

TRANSMITTER AND RECIEVER MEANS PREFERABLY TO BE PLACED IN VEHICLES

5 TECHNICAL FIELD

The invention presented here concerns a mountable and removable transmitting and receiving unit primarily intended for placing in a vehicle. The equipmen, furnished with a transponder, is preferably placed inside the windscreen of the vehicle and intended for radio communication with a transmitting and receiving unit outside the vehicle.

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STATE OF THE ART

A common arrangement for debiting road charges at toll-road stations is to equip the vehicle with transmitting and receiving equipment for radio communication with transmitting and receiving equipment in a roadside toll station. By means of radio communication a
15 payment/debiting operation can be performed while the vehicle is passing the toll station without needing to stop. The communication unit in the vehicle is often in the form of a transponder, that is to say a device which is designed to receive a radio signal and retransmit it modulated, so as to transmit a reply to the received signals content. Toll systems of this type are described, for example, in US, A, 4 303 904 (Chasek) and US, A, 5 422 473 (Hassett
20 et al). This type of system for remote debiting of traffic charges has its equivalent in other remote communication systems with similar equipment. Examples of such systems are that for supervision of certain areas where only authorized vehicles may pass in and out, or that for establishing the position of busses in public transport systems.

25 In systems where the described communication equipment is used there is usually a requirement that the vehicle units are to be identified with a specific vehicle and can only be used for payment operations when the vehicle in question is passing. It is often desirable that the vehicle equipment consists of a single unit, which thereby must be positioned in the vehicle such that the radio communication is not disturbed by shielding from parts of the
30 vehicle. In practice this means that the unit is visibly placed inside the windscreen of the

vehicle. The unit is thus secured to the vehicle in such a way that special measures are required to have it removed.

5 This sort of installation in the vehicle carries, however, the disadvantage that, in the event of the vehicle being unguarded, it is open to theft if someone uses force of a nature that allows the unit to be removed. This means not only a significant financial loss but possibly even the illegitimate use of the unit, so that the owner will be liable for payment for passing toll stations done by another person while using the unit. Equipment of this sort is programmed to, on communication, not only identify the vehicle but also to debit the toll charge to the
10 person responsible for payment. In addition, with the vehicle equipment designed as a single unit, which is positioned on the windscreen and often in a high position, it is difficult to service, for example when programming with user data, when setting the control unit, when entering and removing the so called smart card or programming the balance and when reading information from a display.

15 Because of this factor it would be advantageous if the vehicle unit could be removed from its position in the vehicle. Doing this would eliminate the risk of theft of the unit from the vehicle when it is left unguarded, since the unit could be removed, and at the same time the said servicing would be facilitated. The possibility of being able to temporarily remove the
20 unit from the vehicle and to conveniently replace it must be arranged in such a way that identification between the unit and a specific vehicle is not violated. In other words, it must not be possible to use the unit by reinserting it in a vehicle other than that for which the unit is intended.

25 DESCRIPTION OF THE INVENTION

The purpose of the invention is to produce a device which makes possible the easy removal and remounting of the vehicle unit but which, nevertheless, is securely identified to the mounting position the unit is intended to be placed when in use.

30 The purpose of the invention is accomplished by dividing the vehicle equipment into two

components, of which one is fixed in the position of use, while the other component is possible to remove from the fitted component when the equipment is not being used. The detachable component is the unit that performs the communication, and is the carrier of the devices which need servicing, such as the control unit and reading device. When in use, with
5 both of the components assembled together, signals are transmitted between the two components on using a signal coding, which permits the intended operation only when the two complementary components are brought together. The fixed component is identified with the mounting position by nature of it being secured but lacks a device for independent execution of remote communication. The equipment which is designed for the execution of
10 this communication, together with the fixed component, is, on the other hand, linked to the identity of the person responsible for payment, from which activation of the payment operation starts. In the predicted embodiment the fixed component is secured to the vehicle, preferably on the inside of the its windscreen. This component does not comprise any device for independent remote communication, but rather can be regarded as an electronic "key",
15 which is coupled to the lock, which is carried by the detachable component. This in turn is, as already mentioned, identified with the person responsible for payment of the traffic charges, usually the owner of the vehicle in which the fixed component is mounted.

DESCRIPTION OF THE FIGURES

- 20 Below is described an embodiment of the invention with reference to the accompanying diagrams in which is shown
- in Fig. 1 a perspective view of the vehicle equipment with both components installed for use in a vehicle on the inside of the windscreen;
- in Fig. 2 an analogous perspective view displaying the two components separated from
25 each other; and
- in Fig. 3 a block diagram of the equipment.

