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(71) Applicant *(for all designated States except US)*: **ABA OF SWEDEN AB** [SE/SE]; P.O. Box 100, S-334 00 Anderstorp (SE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **RYMAN, Morgan** [SE/SE]; Nygatan 11, S-334 33 Anderstorp (SE).

(74) Agent: **AWAPATENT AB**; P.O. Box 11394, S-404 28 Göteborg (SE).

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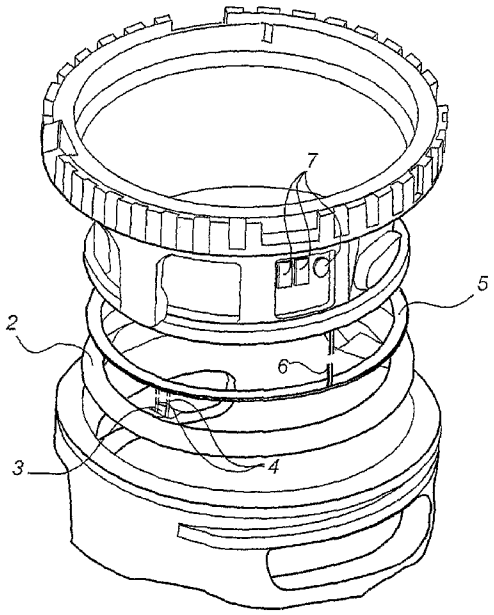
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(54) **Title:** A SYSTEM FOR WIRELESS TRANSMISSION OF MEASUREMENT RESULTS INTENDED TO BE USED IN A COUPLING DEVICE AND A USE OF THE SYSTEM IN A VEHICLE



(57) **Abstract:** A coupling device (1) for gas and liquid systems comprises a passive transponder and at least one sensor for measuring at least one quantity. The transponder is connected to the sensor and arranged to wirelessly transmit and receive data via communication protocols. Moreover the sensor is passive, connected to and integrated with the transponder, the sensor being activated with energy induced by the transponder. An independent claim is included for a use of a wireless transmission system in a vehicle.

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A system for wireless transmission of measurement results intended to be used in a coupling device and a use of the system in a vehicle.

Field of the Invention

The present invention relates to a coupling device for gas and liquid systems, comprising a passive transponder and at least one sensor for measuring one or more quantities, the transponder being connected to the sensor and arranged to wirelessly transmit and receive data via communication protocols.

Background Art

Such coupling devices are used in many applications, for example in vehicles, in fixed installations and in various types of machine constructions. In most cases, the sealing function of the coupling device is essential as are also reliability, price and handling aspects, including time required for mounting.

Furthermore, continuously increased demands are placed on engines as to, for example, performance, environmental influence and life. In order to satisfy these requirements, it is therefore necessary for the control systems to have the current status of flow rates, temperatures etc for gases and liquids in the engine. Such information in real time from different parts of an engine therefore makes it possible to optimise operation.

One example of wireless communication is disclosed in US 6,649,829 which uses RFID technology (RFID = radio frequency identification). The sensors in said document are, however, relatively expensive and beside require direct connection to a power source, such as a battery. The exchange of batteries involves an extra operation and thus causes inconvenience for the user.

RFID can be resembled to “electronic bar codes”, but with the difference that the RFID tag (RFID transponder) need not be visible for reading. An RFID system usually comprises readers with antenna and a data carrier with the unique code. As a rule, the data carrier is encapsulated to optimally fit the application. The most common encapsulating materials are different types of plastic; proximity to metal shields the product and greatly

affects the performance of the system. RFID systems are available with active and passive transponders.

An active transponder has a power source (battery) of its own to be able to perform reception and transmission, a common reading distance being about 10 m.

A passive RFID system can be described as a radio system for short distances. The transponder has no power source of its own but is operated with the power induced by the antenna. The reading distance is usually below 0.5 m. The reading distance is highly dependant on the output power of the reader, the antenna size in both reader and transponder and also the ambient conditions, where metal usually has a negative effect on performance.

