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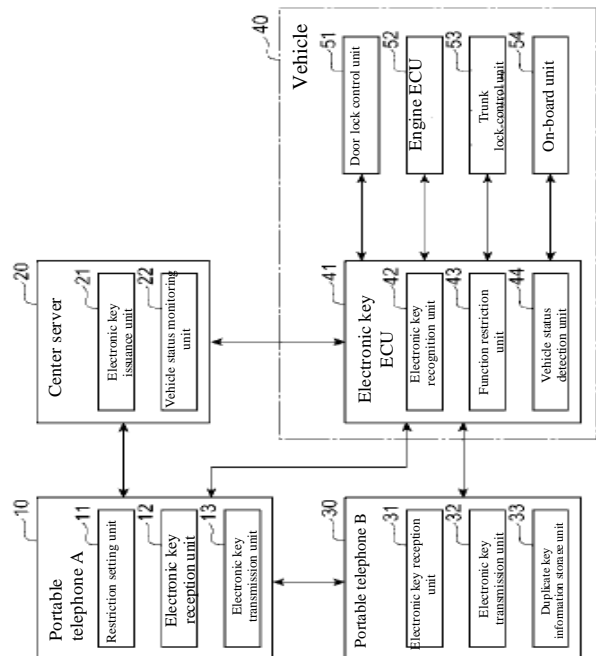
(54) (Title of the invention) Electronic key system

(57) (Abstract)

(Problem) To provide an electronic key system that allows restrictions on functions that can be executed with a duplicate electronic key to be imposed when a duplicate electronic key is generated.

(Means for solving) A configuration is employed comprising a first terminal 10 comprising a transmission means that transmits a signal that allows execution of only a subset of functions out of a plurality of functions, whereby a duplicate electronic key containing a signal that allows execution of only a subset of functions is transmitted to another terminal 30. The configuration furthermore comprises a second terminal 30 which recognizes the signal transmitted by the transmission means, comprises a storage means for storing the recognized signal, and enables execution of only a subset of functions based on said signal, whereby the duplicate electronic key containing a signal that allows execution of only a subset of functions is received from the first terminal 10 and stored, and execution of only a subset of functions is enabled on the basis of the stored duplicate electronic key.

(Selected drawing) FIG. 1



(Scope of patent claims)

(Claim 1)

An electronic key system characterized in that it comprises: a first terminal comprising a transmission means that transmits a signal that allows execution of only a subset of functions out of a plurality of functions; and a second terminal which recognizes the signal transmitted by said transmission means, comprises a storage means for storing the recognized signal, and enables execution of only said subset of functions based on said signal.

(Claim 2)

An electronic key system as set forth in Claim 1, characterized in that said subset of functions is a function of locking/unlocking a door lock of a vehicle, and a function of starting a drive source of said vehicle.

(Detailed Description of the Invention)

(Technical field)

(0001)

The present invention relates to an electronic key system.

(Background art)

(0002)

Conventionally, in this field of technology, electronic key systems are known, which perform authentication between a vehicle key and a vehicle using wireless communication and enable execution of various operations of a vehicle (for example, Patent Literature 1 to 4). In the technology described in Patent Literature 1, apart from a dedicated key, a portable telephone is used to transmit an ID code with an expiration, thereby enabling locking and unlocking of the vehicle and starting of the engine when one does not have the dedicated key.

(0003)

Furthermore, in the technology described in Patent Literature 2, users are restricted by sending, to a wireless portable terminal, a key code needed for operations subject to remote control, and performing locking and unlocking using the wireless portable terminal that has received the key code. In the technology described in Patent Literature 3, improvement of security in case of loss of a portable telephone is achieved by imposing restrictions on the number of activations with an electronic key based on a portable telephone. In the technology described in Patent Literature 4, improvement of security is achieved by generating signature data based on random numbers during communication between an electronic key and a vehicle.

(Patent Literature 1) Japanese Unexamined Patent Application Publication 2007-137136

(Patent Literature 2) Japanese Unexamined Patent Application Publication 2004-243395

(Patent Literature 3) Japanese Unexamined Patent Application Publication H6-243395

(Patent Literature 4) Japanese Unexamined Patent Application Publication 2006-9333

(Disclosure of the invention)

(Problem to be solved by the invention)

(0004)

For example, in valet parking, where employees move vehicles to predetermined locations within a parking lot, lending a dedicated vehicle key to another person could pose a security risk. Furthermore, since portable telephones are carried by their owners at all times, there is the problem that lending one's personal portable telephone to another person would be difficult.

