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(72) Inventor: **Sbrissa, Guiseppe**
20063 Cernusco Sul Naviglio (MI) (IT)

(74) Representative:
Cagnolini, Sergio
Viale Venezia 277
33100 Udine (IT)

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(71) Applicant: **EASY DRIVE S.r.l.**
34123 Trieste (IT)

(54) **Highway driving assistance system for car drivers**

(57) The present invention relates to an assisted-driving system for car drivers using highways or roads in general, characterized in that said routes (1) are equipped with suitable radar sensors (3) and/or infrared devices which are fixed and transmit, over a wireless (radio, GSM) link or by means of optical fibers, the processed data related to traffic conditions on the respective

lanes, and are connected to suitable receivers or consoles installed on the cars in transit. Said system assists and informs the car driver in real time regarding traffic conditions or any traffic jams or road accidents or particular existing atmospheric conditions.

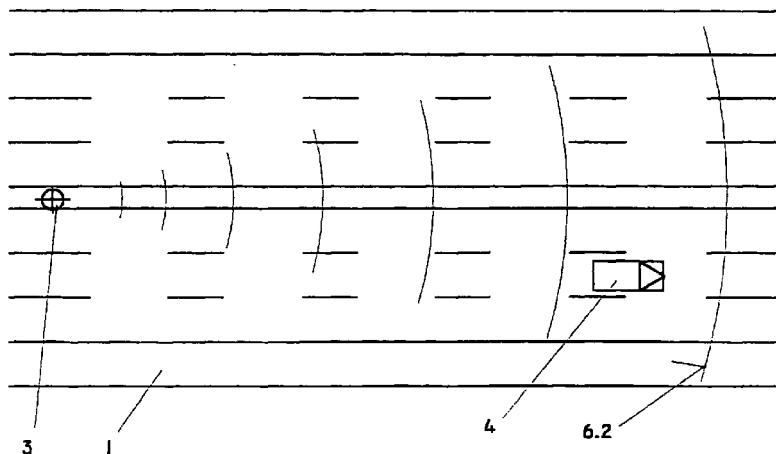


FIG.3

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Description

[0001] The present invention relates to an assisted-driving system for car drivers using highways or roads in general, characterized in that said routes are equipped with suitable radar sensors and/or infrared devices which are fixed and transmit, over a wireless (radio, GSM) link or by means of optical fibers, the processed data related to traffic conditions on the respective lanes, and are connected to suitable receivers or consoles installed on the cars in transit. Said system assists and informs the car driver in real time regarding traffic conditions or any traffic jams or road accidents or particular existing atmospheric conditions (for example, low visibility, fog, storms, et cetera) in the direction of travel and in detail on the individual lanes. By virtue of the connection according to the invention it is furthermore possible to provide the driver with further useful information, such as the distance from exit/access junctions, service stations, traffic jams, accidents, et cetera.

[0002] In the current state of the art, there are already various information systems for driving assistance; some have a predominant influence on the assistance provided to drivers in order to increase their safety, others on the information supplied, which depending on its kind indirectly contributes to the drivers' safety or simply increase driving comfort. Systems are known which provide an acoustic indication when, for example when reversing into a parking space, one moves to close to the vehicle parked to the rear; anticollision onboard devices, that is to say, devices which during normal travel report the presence of vehicles ahead and to the sides of one's own vehicle, are also known. There are also radio or telephone systems dedicated to the transmission of traffic news, bad weather conditions, et cetera, and there are onboard devices which by having an archive of road maps progressively display the optimum route to reach the intended destination. From the constructive point of view, these systems can be of three kinds: vehicle-based; infrastructural; mixed.

[0003] Devices of the first type are those which can operate correctly without requiring the support of any external apparatus in addition to those installed on the vehicle (for example mapping devices, anticollision radars, et cetera), whereas so-called infrastructural devices are those which, like for example the variable-message information stations placed along roads or highways, inform drivers without requiring the adoption of any particular device on board the vehicle.

