(19) DANMARK

(10) **DK/EP 2779019 T3**

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *G 06 K 7/10 (2006.01)* *G 02 B 6/38 (2006.01)* *H 01 R 9/24 (2006.01)*
H 04 Q 1/02 (2006.01)

(45) Oversættelsen bekendtgjort den: **2017-03-27**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2016-12-21**

(86) Europæisk ansøgning nr.: **13158758.6**

(86) Europæisk indleveringsdag: **2013-03-12**

(87) Den europæiske ansøgnings publiceringsdag: **2014-09-17**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **System og fremgangsmåde til bestemmelse af forbindelsestilstanden mellem mindst to systemapparater, som er placeret på forskellige steder.**

(56) Fremdragne publikationer:
EP-A1- 2 333 691
US-A1- 2010 098 425

Description

[0001] The invention relates to a connection line for transmitting data, energy and fluids between two system devices arranged in different locations according to the preamble of claim 1.

[0002] The invention also relates to a system and to a method for determining the state of a connection between at least two system devices arranged in different locations according to the preamble of claims 8 and 11.

[0003] Reference is made to EP 2 333 691 A1, from which a system for locating an object by means of an RFID transponder system is known, in which an RFID reader is arranged at a first location and a transponder is located at a second location. A first antenna is associated with the RFID reader and a second antenna assembly is located in spatial proximity to the RFID transponder, the antenna assemblies being interconnected via an electrical line connection. In this case, the RFID transponder is read by the RFID transponder signal being received at the remote second antenna, the signal being transferred via the line connection to the first antenna and this signal being received by the first antenna at the RFID reader. If the antenna assemblies are arranged at the ends of data cables, remote RFID transponders contained in a remote system device can be identified and located in this manner in order to allow remote reading of an allocation of sockets of system or terminal devices in a cable management system.

[0004] EP 1 837 798 A2 discloses an RFID antenna bridge system, in which a first antenna is arranged in proximity to a tag and the signal received by the antenna is transmitted to a second antenna via a cable connection, with which antenna a reader is associated. The detection distance for reading a tag can thereby be increased significantly.

[0005] The system disclosed in EP 2 333 691 A1 uses data cables which correspond to conventional data cables. Although the system can detect the presence of a remote transponder, it cannot detect whether the data connection has been successfully established. In addition, it cannot be determined whether the data cable used meets the necessary data transmission security requirements.

[0006] Proceeding from EP 2 333 691 A1, the problem addressed by the present invention is that of providing a connection line which is suitable for transmitting data, energy or fluids between two system devices arranged in different locations

and which can be used in a system that can analyse the properties and the connection state of the connection line.

[0007] The invention also relates to a system which is suitable for determining the state of a connection between at least two system devices arranged in different locations and provides for an analysis of the nature and connection state of the connection line which is used.

[0008] The invention lastly relates to a method which is suitable for determining the state of a connection between at least two system devices arranged in different locations.

[0009] Proceeding from the respective preambles, the problems are solved by the invention disclosed in claims 1, 5 and 11. Advantageous embodiments of the invention are disclosed in the dependent claims.

[0010] In the system according to the invention, at least one of the coupling elements of the connection line between the system devices is provided with an RFID cable transponder, of which the data stored therein regarding physical properties of the connection line can be read and analysed by an RFID reader on another of the system devices.

[0011] In this case, the cable transponder associated with the coupling element is located in proximity to an antenna assembly of the relevant end of the connection line, and therefore the cable transponder can be read by the associated antenna assembly. The information collected by the antenna assembly can be transmitted between the antenna assemblies via the line connection and read and analysed on the RFID reader when the cable transponder is located at the remote end of the line connection. If the cable transponder is arranged at the end of the connection line that is associated with the RFID reader, the reading takes place by means of the antenna which is directly associated with the RFID reader, or directly by the RFID reader insofar as the spatial arrangement between the cable transponder and the RFID reader is sufficiently close.

[0012] The cable transponder contains data regarding physical properties of the connection line. In the case of an electrical cable, these physical properties may be, for example, attenuation, cable length, shielding properties, number of conductors, manufacturer's specifications, identification numbers, manufacturing data

and the like. In the case of a fibre optic cable, the degree of attenuation, spectral properties of the cable, transmission performance, permissible transmission speed and other data may be included in the information to be transmitted.

