



EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.10.2020 Bulletin 2020/43

(51) Int Cl.:
G07B 15/00 (2011.01)

(21) Application number: **19169640.0**

(22) Date of filing: **16.04.2019**

(84) Designated Contracting States:
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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **A METHOD FOR DETERMINING A LOCATION WITHIN A TRANSPORTATION VEHICLE WHICH IS OCCUPIED BY AN AUTHORIZED PASSENGER**

(57) A method for determining at least one location within a transportation vehicle which is occupied by an authorized passenger, a system implementing a such

method, a corresponding program and a corresponding computer readable medium.

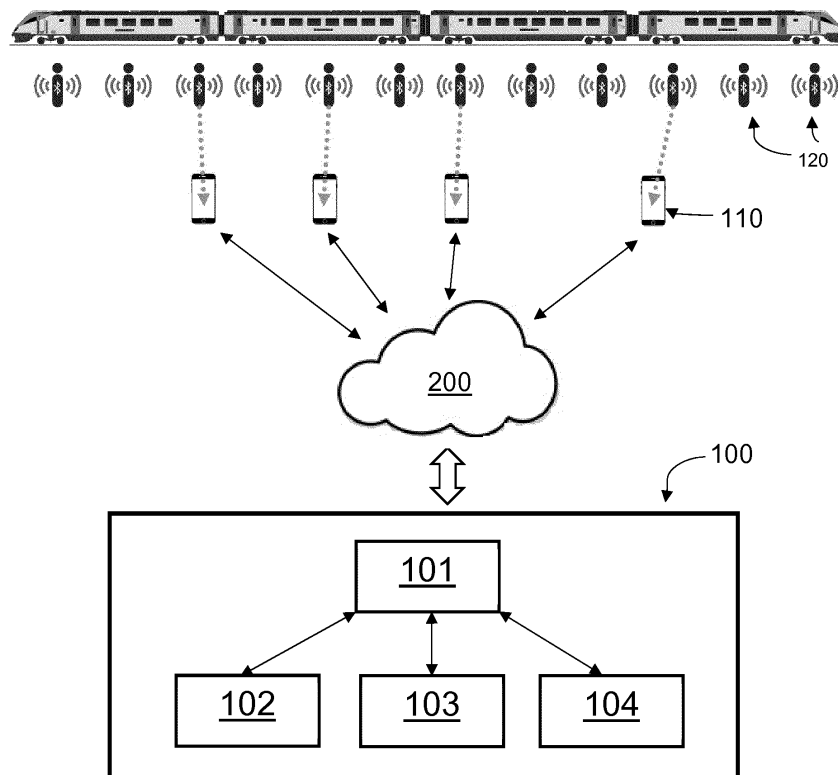


Figure 1

Description

Field of the invention

[0001] The present invention pertains to the field of methods and systems for facilitating passengers' management procedures in public transport infrastructures operating transportation vehicles such as buses, trains, aircrafts or vessels. The invention concerns especially a method for determining at least one location within a transportation vehicle which is occupied by an authorized passenger.

Background of the invention

[0002] Nowadays, most railway companies have implemented computer systems for facilitating passengers' management procedures that interact with applications which may be downloaded and executed by mobile devices such as smartphones. Usually, through such applications passengers can purchase tickets, travel information may be gathered and other functionalities targeting passengers' satisfaction enhancement may be provided. Amongst those functionalities designed to enhance passengers' satisfaction, most applications provide electronic tickets storage functionalities in order to facilitate electronic tickets checking procedures.

[0003] However, generally, electronic tickets checking procedures that are implemented in relation to those functionalities still rely on controllers and regular tickets checking procedures, i.e. procedures during which each and every passenger is at some point approached by a controller. In consequence, some passengers may feel bothered by such tickets checking procedures. Moreover, the time spent by controllers on performing electronic tickets checking procedures, a time that could be spent on performing other useful tasks (e.g. security checks), is in no way minimized. Therefore, such systems are neither efficient for enhancing passengers' satisfaction nor for minimizing the time spent by controllers on performing electronic tickets checking procedures.

