



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
04.10.2000 Bulletin 2000/40

(51) Int. Cl.⁷: **G08G 1/017, G07B 15/00**

(21) Application number: **99949338.0**

(86) International application number:
PCT/JP99/05807

(22) Date of filing: **20.10.1999**

(87) International publication number:
WO 00/23961 (27.04.2000 Gazette 2000/17)

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**

(30) Priority: **22.10.1998 WO PCT/JP98/04800**

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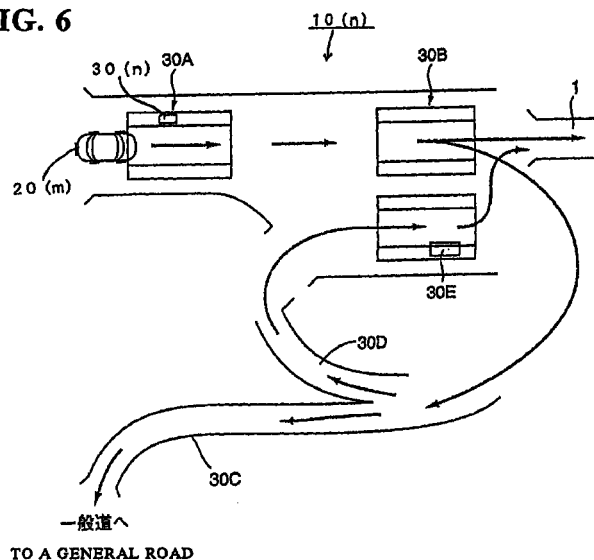
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(54) **TRAFFIC CONTROL SYSTEM**

(57) A vehicle passage management system (3) managing a vehicle (2) passing through a toll road (1) has a vehicle side communication device (20) installed in the vehicle (2) and gate side communication devices (30) installed in gates (10) installed at a plurality of positions for coming in and out the toll road (1). The gate (10) has a communication gate (30A) and a check gate

(30B). By communication between both of the communication devices, toll of each vehicle or so forth can be calculated without relying on a toll ticket or manpower. When failure is caused in the communication device, entry of such vehicle is inhibited by the check gate (30).

FIG. 6



Description

TECHNICAL FIELD

[0001] The present invention relates to a vehicle passage management system performing passage management of a vehicle traveling on a toll road, such as a highway or the like, passage management of a vehicle coming in and out a pay parking lot, and passage management of a vehicle coming in and out a plant premises or so forth.

[0002] Also, the present invention relates to a communication system for vehicle identification suitable for use in such vehicle passage management system.

BACKGROUND ART

[0003] In a passage management system for a vehicle traveling on a highway, a toll causing gate can be identified by arranging a gate is arranged in an interchange as entrance and exit of the highway, and making a driver of the vehicle entering into the highway to get a toll ticket. On the other hand, upon exiting from the highway, by handing the toll ticket to a toller from the driver at an exit gate, toll is calculated on the basis of the toll ticket, and the toll is paid in cash, prepaid card, credit card or so forth.

[0004] In such typical vehicle passage management system of the toll road, toll is calculated by making the driver traveling thereon to get the toll ticket at the entrance gate and submit the toll ticket at the exit gate. On the other hand, collection of toll is performed by the toller receiving the toll ticket or an automatic toll collection system.

[0005] Similarly, in the pay parking lot, a gate is arranged at the entrance and exit to issue a ticket to the driver of the vehicle entering thereinto to manage a parking fee. Upon exiting from the parking lot, settlement of the parking fee is performed by a fee collecting device installed at the exit gate using the ticket.

[0006] On the other hand, in the plant or so forth, vehicle coming in and out is monitored by security guard to avoid outsider from entering into the plant.

[0007] As set forth above, a method using a medium, such as toll ticket or the like and a method by the security guard is typical in the passage management of the vehicle coming in and out the particular road, site or so forth. However, the former method is troublesome since handing of the medium, such as the toll ticket or so forth is required. Since the later method relies on manpower, accuracy is insufficient, and difficulty is encountered in taking around the clock security.

[0008] Therefore, the applicant has previously proposed a vehicle passage management system of a highway performing passage management of the vehicle of the highway by communication. In the system, communication devices are provided in the gate of the highway and each vehicle, respectively to enable man-

agement with automatically identifying the vehicle passing through the gate, and in conjunction therewith, traveling zone can also be identified by communication to enable calculation of toll or so forth. Such vehicle passage management system may also be installed in shoulder of the road to identify vehicle passing there-through to obtain data, such as traffic volume.

[0009] In such vehicle passage management system, the following points to improve are left.

[0010] At first, in the gate or so forth on the highway, it has to make judgment whether the vehicle is permitted to enter into the highway or not at a timing where the vehicle is short of the gate to the highway. The reason is that if judgment is made upon passing through the gate, entry into the highway cannot be prevented.

[0011] Secondly, in such vehicle passage management system, the vehicle is identified by performing communication with the vehicle about passing the gate. Accordingly, with using this system, a communication system for identifying vehicle for detecting a vehicle, such as stolen vehicle or so forth.

DISCLOSURE OF THE INVENTION

[0012] An object of the present invention is to provide a vehicle passage management system which can make judgment whether passage of the vehicle is permitted or not and control passage of gate of a vehicle on the basis of the result of judgment by employing a double gate system.

[0013] On the other hand, an object of the present invention is to propose a communication system for identifying vehicle which can detect passage of a particular vehicle, such as a stolen vehicle, detect position of the stolen vehicle or so forth and detect passage history of the stolen vehicle or so forth which is dropped off with using the vehicle passing management system.

[0014] In order to accomplish the foregoing object, according to the first invention of the present application, a vehicle passage management system managing a vehicle passing through a particular zone, such as a toll road or the like, comprises:

a gate for coming in and out the particular zone, such as the toll road or the like, a vehicle side communication device installed on a vehicle and a gate side communication device installed in the gate, the vehicle side communication device being able to transmit an identification information of the vehicle and being able to receive a gate information of passed gate;
the gate side communication device being able to receive the identification information of the vehicle and being able to transmit gate information identifying the gate;
the gate including a communication gate being installed the gate side communication device for performing transmission and reception of the gate

information and the identification information of the vehicle with passing vehicle and a check gate located at frontal side of the communication gate in a vehicle traveling direction and inhibiting entry of the vehicle into the particular zone when transmission and reception of the gate information and the identification information of the vehicle at the communication gate is not properly performed.

[0015] The vehicle passage management system according to the present invention constructed as set forth above, a double gate system having a communication gate and a check gate are employed. Accordingly, for example, judgment whether entry into the toll road of the vehicle is permitted or not can be certainly performed before entry into the toll road. When the communication device of the vehicle is not in operation, the fact is announced to the driver in advance.

[0016] Considering the case where failure is caused in the communication device, it is desirable that the gate further comprises a ticket issuing portion for issuing a ticket for entering into the particular zone for the vehicle inhibited entry into the particular zone by the check gate.

[0017] On the other hand, it is desirable that the vehicle passage management system comprises an exit road to return the vehicle inhibited entry into the particular zone, out of the particular zone.

[0018] Furthermore, so that the driver of the vehicle may check whether the installed communication device is in operation or not, it is desirable to arrange an announcing means announcing the fact in the operating portion of the driver's seat. The announcing means may be at least one of an indication lamp mounted on an operation surface of a driver's seat of the vehicle and an audio indication means mounted on the driver's seat.

[0019] Such announcing means may take a vehicular battery as a driving power source for turning ON and OFF according to turning ON and OFF of a vehicular accessory power source.

[0020] On the other hand, the vehicle side communication device is mounted on a back side surface of a number plate of the vehicle. In this case, so that the outsider, such as security guard or so forth, on the gate may check whether the vehicle side communication device is in operation or not, an indicator lamp indicating the fact is desirable mounted in the position visible from the outside. For example, the indicator lamp is desirably buried in a seal portion of the number plate in an externally visible state. Here, the indicator lamp may take a vehicular battery as a driving power source for turning ON and OFF according to turning On and OFF of the vehicular accessory power source.

[0021] Next, the vehicle communication management system of the present invention set forth above, is applicable as the vehicle passage management system in the parking lot or the vehicle passage management system for coming in and out the particular zone, such

as a plant or the like. In these case, the gate may be common in the entrance gate and the exit gate.

[0022] Herein a typical vehicle side communication device to be employed in the vehicle passage communication system according to the present invention may comprise identification information storage portion storing an identification information of a vehicle installed the vehicle side communication device, a reception portion receiving a passage management information transmitted from the gate side communication device installed in the gate being passed, a received information storage portion capable of storing information received by the receiving portion and a transmitting portion transmitting information held in the identification information and the received information storage portion to the gate side communication device upon reception of a response demand signal from the gate side communication device.