[0013] The invention is not, however, limited to data transmission applications, but can also be used in other types of connection lines, such as power cables, and also hoses, in particular hydraulic hoses or fluid hoses, it being possible to use the invention in particular in connection lines which only temporarily interconnect two coupling points. In addition to the use in a cable management system, in which a plurality of ports are each intended to be flexibly interconnected via a cable connection, the invention can also be used, for example, for coupling fluid lines between holding and dispensing tanks or, in mechanical engineering, for flexibly coupling hydraulic or pneumatic lines in machines.

[0014] Cable management is to be understood not only to mean the management of electrical or optical cables and the association thereof with terminal elements in system devices, but also the management and proper connection of pneumatic or hydraulic hoses.

[0015] The essential elements of the invention are at least two system devices arranged in different locations which are intended to be interconnected via a connection line, an RFID reader in one of the system devices and an RFID transponder in another system device, an electrical line connection associated with the connection line for electrically coupling antennae which are arranged at the ends of the connection line and which are in spatial proximity to the RFID reader or the RFID transponder in each case, as well as a cable transponder which contains data regarding the properties of the connection line and can also be read by one of the antenna assemblies.

[0016] A connection line according to the invention is characterised in that at least one of the coupling elements thereof is provided with an RFID cable transponder located in radio range of one of the antenna assemblies on a line connection associated with the connection line. The data stored in the cable transponder can be read by means of one of the antenna assemblies. The properties of the connection line are thus transmitted to the RFID reader, these properties being physical properties of the connection line which are relevant to the use of the connection line. In the case of a data cable, it can, for example, be quickly determined whether a cable which is intended to be used has the required transmission

properties. In the case of a hydraulic line, it can, for example, be quickly determined whether the line can comply with the given hydraulic pressures and volumetric flow rates.

[0017] The invention can also be used for connection lines which are designed as Y-shaped lines. In many cases, it is sufficient for a cable transponder to be arranged on one leg of the Y-end of the cable. In other applications, both legs can also each be provided with a selectively identifiable cable transponder if differentiation between the coupling elements is required.

[0018] Preferably, the cable transponder is located on a circuit board, which also contains the antenna assembly, on one of the coupling elements. A circuit board of this type can either be flanged directly onto the coupling element or in the immediate proximity thereto, e.g. by means of a clip connection, or it can also be bonded to the coupling element or integrated therein. What is important is that the antenna assembly is both able to read the cable transponder and capable of reading the content of the RFID transponder arranged in the system device in question.

[0019] The use of a cable transponder not only allows the line connection in question to be identified, but it also allows the connection state of the connection line to be analysed. According to the method according to the invention, the data received at the RFID reader is used to determine whether, in addition to the data received from the RFID cable transponder, additional data can be received from an RFID transponder of a remote second system device, if the cable transponder is located at the second end of the connection line which is remote from the RFID reader. If, in this manner, it is determined that data is only received from the cable transponder, and not from the RFID transponder in the second system device, this results in the statement that the corresponding coupling element is either inserted in a defective port or a port which is not associated with an RFID transponder. If the RFID cable transponders of the second system device which are associated with the individual ports are suitably coded, it can be easily determined thereby whether the coupling element is inserted in the "correct" port.

[0020] It can of course also be determined whether the remote coupling element is actually inserted in a port or whether it is exposed.

[0021] In a second embodiment of the invention, in which the cable transponder is located at the end of the connection line, the coupling element of which is inserted in a port on the first system device containing the RFID reader, it can likewise be determined whether the coupling element at the other end of the connection line is inserted in a terminal port or whether the "correct" port is used. The connection line used can therefore be used in alternating terminal directions insofar as the corresponding coupling elements are identical. It is also possible to use cable transponders at both ends of the cable if this is desirable in order to distinguish the coupling elements. Since, however, the antenna assemblies in this case collect data from both cable transponders, the distinction between the two can only take place if the reading takes place in a different way, e.g. by using different transmission frequencies of the cable transponders or by the cable transponders having other, different identification elements or contents.

