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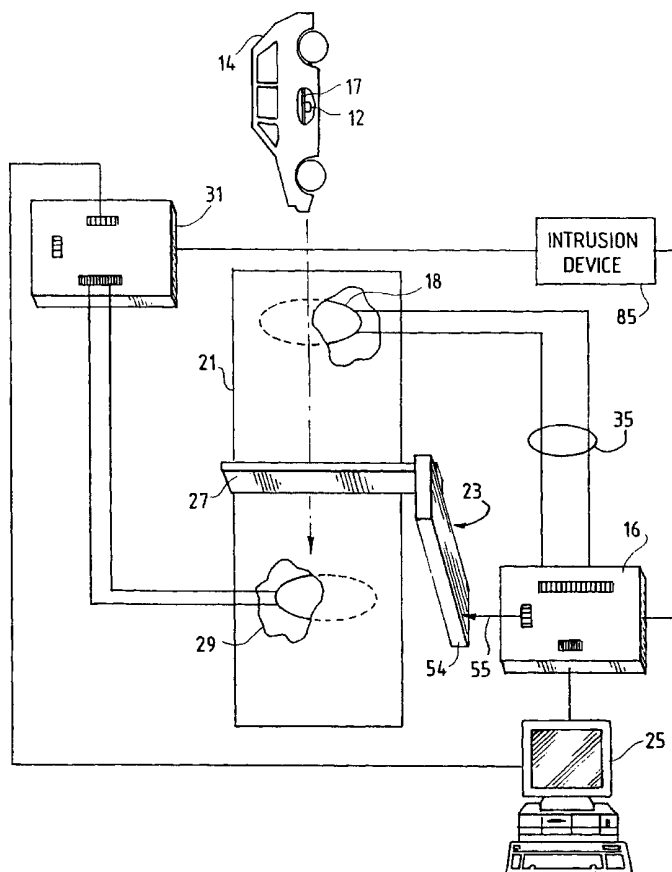
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(54) Title: VEHICLE IDENTIFICATION SYSTEM AND METHOD OF USING SAME



(57) Abstract: The new vehicle identification system includes a radio frequency identification tag or transceiver (12) mounted inconspicuously on the outside of a moving vehicle (14) traveling over a buried loop antenna (18) of a reader (16) to determine the identity of the vehicle.

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## TITLE OF THE INVENTION

## VEHICLE IDENTIFICATION SYSTEM AND

## METHOD OF USING SAME

## CROSS-REFERENCE TO RELATED APPLICATIONS

5 Not applicable

## STATEMENT REGARDING FEDERALLY SPONSORED

## RESEARCH OR DEVELOPMENT

Not Applicable

## REFERENCE TO A "MICROFICHE APPENDIX"

10 Not Applicable

## BACKGROUND OF THE INVENTION

Technical Field

This invention relates in general to a vehicle identification system, and it more particularly relates to a system and method for automatically permitting  
15 access of a vehicle to a protected area based on the identification of the vehicle against a database of registered users.

### Background Art

There have been a variety of electronic identification systems used for a number of different applications. For example, reference may be made to U.S. patents 5,184,132; 5,475,377; 5,629,981 and 5,905,247, as well as Japanese patent  
5 9297900A.

One type of such a system is a parking security system. Typical parking security systems currently available require the use of either a handheld electronic device (such as a commercially available garage door opener or a magnetic security card) or a sequence of key strokes by the driver at a centrally located  
10 keypad. Such techniques have significant disadvantages in both convenience of use and basic security of the system.

A system with a typical garage door opener can be duplicated by an unauthorized person desiring to gain access to the secured parking facility or area. Such devices employ radio transmissions on frequency bands which are used on  
15 many commercially available products, thereby making the technology almost common knowledge. Manufacturers provide equipment on these bands because the equipment does not require FCC licensing by the manufacturer or user. Property managers distribute these devices to their tenants. It is common for

tenants to "loan" their opening device to a visitor. Such "loaning" of devices defeats the purpose of having a secured area. This type of activity, which is common, prevents management from insuring that visitors check with on-site security for proper entry onto the property. Such devices often do not have any  
5 unique coding for identification of the user or device.