[0004] In an attempt to overcome these disadvantages, some public transport infrastructures' operators have implemented computer systems enabling electronic tickets checking procedures to be performed by means of ticket barriers arranged at stations. However, since ticket barriers are expensive, such systems thus imply significative deployment costs.

Summary of the invention

[0005] Accordingly, the goal of the invention is to remedy these disadvantages. Specifically, the goal of the invention is to provide a method and a system that facilitate electronic tickets checking procedures so that authorized passengers, i.e. those passengers holding a valid ticket, are never bothered by the controllers for tickets checking procedures. Another goal of the invention is to

minimize the time spent by controllers on performing electronic tickets checking procedures. Another aim of the invention is to provide a system and a method that allow electronic ticket checking procedures to be performed without ticket barriers.

[0006] These goals are achieved, according to a first object of the invention, with a method for determining at least one location within a transportation vehicle which is occupied by an authorized passenger, said method comprising the steps of:

- receiving, from one or more mobile devices present in said vehicle, identification data of one or more beacons arranged in said vehicle and identification data of one or more passengers,
- determining one or more occupied locations within said vehicle in relation to said one or more mobile devices using said identification data of said one or more beacons,
- retrieving vehicle related data using said identification data of said one or more beacons,
- checking the presence in a data storage medium of one or more tokens using said identification data of said one or more passengers and, if at least one token is present, determining if at least one token is valid using said vehicle related data, and,
- if at least one token is valid, determining one or more valid locations amongst said occupied locations using said identification data of said one or more passengers.

[0007] Consequently, electronic checking procedures may be performed without using electronic ticket barriers and authorized passengers may enjoy their journey without being bothered by ticket checking procedures. Moreover, the method according to the invention thus limits the time spent by controllers for performing electronic ticket checking procedures and ensures that ticket barriers are no longer required for handling such procedures.

[0008] According to specific embodiments of the invention, said one or more mobile devices may determine said identification data of said one or more beacons by performing measurements of the power of radiofrequency signals received from said one or more beacons. Accordingly, the location of a passenger may be accurately determined through measurements that mobile devices known nowadays can easily handle, thereby improving the speed at which the method according to the invention may be performed.

[0009] According to specific embodiments of the invention, said one or more beacons may be configured to communicate with said one or more mobile devices by means of radiofrequency signals generated in accordance with one of the Bluetooth standard protocols. Accordingly, the method of the invention relies on standards that are implemented by most mobile devices known nowadays, thereby allowing the method according to the invention to be easily deployed within existing public

transportation infrastructures.

[0010] According to specific embodiments of the invention, the method may include a step of transmitting said one or more valid locations to a predefined mobile device by means of radiofrequency signals transmitted over a wireless communication network.

[0011] According to specific embodiments of the invention, the method may include the steps of:

- deducing one or more invalid locations amongst said occupied locations on the basis of said one or more valid locations,
- recording in the data storage medium presence data in relation to identification data of one or more unauthorized passengers that occupy said one or more invalid locations.

[0012] According to specific embodiments of the invention, the method may include a step of transmitting said one or more invalid locations to a (the) predefined mobile device by means of radiofrequency signals transmitted over a wireless communication network.

[0013] Accordingly, the method according to the invention may drastically ease the work of controllers. Another object of the invention concerns a system for determining at least one location within a transportation vehicle which is occupied by an authorized passenger, said system comprising means carrying out the steps of a method as described above.

[0014] According to specific embodiments of the invention, the system may comprise at least one computer and a data storage medium, in which at least one program for carrying out steps of the method carried out by the system is stored.

[0015] Another object of the invention concerns a computer program comprising instructions for carrying out the steps of a method as described above.

[0016] Another object of the invention concerns a medium which can be used in a computer and on which a program as described above is recorded.

Brief description of the drawings

[0017] Practicable embodiments of the invention are described in further detail below by way of example only with reference to the accompanying drawings, which show:

- figure 1, a schematic view illustrating the main components of a system according to the invention; and
- figure 2, a block diagram showing some steps of a method according to the invention.