[0023] On the other hand, the typical vehicle side communication device may comprise a transmitting portion transmitting the response demand signal and the passage management information to the vehicle side communication device of the vehicle passing through the gate, a receiving portion receiving the identification information of the vehicle transmitted by the vehicle side communication device in response to the response demand signal and the passage management information, a toll calculating portion calculating a toll of the vehicle passing through the gate on the basis of received information in the receiving portion and passage management information storage means for storing the calculated toll and the received information in the receiving portion with correspondence therebetween.

[0024] The transmitting portion in the gate side communication device may transmit the response demand signal again when reception failure of the transmission information of the vehicle side communication device passing through the gate.

[0025] Furthermore, the gate may further comprise image pick-up means for picking up image of the passing vehicle, and when information cannot be received from the side of the vehicle passing through the gate, image of the passing vehicle is picked up by the image pick-up means.

[0026] In addition, it is desirable that the gate further comprises toll collection device receiving payment of toll calculated by the toll calculating portion.

[0027] Furthermore, the vehicle passage management system may include a headquarter device, the gate side communication device installed in each of a plurality of the gates, and the vehicle side communication device installed in each of the vehicles, the passage management information of the passing vehicle received by the gate side communication device is concentrically managed on the side of the headquarter device.

[0028] Next, according to the second invention of

the present application, a communication system for vehicle identification to be employed in a vehicle passage management system managing a vehicle passing through a gate arranged on a road or so forth, comprises:

a gate side communication device installed in the gate and a vehicle side communication device installed in the vehicle;

the vehicle side communication device comprising a transmitting portion transmitting the response demand signal and a passage management information to the vehicle side communication device of the vehicle passing through the gate, a receiving portion receiving an identification information of the vehicle transmitted by the vehicle side communication device in response to the response demand signal and the passage management information, passage management information storage means for storing received information in the receiving portion, identifying vehicle information storage means storing identification information of identification objective vehicle, judgment means for making judgment whether the vehicle passing through the gate is the identification objective vehicle or not by comparing the storage content of the identifying vehicle information storage means and the identification information of the vehicle received by the receiving portion, and announcing means for announcing the fact when passage of the identification objective vehicle is detected; and

the vehicle side communication device comprising a vehicle identification information storage portion storing identification information of the vehicle on which the vehicle side communication device is installed, a receiving portion for receiving a passage management information transmitted from the gate side communication device installed in the gate being passed, a reception information storage portion capable of storing the passage management information received by the receiving portion, and a transmitting portion transmitting the vehicle identification information and the passage management information held in the received information storage portion to the gate side communication device.

[0029] In the communication system for vehicle identification to be employed in the vehicle passage management system according to the present invention constructed as set forth above, when the vehicle as identification object passes the gate, it is detected by the gate side communication device, and the fact is alarm displayed on the display screen or so forth. Accordingly, stolen vehicle or so forth can be found quickly and accurately.

[0030] Here, the gate side communication device may further comprise transmission control means for

making a continuous transmission demand signal toward the vehicle side communication device of the vehicle via the transmitting portion of the gate side communication device when passage of the identification objective vehicle is detected. On the other hand, the vehicle side communication device may comprise announcing signal control means for continuously transmitting or intermittently transmitting an announcing signal indicative that the vehicle is the identification objective vehicle bias the transmitting portion of the vehicle side communication device upon reception of the continuous transmission demand signal via the receiving portion of the vehicle side communication device.

[0031] In the communication system for vehicle identification according to the present invention constructed as set forth above, after the identification objective vehicle passes through the gate, the vehicle side communication device receiving the continuous transmission demand signal from the gate side continuously or intermittently transmit the announce signal indicative that the vehicle is the identification objective vehicle. Accordingly, by tracing the announce signal, the position of the identification objective vehicle can be quickly and accurately detected. For example, detection of the stolen vehicle or so forth becomes easy.

[0032] The vehicle side communication device is mounted on a back side surface of a number plate of the vehicle. In this case, so that the outsider, such as security guard or so forth, on the gate may check whether the vehicle side communication device is in operation or not, an indicator lamp indicating the fact is desirable mounted in the position visible from the outside. For example, the indicator lamp is desirably buried in a seal portion of the number plate in an externally visible state. Here, the indicator lamp may take a vehicular battery as a driving power source for turning ON and OFF according to turning On and OFF of the vehicular accessory power source.

[0033] The gate, which provided with the gate side communication device as constituted may be portable. With taking the movable gate mounted on the vehicle or the like, vehicle identification can be performed at a desired site. Also, it is convenient for tracing or so forth of the stolen vehicle or the like.

[0034] Next, in the vehicle side communication device of the construction set forth above, the present invention employs a construction, in which the identification information storage portion and the received information storage portion are mounted on the device casing of the vehicle side communication device covered with a protecting member. With this, for example, by analyzing the storage content by removing the storage portion from the illegally abandoned vehicle, dropped off vehicle or so forth, the owner and traveling history and so forth can be conveniently known.

[0035] On the other hand, when the stolen vehicle is used for criminal offense, it can be a strong evidence

for getting the pass-through sites and pass-through site passing times.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

Fig. 1 is a general constructional illustration showing one example of a vehicle passage management system according to the first invention of the present application;

Figs. 2(A) and (B) are general constructional illustration showing construction of a communication device on the side of a gate and a communication device on the side of vehicle;

Fig. 3 is an exploded perspective view showing a construction of a number plate, on which the communication device on the side of the vehicle is mounted;

Figs. 4(A) and (B) are explanatory illustrations for showing directionality of antenna of the communication device on the side of the vehicle;

Fig. 5 is a general flowchart showing operation of the system shown in Fig. 1;

Fig. 6 is an explanatory illustration showing a double gate system applied for each gate in the vehicle passage management system of Fig. 1;

Fig. 7 is a general constructional illustration showing one example of a communication system for identifying vehicle according to the second invention of the present application;

Fig. 8 is a schematic block diagram of the communication device on the side of the gate shown in Fig. 7;

Figs. 9(A) and (B) are a functional block diagram of the communication device on the side of the vehicle of Fig. 7 and a functional block diagram of a microprocessor unit thereof;

Fig. 10 is a general flowchart showing operation of the communication system for identifying vehicle of Fig. 7; and

Fig. 11 is a general flowchart showing judgment operation of objective vehicle for identification by the communication system for identifying the vehicle of Fig. 7.

BEST MODE FOR IMPLEMENTING THE INVENTION

[0037] Embodiments of a vehicle passage management system and a communication system for identifying vehicle according to the present invention will be discussed hereinafter in detail with reference to the accompanying drawings.

(First Embodiment)

[0038] In Fig. 1 to Fig. 6, there is shown an embodiment, in which a vehicle passage management system

according to the first invention of the present application is applied to a vehicle passage management of a highway.

[0039] Fig. 1 is a general constructional illustration of the shown embodiment of the vehicle passage management system. Referring to this drawing, a vehicle passage management system 3 managing passage of vehicles 2(m) ($m = 1, 2, 3 \dots$) traveling on a toll road 1 includes gates 10(n) ($n = 1, 2, 3 \dots$) installed at a plurality of positions for coming in and out the toll road 1, vehicle side communication devices 20(m) mounted on the vehicles 2(m), gate side communication devices 30(n) installed in the gates 10(n), and a headquarter device 50 connected to the gate side communication devices 30(n) through radio or wired communication circuits 40(n).

[0040] Here, each vehicle side communication device 20(m) can transmit an identification information 21(m) of the vehicle 2(m) and can receive gate information 11(n) capable of identifying the passed gate 10(n). For this, each gate side communication device 30(n) can receive the identification information 21(m) of the passing vehicle 2(m) and can transmit the gate information 11(n) for identifying the gate.

[0041] Figs. 2(A) and (B) are schematic block diagrams of the vehicle side communication device and the gate side communication device. Discussing with reference to these drawings, the vehicle side communication device 20(m) is constructed with a transmission and reception module 21, a microcomputer unit 22 having ROM and RAM and a vehicle mounted battery 23 as a power source. The identification information 24 of the vehicle 2(m) is stored in ROM. The transmission and reception module 21 receives a passage management information S1 transmitted from the gate side communication device 30(n). The received information is stored and held in RAM. On the other hand, the transmission and reception module 21 is responsive to reception of a response demand signal R from the gate side communication device 30(n) to transmit the identification information 24 and the information held in RAM to the gate side communication device 30.

[0042] On the other hand, the gate side communication device 30 includes a transmission and reception module 31 transmitting the response demand signal R, the gate information 11 and the passage management information S toward the vehicle side communication device 20 of the vehicle 2 passing through the gate 10 and receiving vehicle identification information 24 and the passage management information S2 transmitted from the vehicle side communication device 20 in response to the response demand signal R, a microcomputer unit 32 having a toll calculating function calculating toll of the vehicle 2 passing the gate 10 on the basis of received information by the transmission and reception module 31, RAM storing the calculated toll and the received information with correspondence therebetween, and a power source 33. On the other hand,

the microcomputer unit 32 is connected to the side of the superior host computer 34.