(0005)

The present invention was made to solve such problems, it being an object of the present invention to provide an electronic key system that allows restrictions on the functions that can be executed with a duplicate electronic key to be imposed when such a key is generated.

(Means for solving the problem)

(0006)

The electronic key system according to the present invention is characterized in that it comprises: a first terminal comprising a transmission means that transmits a signal that allows execution of only a subset of functions out of a plurality of functions; and a second terminal which recognizes the signal transmitted by the transmission means, comprises a storage means for storing the recognized signal, and enables execution of only the subset of functions based on said signal.

(0007)

With this electronic key system, a configuration is employed comprising a first terminal comprising a transmission means that transmits a signal that allows execution of only a subset of functions out of a plurality of functions, whereby a duplicate electronic key containing a signal that allows execution of only a subset of functions is transmitted to another terminal. Furthermore, with this electronic key system, the configuration further comprises a second terminal which recognizes the signal transmitted by the transmission means, comprises a storage means for storing the recognized signal, and enables execution of only a subset of functions based on said signal, whereby the duplicate electronic key containing a signal that allows execution of only a subset of functions is received from the first terminal and stored, and execution of only a subset of functions is enabled on the basis of the stored duplicate electronic key.

(0008)

Here, the subset of functions is preferably a function of locking/unlocking a door lock of a vehicle, and a function of starting a drive source of the vehicle. As a result, when a duplicate electronic key is generated, it is possible to enable only the locking/unlocking of the vehicle's door lock and the starting of the vehicle's drive source, and disable execution of other functions, thereby enhancing security features and strengthening the protection of personal information. The "other functions" mentioned here may include "unlocking the trunk," "unlocking the console compartment," and "electronic devices such as the navigation system."

(Effect of the Invention)

(0009)

According to the present invention, it is possible to provide an electronic key system that allows restrictions on the functions that can be executed with a duplicate electronic key to be imposed when the duplicate electronic key is generated. Furthermore, the electronic key system of the present invention makes it possible to implement duplicate electronic keys with improved security performance by allowing restrictions to be imposed on the functions that can be executed with the duplicate electronic keys.

(Best mode for carrying out the invention)

(0010)

A preferred embodiment of the electronic key system according to the present invention will be described below with reference to the drawings. It should be noted that, in the description of the drawings, identical or corresponding elements will be denoted by the same reference symbol, and redundant description thereof will be omitted. FIG. 1 is a block diagram illustrating an electronic key system according to an embodiment of the present invention, and FIG. 2 is a schematic diagram illustrating the transfer of a duplicate electronic key in the electronic key system according to an embodiment of the present invention.

(0011)

The electronic key system shown in FIG. 1 is a keyless entry system using portable telephones, allowing for the unlocking of a door lock of a vehicle 40 using portable telephones 10, 30, which store key information, without possession of a dedicated key. As shown in FIG. 2, this electronic key system has a configuration that allows key information to be transmitted from portable telephone A (first terminal) 10, which functions as a master key, to portable telephone B (second terminal) 30, which functions as a duplicate electronic key.

(0012)

Portable telephone A 10 is, for example, the portable telephone of the owner A of the vehicle 40, and functions as a master key that allows all functions of the vehicle 40 to be executed without restrictions. Portable telephone B 30 is the portable telephone of another person B, to whom a duplicate electronic key is lent, and functions as a restricted duplicate electronic key that allows only a subset of the plurality of functions of the vehicle 40 to be executed. Details will be described later.

(0013)

As shown in FIG. 1, the vehicle 40, to which the electronic key system of the present embodiment is applied, is equipped with an electronic control unit (hereinafter referred to as "electronic key ECU") 41, which performs control related to locking/unlocking (permission of operation/denial of operation) using electronic keys (portable telephone A 10 and portable telephone B 30).

