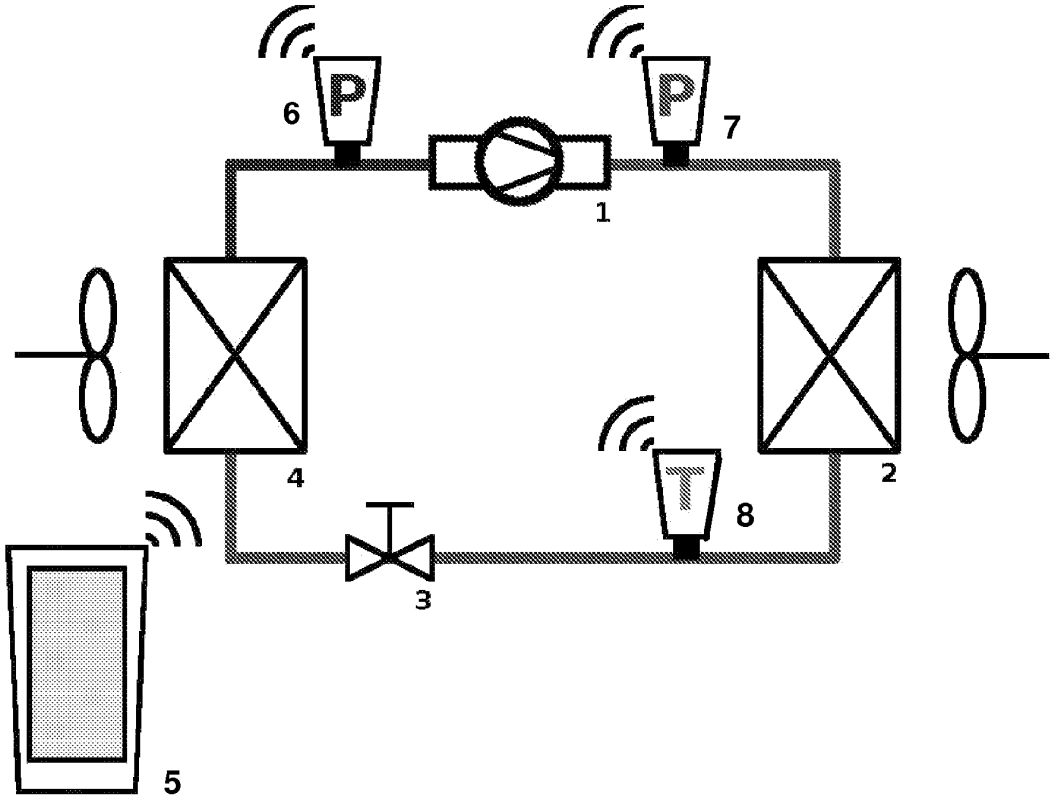

FIG 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to improved monitoring equipment for heat pump or refrigerating systems.

BACKGROUND OF THE INVENTION

[0002] Both heat pumps and refrigerating systems like refrigerators, freezers, coolers, air conditioners, etc. are systems based on the thermodynamic refrigeration cycle wherein a fluid refrigerant is exposed to a continuous compression and expansion cycle.

[0003] Since such heat pump and refrigerating systems require regularly monitoring and maintenance in order to see whether the system is working properly and during which several thermodynamic parameters of the system have to be measured or monitored, a number of monitoring units are available on the market to be used by field technicians.

[0004] A first example of a very commonly used state-of-the-art monitoring unit is a conventional mobile manifold kit with mechanical analogue gauges to measure pressure values of system gases, like for example the refrigerant. An obvious problem herewith is that only pressure can be measured, such that a field technician is obliged to use other measurement tools if he is interested in other thermo dynamical parameters.

[0005] A second problem is that the field technician is not able to measure simultaneously or remotely at different pressure measuring points.

[0006] A third problem is that only on the spot pressure reading is possible, as well in time as in place, and that pressure data logging is only possible by hand. In particular this is a problem for example if the evaporator unit and the condensing unit of a heat pump or refrigerating system are located at a significant distance from each other, or if one is located inside a building while the other is outside or on top of the building.