[0043] Here, upon occurrence of reception failure of the transmitted information of the vehicle side communication device 20 of the vehicle 2 passing through the gate 10, a transmitting portion 32 in the gate side communication device 30 transmits the response demand signal R again to certainly perform communication with the passing vehicle.

[0044] Next, preferred construction of the vehicle side communication device 20 will be discussed. As set forth above, since the vehicle side communication device 20 is for transmitting the vehicle information for identifying the vehicle, it is preferable that the device cannot be arbitrarily removed by the driver. For this purpose, it is desirable to arrange the vehicle side communication device 20 in a portion of the number plate. On the other hand, the vehicle side communication device 20 has to be constantly set in a condition enabled for transmitting the vehicle identification information (namely, operating state) during driving of the vehicle.

[0045] For this purpose, it is desirable that as the power source of the communication device 20, the vehicular battery is used, and a power supply path for the communication device 20 is established in the condition where a key is inserted and turned into ON position of vehicular accessories. Thus, in the vehicle driving condition, power is constantly supplied to the communication device 20 to enable the vehicle identification information.

[0046] In addition to the foregoing construction, in order to avoid the driver to arbitrarily set the communication device 20 at inoperative state, it is desirable to mount an indicator lamp visually perceptible whether the communication device 20 is in operating state or not, from outside.

[0047] In Fig. 3, there is shown an example of mounting of the vehicle side communication device 20 on the number plate of the vehicle.

[0048] In the example of this drawing, a number plate 70 is constructed with a box shaped receptacle casing 71, a number plate body 73 mounted in a side surface opening 72 of the receptacle casing 71, a transmission and reception circuit board 74 and an antenna plate 75. On the surface of the transmission and reception circuit board 74, a transmission and reception module 76 is mounted, and also, a light emitting body 77, such as LED or the like which is illuminated while the transmission and reception circuit is in operative state, is mounted. The light emitting body 77 is arranged at the same position as a seal 78 mounted on the number plate body 73 and is covered with the seal 78. The seal 78 is formed of a transparent material. Accordingly, the light emitting body 77 can check illumination/extinction of the light emitting body 77 externally through the seal 78.

[0049] Here, the receptacle casing 71 may be entirely formed of a non-conductive material, and, also,

in order to provide directionality for the built-in antenna plate 75, it may be formed of non-conductive material easy to pass a radio wave only in part. Of course, the built-in antenna plate 75 perse may be provided directionality. For example, as shown in Fig. 4, it is desirable to provide directionality in vertical direction.

[0050] Next, Fig. 5 is a flowchart showing operation of the shown embodiment of the vehicle passage management system 3. On the gate side, it is placed in vehicle waiting state and continuously effecting call (step ST1). In this transmitting operation, presence and absence of communication at the same frequency band is detected by performing carrier sensing (step ST2). When communication is present, communication at different vacant frequency is attempted. When communication at the same frequency band is absent, the response demand signal R is transmitted (step ST3).

[0051] On the gate side, when the control signal including the identification information 23 and the passage management information S2 are received from the side of the vehicle (step ST4), the gate information 11 of the gate is transmitted toward the vehicle (step ST5). On the gate side, when the gate information 11 is received from the gate side (step ST14), a confirmation signal indicative of reception is transmitted to the gate side (step ST15). On the side of the vehicle passing through the gate, when the confirmation signal is received (step ST6), it returns to reception waiting state again (step ST7). Similarly, even at the gate side, it returns to the waiting state (step ST16).

[0052] Thus, in the vehicle side communication device 20, so as not to cause difficulty in recognition at the same frequency when a plurality of vehicles enter into the gate in series, carrier sensing is performed with the gate side before performing communication, to perform communication with automatically switching to a vacant channel frequency. Accordingly, even when a plurality of vehicles are in series, communication with each vehicle can be performed certainly.

[0053] Next, in the shown embodiment of the vehicle passage management system, so that the vehicular driver may check whether the mounted communication device is in operative condition or not, announcing means for announcing the condition is desirably arranged in an operating portion of a driver's seat. The announcing means may be an indicator lamp mounted on an operation surface of the driver's seat of the vehicle or a audio indication means, such as speaker or the like, mounted on the driver's seat. Of course, both of these may be provided. Such announcing means may take the vehicular battery as a driving power source so that it is turned ON and OFF according to ON and OFF of in-vehicle accessory power source.

[0054] Here, in the shown embodiment of the vehicle passage management system 3, each gate 10(n) is a double gate system. Namely, as shown in Fig. 6, each gate 10(n) has a communication gate 30A and a checking gate 30B. The communication gate 30A has the

gate side communication device 30(n) of the construction set forth above for transmitting and receiving the gate information and the vehicle identifying information with the passing vehicle. The check gate 30B is located at the frontal side of the communication gate in vehicle traveling direction, and when transmission and reception of the gate information and the vehicle identification information in the communication data is not performed properly, entry of the vehicle into the toll road 1 is inhibited.

[0055] As set forth, in the shown embodiment, each gate is the double gate system. With this construction, it can announce that the vehicle side communication system is not in operation.

[0056] On the other hand, in the gate 10(n) of the shown embodiment, an exit road 30C is provided for returning the vehicle which cannot enter the highway to the open road from the check gate 30B. In this case, by forming a branched road 30D returning to the toll road at the midway of the exit road 30C, and by installing a gate 30E having a ticket issuing machine issuing an entry ticket to the highway, even the vehicle causing failure of the communication device may use the highway in normal manner of use.

[0057] It should be noted that the foregoing discussion is the embodiment, in which the present invention is applied to the passage management system of the highway. The present invention is equally applicable as the passage management system of the vehicle in a parking lot. Also, the invention is equally applicable for the passage management system for the vehicle coming in and out to particular area, such as factory site or so forth.

(Second Embodiment)

[0058] Next, discussion will be given for one example of the communication system for identification of the vehicle to be used in the vehicle passage management system according to the present invention with reference to Fig. 7 to Fig. 11.

[0059] Fig. 7 shows an overall construction of the shown embodiment of a communication system for identification of a vehicle. As shown in this drawing, a vehicle identifying communication system 400 is constructed with a gate side communication device 104 installed in a gate 103 arranged on a shoulder of a road 102, and a vehicle side communication device 1056 installed in each vehicle 105. Each vehicle side communication device 106 can transmit an identification information 5S of the vehicle 105 and can receive gate information 3S capable of identifying the passed gate 103. Each gate side communication device 104 can receive the identification information 5S of the passing vehicle 105 and can transmit the gate information 3S for identifying the gate.

[0060] In Fig. 8, a construction of the gate side communication device 104 is shown. The gate side

communication device 104 has a transmission and reception module 41, a microcomputer unit 42, a power source 43 of the device, a superior host computer 44 connected to the microcomputer unit 42 and a display device 45.

[0061] The transmission and reception module 41 transmits the response demand signal R directed to the vehicle side communication device 106 of the vehicle 105 passing through the gate 103, the gate identification information 3S and the passage management information S1 and receives the vehicle identification information 5S and the passage management information S2 transmitted from the vehicle side communication device 106. In the microcomputer unit 42, RAM for storing the passage management information, such as passing date, time and so forth of the vehicle 105 passing through the gate 103, with correspondence to reception information, on the basis of the reception information in the transmission and reception module 41, ROM having a storage region of the gate identification information 3S and a storage region of control program or so forth, and CPU performing control for respective portions.

[0062] In RAM of the microcomputer unit 42, a storage region storing an identified vehicle information list storing the identification information of the identification objective vehicles is formed. The identified vehicle information list is supplied from the side of the host computer, for example. The microcomputer unit 42 has a judgment function for making judgment whether the identification information 5S of the passing vehicle 105 received via the transmission and reception module 41 appears on the identified vehicle information list or not under control of CPU. On the other hand, an announcing function for announcing the fact when the passing vehicle 5 is judged as the vehicle appearing on the identified vehicle information list. On the side of the host computer 44, when the signal indicative of passing of the vehicle as object for identification is received from the microcomputer unit 42, the fact is displayed on a display screen of the display device 45 for providing alarm to an operator.

[0063] On the other hand, a transmission control function transmitting a continuous transmission demand signal R1 to the vehicle side communication device 106 of the vehicle via the transmission and reception module 41 of the gate side communication device 4, when the microcomputer unit 42 of the gate side communication device 104 further detects passing of the identification objective vehicle.

[0064] In Fig. 9, the construction of the vehicle side communication device 106 is shown. At first, as shown in Fig. 9(A), the vehicle side communication device 106 is constructed with a transmission and reception module 61, a microcomputer unit 62 and a vehicular battery 63 as a power source.