(0014)

The electronic key ECU 41 comprises a CPU that performs computation processing, ROM and RAM that serve as a storage unit, an input signal circuit, an output signal circuit, a power supply circuit, etc., and is electrically connected to a door lock control unit 51, an engine ECU 52, a trunk lock control unit 53 and on-board unit 54. In the electronic key ECU 41, an electronic key recognition unit 42, a function restriction unit 43 and a vehicle status

detection unit 44 are constructed by executing programs stored in the storage unit. Furthermore, the electronic key ECU 41 is configured to be capable of communicating with portable telephones 10, 30, as well as with a center server 20 of a management center that performs issuance of electronic keys.

(0015)

The electronic key recognition unit 42 reads key information from the portable telephone 10, 30 and determines whether the electronic key is a key that allows execution of functions of the vehicle 40. The electronic key recognition unit 42 authenticates the electronic key by comparing the encrypted data stored in the storage unit with the key information read from the portable telephone 10, 30.

(0016)

Furthermore, the electronic key recognition unit 42 recognizes the key information and determines whether it is dealing with portable telephone A 10, which functions as a master key, or portable telephone B 30, which functions as a restricted duplicate electronic key. In other words, depending on whether it is dealing with portable telephone 10 or 30, the electronic key recognition unit determines the functions that can be executed, the conditions for using those functions (for example, usage time), etc.

(0017)

Examples of functions of the vehicle 40 whereof execution is enabled depending on the electronic key may include “locking and unlocking of the door lock,” “permission to start the engine,” “locking and unlocking of the trunk,” “locking and unlocking of the console compartment,” “permission to use the on-board unit functioning as a car navigation device,” “permission to use the on-board unit functioning as a communication device capable of sending and receiving email,” etc.

(0018)

The function restriction unit 43 controls the enablement of execution or disablement of execution of various functions of the vehicle 40 based on the key information recognized by the electronic key recognition unit 42. The function restriction unit 43 outputs command signals to the door lock control unit 51, controlling the locking and unlocking of the door lock. The function restriction unit 43 outputs command signals to the engine ECU 52, controlling the permission for engine start. The function restriction unit 43 outputs command signals to the trunk lock control unit 53, controlling the locking and unlocking of the trunk. The function restriction unit 43 outputs command signals to the on-board unit 54, controlling the permission for using the on-board unit.

(0019)

The vehicle status detection unit 44 accepts as input the signals outputted from the door lock control unit 51, engine ECU 52, trunk lock control unit 53 and on-board unit 54 to detect the locked/unlocked status of the door lock, the operational status of the engine, the locked/unlocked status of the trunk, and the operational status of the on-board unit 54.

(0020)

The vehicle status detection unit 44 is connected to an unillustrated on-board camera, and can detect the driver's face. For example, when the door lock of the vehicle 40 has been unlocked using a master key, the driver's face is detected, and functions of the vehicle 40 may be restricted based on the results of this detection. If the detected driver's face is not registered in the user information, a drive mode with restricted usable functions may be set, or a setting may be made that prevents the engine from starting.

(0021)

In the electronic key system, issuance of electronic keys, monitoring of the vehicle status of the vehicle 40, and the like, is performed by a management center connected to a network. In the server 20 of the management center, there is constructed an electronic key issuance unit 21 and a vehicle status monitoring unit 22.

(0022)

The electronic key issuance unit 21 generates electronic keys that can be used with the vehicle 40. The electronic key issuance unit 21 generates a restricted duplicate electronic key based on the signal outputted from portable telephone A 10. The generated electronic key, the restricted duplicate electronic key, is transmitted to portable telephone A 10.

(0023)

The vehicle status monitoring unit 22 acquires information related to the vehicle status of the vehicle 40 based on signals outputted from the vehicle 40. The vehicle status monitoring unit 22 outputs the acquired vehicle status related information to portable telephone A 10.

(0024)

Portable telephone A 10 has calling functions, email sending and receiving functions, and network connection functions. Furthermore, as mentioned above, portable telephone A 10 functions as a master key that enables execution of functions of the vehicle 40. In portable telephone A 10, there is constructed a restriction setting unit 11, an electronic key reception unit 12, and an electronic key transmission unit 13.