[0022] The invention is described in greater detail in the following with reference to an embodiment. In the drawings:

Fig. 1a, b is a schematic view of the invention, in which the cable transponder is located either on the remote system device or in proximity to the RFID reader, both the RFID transponder and the cable transponder being capable of being read,

Fig. 2a, b shows a corresponding arrangement, in which the RFID transponder in the second system device cannot be read, and

Fig. 3a, b shows a connection, in which the first system device is decoupled from the connection line.

[0023] In the arrangement shown in Fig. 1, a first system device 1 and a second system device 2 are interconnected via a connection line 3. An electrical line connection 4 is associated with the connection line 3, in parallel, which line connection contains two antenna assemblies 5 and 6 at the ends thereof, which assemblies are in spatial proximity to an RFID reader 7 or an RFID transponder 8. The RFID reader has a reading antenna 9 which can communicate with the antenna 5.

[0024] In Fig. 1a, a cable transponder 10 is arranged at the end of the connection line 3 that is coupled to the second system device 2. The analysis of the state of the connection on the RFID reader 7 shows that data is received both from the

remote RFID transponder 8 and the cable transponder 10. This shows that the coupling connection on the remote second system device 2 is "correctly" inserted and, in addition, that a corresponding coupling connection exists on the first system device. The RFID reader 7 therefore reads data from both the remote RFID transponder 8 and from the cable transponder 10.

[0025] In Fig. 1b, the RFID reader 7 likewise reads data from the remote RFID transponder 8 and the cable transponder 11, the cable transponder 11 in this case being located in the vicinity of the RFID reader 7 or the antenna 5.

[0026] Fig. 2a shows the case in which the connection cable 3 is not or is not correctly connected to the second system device 2. The RFID reader 7 can only receive data from the cable transponder 10, but not from the RFID transponder 8, and therefore it can be assumed that there is a coupling defect. Accordingly, the RFID reader 7 according to Fig. 2b reads data from the cable transponder 11, which is located in the vicinity of the RFID reader 7, but does not read data from the RFID transponder 8 in the remote system device 2.

[0027] In the case according to Fig. 3, in which the connection line 3 is separated from the first system device 1, the RFID reader 7 does not read data from the cable transponders 10 or 11 either in the case of Fig. 3a or in the case of Fig. 3b. Owing to the defective coupling connection, the RFID transponder 8 of the second system device 2 also cannot be read in this case, irrespective of whether the corresponding coupling connection is "correctly" set up.

[0028] It is therefore particularly important to initially establish a "correct" association of the connection line 3 with the terminal on which the RFID reader 7 is arranged.

[0029] The electrical line connection 4 can be associated with the line connection 3 in a fixed manner, the cable transponders 10 or 11 being inserted in the respective coupling elements in a preferably fixed manner, in particular on a printed circuit board embedded in the connector, or they can also be produced separately from the cable and subsequently connected to the cable, e.g. by clamped connections, the ends of the line connection 4 being connected to the coupling elements by latching elements. The latter embodiment can preferably be used for optical cables, since producing optical cables and electrical line connections at the same time is problematic in terms of production techniques.

Reference numerals

[0030]

1	first system device
2	second system device
3	connection line
4	line connection
5	first antenna
6	second antenna
7	RFID reader
8	RFID transponder
9	reading antenna
10	cable transponder
11	cable transponder

PATENTKRAV

1. Forbindelsesledning til transmission af data, energi eller fluida mellem to systemapparater (1, 2), der er placeret på forskellige steder, hvorved de respektive ender af forbindelsesledningen (3) er forsynet med koblingselementer for forbindelse til terminalelementer i systemapparaterne (1, 2), og som er udstyret med RFID-læsere (7), henholdsvis transpondere (8), og koblingselementerne for forbindelsesledningen (3) hvert er forsynet med én elektrisk antenneanordning (5, 6), hvilke anordninger er koblet til hinanden ved hjælp af en elektrisk ledningsforbindelse (4), som er forbundet til forbindelsesledningen (3), og hvorved i det mindste et af koblingselementerne desuden er forsynet med en RFID-kabeltransponder (10, 11), som befinder sig inden for radiosignal-rækkevidden for en af antenneanordningerne (5, 6),
k e n d e t e g n e t v e d , at RFID-kabeltransponderen (10, 11) indeholder lagrede data vedrørende fysiske egenskaber hos forbindelsesledningen.