[0065] As shown in Fig. 9(B), the microcomputer unit 62 includes a data transmitting and receiving IC

621, CPU 622, EEPROM 623, D-RAM 624, an interface portion 625 with peripheral devices, and so forth. The identification information 5S of the vehicle 105 is stored in EEPROM 623. The passage management information received via the transmission and reception module 61 is also stored and held in EEPROM 623. When the response demand signal R is received via the transmission and reception module 61, the vehicle identification information 5S and the passage management information S2 held in the EEPROM 623 are transmitted to the gate side communication device 4 via the transmission and reception module 61.

[0066] On the other hand, the microcomputer unit 62 of the vehicle side communication device 106 has an announcing signal transmission control function for continuously or intermittently transmitting an announcing signal WS indicative that the vehicle 5 is the identification objective vehicle via the transmission and reception module 61 of the vehicle side communication device 106 when the continuous transmission demand signal R1 is received via the transmission and reception module 61 of the vehicle side communication device 6.

[0067] Here, since the vehicle communication device 106 is adapted to transmit the vehicle identification information 5S for identifying the vehicle, it is desirable to be arranged on a portion of the number plate so that it may not be subject to arbitrary removal or so forth on the side of the driver.

[0068] On the other hand, the vehicle side communication device 20 has to be constantly set in a condition enabled for transmitting the vehicle identification information (namely, operating state) during driving of the vehicle. For this purpose, it is desirable that as the power source of the communication device 6, the vehicular battery is used, and a power supply path for the communication device 106 is established in the condition where a key is inserted and turned into ON position of vehicular accessories.

[0069] In addition, in order to avoid the driver to arbitrarily set the communication device 106 at inoperative state, it is desirable to mount an indicator lamp visually perceptible whether the communication device 106 is in operating state or not, from outside.

[0070] Next, Fig. 10 is a flowchart showing operation of the shown embodiment of the vehicle identification communication system 400.

[0071] At first, on the side of gate 103, it is placed in vehicle 105 waiting state and continuously effecting call (step ST201). In this transmitting operation, presence or absence of communication at the same frequency band is detected by performing carrier sensing (step ST202). When communication is present, communication at different vacant frequency is attempted. When communication at the same frequency band is absent, the response demand signal R is transmitted (step ST203).

[0072] Upon approaching to the gate 103 in waiting state capable of reception and reception of the response demand signal R (step ST211), the vehicle

side communication device 106 of the vehicle 105 passing through the gate 103, performs carrier sensing (step ST212) to transmit the identification information 5S, the passage management information S2 and so forth of the vehicle 5 to the gate side communication device 4 at a wavelength of the vacant frequency band (step ST213).

[0073] On the gate side communication device 104, When the control signal including the vehicle identification information 5S and the passage management information S2 are received from the side of the vehicle side communication device 106 (step ST204), the gate information 3S of the gate 103 is transmitted toward the vehicle side communication device 106 (step ST205).

[0074] Upon reception of the gate identification information 3S from the gate side communication device 4 (step ST 214), the vehicle side communication device 106 transmits the confirmation signal indicative of reception, to the gate side communication device 104 (step ST215). Upon reception of this confirmation signal (step St206), the vehicle side communication device 106 of the vehicle 105 passing through the gate 103 returns to the waiting state again (step ST207). Similarly, even the gate side communication device 104 returns to the waiting state (step ST216).

[0075] Thus, in the vehicle side communication device 106, so as not to cause difficulty in recognition at the same frequency when a plurality of vehicles enter into the gate in series, carrier sensing is performed with the gate side before performing communication, to perform communication with automatically switching to a vacant channel frequency. Accordingly, even when a plurality of vehicles are in series, communication with each vehicle can be performed certainly.

[0076] Here, in Fig. 11, there is shown a general flowchart of judgment operation of the identification objective vehicle to be performed at every time of passing of the vehicle in the gate side communication device 104. On the side of the gate side communication device 104, the identification information of the identification objective vehicle is stored in D-RAM 624 in a form of list. At every occasion of reception of the vehicle identification information 5S, interrupt process of judgment operation is executed to perform judgment whether the received vehicle identification information 5S matches with the vehicle identification information contained in the stored identification objective vehicle list (step ST221). Upon matching, the fact is announced to the host computer 44. As a result, on the screen of the display device 45, an alarm display of the fact is performed (step ST222). For example, when the identification objective vehicle is that on the stolen vehicle list, displaying of passage of the stolen vehicle is performed. Subsequently, the continuous transmission demand signal R1 is transmitted via the transmission and reception module 41 toward the vehicle side communication device 106 of the passed vehicle 105 (step ST223).

[0077] On the side of the vehicle side communica-

tion device 105 of the vehicle 105, upon reception of the continuous transmission demand signal R1 (step 231), it continues transmission of the alarm signal WR indicative that the vehicle 105 is the identification objective vehicle (step ST 232), and other operation is forcedly placed in enabled condition.

[0078] The foregoing embodiment is an example of the case where the gate 103 is installed on the road-side. In stead, the gate 103 may be portable type. For example, with a vehicle mounting type gate, identifying operation of the passing vehicle can be performed at desired site. On the other hand, since the vehicle continuously transmitting the alarm signal WR can be traced, the stolen vehicle or so forth can be quickly found.

INDUSTRIAL APPLICABILITY

[0079] As discussed above, in the vehicle passage management system by the first invention of the present application, a function for transmitting identification information of the vehicle is provided, and the gate information identifying the passed gate is stored. On the other hand, on the gate side, the function for receiving the vehicle identification information transmitted by the passing vehicle and transmitting the gate information identifying the gate to the side of the passing vehicle. Furthermore, the gate is the double gate system to perform communication with the vehicle in the first gate and make judgment whether entry into the highway, parking lot or particular zone is permitted or not on the basis of the result of communication, in the second gate.

[0080] With the vehicle passage management system of the present invention constructed as set forth above, on the side of the vehicle passing through the entrance gate, since the passed gate is stored, toll can be calculated on the basis of the gate information stored in each vehicle in the exit gate. In the passage management system of the vehicle coming in and out the parking lot, information of the vehicle entering through the gate and the time are stored. Upon exiting through the gate, parking time is calculated to perform settlement process of the parking fee can be performed automatically. On the other hand, upon occurrence of failure of the vehicle side communication device, or so forth, entry of the vehicle can be prevented to certainly perform management.

[0081] Furthermore, in the driver's seat of the vehicle, announcing means whether the communication device is operating state or not, is arranged. Upon coming into the highway or so forth, the driver feels discomfort when confirmation can be made. Such discomfort can be resolved.

[0082] Next, the communication system for vehicle identification to be used in the vehicle passage management system according to the second invention of the present application, the function for transmitting the identification information of the vehicle is provided, and

for storing the gate information identifying the gate. On the other hand, on the gate side, a function for receiving the vehicle identification information transmitted by the passing vehicle and transmitting the gate information identifying the gate is provided. Furthermore, on the gate side, the identification objective vehicle list is preliminarily stored. Judgment whether the received vehicle identification information is the identification objective vehicle or not.

[0083] By the communication system for vehicle identification according to the second invention of the present application constructed as set forth above, the vehicle, such as stolen vehicle or so forth can be quickly and accurately identified.

[0084] On the other hand, when the identification objective vehicle passes, a demand for continuously or intermittently transmitting an alarm signal is issued to the vehicle side communication device of the vehicle. Subsequently, the alarm signal is continuously or intermittently transmitted from the vehicle side communication device. Accordingly, on the basis of the alarm signal, the position of the identification objective vehicle can be easily found.

[0085] Furthermore, in the vehicle side communication device employed in the communication system for vehicle identification, the storage portion storing the vehicle identification information and the passage management record is mounted and secured on the device casing in the condition covered by the protective member. Accordingly, by analyzing the storage content by removing the storage portion from the illegally abandoned vehicle, dropped off vehicle or so forth, the owner and traveling history and so forth can be conveniently known.

Claims

1. A vehicle passage management system managing a vehicle passing through a particular zone, such as a toll road or the like, comprising:

a gate for coming in and out the particular zone, such as the toll road or the like, a vehicle side communication device installed on a vehicle and a gate side communication device installed in said gate, said vehicle side communication device being able to transmit an identification information of said vehicle and being able to receive a gate information of passed gate; said gate side communication device being able to receive said identification information of said vehicle and being able to transmit gate information identifying the gate; said gate including a communication gate being installed said gate side communication device for performing transmission and reception of the gate information and the identifica-

tion information of the vehicle with passing vehicle and a check gate located at frontal side of said communication gate in a vehicle traveling direction and inhibiting entry of the vehicle into said particular zone when transmission and reception of said gate information and said identification information of the vehicle at said communication gate is not properly performed.

2. A vehicle passage management system as set forth in claim 1, wherein said gate further comprises a ticket issuing portion for issuing a ticket for entering into said particular zone for the vehicle inhibited entry into said particular zone by said check gate.

3. A vehicle passage management system as set forth in claim 2, which comprises an exit road to return the vehicle inhibited entry into said particular zone, out of said particular zone.