The second problem that is common with handheld garage door opener electronic devices is that they are frequently lost by the tenant. Replacements are issued, but the occurrence of loss is so frequent that changing the frequency code of the garage door opening control system and each issued opener becomes a labor  
10 and financial burden to the property management company. Thus, many months or years go by with no changes to the code causing security issues to begin to arise.

The third problem with such electronic devices is the constant turn over of residents. As new residents move in, others are moving out. Many times new openers have to be issued because the departing tenant cannot find his issued  
15 opener and is many times located during the unpacking at the new residence. The problem arises again with codes not being changed or lost cards not being deactivated.

Using a keypad with a special code is a very expensive approach. Also, many of the same security issues are faced because the code can be passed to other individuals. Unless the property management company changes the code with each new tenant, the advantages of a security entry system quickly deteriorates.

5 Another kind of vehicle identification system relates to the use of a passive radio frequency identification tag which is positioned within a vehicle. Such tags are manufactured by Texas Instruments and are marketed by Sentinel ID Systems, Inc. of Plano, Texas. One application for such a system is intended for use in public parking facilities, such as hospital parking areas, office building garages,  
10 and airport parking lots. A barrier gate is lifted to permit access to an authorized vehicle when a reader having a large loop antenna disposed in an upright manner adjacent to the entrance lane transmits energy to the window-mounted passive identification tag. An identity code is then sent from the tag to the reader via its loop antenna. If the identity is of an authorized vehicle, the reader causes the gate  
15 to be raised to permit access to the parking facility.

However, the window mounted tag is visible from outside the vehicle, and thus is subject to being taken from the vehicle by an unauthorized individual who could then use the misappropriated tag on his or her own vehicle to enter the secure

parking area. Thus, the integrity of the secure area could be violated. Also, the person who has misappropriated the tag, could therefore gain access to confidential information such as credit card information stored in the passive stage.

Additionally, the large antenna loop is subject to being vandalized.

5 Therefore, it would be highly desirable to have a new and improved vehicle identification system which overcomes the foregoing problems and is relatively less expensive to manufacture.

#### SUMMARY OF THE INVENTION

Therefore, principal object of the present invention is to provide a new and  
10 improved vehicle identification system, which is a more secure and convenient to use system for a variety of applications.

Briefly, the above and further objects of the present inventions are realized by providing a new and improved vehicle identification system for use in a variety of applications in a secure manner and at a relatively low cost of manufacture.

15 The new vehicle identification system includes a radio frequency identification tag or transceiver mounted inconspicuously on the outside of a vehicle. The vehicle travels over a buried loop antenna interfaced to a reader system for determining the identity of the vehicle.

Since the tag is mounted inconspicuously, such as on the undercarriage of the vehicle, the tag is not subject to misappropriation, since it is not visible to the casual observer. The loop antenna is also not visible to an observer, and thus the antenna is not subject to being vandalized.

5

### BRIEF DESCRIPTION OF DRAWINGS

The above mentioned and other objects and features of this invention and the manner of attaining them will become apparent, and the invention itself will be best understood by reference to the following description of the embodiment of the invention in conjunction with the accompanying drawings, wherein:

10

FIG. 1 is a diagrammatic view of a vehicle identification system which is constructed in accordance with the present invention;

FIG. 2 is a symbolic block diagram of the system of FIG. 1;

FIG. 3 is an enlarged diagrammatic detail view of the radio frequency tag of

15

FIG. 1, illustrating the manner of attachment to the vehicle; and

FIG. 4 is an enlarged sectional view of the loop antenna, illustrating the manner of mounting the antenna within the roadway or pathway.



FIG. 5 is an enlarged diagrammatic detail view of another radio frequency tag of FIG. 1, illustrating the manner of attachment to the vehicle; and

FIG. 6 is an enlarged diagrammatic detail view of another radio frequency tag of FIG. 1, illustrating the manner of attachment to the vehicle

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### BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawings, and more particularly to FIG. 1, there is shown a vehicle identification system 10, which is constructed according to the present invention. The system 10 has many different applications including, but not limited to, pre-paid parking lot facilities, condominium and apartment complexes with secured parking areas, rental car agencies, hospital employee parking facilities, government employee parking facilities, airport employee parking facilities, industrial parking facilities with controlled employee parking areas, business office complexes having secured parking facilities, quick service restaurants with drive-through and drive-in service facilities for frequent dining identification, and petroleum company service stations.