[0007] In case on the spot data analysis is required, a fourth problem is that data processing and analyzing is to be done manually, which obviously induces greater risk, since the quality of the analysis depends directly on the skills of the field technician.

[0008] A specific fifth problem is that for each pressure measurement a connection is to be made between the gauges and the heat pump or refrigerating system by means of one or more hoses. Moreover, the gas to be measured remains in the hoses and is vented every time the measurement is performed and the connection is cut off. The latter is an important drawback, and in particular in case refrigerant is vented, for safety and health reasons, for ecological reasons such as ozone depletion, and/or for economical reasons.

[0009] An example of a state-of-the-art monitoring unit attempting to solve several of the above drawbacks is the Stargate SG3000. This monitoring unit comprises a portable receiver unit and a remote transmitter unit sending measurement data to the receiver unit. The receiver unit has sensors that monitor temperatures and pressure readings. Both the data of the transmitter unit and the receiver unit are analyzed in the receiver unit and the results are shown on the receiver LCD screen.

[0010] A major drawback of the Stargate SG3000 is still that pressure measurement is to be done by connecting the receiver's pressure sensor(s) to the heat pump or refrigerating system by means of hoses, resulting in undesired venting.

[0011] Another remaining drawback is that the field technician is still not able to measure simultaneously or remotely at different pressure measuring points since he is obliged to take the receiver to every pressure measuring point to be measured.

[0012] Considering the drawbacks of state-of-the-art monitoring unit, it is an object of the present invention the provide a heat pump and refrigerating system monitoring unit adapted to measure pressure values while venting considerably less fluid compared to conventional monitoring units.

[0013] It is another object of the present invention to provide a heat pump and refrigerating system monitoring unit adapted to measure simultaneously or remotely at different pressure measuring points.

[0014] Another object of the present invention is to provide a heat pump and refrigerating system monitoring unit adapted to monitor a number of different thermo dynamical parameters.

[0015] Still another object of the heat pump and refrigerating system monitoring unit according the present invention is to provide high quality data processing and analysis, independently of the field technician's skills.

[0016] To meet the above objects, the present invention provides a heat pump and refrigerating system monitoring unit wherein at least one pressure sensor communicates to a receiving unit via a wireless connection.

SUMMARY OF THE INVENTION

[0017] The present invention is directed to a heat pump or refrigerating system monitoring unit comprising:

a) a receiving unit for receiving measurement data,
b) at least one pressure sensor for measuring a pressure value of a fluid present in the heat pump or refrigerating system,

characterized in that the at least one pressure sensor communicates to the receiving unit via a wireless connection.

[0018] Further, the present invention is directed to a heat pump or refrigerating system comprising such monitoring unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

FIG 1 illustrates an example of an embodiment in accordance with the present invention.

DESCRIPTION OF THE INVENTION

[0020] A person skilled in the art will understand that the embodiments described below are merely illustrative in accordance with the present invention and not limiting the intended scope of the invention. Other embodiments may also be considered.

[0021] In the context of the present invention, heat pumps and refrigerating systems are to be understood as all systems based on the thermodynamic refrigeration cycle, such as reversible cycle heat pumps, refrigerators, freezers, coolers, air conditioners, etc.

[0022] According to a first embodiment of the present invention a heat pump or refrigerating system monitoring unit is provided comprising:

a) a receiving unit for receiving measurement data,
b) at least one pressure sensor for measuring a pressure value of a fluid present in the heat pump or refrigerating system,

characterized in that the at least one pressure sensor communicates to the receiving unit via a wireless connection.

[0023] By ensuring that the at least one pressure sensor communicates with the receiving unit via a wireless connection, the pressure sensor is separated from the receiver unit such that remote pressure measurement is possible and the field technician is not obliged to on the spot pressure reading anymore.

[0024] Further, it becomes possible now to provide more than one pressure sensor in the monitoring unit and achieve simultaneous measurement on more than one pressure measuring point.

[0025] The pressure sensor may be any analogue or digital pressure sensor used in heat pump or refrigeration technique which is adapted to communicate its signal via a wireless connection to the receiving unit, for example mechanical deflection sensors, fiber optics sensors, piezo-resistive sensors, variable capacitance sensors, piezoresonant sensors, ceramic sensors, MEMS sensors, etc.. Its range may be down to 10^{-6} bar absolute vacuum pressure, and up to 250 bar relative pressure.