Summary of the Invention

The object of the present invention therefore is to provide a coupling device, especially a quick coupling for gas and liquid systems, for a wireless signal system which compared to prior art is easier and less expensive both to produce and install and which requires less maintenance. By "quick coupling" is meant a coupling device which without complicated or time-consuming measures can be assembled and which comprises a locking function in the assembled state.

According to the invention, this object is achieved by the coupling device of the type stated by way of introduction being given the features that are defined in claim 1. Preferred embodiments of the coupling device are defined in the dependent claims.

The inventive coupling device, especially a quick coupling, for gas and liquid systems comprises a passive transponder and at least one sensor for measuring at least one quantity, the transponder being connected to the sensor and arranged to wirelessly transmit and receive data via communication protocols, wherein the sensor is passive and integrated with the transponder, and wherein the sensor is activated with energy induced by the transponder.

By "passive" is meant that the reading of the sensor occurs without supply of energy other than by said inducing.

By "integrated" is further meant that the parts constitute a non-dismountable unit. Furthermore "quick coupling" relates to a coupling device for connecting gas or liquid conduits which does not require any tools for mounting and is lockable in the assembled state.

There are fields of application for components of this type both in liquid-based cooling systems and gas-based turbo systems. An "intelligent" cooling system is adaptive and conducts the coolant to the position where it is currently needed, by electrically driven pumps and valve systems. The accuracy requirements placed on the sensor are "normal", but the environmental requirements are stringent, as are also the requirements as to life and freedom of maintenance. A gain that can be achieved is reduction of weight/-volume of the cooling system, which in turn may result in saving in costs in manufacture as well as in operation.

Sensors for turbo systems must have a significantly faster response time than cooling systems since the information is to be used to control the power output of the engine etc. In the worst operation situation, the sensors must also resist considerably higher temperatures. As for the rest, the requirements as to environment and life are equivalent to those of the liquid systems. The gains that can be expected with systems of this kind are improved engine performance and/or lower fuel consumption. Information on suitable quantities contains, for instance, pressure, temperature and flow rate.

Preferably, the coupling device comprises a processor/signal processing unit which most preferably is integrated with the sensor and the transponder.

In a variant of the invention, the sensor, or the sensor and the transponder are arranged in a sealing ring in the coupling device. This results in the advantage that a sensor can easily sense whether the connection between, for example, the female part and the male part is in its locked final position by using a pressure transducer. As an alternative, or in addition, it is possible to arrange a position-detecting sensor.

Pressures and temperatures can be measured by means of integrated sensor elements which are manufactured using what is referred to as the MEMS technology (Micro Electro Mechanical Systems). This technology has

obtained most process properties from production of integrated electronics, that is a technology involving high-definition patterns on silicon. A new property of the MEMS technology is the option of integrating entirely mechanical functional elements. In pressure sensors, thin membranes are used in combination with evacuated cavities as vacuum reference. The signals representing pressure, temperature, flow rate etc. can be provided either as a varying resistance (piezoresistive technology) or capacitance and require certain signal processing in order to allow handling in, for instance, a digital data communication system. The piezoresistive technology is the most common since it is advantageous in terms of immunity to noise and simpler circuitries, but the capacitive technology results in most cases in lower power consumption and can be used at higher temperatures. However, in most cases the encapsulation is the limiting factor to temperature resistance.

Preferably, two or more sensors are arranged in the coupling device. In most cases, values of flow rate, temperature and pressure are desired, but also other quantities can be involved.