2. Forbindelsesledning ifølge krav 1, og som er udstyret med et første koblingselement for forbindelse til et første systemapparat (1), der er udstyret med en RFID-laser (7), hvilken forbindelsesledning er udformet som en Y-formet forgreningsledning, på hvis i det mindste ene bens ende der er tilvejebragt et koblingselement, som er udstyret med en kabeltransponder med henblik på forbindelse til et systemapparat.

3. Forbindelsesledning ifølge enten krav 1 eller krav 2,
k e n d e t e g n e t v e d , at kabeltransponderne (10, 11) befinder sig på en kredsløbsplade på et af koblingselementerne, som desuden er udstyret med en af antenneanordningerne (5, 6).

4. Forbindelsesledning ifølge enten krav 1 eller krav 2, udformet som et skærmet elektrisk datakabel.

5. Forbindelsesledning ifølge enten krav 1 eller krav 2, udformet som et lysleder kabel.

6. Forbindelsesledning ifølge enten krav 1 eller krav 2, udformet som et elektrisk kabel.

7. Forbindelsesledning ifølge enten krav 1 eller krav 2, udformet som en slange- eller rørledning.

8. System til bestemmelse af tilstanden for en forbindelse mellem i det mindste to systemapparater (1, 2), der er placeret på forskellige steder, og som kan forbindes ved hjælp af en forbindelsesledning (3) ifølge krav 1 med henblik på at transmittere data, energi eller fluida, hvorved en RFID-læser (7) er anbragt på en første (1) af de mindst to systemapparater, og en RFID-transponder (8) er anbragt på et andet (2) af systemapparaterne, hvorved de lagrede data kan analyseres ved hjælp af en RFID-læser (7) på et af systemapparaterne (1).

9. System ifølge krav 8,
k e n d e t e g n e t v e d , at dataene på RFID-kabeltransponderen (10, 11) kan transmitteres til en RFID-læser (7) ved hjælp af en af antenneanordningerne (5, 6) på forbindelsesledningen (3).

10. System ifølge krav 9,
k e n d e t e g n e t v e d , at RFID-kabeltransponderen (10, 11) er fastgjort til forbindelsesledningen (3) rumligt nær ved en antenneanordning (5, 6).

11. Fremgangsmåde til bestemmelse af tilstanden for en forbindelse mellem i det mindste to systemapparater (1, 2), der er placeret på forskellige steder, ved hjælp af et system ifølge krav 8, hvorved, når et koblingselement på forbindelsesledningens (3) første ende er blevet forbundet til et terminalelement på et første systemapparat (1), der er forsynet med en RFID-læser (7),

a) hvis en RFID-kabeltransponder (10) befinder sig i den anden ende af forbindelsesledningen (3) modsat det første systemapparat (1), det ved analyse af data, som modtages på RFID-læseren (7), konstateres, om eller ikke yderligere data fra en RFID-transponder (8) i et apparat (2) i et distalt, andet system opsamles ud over dataene, der opsamles fra RFID-kabeltransponderen (10), eller

b) hvis en RFID-kabeltransponder (11) befinder sig i den første ende af forbindelsesledningen (3), der er forbundet til det første systemapparat (1), det ved analyse af data, som modtages i RFID-laseren (7), konstateres, om eller ikke data fra en RFID-transponder (8) i et distalt systemapparat er blevet opsamlet,
hvorved arten af forbindelsestilstanden mellem systemapparaterne fastslås ved analyse af dataene, der opsamles af RFID-læseren (7).

12. Fremgangsmåde ifølge krav 11,
k e n d e t e g n e t v e d , at RFID-læseren (7) ydermere bestemmer og analyserer indholdet af data, der er lagret i det andet systemapparats (2) RFID-transponder (8) og/eller i kabeltransponderen (10, 11).