[0026] The fluid may be any gas or liquid substance used in a heat pump or refrigerating cycle.

[0027] In an embodiment in accordance with the present invention, the fluid may be a refrigerant. The refrigerant may be any fluid used as a heat transportation medium in a refrigerating cycle. For example, widely-adopted refrigerants are hydrofluorocarbons (HFC's), as for example R-134A, or hydrochlorofluorocarbons (HCFC's), as for example R-22. Hydrocarbons (HC's), such as propane, butane or isobutene (R600A), or natural substances such as ammonia or carbon dioxide, may also be used.

[0028] In an embodiment in accordance with the present invention, a heat pump or refrigerating system monitoring unit is provided wherein the at least one pressure sensor may be adapted to be fixed on and removed from a pressure measuring point on the system while venting considerably less fluid compared to conventional monitoring units. This may be achieved by providing sensor connection points, such as nipples, on which the sensor housing may be mounted preferably directly.

[0029] Alternatively, the at least one pressure sensor may be adapted to be permanently fixed on a pressure measuring point such that it is not needed anymore to disconnect the pressure sensor from the heat pump or refrigerating system. Such system may have an additional advantage when monitoring systems having pressure measuring points with limited or difficult access.

[0030] In accordance with the present invention, the at least one pressure sensor may be connected to a transmitting unit which receives the sensor's signal and transmits it wirelessly to the receiver unit. In this case the connection between the transmitter and the pressure sensor may be either wired or wireless. The latter may have an advantage when several pressure sensors at different pressure measuring points are installed. Alternatively, each pressure sensor may include its own wireless transmitting unit adapted for wireless communication with the receiving unit.

[0031] The wireless connection may be obtained by any type of wireless communication adapted to transfer measurement data from a pressure sensor or another sensor to a receiving unit, such as RF or IR communication.

[0032] In an embodiment of the present invention, the receiving unit may be portable and preferably handheld. Further, it may comprise a touch screen.

[0033] In accordance with the present invention, the receiving unit may comprise means for data storage. This may be fixed memory or a memory card. Further, it may comprise means communicating with a PC. The means may comprise plug-in, wired or wireless connections such as WiFi, Bluetooth, RF or IR.

[0034] Preferably, the receiving unit may comprise data presentation means. Even more preferably, it may comprise data analysis embedded software and data analysis presentation means to provide high quality data processing and analysis, independently of the field technician's skills.

[0035] In accordance with the present invention the heat pump or refrigerating system monitoring unit may further comprise at least one additional sensor, such that other thermo dynamical parameters than pressure may be measured. The additional sensor may be at least one temperature sensor and/or at least one humidity sensor, or a dry bulb, or wet bulb sensing unit. The at least one

additional sensor may be also wirelessly connected to the receiving unit.

EXAMPLE

[0036] Below an example of an embodiment in accordance with the present invention is described.

[0037] As illustrated in FIG 1, a heat pump or refrigerating system usually comprises a compressor (1), a condenser (2), a thermostatic expansion valve (3) and an evaporator (4).

[0038] Such system is monitored by a heat pump or refrigerating system monitoring unit in accordance with the present invention, including:

- a receiving unit (5) for receiving measurement data,
- a wireless low pressure sensor (6) between evaporator and compressor,
- a wireless high pressure sensor (7) between compressor and condenser
- and a wireless temperature sensor (8) for measuring the refrigerant temperature after condensing.

[0039] In the context of a more specific example, the monitoring unit comprises:

- one wireless low pressure sensor is in the range of - 1 up to 20 bar relative pressure with accuracy lower than 0,5% Full Scale,
- one wireless vacuum pressure sensor in the range of 0,0001 up to 1000 mbar absolute pressure.
- one wireless high pressure sensor in the range of 0 up to 50 bar relative pressure with accuracy lower than 0,5% Full Scale,
- two wireless temperature sensors in the range of -50 up to 150 °C with accuracy lower than 0,5 °C,

[0040] The wireless sensors are to be fixed on nipples provided on the heat pump or refrigerating system and communicate via an integrated transmitting unit to the receiving unit via wireless communication at an operating frequency of 868 MHz for Europe, and 915 MHz for USA. The communication protocol is developed by the applicant.