4. A vehicle passage management system as set forth in any one of claims 1 to 3, which further comprises announcing means for announcing whether said vehicle side communication device mounted on said vehicle is in operating condition or not, to a vehicular driver.

5. A vehicle passage management system as set forth in claim 4, wherein said announcing means is at least one of an indication lamp mounted on an operation surface of a driver's seat of the vehicle and an audio indication means mounted on the driver's seat.

6. A vehicle passage management system as set forth in claim 4 or 5, wherein said announcing means takes a vehicular battery as a driving power source for turning ON and OFF according to turning ON and OFF of a vehicular accessory power source.

7. A vehicle passage management system as set forth in any one of claims 1 to 6, wherein said vehicle side communication device is mounted on a back side surface of a number plate of the vehicle.

8. A vehicle passage management system as set forth in any one of claims 1 to 7, which comprises an indicator lamp indicating whether said vehicle side communication device is operating state or not, said indicator lamp being buried in a seal portion of said number plate in an externally visible state.

9. A vehicle passage management system as set forth in claim 8, wherein said indicator lamp takes a vehicular battery as a driving power source for turning ON and OFF according to turning On and OFF of the vehicular accessory power source.

10. A vehicle passage management system as set forth in any one of claims 1 to 9, wherein said vehicle side communication device comprises identification information storage portion storing an identification information of a vehicle installed said vehicle side communication device, a reception portion receiving a passage management information transmitted from said gate side communication device installed in said gate being passed, a received information storage portion capable of storing information received by said receiving portion and a transmitting portion transmitting information held in said identification information and said received information storage portion to said gate side communication device upon reception of a response demand signal from said gate side communication device,

said vehicle side communication device comprises a transmitting portion transmitting the response demand signal and the passage management information to said vehicle side communication device of the vehicle passing through said gate, a receiving portion receiving the identification information of the vehicle transmitted by said vehicle side communication device in response to said response demand signal and the passage management information, a toll calculating portion calculating a toll of the vehicle passing through said gate on the basis of received information in said receiving portion and passage management information storage means for storing the calculated toll and the received information in said receiving portion with correspondence therebetween.

11. A vehicle passage management system as set forth in claim 10, wherein said transmitting portion in said gate side communication device transmits said response demand signal again when reception failure of the transmission information of said vehicle side communication device passing through said gate.

12. A vehicle passage management system as set forth in claim 11, wherein said gate further comprises image pick-up means for picking up image of the passing vehicle, and when information cannot be received from the side of the vehicle passing through said gate, image of the passing vehicle is picked up by said image pick-up means.

13. A vehicle passage management system as set forth in claim 12, wherein said gate further comprises toll collection device receiving payment of toll calculated by said toll calculating portion.

14. A vehicle passage management system as set forth

in claim 13, which includes a headquarter device, said gate side communication device installed in each of a plurality of said gates, and said vehicle side communication device installed in each of the vehicles, the passage management information of the passing vehicle received by said gate side communication device is concentrically managed on the side of said headquarter device.

15. A communication system for vehicle identification to be employed in a vehicle passage management system managing a vehicle passing through a gate arranged on a road or so forth, comprising:

a gate side communication device installed in said gate and a vehicle side communication device installed in said vehicle;

said vehicle side communication device comprising a transmitting portion transmitting the response demand signal and a passage management information to said vehicle side communication device of the vehicle passing through said gate, a receiving portion receiving an identification information of the vehicle transmitted by said vehicle side communication device in response to said response demand signal and the passage management information, passage management information storage means for storing received information in said receiving portion, identifying vehicle information storage means storing identification information of identification objective vehicle, judgment means for making judgment whether the vehicle passing through said gate is the identification objective vehicle or nor by comparing the storage content of said identifying vehicle information storage means and said identification information of the vehicle received by said receiving portion, and announcing means for announcing the fact when passage of the identification objective vehicle is detected; and

said vehicle side communication device comprising a vehicle identification information storage portion storing identification information of the vehicle on which said vehicle side communication device is installed, a receiving portion for receiving a passage management information transmitted from said gate side communication device installed in said gate being passed, a reception information storage portion capable of storing said passage management information received by said receiving portion, and a transmitting portion transmitting said vehicle identification information and the passage management information held in said received information storage portion to said gate side communication device.

16. A communication system for vehicle identification as set forth in claim 15, wherein said gate side communication device further comprises transmission control means for making a continuous transmission demand signal toward said vehicle side communication device of said vehicle via said transmitting portion of said gate side communication device when passage of the identification objective vehicle is detected, and

said vehicle side communication device comprises announcing signal control means for continuously transmitting or intermittently transmitting an announcing signal indicative that said vehicle is the identification objective vehicle bias said transmitting portion of said vehicle side communication device upon reception of said continuous transmission demand signal via said receiving portion of said vehicle side communication device.

17. A communication system for vehicle identification as set forth in claim 15 or 16, wherein said vehicle side communication device is mounted on the back side surface of the number plate of the vehicle.

18. A communication system for vehicle identification as set forth in any one of claims 15 to 17, which comprises an indicator lamp indicating whether said vehicle side communication device is operating state or not, said indicator lamp being buried in a seal portion of said number plate in an externally visible state.

19. A communication system for vehicle identification as set forth in claim 18, wherein said indicator lamp takes a vehicular battery as a driving power source for turning ON and OFF according to turning On and OFF of the vehicular accessory power source.

20. A communication system for vehicle identification as set forth in any one of claims 15 to 19, wherein said gate, in which said gate side communication device is installed, is portable.

21. A communication system for vehicle identification as set forth in any one of claims 15 to 20, wherein, in said vehicle side communication device, said identification information storage portion and said received information storage portion are mounted on the device casing of said vehicle side communication device covered with a protecting member.

FIG. 1

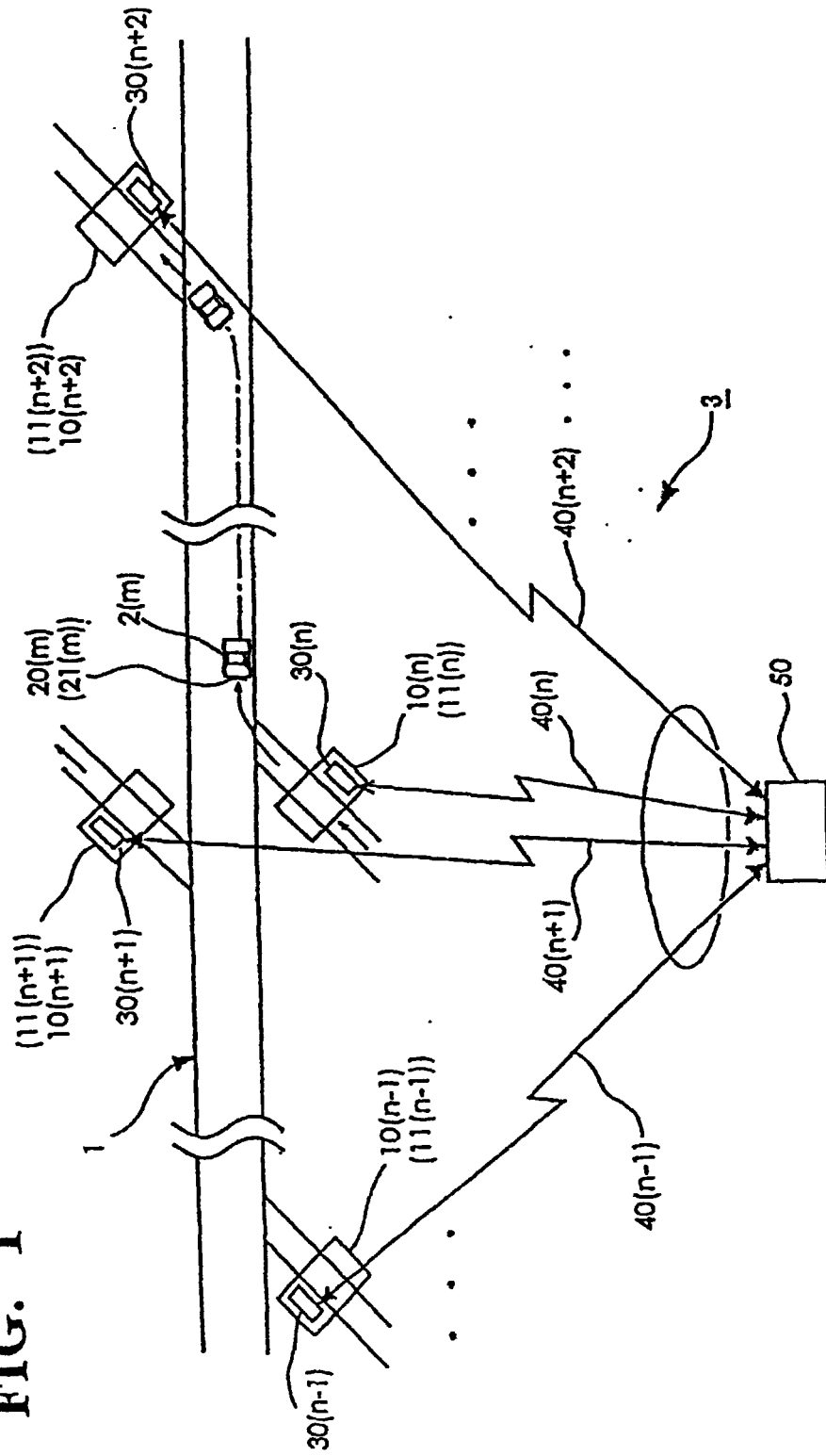
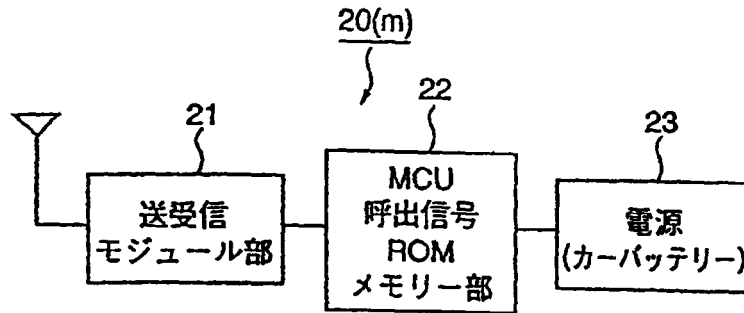
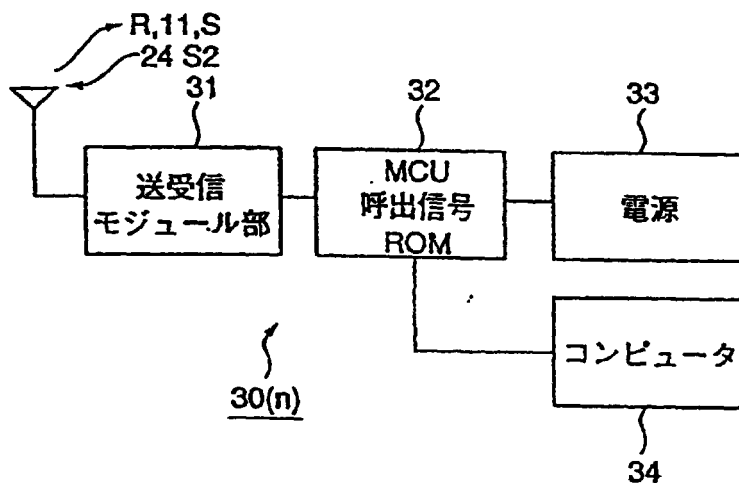