(0025)

The restriction setting unit 11 can set the functions (subset of functions) of the vehicle 40 that can be utilized with the restricted duplicate electronic key based on operations by the operator. Information related to the subset of functions that was set is outputted to the center server 20.

(0026)

The electronic key reception unit 12 functions as an electronic key reception means that receives the electronic key (key information) outputted from the center server 20. The electronic key transmission unit 13 functions as an electronic key transmission means that transmits key information for a restricted duplicate electronic key to portable telephone B 30. Furthermore, the electronic key transmission unit 13 transmits key information for a master key to the electronic key ECU 41. The electronic key transmission unit 13 functions as the transmission means of the present invention that transmits a signal that allows execution of only a subset of functions out of a plurality of functions.

(0027)

Furthermore, the status of the vehicle 40 can be checked on the portable telephone A 10 via the management center. For example, information related to the vehicle status of the vehicle 40 may be acquired when a duplicate key is used. On portable telephone A 10, it is possible to check the door open/closed status, the locked/unlocked status of the door lock, the operational status of the engine, the locked/unlocked status of the trunk, the operational status of the on-board unit 54, the driver's facial image, etc., based on the acquired vehicle status related information.

(0028)

Portable telephone B 30 has calling functions, email sending and receiving functions, and network connection functions. Furthermore, as mentioned above, portable telephone B 30 functions as a restricted duplicate electronic key that enables execution of a subset of functions of the vehicle 40. In portable telephone B 30, there is constructed an electronic key reception unit 31, an electronic key transmission unit 32 and a duplicate key information storage unit 33.

(0029)

The electronic key reception unit 31 functions as an electronic key reception means that receives the electronic key (key information) outputted from portable telephone A 10. The electronic key reception unit 31 receives key information for a restricted duplicate electronic key.

(0030)

The duplicate key information storage unit 33 functions as a storage means that stores the received key information. The electronic key transmission unit 32 transmits the key information stored in the duplicate key information storage unit 33 to 41.

(0031)

Examples of the means of communication going from portable telephone A 10 to portable telephone B 30 include Bluetooth, infrared and other ad hoc communication, human body communication, email attachments, and the like.

(0032)

Next, the operation of the electronic key system according to an embodiment of the present invention will be described. FIG. 3 and FIG. 4 are flowcharts illustrating the operational procedure executed by the electronic key system according to an embodiment of the present invention. It should be noted that steps are abbreviated as S.

(0033)

First, a connection request is made from the portable telephone A 10 of the owner (operator) A to the management center (S1). Portable telephone A 10 transmits a connection request signal to the management center based on operations by the operator. Next, in response to the connection request from portable telephone A 10, the center server 20 of the management center transmits a response signal to portable telephone A 10 (S2) and establishes a connection between portable telephone A 10 and the center server 20 (S3).

(0034)

Next, portable telephone A 10 sets restriction items for the restricted duplicate electronic key based on operations by the operator (S4). Here, the functions that will be usable with the restricted duplicate electronic key, the expiration, etc., are set.

(0035)

Then, portable telephone A 10 performs a restricted duplicate electronic key issuance request (S5). Portable telephone A 10 transmits a restricted duplicate electronic key issuance request signal to the management center based on operations by the operator.

(0036)

Next, the center server 20 of the management center issues an electronic key that functions as a restricted duplicate electronic key in response to the restricted duplicate electronic key issuance request from portable telephone A 10 (S6). Here, the electronic key issuance unit 21 of the center server 20 generates key information for the restricted duplicate electronic key according to the restriction items that were set on portable telephone A 10.

(0037)

Then, the center server 20 transmits the electronic key by transmitting the generated key information to portable telephone A 10 (S7).

(0038)

Next, portable telephone A 10 transmits the received electronic key to portable telephone B 30 (S8). Portable telephone A 10 sends the key information for the restricted duplicate electronic key to portable telephone B 30 based on operations by the operator. In other words, transfer of the electronic key is performed by transmitting the key information to portable telephone B 30. This eliminates the need to lend a physical key.

(0039)

Portable telephone B 30 accepts the electronic key by storing the received key information in the duplicate key information storage unit 33. To use the duplicate electronic key, the duplicate key user B operates portable telephone B 30 to transmit the key information to the electronic key ECU 41. Portable telephone B 30 transmits the key information (electronic key) stored in the duplicate key information storage unit 33 to the vehicle 40 based on operations by the duplicate key user B (S9).