The coupling device according to the present invention is preferably adjusted to a high frequency system. Low frequency systems LF (125 kHz), usually a standard in, for instance, access control systems, are used in difficult environments, metal etc. There are, however, only a few ISO standards for this frequency. A transponder antenna Ø50mm has typically about 500 turns, which in addition makes manufacture complicated. With prior art technique, the high frequency range HF (13.56 MHz) seems to be most appropriate for the present invention. This is partly due to the fact that there are two accepted standards, ISO 14443, standard for payment transactions using contactless technology, for instance public transports, and ISO 15693, standard for logistics but also applicable in most other fields since there are many types of chips according to this standard.

A transponder antenna Ø50mm for HF typically has about 10 turns, which means that manufacture is considerably easier than for low frequency products; for instance it is possible to etch antennas similar to printed cards. Ultrahigh frequency UHF (>400MHz) is relatively new in passive RFID

systems. The transponder usually has an etched dipole antenna which must be adjusted to the base to which it is to be applied.

There are many different types of chips in the different frequency bands, but the high frequency band currently tends to have the greatest assortment and variations according to the current standard.

If smaller antennas are used, one antenna for each measuring point, the need for readers with high output power is reduced. However, a polling function must be added for reading of all measuring points in a predetermined order and at correct intervals. At the time of positioning transponder and reader antennas, tests must be made to determine the output power of the reader units.

The present invention also relates to a wireless signal transmission system for vehicles, especially engine compartments, which comprises a coupling device as stated above.

The completed system is preferably integrated at several system levels:

1) Vehicle system level, communication preferably occurs "upwards"/ "outwards" via the CAN bus system. This provides the possibility of customising the system to individual vehicle manufacturers.

2) The central unit/reader is preferably placed in the engine compartment (for instance the underside of the bonnet). It is also possible to use a plurality of antenna coils when a plurality of connecting points/sensors are to be addressed individually without problems of crosstalk/interference. The central unit is preferably based on general hardware, but with exchangeable and customised software.

3) The transponder units are preferably made in several models (physical size, design, choice of measuring quantity). For example, they can be built on a flexible printed card laminate which also comprises the antenna coil, and which is moulded into the quick coupling.

4) Each sensor chip can be provided with an ASIC (Application Specific Integrated Circuit) for local processing of the sensor signals. This results in the advantage that the sensor signals need not be calibrated. The local micro processor of the transponder preferably is a standard IC, FPGA (Field Programmable Gate Array) or ASIC. It is also possible to combine a plurality of ASIC circuits to a single circuit for additional saving in costs, subject to increased complexity and a risk of lower production yield.

Brief Description of the Drawings

The invention will in the following be additionally described by way of example and with reference to the accompanying drawings.

Fig. 1a is a perspective view of a portion of a coupling device according to the present invention.

Fig. 1b is an exploded view of a coupling device according to the present invention.

Fig. 2 illustrates the fundamental construction of a system according to the present invention.

Fig. 2 is an example of a block diagram for the system according to the present invention.

Description of Preferred Embodiments

Fig. 1a illustrates a coupling device 1 with a sealing ring 2 with a sensor/transponder 3. Fig. 1b illustrates an alternative embodiment of a coupling device according to the present invention. Like in Fig. 1a, the coupling device comprises a transponder 3 and a sealing ring 2. In this embodiment, the sensor/transponder 3 is connected via a coupling 4 to an antenna coil 5. In the assembled state, the coupling 4 is not visible since the sensor/transponder 3 in this embodiment is in contact with the antenna coil 5. The coupling 4 is illustrated for simplified understanding. By means of the antenna coil 5, power is generated when a magnetic field is transmitted from a control unit (not shown). In another alternative embodiment, the antenna coil 5 is connected via a second coupling 6 to a unit 7 for external communication. Like in the case of the coupling 4 above, the coupling 6 is in

this embodiment not visible in the assembled state. In an alternative embodiment, the sensor is the unit that is arranged adjacent the sealing ring, that is the unit designated 3. In this case the transponder is the unit designated 7.