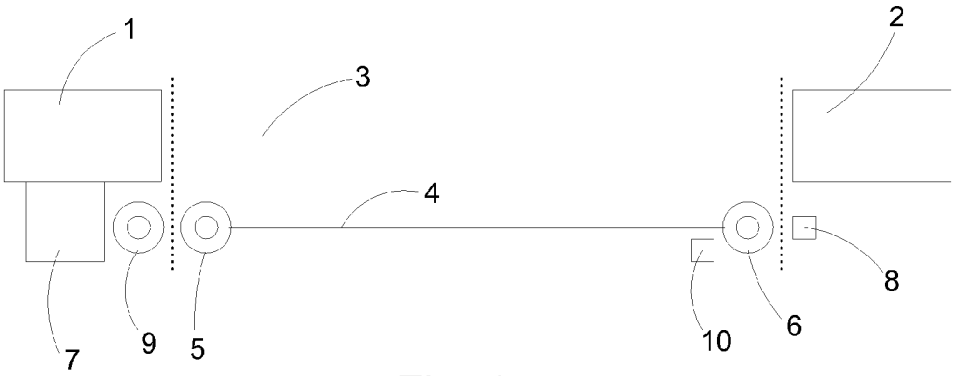

Fig. 1a

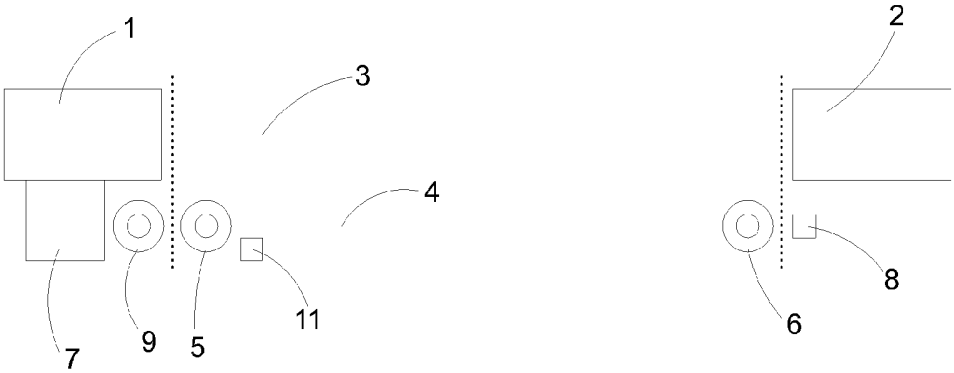

Fig. 1b

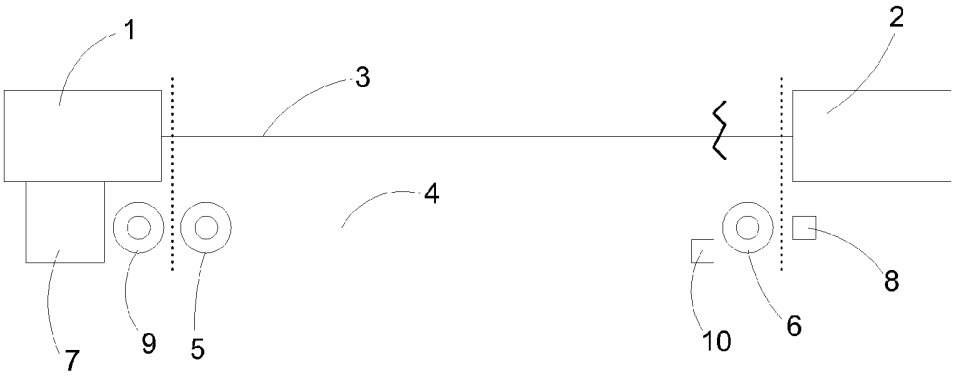

Fig. 2a