(0040)

The electronic key ECU 41 reads the key information outputted from portable telephone B 30 and performs authentication of the electronic key (S10). The electronic key ECU 41 controls the locking/unlocking of the door lock, the permission to start the engine, and so on, based on the recognized key information. Other functions that cannot be used with the restricted duplicate electronic key (for example, unlocking the trunk, operating the on-board unit) are left in an execution-disabled state.

(0041)

Next, a vehicle status related signal (for example, engine start, engine stop, etc.) is transmitted from the vehicle 40 to the management center (S11). The electronic key ECU 41 detects various statuses of the vehicle 40 and transmits a vehicle status related signal to the center server 20 of the management center.

(0042)

The vehicle status related signal received by the management center is transmitted to portable telephone A 10 (S12). Additionally, the management center periodically transmits a signal requesting vehicle status related information to the vehicle 40 (S13). The electronic key ECU 41 transmits a vehicle status related signal to the management center in response to the request from the management center (S14).

(0043)

Furthermore, if the owner A wants to check the status of the vehicle 40, the owner operates portable telephone A 10 to request the acquisition of vehicle status related information. Portable telephone A 10 sends a signal requesting vehicle status related information to the management center in response to operations by the owner A (S15).

(0044)

The management center transmits a vehicle status related signal to portable telephone A 10 in response to the request from portable telephone A 10 (S16).

(0045)

The electronic key ECU 41 determines whether the usage period of the restricted duplicate electronic key has ended, and if the usage period has ended, settings are changed to disable use of the subset of functions that was usable with the restricted duplicate electronic key (S17). Furthermore, the electronic key ECU 41 transmits a signal (usage end data) notifying that the usage period of the restricted duplicate electronic key has ended to the management center (S18).

(0046)

The center server 20 of the management center, upon receiving the usage end data, transmits the received usage end data to portable telephone A 10 (S19) and terminates the connection with portable telephone A 10 (S20).

(0047)

It should be noted that FIG. 2 illustrates an example of the display images that are displayed on portable telephone A 10 and portable telephone B 30 when the restricted duplicate electronic key has been transmitted from owner A to borrower B. For example, the display screen of portable telephone A 10 displays a message such as “Duplicate key information with navigation-disabled settings has been transmitted. Expiration: 3/13 5:04 p.m.,” and the display screen of portable telephone B 30 displays a message such as “Duplicate key information with navigation-disabled settings has been received. Expiration: 3/13 5:04 p.m.”

(0048)

With such an electronic key system, using portable telephone A 10, it is possible to transmit, to portable telephone B 30, a restricted electronic key containing a signal that allows execution of only a subset of functions out of the plurality of functions. Furthermore, portable telephone B 30 can recognize the electronic key transmitted from portable telephone A 10 and enable execution of only a subset of functions of the vehicle 40 based on the key information of the received electronic key. This makes it possible to impose restrictions on the functions that can be executed with the duplicate electronic key, eliminating the need to lend a master key or an electronic key with equivalent privileges to a master key. Therefore, it becomes possible to lend a duplicate electronic key to another person while resolving the security problems involved. The use of a restricted duplicate electronic key is particularly effective in situations such as valet parking. Moreover, by lending a restricted duplicate electronic key with a set expiration time, the need for the borrower to perform the action of returning the duplicate key is eliminated.

(0049)

Furthermore, the subset of functions that become usable with the restricted duplicate electronic key can be set to only the function of locking/unlocking the door lock of the vehicle and the function of starting the drive source of the vehicle, while disabling execution of other functions. Therefore, it is possible to implement a duplicate electronic key with enhanced security features and strengthened protection of personal information. For example, when lending a vehicle to other people, the problem of the information in the on-board unit being seen by others and the problem of the content of the trunk being seen by others can thereby be resolved.

(0050)

Additionally, with conventional electronic key systems, there was the problem that a prerequisite for generating an electronic key was the pre-registration of the electronic device (terminal) to be used as an electronic key, which involved complex procedures, making it difficult to lend an electronic key temporarily. With the electronic key system of the present embodiment, it is possible to issue a restricted duplicate electronic key through a simple procedure.