As shown in FIGS. 1 and 2, the system 10 includes a group of radio frequency identification tags or radio frequency transceivers, such as a tag 12

mounted inconspicuously on the underside of the outside of a vehicle 14 to conceal the tag 12 from view. Each tag is adapted to be mounted on and individually identify its vehicle. The tag may either be active tags or passive tags, although active tags are being currently preferred. The tag 12 is secured by an attachment  
5 device, such as a magnet (15 (FIG. 3), nuts and bolts generally indicated at 90 and 91 of FIG 5 for a like tag 12A, or an adhesive 92 (FIG. 6) for a like tag 12B, to a portion of the vehicle, such as a portion 17 of the undercarriage of the vehicle 14.

A reader 16 having a front detection loop antenna 18 buried under an access roadway or pathway 21 leading to a secure parking area (not shown) or the like  
10 communicates with the tag 12 to help identify the vehicle 14 as being authorized or not. If the vehicle 14 is authorized, a barrier gate 27 of an access gate system 23 at the point of entry into the secure area, is raised to permit access to the vehicle 14 in response to a signal received from the reader 16. The tag 12 is polled by the reader 16, which accesses the tag's identification code and communicates this  
15 information to a controller 25. The controller 25 has a database of information stored within its memory (not shown) and compares the received number to the database to determine if the number is valid and authorized for entry as determined

by other criteria such as time of day. If so, a signal is sent to the gate control system 23 to open or close a gate or door 27.

By utilizing the inventive system 10 for apartment or office facilities, tenants are not required to carry electronic devices or remember entry codes. The tenant is  
5 not able to "loan" his or her device or code to someone else. Therefore, all non-residents of the facility are required to enter the property through a designated proper security entry (not shown) and are denied entry to the secure parking area.

In order to poll the tag on the passing vehicle 14, a query signal is transmitted from the reader 16 to the tag 12 via the buried loop antenna 18. The  
10 loop antenna 18 is located in front of the entry gate or other access point. It is either buried under the pavement of the pathway 21, or otherwise installed within the pavement of the pathway 21 by saw cutting a trace or channel such as the channel 28 (FIG. 4) for the antenna 18. After inserting the antenna into the trace or channel 28, it is then covered with a sealant, such as a sealant 30 (FIG. 4). The tag  
15 12 transmits its response back to the reader 16 via the same loop antenna 18. A second detection loop antenna 29 may be buried in the pathway 21 spaced from the front loop 18 on the secure side of the gate 27. The antenna 29 is buried according to the same technique used for burying the antenna 18. The adjacent loop detector

antenna 29 insures that the information is transmitted back to a reader 31 as the vehicle 14 continues to travel along the pathway 21 beyond the barrier gate 27 which then closes after the vehicle has gained access to the protected area.

The second loop antenna 29 and its associated reader 31 may also be used to  
5 identify a vehicle that is moving to exit the secure area.

As shown in FIG. 2, once the reader 16 receives a coded signal from the tag 12 via the front loop antenna 18, the coded signal is sensed by the reader's radio frequency input circuit 33 via leads 35, and decoded by a microcontroller 37 via a lead 39 to convert the input analog signal to a digital signal for transmission via a  
10 serial interface output or link 42 connected to the microcontroller via a lead 44. A lead 46 couples the serial output signal to the system controller 25.

Under the control of software resident in the system controller 25, the controller polls all readers such as the readers 16 and 31, interfaced to the controller 25 on a routine basis. If a tag has been detected, its identification code is  
15 transmitted from the tag, to the reader, such as the reader 16 and then to the system controller 25 over the serial interface link or input/output 42. This code is compared to the information stored within the system database stored in the controller 25 of information for validation. If the code is validated, then through

the same serial communication link 42, the system controller 25 sends a signal indicating authorization to the specific reader that detected the tag code.

This signal sent to the reader 16 is a command sequence that informs the reader 16 to activate a control relay 51 via a lead 53. The control relay 51 is  
5 interfaced to an entry gate electronic control 54, and provides the signal needed for the gate system 23 to open the gate 27.