Fig. 2 illustrates schematically the construction of the intended system. The sensor or the transponder is applied to or in embedded in the quick coupling and/or sealing ring and contains sensor chips for measuring temperature and pressure, one or more electronic chips for signal processing and data communication, and an antenna receiving radio waves from a larger antenna connected to a central unit, from which all control and checking of data communications occur. Also power transmission occurs via the same central unit. In addition to, for instance, measuring of pressure and temperature, the sensor should also provide position indication for the snap locking of the quick coupling.

Fig. 3 is a fundamental block diagram of the system according to an embodiment of the present invention. The sensors for pressure and temperature, snap locking and optionally flow rate supply measuring signals to a microprocessor on the transponder side. This microprocessor is a "slave" to the processor of the central unit which supplies commands and controls the data communication to the transponder.

The different blocks in Fig. 3 have the following functions: the blocks "temp"., "pressure", "flow", "snap-in pos" indicate sensors for the respective measuring quantities as has been generally described above. The signals from the respective sensors are digitised by analogue/digital converters which according to prior art are often integrated in the block marked "µP" and indicate a general microprocessor according to prior art.

The microprocessor has the capacity of performing sequential, logic and arithmetic operations, and is controlled by a program stored in an integrated storage unit which allows both temporary and permanent storage of information. Output information from the microprocessor controls a switch which is directly connected to the antenna coil of the transponder (indicated as an upward arrow in the figure). The switch can also be used to receive pulsed information via the antenna. Furthermore the transponder part

comprises an electronic circuit for power management. This circuit controls feed power to, inter alia, the sensors and the microprocessor and supplies signals if, for instance, the feed power is insufficient.

The microprocessor, the switch and the circuit for power management can preferably be integrated on one and the same chip and need not have physical dimensions greater than a square millimetre. The cost of manufacture will then be extremely low since thousands of units can be manufactured in parallel.

The central unit also comprises a microprocessor indicated "μP" in Fig. 3 having a considerably larger capacity than the one in the transponder part since the central unit is the main control unit of the system and in the normal case is to manage handling of a plurality of transponders.

The unit "X" is a buffer stage to a switch which in turn is connected to the antenna coil (indicated as an upward arrow). The buffer stage allows supplying the antenna coil with radio frequency signals of relatively high power in order to manage reasonable reading distances to the transponder part.

The switch makes it possible to control serial digital information transmission from the central unit to the transponder part, for instance, by switching between two power levels. The switch can also be used to reverse the flow of information. When the antenna coil of the transponder is switched between low and high impedence states, this can be detected as a wirelessly transmitted load change in the antenna coil of the central unit.

Protocols for this communication are available either as a freely available standard or in the form of licensed software products which are sold together with the processor chips. Many leading semiconductor manufacturers are selling such products. The central unit is driven by the accumulators of the vehicle, currently in most cases 12V DC, which will probably be increased to 48 V within the next few years. Data communication with other vehicle units usually occurs via a CAN bus, which is an established standard for data communication in the field of vehicles.

An example of a specification of requirements for two examples of fields of application is to be found in the table below:

	Liquid system	Turbo system
Temperature range	-40 °C – +150 °C	-40 °C – +260 °C
Pressure	0 - 0.5 MPa	0 – 0.5 MPa
Accuracy	± 1% of the measuring range	± 1% of the measuring range
Response time	20-30 s	<1 s
Maintenance	Maintenance free	Maintenance free
Life	> that of the vehicle	> that of the vehicle
Inner diameter	8-60 mm	35-100 mm

One way of measuring the flow rate is using information from two or more pressure or temperature sensors in the inlet and the outlet, respectively, of a conduit with a known flow resistance.

It will be appreciated that many modifications of the above described embodiments of the invention are conceivable within the scope of the invention, as defined by the appended claims.

CLAIMS

1. A coupling device (1) for gas and liquid systems, comprising a passive transponder and at least one sensor for measuring at least one quantity, the transponder being connected to the sensor and arranged to wirelessly transmit and receive data via communication protocols, c h a r a c t e r i s e d in that the sensor is passive, connected to and integrated with the transponder, the sensor being activated with energy induced by the transponder.