[0041] Each sensor is equipped with amplifying, stabilizing and digitalizing electronics, with field-calibration allowing calibration in the field, and with Li-Ion-polymer rechargeable batteries.

[0042] The receiving unit is a handheld console able to communicate with at least 10 sensors. It contains an analogue capacitive touch panel with integrated on/off button. The receiving unit further includes an USB connector for communication with a PC, a 1 GB SD card for data storage and firmware allowing data-analysis, calculations, troubleshooting , data plotting, data logging and report layout.

Claims

1. A heat pump or refrigerating system monitoring unit comprising:

a) a receiving unit for receiving measurement data,
b) at least one pressure sensor for measuring a pressure value of a fluid present in the heat pump or refrigerating system,

characterized in that the at least one pressure sensor communicates to the receiving unit via a wireless connection.

2. A heat pump or refrigerating system monitoring unit according to claim 1, wherein the fluid is a refrigerant.

3. A heat pump or refrigerating system monitoring unit according to claim 1 or 2, wherein the at least one pressure sensor is adapted to be permanently fixed on the heat pump or refrigerating system.

4. A heat pump or refrigerating system monitoring unit according to claim 1 or 3, wherein the pressure sensor is connected to a transmitting unit adapted for wireless communication with the receiving unit.

5. A heat pump or refrigerating system monitoring unit according to claim 1 or 3, wherein the pressure sensor includes a transmitting unit adapted for wireless communication with the receiving unit.

6. A heat pump or refrigerating system monitoring unit according to claims 1 to 5, wherein the receiving unit is portable.

7. A heat pump or refrigerating system monitoring unit according to claims 1 to 6, wherein the receiving unit is handheld.

8. A heat pump or refrigerating system monitoring unit according to claims 1 to 7, wherein the receiving unit comprises a touch screen.

9. A heat pump or refrigerating system monitoring unit according to claims 1 to 8, wherein the receiving unit comprises means for data storage.

10. A heat pump or refrigerating system monitoring unit according to claims 1 to 9, wherein the receiving unit comprises means for communicating with a PC.

11. A heat pump or refrigerating system monitoring unit according to claims 1 to 10, wherein the receiving unit comprises data presentation means.

12. A heat pump or refrigerating system monitoring unit

according to claims 1 to 11, wherein the receiving unit comprises data analysis software.

13. A heat pump or refrigerating system monitoring unit according to claims 1 to 12, wherein the receiving unit comprises data analysis presentation means.

14. A heat pump or refrigerating system monitoring unit according to any of the above claims further comprising at least one temperature sensor and/or at least one humidity sensor.