Detailed description of the invention

[0018] As illustrated in Figure 1, the system 100 for determining at least one location within a transportation vehicle which is occupied by an authorized passenger

according to the invention comprises an information processing unit 101, comprising one or more processors, a data storage medium 102, input and output means 103 and, optionally, display means 104. According to some embodiments, the system 100 comprises one or more computers, one or more servers, one or more supercomputers and/or any combination comprising one of these computer systems. Preferably, the information processing unit 101 consists of a computer or a server provided with one or more communication interfaces and one or more pieces of software specifically designed and configured for carrying out the tasks and the steps described below.

[0019] For some tasks, the system 100 interacts, via a communication channel 200 that preferably includes a mobile communication network (e.g. GSM, 3G, 4G, 5G), with mobile devices 110, for instance smartphones, located in a transportation vehicle such as a train. The system 100 is thus able to send data to the mobile units 110 and to receive data from them. This is particularly advantageous because some steps of the method according to the invention rely on data that is determined by means of functionalities implemented by additional components of the system 100 (not represented) bundled in an application which is hosted in each mobile unit 110 and executed either punctually or continuously. Accordingly, when performing certain steps in accordance with these additional components, the mobile devices 110 interact with one or more beacons 120 arranged in the transportation vehicle by means of radiofrequency signals, preferably generated according to one of the Bluetooth standard protocols. Likewise, all beacons 120 are also compatible with the Bluetooth technology, that is they are all adapted for generating radiofrequency signals in accordance with one of the Bluetooth standard protocols.

[0020] All the elements described above contribute to enable the system 100 to implement the method for determining at least one location within a transportation vehicle which is occupied by an authorized passenger, i.e. a passenger that has a valid electronic ticket for a certain trip, as described below in relation to figure 2.

[0021] In a step 201, the system 100 receives, from one or more mobile devices of one or more passengers located in said vehicle, identification data of one or more beacons arranged in said vehicle and identification data of one or more passengers.

[0022] Indeed, when a passenger purchased a ticket for a trip, an electronic ticket has been automatically generated and stored in a data storage facility (not represented), comprising one or more data storage mediums, to which the system 100 is connected so that data stored in the data storage facility may be retrieved and extracted by the system 100. Then, the passenger reached the transportation vehicle holding a mobile device 110 in which a copy of the electronic ticket had also been stored when the ticket was purchased. When the passenger entered the transportation vehicle, the mobile device 110 with its Bluetooth functionalities activated automatically

detected one or more beacons 120 arranged in the vicinity. Then, the mobile device 110 determined the closest beacon arranged in the vicinity, preferably by performing measurements of the power of radiofrequency signals received from several beacons 120. Then, the mobile device 110 extracted identification data of the closest beacon and transmitted this data to the system 100. Alternatively, or cumulatively, this data was also transmitted to the data storage facility. In addition, each mobile device 110 transmitted also identification data of a passenger. Advantageously, this data had also been previously recorded in the data storage facility, for instance when the user installed the application on its mobile device 100. In other terms, each mobile device 110 has transmitted identification data of a passenger, which may be used by the system 100 for unambiguously identifying a passenger, together with identification data of a closest beacon. Accordingly, this data transmitted by each mobile device 110 is received by the system 100.

[0023] In a step 202, the system 100 determines one or more occupied locations within the transportation vehicle in relation to said one or more mobile devices 110 using said identification data of said one or more beacons 120. To this end, the system 110 browses the data storage facility where data referencing beacons in relation to locations in the transportations vehicles is stored. On the basis of this data, the system 100 determines a corresponding location for each beacon 120 which identification data is received. Then, the system 100 determines the mobile units 110 from which identification data of beacons 120 is received. Accordingly, the system extrapolates which locations within the transportation vehicle are occupied by passengers holding the mobile devices 110 from which beacons identification data is received.