2. A coupling device (1) as claimed in claim 1, which also comprises a processor/signal processing unit.

3. A coupling device (1) as claimed in claim 2, in which said processor/signal processing unit is integrated with the sensor and the transponder.

4. A coupling device (1) as claimed in any one of claims 1-3, in which the sensor and the transponder are arranged in a sealing ring (2) in the coupling device.

5. A coupling device (1) as claimed in any one of claims 1-4, which is a quick coupling.

6. A coupling device (1) as claimed in any one of claims 1-5, which is adapted to a high frequency system.

7. A wireless signal transmission system for vehicles, especially engine compartments, which comprises a coupling device (1) as claimed in any one of claims 1-6.

8. A wireless signal transmission system as claimed in claim 8, which comprises a microprocessor.

9. A wireless signal transmission system as claimed in claim 7 or 8, which comprises an antenna.

10. A wireless signal transfer system as claimed in any one of claims 7-9, which comprises an antenna and a microprocessor in a unit, which unit is arranged to communicate wirelessly with the coupling device (1).

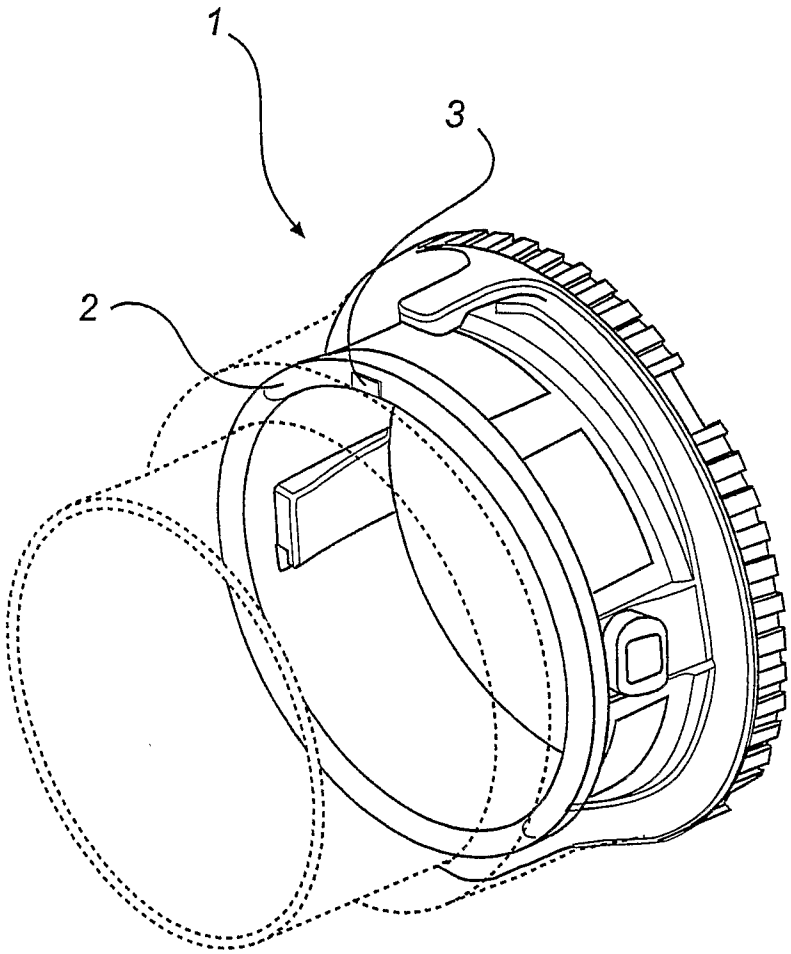


Fig. 1a

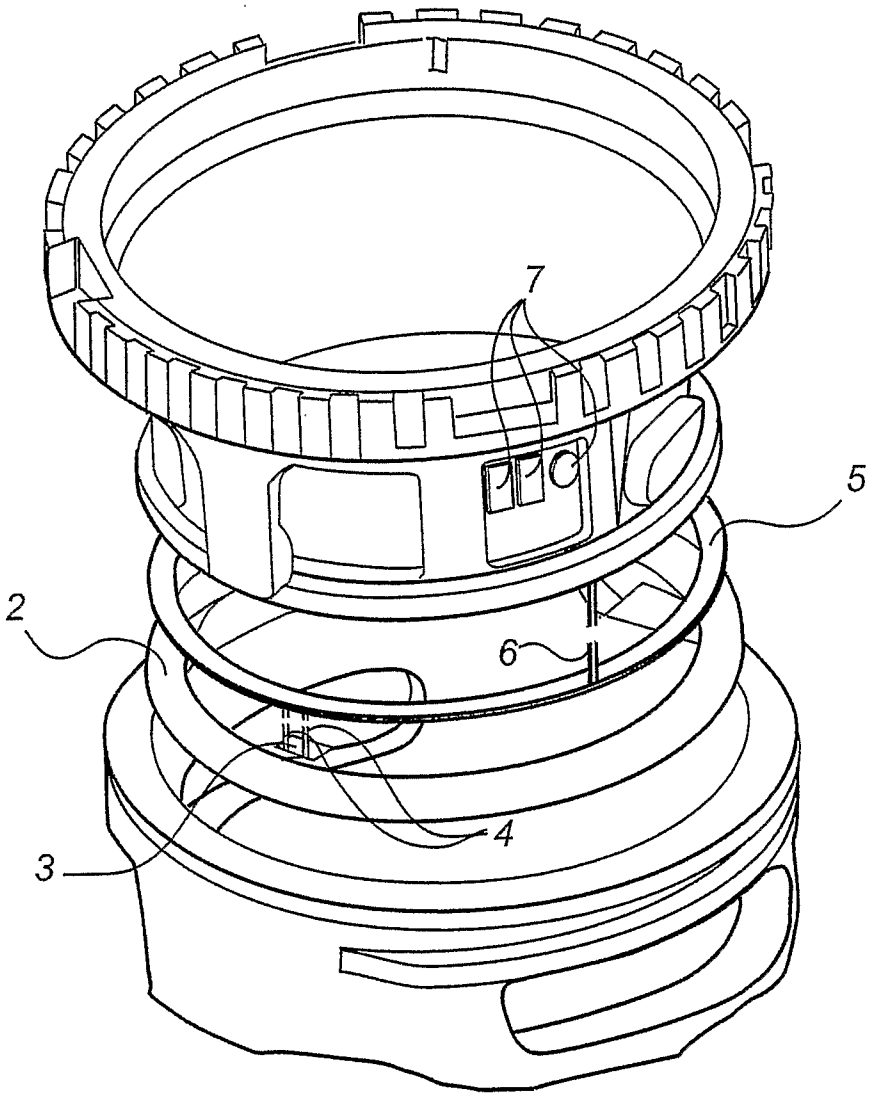


Fig. 1b

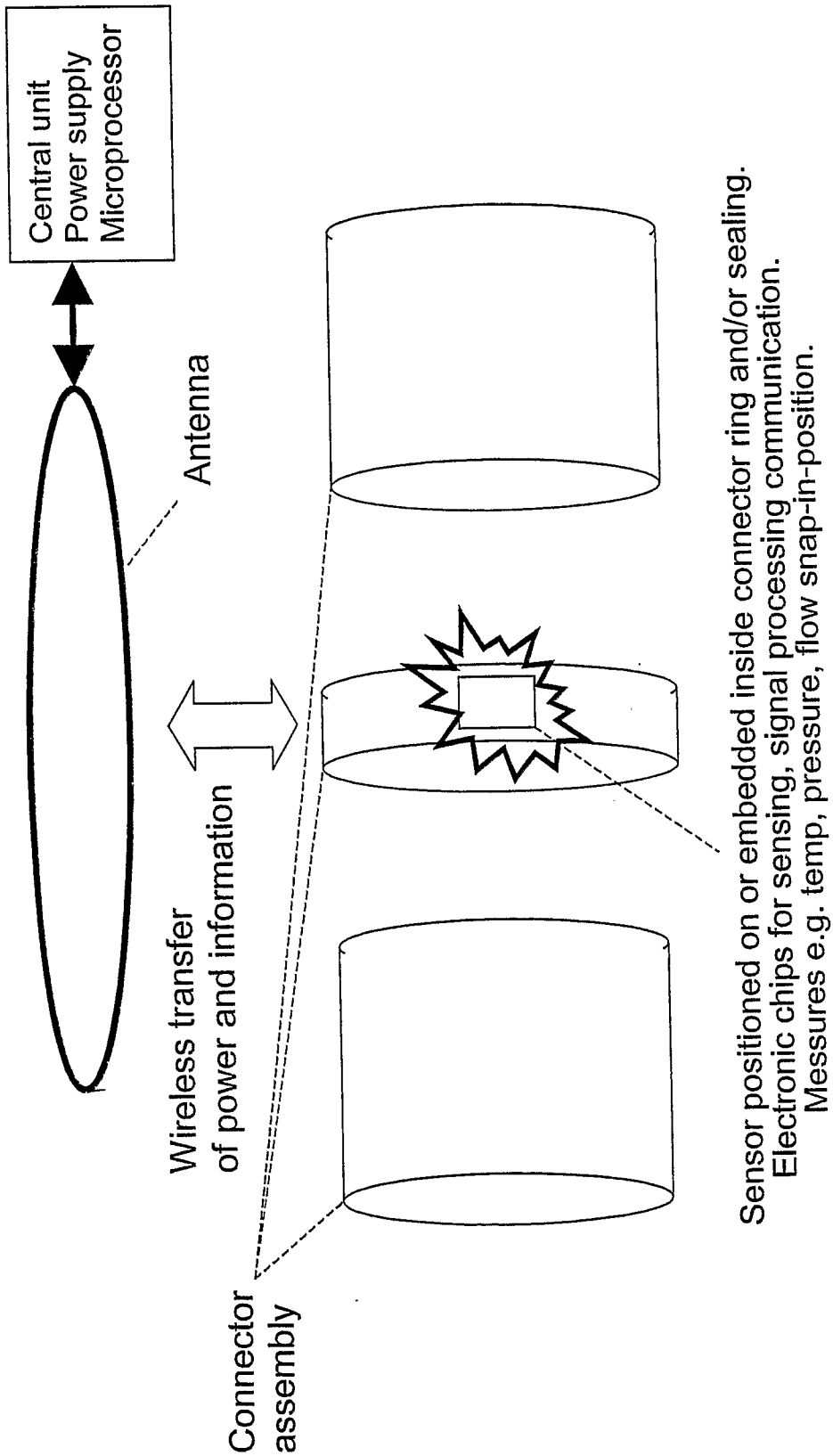

Central unit
Power supply
Microprocessor
Antenna
Wireless transfer
of power and information
Connector
assembly
Sensor positioned on or embedded inside connector ring and/or sealing.
Electronic chips for sensing, signal processing communication.
Messures e.g. temp, pressure, flow snap-in-position.