The system 10 employs a signal messaging method or scheme, whereby the reader 16 sends a poll signal burst at a pulse width equal to an integer number of cycles of the RF carrier. The reader 16 enters a receive mode for an equal pulse  
10 width of a similar integer number of cycles. If the tag 12 detects this poll signal burst, the tag 12 transmits an acknowledgment signal burst of data. If the reader 16 receives this acknowledge burst, the reader 16 responds with an interrogate signal burst of pulses. The reader 16 then enters a receive mode for a period of time. When the tag 12 receives this interrogate signal burst, the tag 12 sends a predefined  
15 number of distinct bursts of data, the last burst being a finish signal burst. Upon receiving this signal burst, the reader 16 again begins to transmit routine poll signal bursts.

During the reader receive mode, the data received via radio frequency from the radio frequency identification is decoded and output as digital data. That data is either input into the microcontroller 37 within the reader 16 for decision making processes, or converted to a serial data stream for output to the controller 25. The  
5 controller 25 can be a microcontroller based unit, a standard personal computer, or a miniature or large mainframe computer.

The reader 16 is capable of detecting the presence of the vehicle 14, even if the vehicle does not have a radio frequency identification tag. The presence of the vehicle is translated to a signal to be used by the system 10 for whatever purpose is  
10 useful to the owner of the parking facility. An intrusion device 85, such as a camera system, an annunciation alarm, or a display message, is triggered via the microcontroller, such as the microcontroller 37 of the reader 16 to confront the driver of the vehicle that he or she is not authorized to enter the secured area.

While particular embodiments of the present invention have been disclosed,  
15 it is to be understood that various different modifications are possible and are contemplated within the true spirit and scope of the appended claims. There is no intention, therefore, of limitations to the exact abstract or disclosure herein presented.

## CLAIMS

What is claimed is:

1. A vehicle identification system for controlling access of a vehicle to a secure area, the vehicle having an access pathway, comprising:

5 at least one radio frequency identification tag for storing the identity of the vehicle therein;

means for mounting the tag inconspicuously on the outside of the vehicle;

10 reader means disposed near the point of enter into the secure area for communicating via radio frequency signals with the tag to receive its vehicle identity information;

a detection loop antenna connected in communication with said reader means for transmitting and receiving signals to and from said tag; and

15 means defining a sealed opening in the top surface of the access pathway near the point of access for causing the loop antenna to be concealed from view.

2. A vehicle identification system according to claim 1, wherein the tag is a transceiver.

3. A vehicle identification system according to claim 1, wherein said means for mounting includes a magnet.

4. A vehicle identification system according to claim 1, wherein said means for mounting includes nuts and a bolts.

5 5. A vehicle identification system according to claim 1, wherein said means for mounting includes an adhesive material.

6. A vehicle identification system according to claim, wherein said means defining a sealed opening includes means defining a channel in the pathway, and a sealant for securing in place the loop antenna in an inconspicuous  
10 manner.

7. A vehicle identification system according to claim 1, further including an adjacent loop antenna disposed on the opposite side of the access point, and including an adjacent reader.

8. A vehicle identification system according to claim 1, further including  
15 an adjacent reader connected in communication with the adjacent loop antenna, and a system controller coupled in communication with the readers for comparing the vehicle identity with authorized vehicle identities.

9. A vehicle identification system according to claim 1, further including



control means responsive to the determination that a vehicle is authorized to cause the point of access to permit entry to the vehicle.

10. A method of using a vehicle identification system for controlling access of a vehicle to a secure area, the vehicle having an access pathway,

5 comprising:

mounting radio frequency tags on the underside of the outside of the vehicle; and

burying a reader loop antenna near the point of entry in the pathway for communicating with the tag as the vehicle travels along the pathway near the

10 point of access to the secure area.