(0051)

Moreover, with the electronic key system of the present embodiment, it is possible to check the vehicle status of the vehicle 40 while the duplicate electronic key is lent out, allowing the owner A to lend the duplicate electronic key to others with peace of mind.

(0052)

While the present invention has been described above concretely based on an embodiment, the present invention is not limited to the embodiment described above. It should be noted that while the terminal capable of being used as an electronic key was described in the above embodiment as a portable telephone, other terminals capable of communication may be used as well.

(Brief description of the drawings)

(0053)

(FIG. 1) is a block diagram illustrating an electronic key system according to an embodiment of the present invention.

(FIG. 2) is a schematic diagram illustrating the transfer of a duplicate electronic key in the electronic key system according to an embodiment of the present invention.

(FIG. 3) is a flowchart illustrating the operational procedure of an electronic key system according to an embodiment of the present invention.

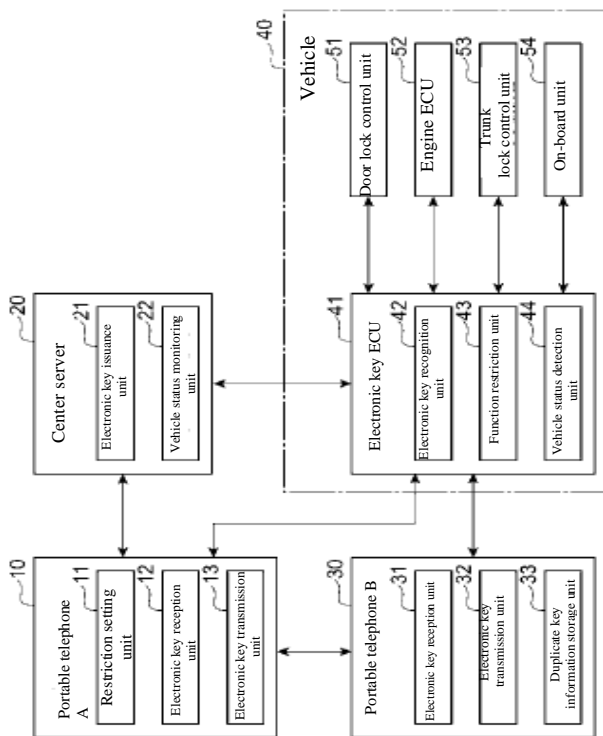
(FIG. 4) is a flowchart illustrating the operational procedure of an electronic key system according to an embodiment of the present invention.

(Description of reference symbols)

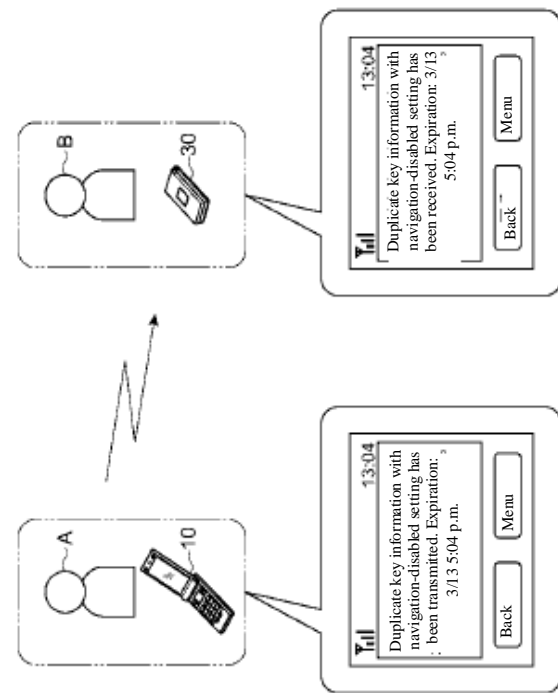
(0054)

10... Portable telephone A (first terminal), 11... Restriction setting unit, 12... Electronic key reception unit, 13... Electronic key transmission unit, 20... Center server, 21... Electronic key issuance unit, 22... Vehicle status monitoring unit, 30... Portable telephone B (second terminal), 31... Electronic key reception unit, 32... Electronic key transmission unit, 33... Duplicate key information storage unit, 40... Vehicle, 41... Electronic key ECU, 42... Electronic key recognition unit, 43... Function restriction unit, 44... Vehicle status detection unit, 51... Door lock control unit, 52... Engine ECU, 53... Trunk lock control unit, 54... On-board unit.