PREFERRED EMBODIMENT

- Fig. 1 shows vehicle equipment for remote communication by means of radio waves and
30 mounted inside the windscreen of a vehicle. The equipment is intended to carry out, by

remote communication, payment operations or identification operations or other operations according to that stated in the introduction. The vehicle equipment, which in its entirety is denoted by 1, comprises a single unit when in use, but consists of two main components, a fixed holder 2 and a holder-detachable component 3, which comprises most, if not all, of the principally electronic parts which are required for the operation of the communication equipment. It includes even the servicing unit, here indicated to include control keys (4), a display unit (5) and an insert aperture (6) for a card reader for a smart card (see Fig. 2).

As evident from Fig. 2 the two components 2 and 3 can be separated from each other, whereby the holder (2), which is permanently secured, remains attached to the vehicle's windscreen, while the component (3) can be handled completely separately and can even be removed and stored in a place other than the vehicle.

As shown in Fig. 2 the fixed component (2) is equipped with a seat (10) for part 3 and in this said seat there is an electrical contact member 11 for communication with component 3, which is equipped with a corresponding electrical contact member. The shown contact member 11 is intended to have contact with component 3's contact member. The internal communication between the components can, however, be alternatively arranged contact free by means, for example, of light or electrostatic induction. Fig. 2 shows, in addition, that the holder 10 is equipped with a controllable simple locking device 12 for secure support of component 2. This sort of locking device can be designed in several ways, and as an alternative to locking by direct contact, such as snap locking with a spring-mounted device. It is even possible to design the locking for key control, such as by means of a mechanical lock or an electronic code lock. In this way it can be insured that component 2 cannot be removed if one, for example during short stops, wishes to leave the component in the vehicle and mounted in the holder.

In the embodiment, it is assumed that the communication is carried out by means of microwaves, and therefore the vehicle equipment is supplied with a transponder. This same transponder is placed in the detachable component 3, with the transponder's antenna elements

placed on the side of the component which is intended to be placed in the seat of the holder 2, thereby exposing the antenna element through an aperture 13 in the holder. In addition to the transponder, the component 3 contains the principal electronic equipment which is needed for communication via the transponder. One part of the electronic equipment is a blocking
5 circuit, which has to be activated before the component's device for communication can start working. This blocking circuit is designed to cooperate/interact with an activation circuit in the holder 2.

The holder, for its part, is secured by gluing, preferably on the vehicle's windscreen, . For
10 this purpose the holder is provided with a frame along its outer edges and surrounding the aperture 13. The glued edges are preferably designed so that the said electric circuit is broken and is unable to function, if someone attempts to break the glue joint. For example, the circuit can be positioned in a section of the holder's glued edge which is more brittle than the intended glue joint and which thereby makes it impossible to break the glue joint and remove
15 the holder without eliminating important functions of the said activation circuit. The safety circuit in the detachable component 3 is designed to connect with the activation circuit in the holder by means of a device for signal transmission between the two components, when they are coupled with one another. The contact member 11 in the holder 2 exemplifies such a device.

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Fig. 3 shows schematically both components of the vehicle equipment, the holder 2 from its side facing the interior of the vehicle with the seat 10, while the detachable component 3 is shown from the side which is to face towards the vehicle when positioned in the seat 10. The figure consists both of the said schematic view of the parts and a block diagram of its
25 functional parts. The said devices for signal transmission between the components are indicated here. These are connected to the said activation circuit, denoted here by 16. This is positioned in the glued edge of component 2.

In the detachable component 3, just in front of the aperture 13, is the transponder's antenna
30 element, denoted here by 20. This is electrically linked to a microprocessor 21, equipped

with the memory, a ROM 22 and a RAM 23. The microprocessor 21 is, in addition, connected to the said blocking circuit, denoted by 24 here, which in its turn is connected to the signal transmission device, shown here as contact member 25 matched with contact member 11. Furthermore, there is a battery 26 for power supply.

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In the described design the holder 2 is a simple component for supporting the functional component 3. Apart from its purely mechanical construction, the holder contains only the electronic activation circuit 16 with its safety circuit, which may be a simple tie circuit. Moreover, the blocking circuit may, in its entirety, be constructed and positioned for the said safety function, that is to say to break on attempts to break the glue joint. Because of its design, the holder is so simple that it is unlikely to be prone to theft. Alternatively, the holder's safety circuit could be constructed as a detachable part, as a rod for example, the removal of which means that the blocking circuit ceases to function. If the part must be removed from the mounting position with greater force than required to remove it from the rest of the holder, the holder will not be able to be removed without first separating the part from the main part of the holder.