[0024] In a step 203, the system 100 retrieves vehicle related data using said identification data of said one or more beacons. To this end, the system 110 browses again data referencing beacons in relation to locations in transportations vehicles stored in the data storage facility. However, this time, the system uses the identification data of beacons that is received to determine corresponding transportation vehicles. Advantageously, in the data storage facility is also stored vehicle related data referencing transportation vehicles in relation to data about routes and/or schedules or to elements allowing such data to be accessed. Preferably, the system 100 retrieves at this stage all vehicle related data that is needed in relation to an electronic ticket checking procedure, i.e. a procedure during which it must be established if an electronic ticket is valid for a certain trip.

[0025] In a step 204, the system 100 checks the presence of one or more electronic tokens, e.g. electronic tickets, on some data storage medium of the data storage facility using said identification data of the passengers. In other words, the system 100 checks if electronic tickets have been purchased by passengers holding mobile units 110 that transmit beacons identifiers and passenger data. As previously stated, an electronic ticket is stored

in the data storage facility in relation to a particular passenger as soon as a ticket is purchased. Thus, for all mobile units that have been transmitting data, the system 100 thus determines if one or more electronic tickets exist. If the result of the search performed by the system 100 shows that there are one or more electronic tickets present, the system 100 determines, using the vehicle related data previously determined, if one or more tickets are valid. To this end, the system 100 examines the electronic tickets in relation to routes and/or schedules characterized by the vehicle related data. An electronic ticket is considered valid when it corresponds to the routes and/or schedules characterized by the vehicle related data.

[0026] Then, if the result of the preceding step shows that one or more electronic tickets are valid, the system 100 determines, in a step 205, one or more valid locations that correspond to said valid tickets. To do so, the system retrieves the identification data of the passengers that own the valid tickets. It then determines to which locations within the transportation vehicle said passengers are located, i.e. it determines where the mobile devices 100 held by these passengers are located. Accordingly, the system determines which locations of the transportation vehicle are valid locations, i.e. which locations are occupied by authorized passengers, i.e. which locations are occupied by passengers that own valid electronic tickets.

[0027] In a particular embodiment, the system 100 performs an additional step during which it transmits said one or more valid locations to a predefined mobile device 110 by means of radiofrequency signals transmitted over the wireless communication network 200. Preferably, this predefined mobile device 110 is held by a controller and provided with additional components of the system 100. These components enable functionalities to extract the valid locations received and to use it to create visual representations of the valid locations that can be displayed on a screen of the device so that they may be easily visualized.

[0028] In another particular embodiment, the system 100 performs a first additional step during which it determines a set of one or more locations within the transportation vehicle that are invalid, i.e. it determines one or more locations that are occupied by unauthorized passengers, i.e. passengers that do not own valid electronic tickets. To do so, the system 100 preferably deduces the one or more invalid locations from the one or more valid locations previously determined. Indeed, occupied locations that are not valid locations are necessarily invalid locations. Then, the system 100 performs a second additional step during which it records on some data storage medium of the data storage facility presence data in relation to identification data of all unauthorized passengers, i.e. the passengers that actually occupy the invalid locations, i.e. the passengers which hold mobiles devices that are located at the invalid locations. Then, the system 100 performs a third additional step during which it triggers a billing procedure, handled, immediately or after

some time, either by the system 100 itself or by an independent billing system (not represented) to which the system 100 is connected, during which the presence data is retrieved and used for billing all the unauthorized passengers. Alternatively, the third additional step performed by the system 100 consists of transmitting said one or more invalid locations to the predefined mobile device 110 by means of radiofrequency signals transmitted over the wireless communication network 200. Thanks to the additional components of the system 100 executed by the predefined mobile device 110, the invalid locations may also be displayed on the screen of the predefined mobile device 110 so that they may be easily visualized by the controller.

[0029] Thus, according to the system and the method according to the present invention described above, necessary components are made available for providing functionalities allowing electronic tickets checking procedure to be performed in less time, without bothering authorized passengers and without requiring the use of ticket barriers.