15. A heat pump or refrigerating system comprising a monitoring unit according to any of the above claims.

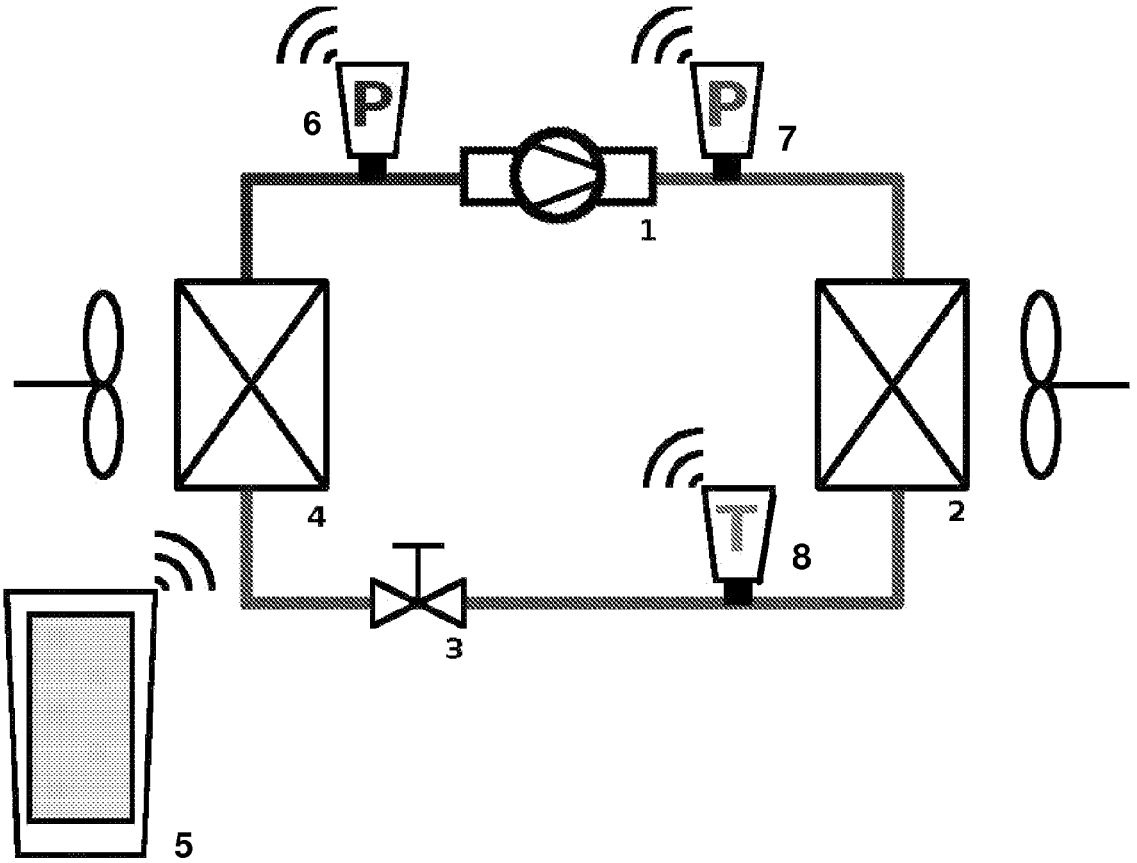

FIG 1

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 2577

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/066474 A1 (PORTER MICHAEL RAMEY [US] ET AL) 20 March 2008 (2008-03-20) * paragraph [0023] - paragraph [0024]; figures 1,3,5 *	1-15	INV. F25B49/00
X	US 2008/077260 A1 (PORTER MICHAEL RAMEY [US] ET AL) 27 March 2008 (2008-03-27) * the whole document *	1-15	
X	US 6 128 910 A (FAIRCLOTH JOHN E [US]) 10 October 2000 (2000-10-10) * column 5, line 42 - column 6, line 30 *	1	
X	US 2005/210899 A1 (MAIER ALBERT W [US] ET AL MAIER ALBERT W [US] ET AL) 29 September 2005 (2005-09-29) * the whole document *	1	
X	WO 2007/130769 A2 (PARKER HANNIFIN CORP [US]; DOLIN BRIAN J [US]) 15 November 2007 (2007-11-15) * the whole document *	1	TECHNICAL FIELDS SEARCHED (IPC) F25B
X	US 2006/179854 A1 (ESSLINGER STEVE [US]) 17 August 2006 (2006-08-17) * the whole document *	1	
A	US 2006/090484 A1 (BELL BRIAN D [US] ET AL) 4 May 2006 (2006-05-04) * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 April 2010	de Graaf, Jan Douwe

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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08-04-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008066474 A1	20-03-2008	NONE	
US 2008077260 A1	27-03-2008	NONE	
US 6128910 A	10-10-2000	NONE	
US 2005210899 A1	29-09-2005	AU 2005223023 A1	29-09-2005
		EP 1738116 A2	03-01-2007
		US 2008034771 A1	14-02-2008
		WO 2005089345 A2	29-09-2005
WO 2007130769 A2	15-11-2007	EP 2005081 A2	24-12-2008
		KR 20080111517 A	23-12-2008
		US 2010031681 A1	11-02-2010
US 2006179854 A1	17-08-2006	US 2006196224 A1	07-09-2006
US 2006090484 A1	04-05-2006	CA 2585761 A1	11-05-2006
		CN 101091093 A	19-12-2007
		US 2007205296 A1	06-09-2007
		WO 2006049919 A2	11-05-2006

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