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With respect to the function, there are, however, alternative ways of construction than those described, such as providing the holder with one or more functional parts. For example, the holder could include, instead of the aperture 13, the transponder's antenna elements on the side facing the windscreen. Communication between the other functional parts in the detachable component and the antenna elements can then occur by the said signal communication. An essential feature of the invention is that the detachable component's functional parts are unable to work without a signal communication with the activation circuit in the holder. The blocking circuit in the detachable component is coded to the activation circuit in such a way that the main part of the detachable component can only function when positioned in the holder, to which it is coupled and which contains an appropriately coded activation circuit. A further prerequisite is that the detachable component is the carrier, by means of a coding in the RAM memory, of the identity of the person responsible for payment. Since the detachable component is coupled to the holder the identity of the person responsible

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for payment is even coupled to the vehicle, and can be coupled only to that vehicle, in which the detachable component-linked holder is fixed.

When in use, with the detachable component 3 inserted in its complementary holder in the vehicle, and when approaching a toll-road station having transmitting and receiving equipment for payment operations, the vehicle equipment will be activated by the microwaves, transmitted from the toll-road station, by being intercepted by the transponder. This leads to activation of the the microprocessor 21, which via the said blocking function reads the coding in the holder's activation circuit 17. This is performed by the coding stored in the processor's memory. If this comparison produces a predetermined result, only then is the microprocessor made accessible to allow communication with the toll-road station. Consequently, the processor is not made available for this communication by simply placing the detachable component in the holder, but rather on activation of the vehicle equipment from the toll-road station, and each occasion on which this occurs. The blocking function's code and the identity code for the identity of the person responsible for payment as well as the programme code for execution of the payment operation is stored internally in the processor's ROM or RAM, in a way that they cannot be changed without considerable tampering with the detachable component.

The carrier of the safety function, which one wishes to achieve, is the encrypted communication between the detachable component's active blocking function and the holder's passive activation function. By active is meant here that the microprocessor transmits the code signal while the activation circuit merely reflects the same in a specific, modulated form, which is the carrier of the safety code. If someone attempts to manipulate the safety function it is conceivable that this would happen by, in some way, reading the communication between the microprocessor and the holder's activation circuit. However, this can be prevented by the microprocessor successively modifying the transmitted signal so that the codes are gradually changed. Thus, the holder's activation circuit is to be designed in such a way as to gradually modify the reflected code, at the same time as the microprocessor is designed to activate communication with the toll-road station only if every specific code in

the modified pattern corresponds to a matched reflected code from the holder's activation circuit. This means that the activation circuit in the holder will successively block the reply codes as they are used and reply with the following code in a repeating schedule, which can be repeated after a large number of sequences. A possible design is that the active, detachable
5 component, before a removal from the holder, programmes this with a new code, which is valid at the next time of use.

The emphasis of the described embodiment has been on a radio communication system for the execution of payment operations between a toll-road station and vehicular equipment
10 including a transponder. The invention's stated fundamental principles are, however, as outlined in the introduction, also applicable in other applications, such as other vehicle associated systems for operations other than payment at toll-road stations. allows for other Communication medium other than radio waves, for example optic signals, are admissible within the scope of the invention .

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CLAIMS

1. Transmitting and receiving equipment of a first type and designed primarily for placing in vehicles for remote communication with transmitting and receiving equipment of a second type placed mainly in stationary roadside units such as toll-road stations, which with said equipment are designed for communication for the execution of operations such as payment and identification operations, whereby in the first mentioned equipment there is stored data, including the position of the vehicle and the identity of the vehicle and/or the vehicle owner, which the data equipment is designed to communicate to the equipment of the second type, characterized in, that the equipment (1) of the first type comprises two major components, of which one is made up of a holder (2), which is designed for fixing to its position of use as in a vehicle, and the second major component (3) is designed for detachable coupling with the holder, whereby the second component placed in the holder can be used for communication and is designed to be separable from the holder, as well as from the position of use, thereby blocking, significantly at least, the said communication by means of an electronic blocking function, with the blocking function detachable so as to permit activation of communication by means of a predetermined code signal, and that the holder (2) is designed with device (16) for indicating the said predetermined code signal when the second component is placed in the holder.
2. Equipment according to claim 1, characterized in that essentially all functional parts for execution of remote communication are accommodated in the detachable component (3), while the holder (2) is primarily designed for the functions; permanent securing of the holder in the position of use, as in the vehicle, detachable support of the detachable component (3), and accommodation of the device (16), which is designed to interact with the detachable component for its blocking function.
3. Equipment according to claim 2, characterized in that the holder's device (16) for indicating the code signal is designed in such a way that elements essential to signal formation are put out of operation if the holder is subjected to force with the purpose of removing it from its fixed position.

4. Equipment according to claim 3, characterized in that said elements are formed by one or more parts designed, together with the rest of the holder, to be secured in the fixed position by a joint which is stronger than that required for separation of said elements from the holder in general.

5. Equipment according to any of the preceding claims, characterized in that the second component (3) and the holder's (2) device (16) for the blocking function are designed to be jointly reprogrammed with regard to the code signal as a consequence of the second component's repeated removal from the holder.