FIG. 2

(A) (車側ブロック図)



(B) (ゲート側ブロック図)



(A) (VEHICLE SIDE BLOCK DIAGRAM)

21 TRANSMISSION AND RECEPTION MODULE PORTION

22 MCU CALL SIGNAL ROM MEMORY PORTION

23 POWER SOURCE (VEHICULAR BATTERY)

(B) (GATE SIDE BLOCK DIAGRAM)

31 TRANSMISSION AND RECEPTION MODULE PORTION

32 MCU CALL SIGNAL ROM

33 POWER SOURCE

34 COMPUTER

FIG. 3

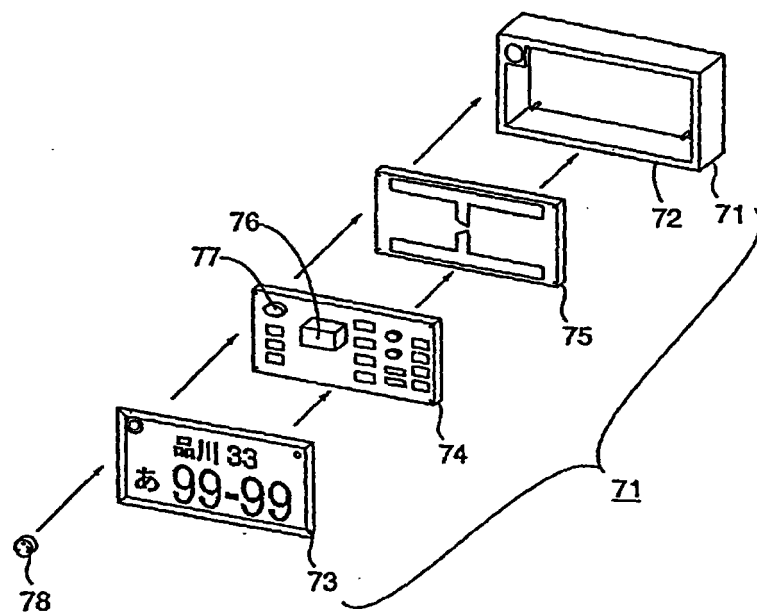
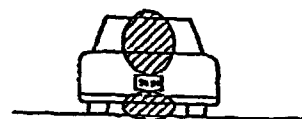


FIG. 4

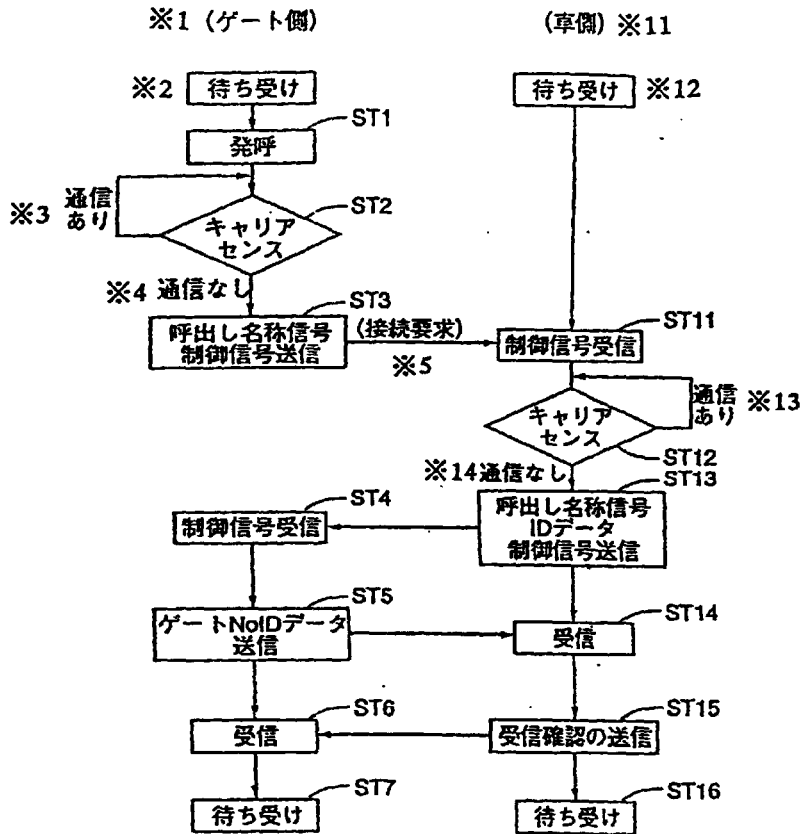


(A)



(B)