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FIG. 1

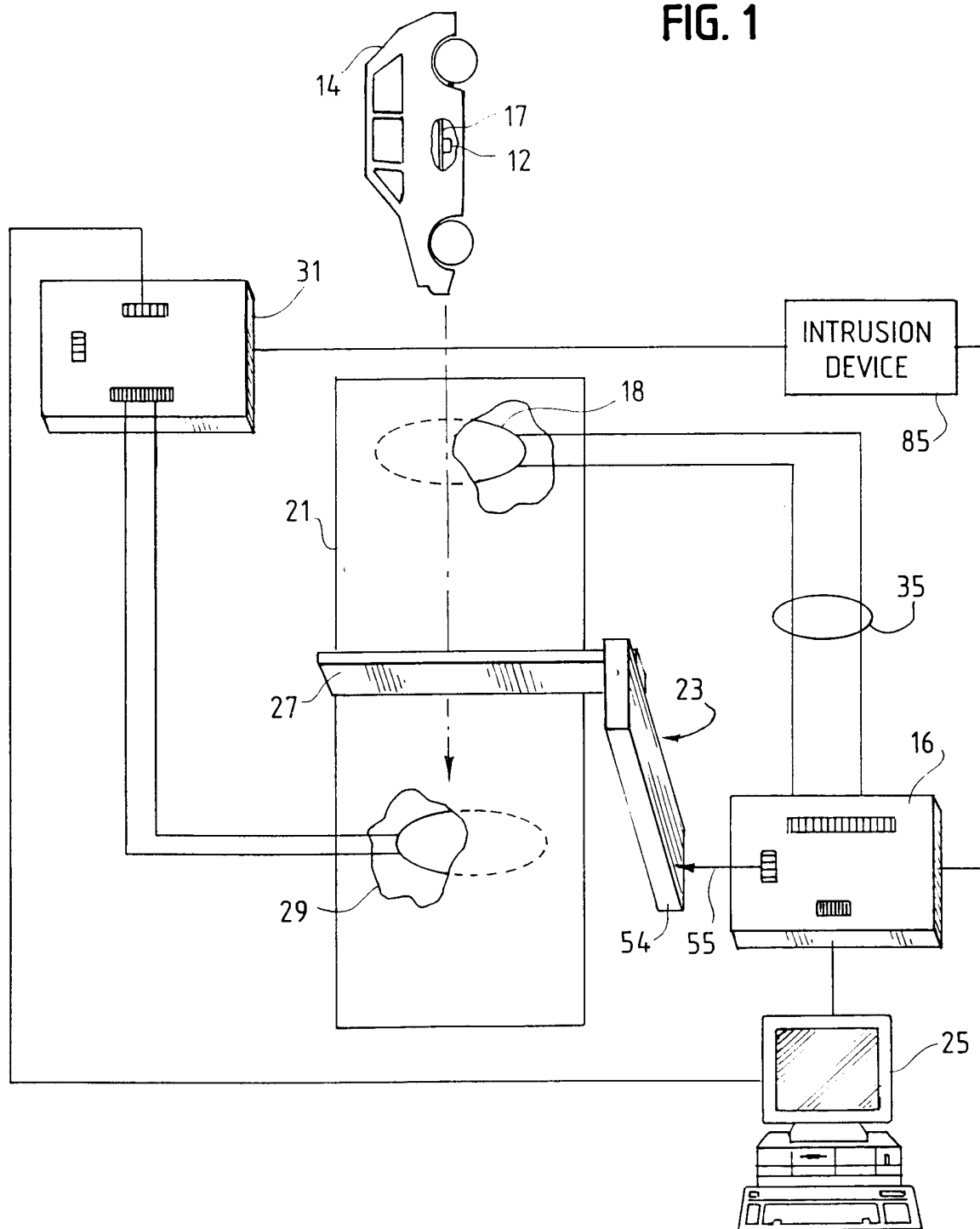


FIG. 2

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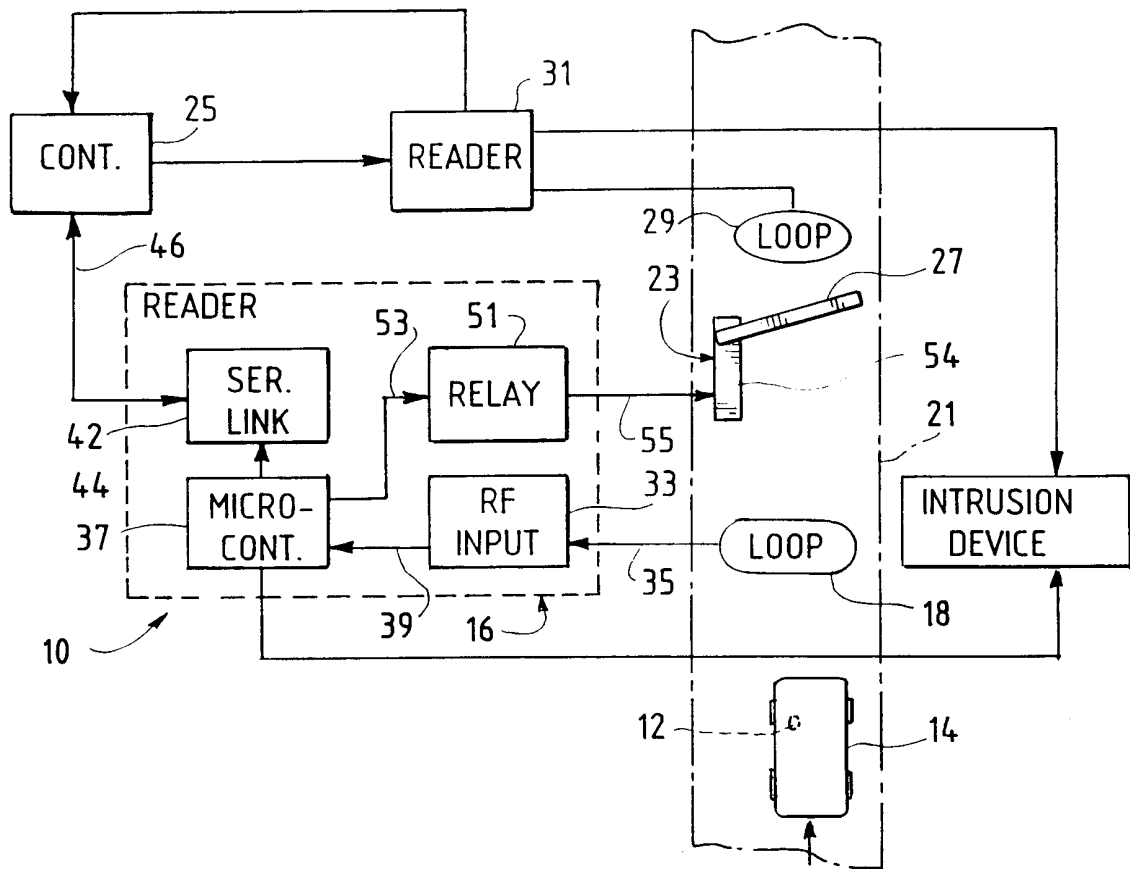


FIG. 3

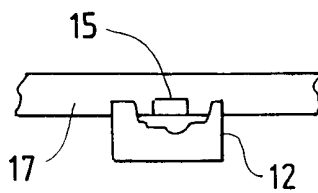


FIG. 4

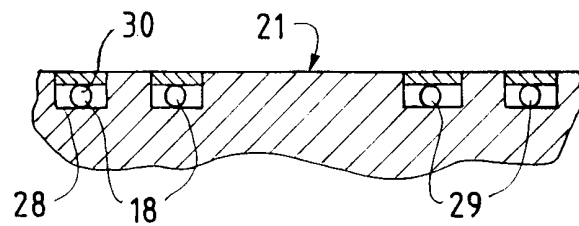


FIG. 5

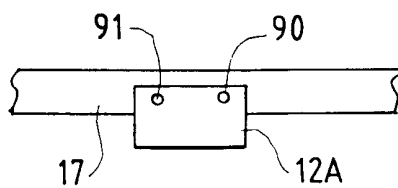
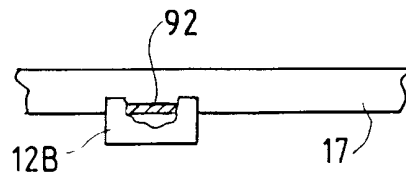


FIG. 6



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/30468

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : B60Q 01/48, G08G 01/01, G06F 07/04

US CL : 340/933,932.2,928,825.31

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)

U.S. : 340/933,932.2,928,825.31,905,941,825.34,825.69,825.72; 235/384

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,665,395 A (VAN NESS) 12 May 1987, abstract, col.2, lines 56-60; col.5, lines 20-42; col.10, lines 27-30.	1-10
Y	US 5,196,846 A (Brockelsby et al.) 23 March 1993, Fig. 17, Col.2, lines 45-52, col.6, lines 21-34, col.10, lines 20-24 and 50-54, col.12, lines 30-50, col.14, lines 21-29.	1-10
Y	US 5,414,624 A (ANTHONYSON) 09 May 1995, abstract, Fig.1, col.2, lines 1-8 and 42-51.	7-8
A	US 5,473,318 A (MARTEL) 05 December 1995, abstract.	1-10

☐ 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
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