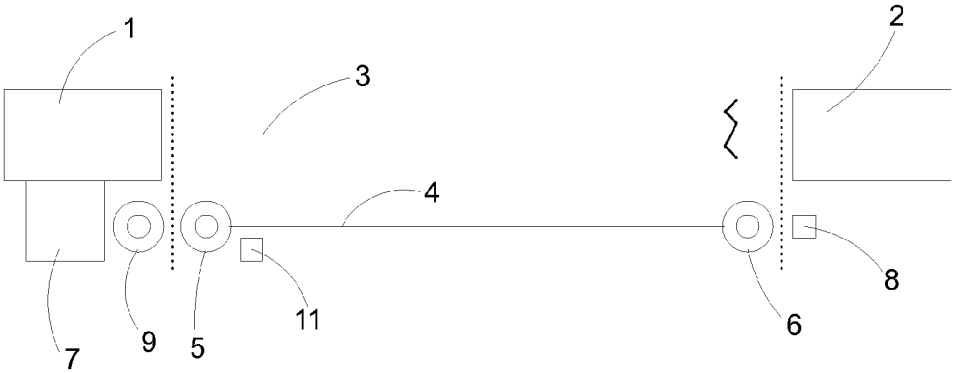

Fig. 2b

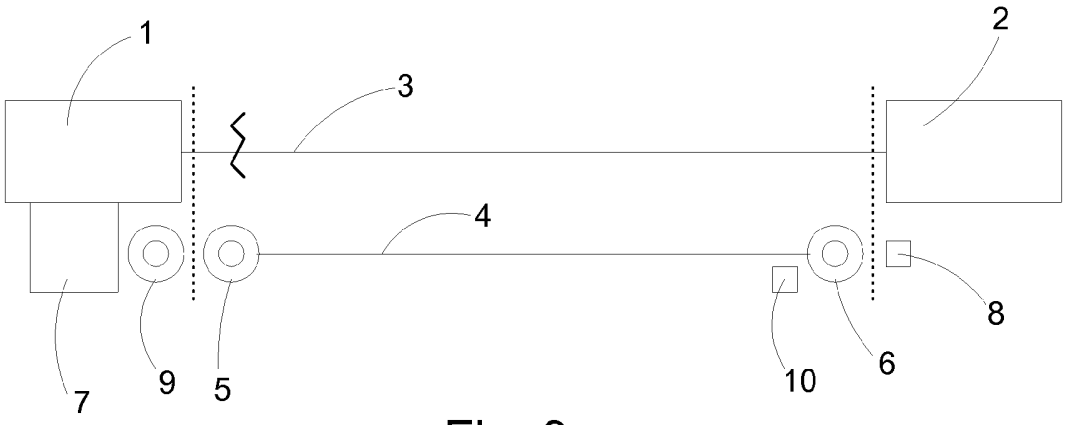

Fig. 3a

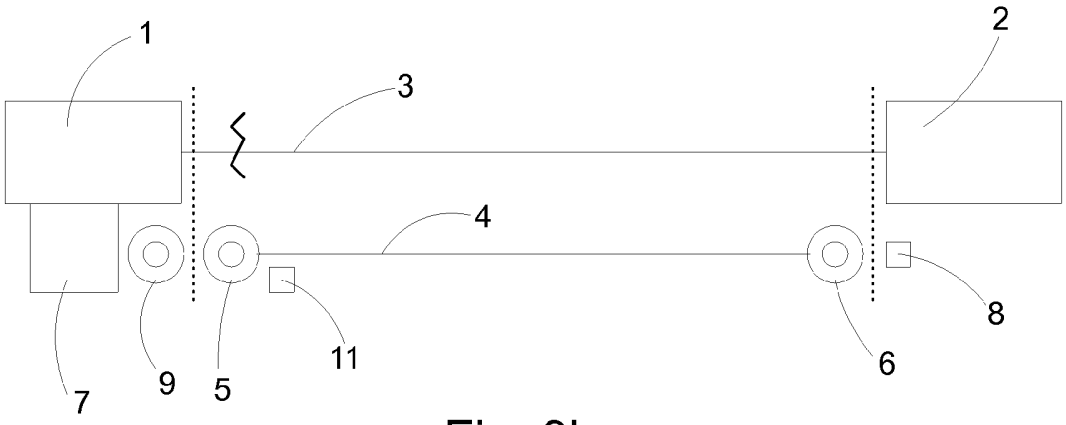

Fig. 3b