FIG. 5



※1 GATE SIDE

※2 WAIT

※3 COMMUNICATION PRESENT

※4 COMMUNICATION ABSENT

※5 CONNECTION DEMAND

ST1 CALL

ST2 CARRIER SENSING

ST3 TRANSMIT CALL NAME SIGNAL,
CONTROL SIGNAL

ST4 RECEIVE CONTROL SIGNAL

ST5 TRANSMIT GATE NO. ID DATA

ST6 RECEPTION

ST7 WAIT

※11 VEHICLE SIDE

※12 WAIT

※13 COMMUNICATION PRESENT

※14 COMMUNICATION ABSENT

ST11 RECEIVE CONTROL SIGNAL

ST12 CARRIER SENSING

ST13 TRANSMIT CALL NAME SIGNAL,
ID DATA, CONTROL SIGNAL

ST14 RECEPTION

ST15 TRANSMIT RECEPTION CONFIRMATION

ST16 WAIT

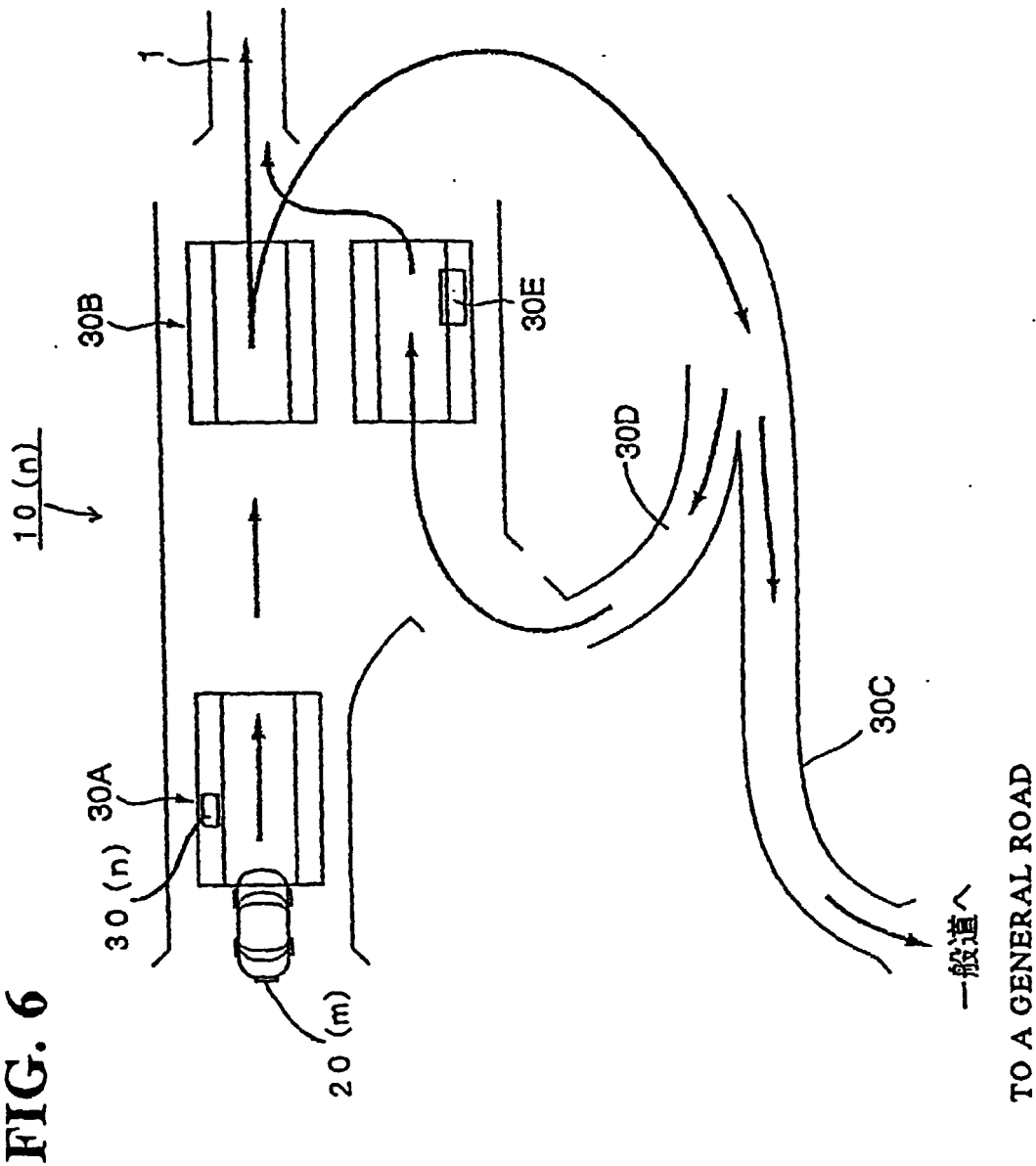
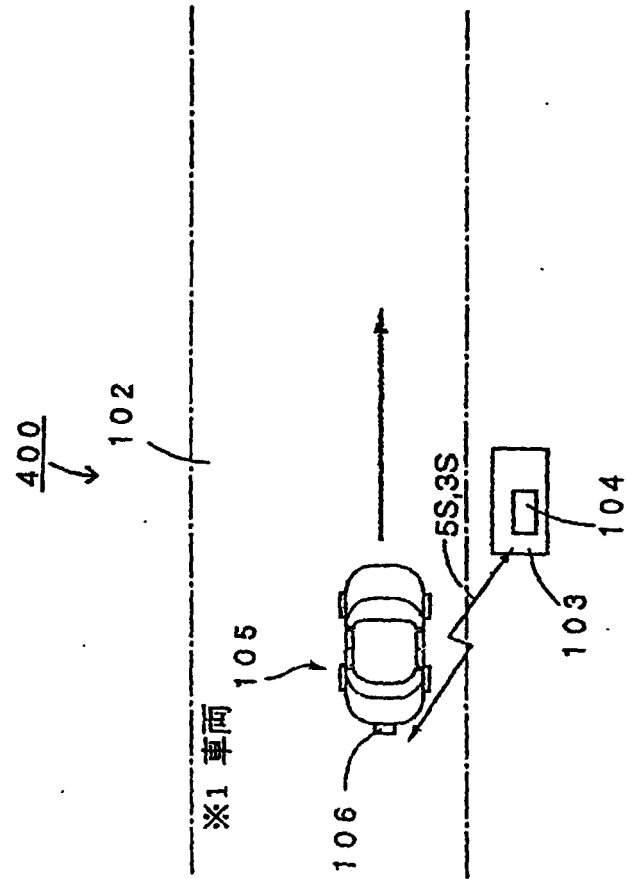
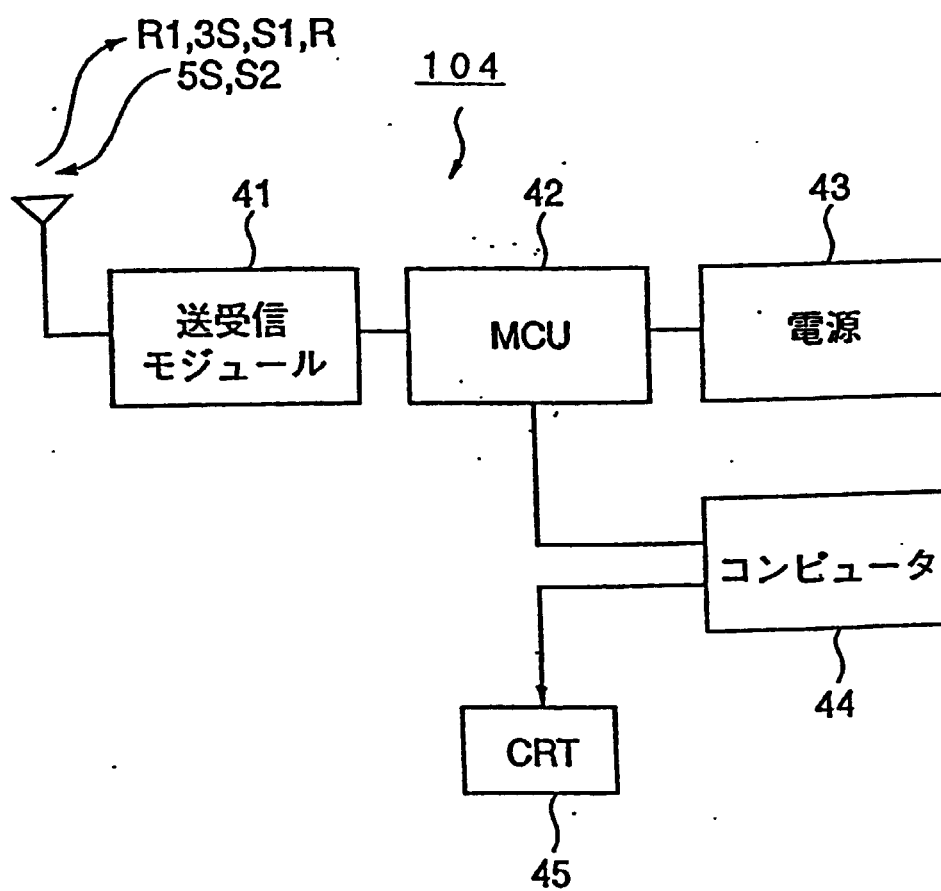