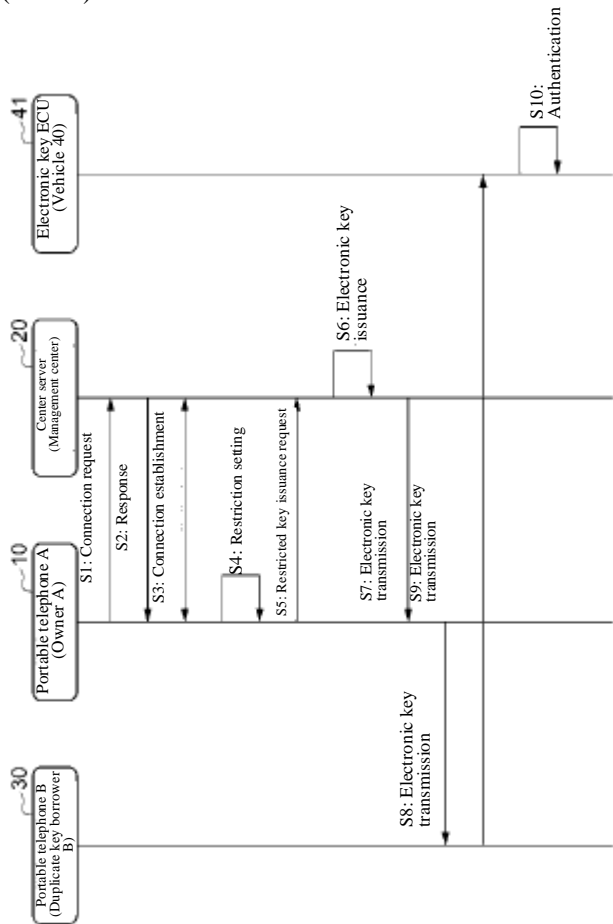
(FIG. 1)



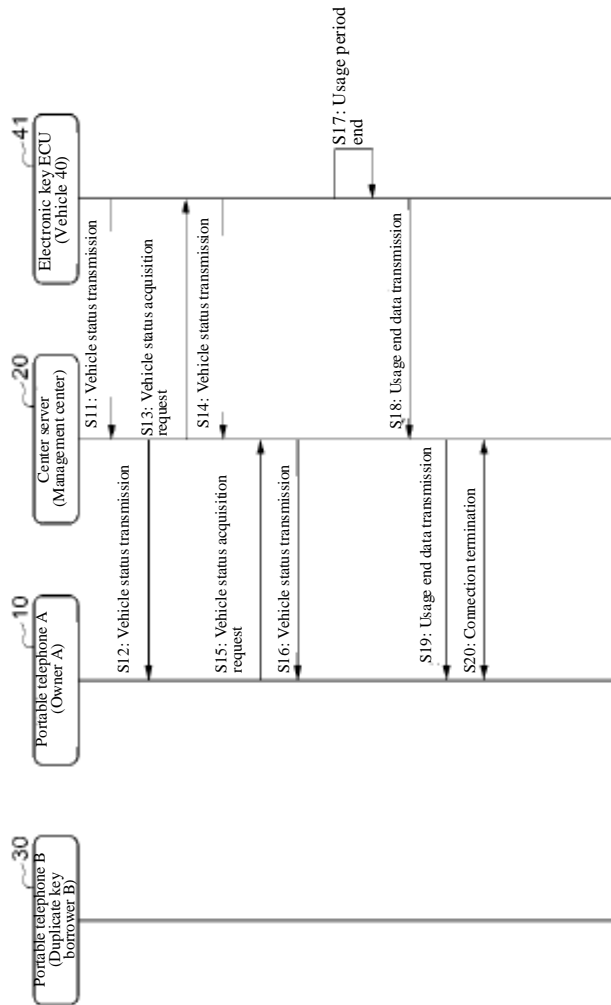
(FIG. 2)



(FIG. 3)



(FIG. 4)



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Continuation of the front page

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