Fig. 2

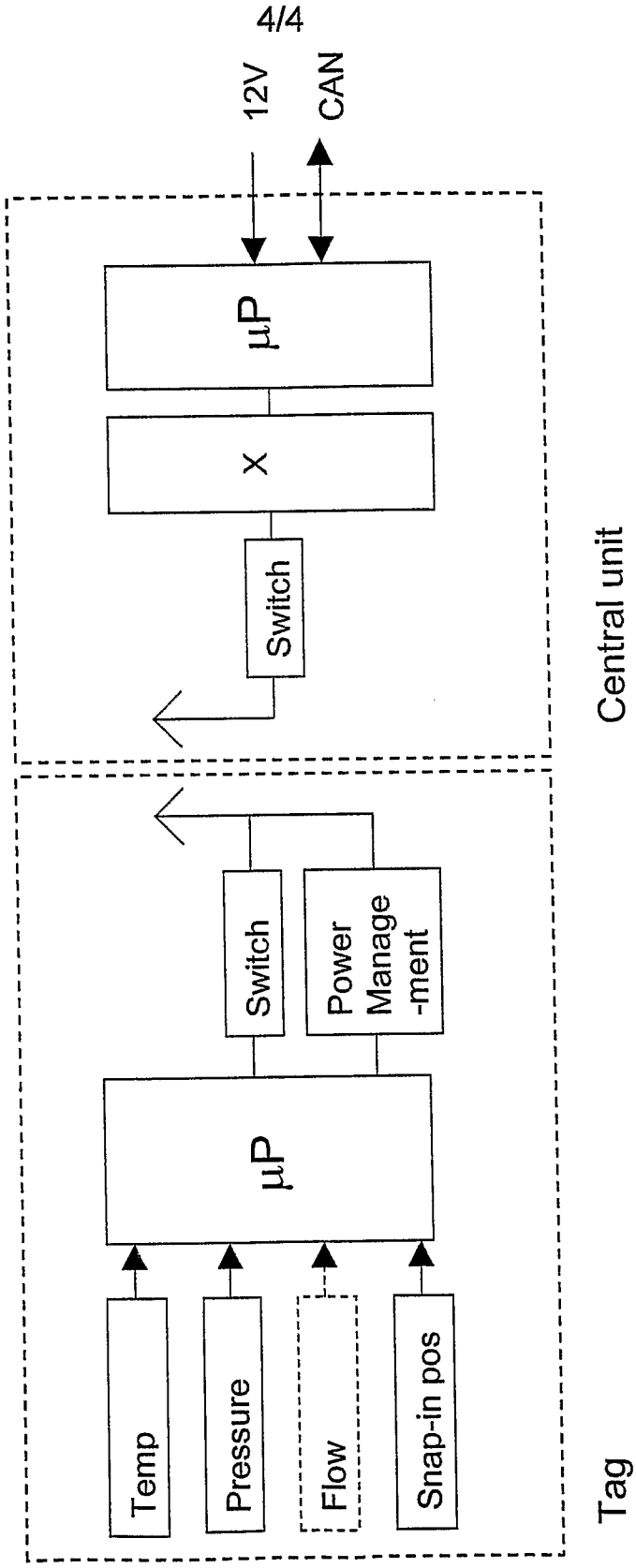

12V
CAN
µP
X
Switch
Central unit
Switch
Power Manage -ment
µP
Temp
Pressure
Flow
Snap-in pos
Tag

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B67D, F16L, G08C, B60K, G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	WO 02073523 A1 (IP AND INNOVATION COMPANY HOLDINGS (PROPRIETARY) LTD), 19 Sept 2002 (19.09.2002), page 5, line 3 - line 4; page 8, line 22 - page 9, line 14; page 12, line 6 - line 9, abstract, column 13, line 15 - line 20	1-10
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 Sept 2007	03-09-2007
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000434

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

A coupling device (1) for gas and liquid systems comprises a passive transponder and at least one sensor for measuring at least one quantity. The transponder is connected to the sensor and arranged to wirelessly transmit and receive data via communication protocols. Moreover the sensor is passive, connected to and integrated with the transponder, the sensor being activated with energy induced by the transponder. An independent claim is included for a use of a wireless transmission system in a vehicle.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000434

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International patent classification (IPC)

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G08C 17/02 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

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WO	2004014009	A2	12/02/2004	AU	2003261345	A	23/02/2004
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