FIG. 7



※1 VEHICLE

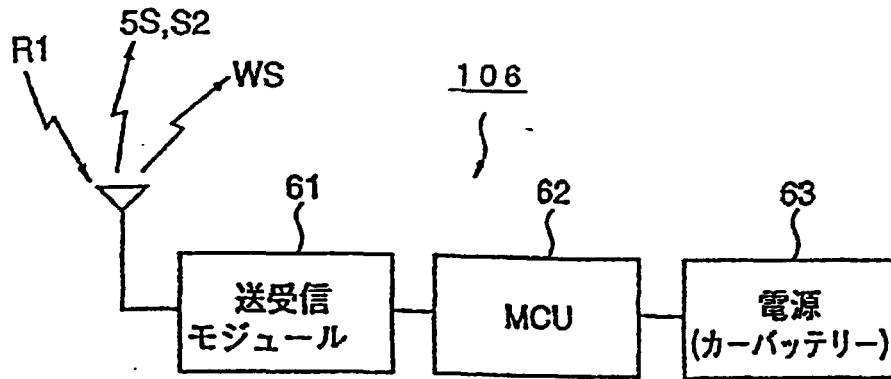
FIG. 8



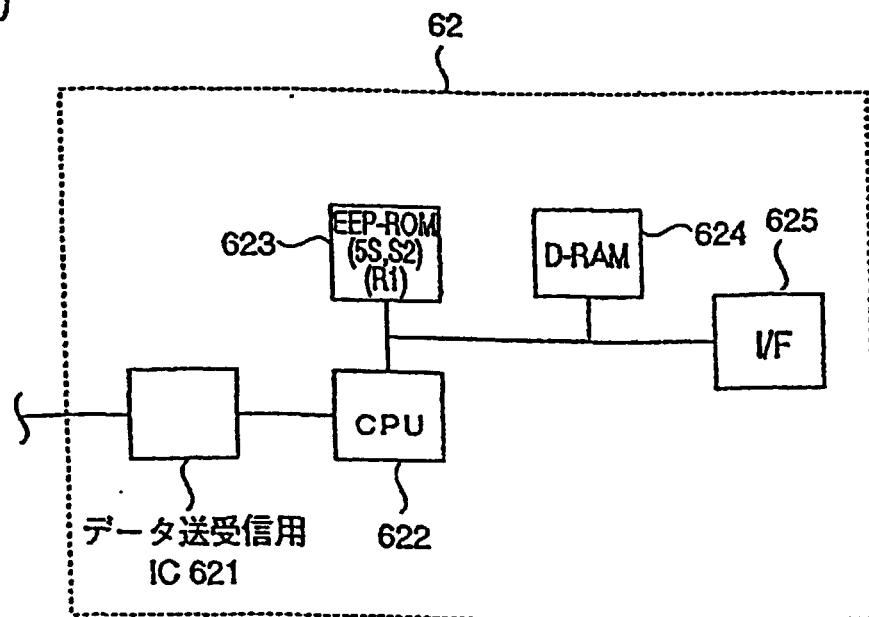
- 41 TRANSMISSION AND RECEPTION MODULE
- 43 POWER SOURCE
- 44 COMPUTER

FIG. 9

(A)

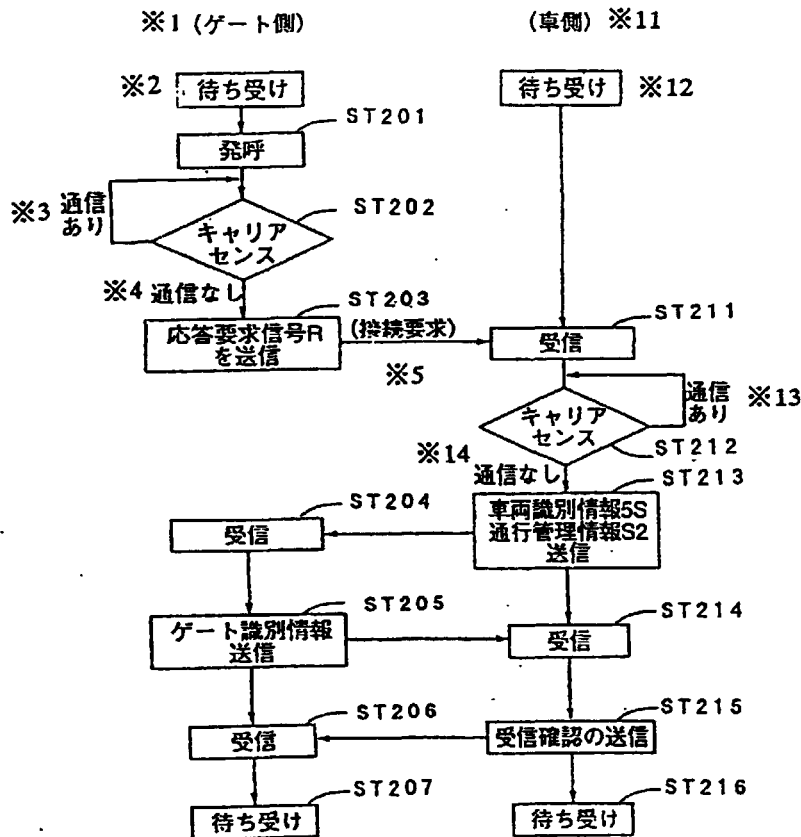


(B)



- 61 TRANSMISSION AND RECEPTION MODULE
- 63 POWER SOURCE (VEHICULAR BATTERY)
- 621 DATA TRANSMISSION AND RECEPTION IC

FIG. 10



※1 GATE SIDE

※2 WAIT

※3 COMMUNICATION PRESENT

※4 COMMUNICATION ABSENT

※5 CONNECTION DEMAND

ST201 CALL

ST202 CARRIER SENSING

ST203 TRANSMIT
RESPONSE DEMAND SIGNAL R

ST204 RECEPTION

ST205 TRANSMIT
GATE IDENTIFICATION INFORMATION

ST206 RECEPTION

ST207 WAIT

※11 VEHICLE SIDE

※12 WAIT

※13 COMMUNICATION PRESENT

※14 COMMUNICATION ABSENT

ST211 RECEPTION

ST212 CARRIER SENSING

ST213 TRANSMIT VEHICLE IDENTIFICATION
INFORMATION 5S

AND PASSAGE MANAGEMENT

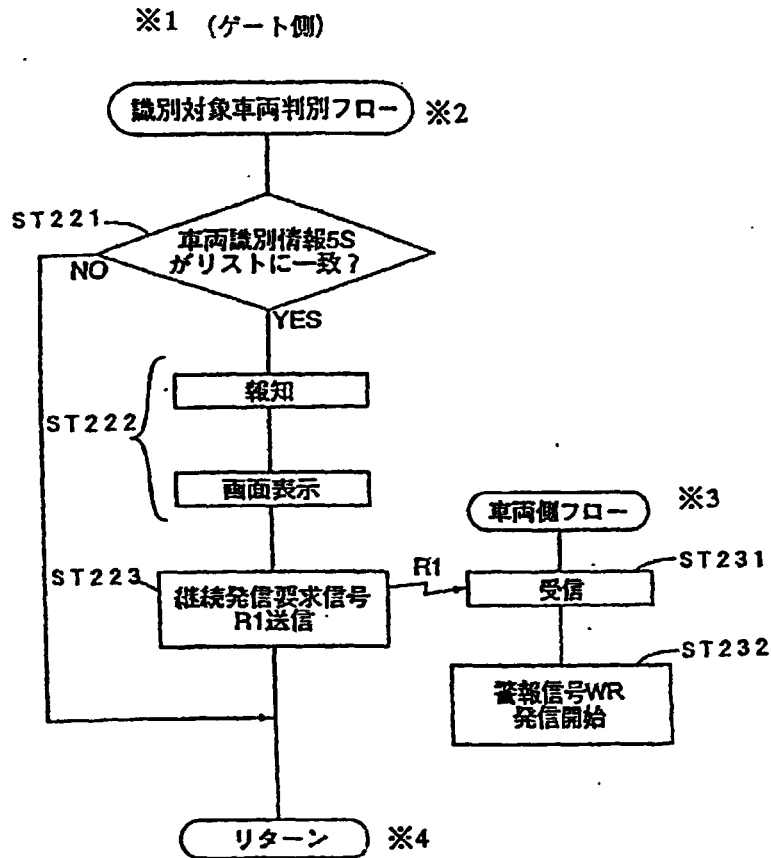
INFORMATION S2

ST214 RECEPTION

ST215 TRANSMIT RECEPTION CONFIRMATION

ST216 WAIT

FIG. 11



※1 GATE SIDE

※2 IDENTIFICATION OBJECTIVE VEHICLE JUDGMENT FLOW

※3 VEHICLE SIDE FLOW

※4 RETURN

ST221 VEHICLE IDENTIFICATION INFORMATION 5S MATCH WITH LIST?

ST222 ANNOUNCE DISPLAY

ST223 TRANSMIT CONTINUOUS TRANSMISSION DEMAND SIGNAL R1

ST231 RECEPTION

ST232 START TRANSMISSION OF ALARM SIGNAL WR

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/05807

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁷ G08G1/017, G07B15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.⁷ G08G1/017, G07B15/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 8-161559, A (Toshiba Corporation), 21 June, 1996 (21.06.96), Full text; Figs. 1 to 5	1, 2
A	Full text; Figs. 1 to 5 (Family: none)	3-21
A	JP, 10-105874, A (OMRON CORPORATION), 24 April, 1998 (24.04.98), Full text; Figs. 1 to 15 (Family: none)	1-21
A	JP, 10-105872, A (OMRON CORPORATION), 24 April, 1998 (24.04.98), Full text; Figs. 1 to 14 (Family: none)	1-21
A	JP, 8-235490, A (Hitachi, Ltd.), 13 September, 1996 (13.09.96), Full text; Figs. 1 to 13 (Family: none)	1-21
A	JP, 8-221617, A (Mitsubishi Heavy Industries, Ltd.), 30 August, 1996 (30.08.96), Full text; Figs. 1 to 11 (Family: none)	1-21

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
18 January, 2000 (18.01.00)

Date of mailing of the international search report
01 February, 2000 (01.02.00)

Name and mailing address of the ISA/
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