Claims

1. A method for determining by a computer system (100) at least one location within a transportation vehicle which is occupied by an authorized passenger, **characterized in that** said method comprises the steps of:

- receiving, from one or more mobile devices (110) present in said vehicle, identification data of one or more beacons (120) arranged in said vehicle and identification data of one or more passengers,
- determining one or more occupied locations within said vehicle in relation to said one or more mobile devices (110) using said identification data of said one or more beacons,
- retrieving, from a data storage facility, vehicle related data using said identification data of said one or more beacons,
- checking the presence in a data storage medium of one or more tokens using said identification data of said one or more passengers and, if at least one token is present, determining if at least one token is valid using said vehicle related data, and,
- if at least one token is valid, determining one or more valid locations amongst said occupied locations using said identification data of said one or more passengers.

2. The method according to claim 1, **characterized in that** said one or more mobile devices (110) determine said identification data of said one or more beacons (120) by performing measurements of the pow-

er of radiofrequency signals received from said one or more beacons (120).

3. The method according to one of the preceding claims, **characterized in that** said one or more beacons (120) are configured to communicate with said one or more mobile devices (110) by means of radiofrequency signals generated in accordance with one of the Bluetooth standard protocols.

4. The method according to one of the preceding claims, **characterized in that** it includes a step of transmitting said one or more valid locations to a predefined mobile device by means of radiofrequency signals transmitted over a wireless communication network.

5. The method according to one of the preceding claims, **characterized in that** it includes the steps of:

- deducing one or more invalid locations amongst said occupied locations on the basis of said one or more valid locations,
- recording in the data storage medium presence data in relation to identification data of one or more unauthorized passengers that occupy said one or more invalid locations.

6. The method according to claims 4 and 5, **characterized in that** it includes a step of transmitting said one or more invalid locations to the predefined mobile device (110) by means of radiofrequency signals transmitted over a wireless communication network (200).

7. A system (100) for determining at least one location within a transportation vehicle which is occupied by an authorized passenger, **characterized in that** it comprises means (101, 102, 103, 104) carrying out the steps of a method according to one of the preceding claims.

8. The system according to claim 7, **characterized in that** it comprises at least one computer (101) and a data storage medium (102), in which at least one program for carrying out steps of the method carried out by the system is stored.

9. Computer program comprising instructions for carrying out the steps of a method according to claims 1 to 6.

10. Medium which can be used in a computer and on which a program according to claim 9 is recorded.

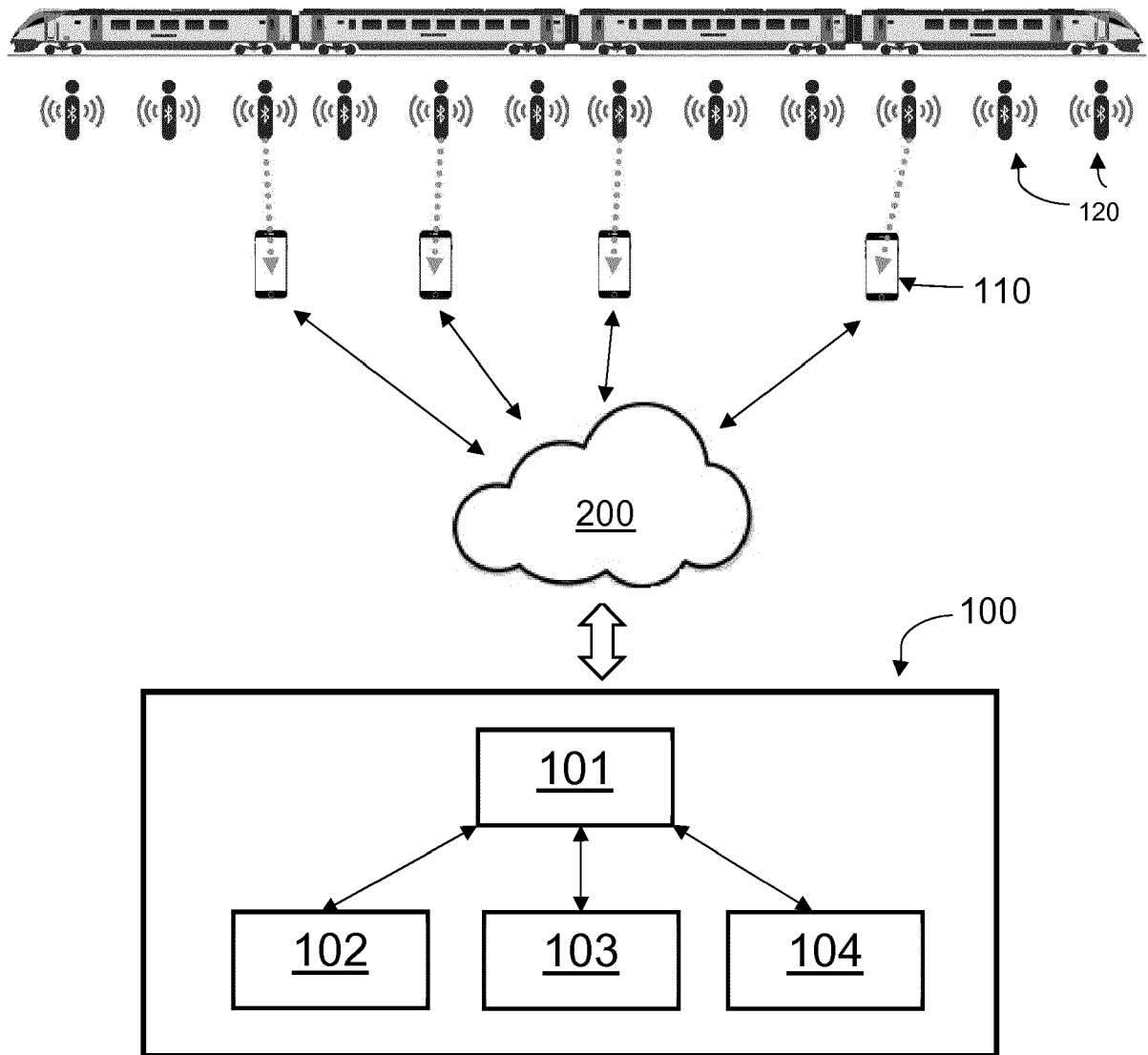


Figure 1

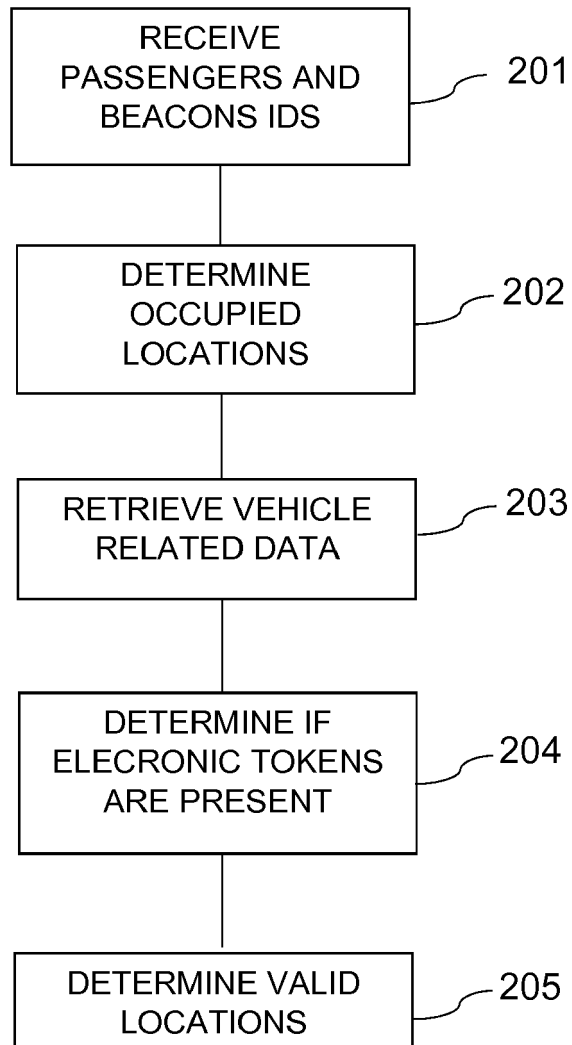


Figure 2



EUROPEAN SEARCH REPORT

Application Number
EP 19 16 9640

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 October 2019	Examiner Holzmann, Wolf
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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