[0004] Finally, mixed systems are those which in order to operate correctly require both particular infrastructures on the road system and the adoption of dedicated devices on board the vehicle. A typical example of these solutions is constituted by traffic information broadcast over radio or telephone channels, satellite navigation systems, et cetera.

[0005] Up to now, the anticollision function, or more generally the automatic monitoring of the area ahead of

(or surrounding) the vehicle has been performed by means of vehicle-mounted devices, mostly based on sensors using radar, laser or IR (infrared) technologies. Their characteristics, in addition to obviously depending on the specific methods of embodiment, are highly influenced by the technology used. These systems are expensive, have a limited range (no more than 60-100 m) and in any case do not allow to detect vehicles located beyond the nearest ones; they are affected by frequent false alarms, in that they very often detect vehicles which do not exist or detect them in incorrect positions; and they are of the single-function type, in that they cannot provide other information apart from data regarding the nearby vehicles.

[0006] The aim of the present invention is to provide a system for assisting and informing the driver, overcoming all of the described drawbacks.

[0007] The present invention provides for the availability, on board vehicles traveling on suitably equipped highways and roads, of a particular console which has a modest cost (on the order of the cost of an ordinary car radio) because it transfers to the road infrastructure the burden of monitoring the vehicles that are present. Other burdens for the driver might be dependent on the auxiliary services requested.

[0008] The information regarding the vehicles that are present in the region ahead of the travel area supplied to the vehicle equipped with suitable devices as described above will be more complete and exact. The sensors installed along the road in fact reveal the entire traffic situation. On board one can also be informed regarding vehicles located further away than the immediately neighboring ones. The sensors located in fixed positions on the road in fact overcome the drawbacks of mobile ones, that is to say, false alarms and vehicle detection failures are less likely, accordingly providing more reliable information.

[0009] Furthermore, multiple functions are possible with a single vehicle-mounted apparatus. In addition to the specific tasks of an anticollision sensor, it is possible to use the data link to the central computer to send other information which is useful to the driver, such as the distance from exit/access junctions, service stations, highway restaurants, traffic jams, accidents, et cetera.

[0010] According to the present invention, the aim of the system, as mentioned, is to provide assistance to people driving in poor visibility, for example due to fog or heavy rain, by means of a small console installed on board, which displays: the vehicles located ahead, differentiating them in terms of distance, travel lane and relative speed; stationary or very slow-moving vehicles; approaches to exit/access junctions, service stations, highway restaurants, et cetera; indication of roadwork; other useful information. The information displayed on the console is updated continuously.

[0011] Another no less important function of the system is to allow remote, continuous and real-time monitoring of the highway route, since it provides the

control center with information related to: vehicles stopped on the emergency lane or on a traffic lane; accidents requiring immediate intervention of rescue vehicles; traffic congestion or building up of traffic jams; development of traffic.

[0012] The system for acquiring information related to the traffic on the roadway uses a network of sensors constituted by radars and IR (infrared) sensors. The information collected by the sensors is sent to a central computer over the data transmission network (for example of the fiber-optics type) of the highway, where it is processed, providing tracking (that is to say, determining at each instant the position and speed) of the detected vehicles in real time.

[0013] The data produced by the processing and related to the position and speed of the vehicles that are present are grouped appropriately and sent to the highway control center, in order to update the current traffic situation, and to the vehicles, by means of a digital wireless network link, for example of the GSM type, where they are displayed graphically on the onboard console and/or acoustically.

[0014] The operation of the system therefore requires the development of a series of units or sub-assemblies, the main ones being: the radar and IR sensors to be installed in fixed positions along the highway route; the local sensor control units, in which the information obtained from the sensors is digitized and processed; a central computing unit, which is connected to the sensors by means of a high-speed link (for example of the ATM (Asynchronous Transfer Mode) type) and to the vehicles by means of the GSM telephone network or the like; and an onboard console for each vehicle.

[0015] The radar and IR sensors, which constitute the network of sensors by means of which information concerning vehicle traffic is acquired, have the same functions and generate the same kinds of data, differing only in their different underlying technologies and different coverage areas.

[0016] The function of each sensor, common to the radar and to the IR sensor, is in fact to detect and locate vehicles with great accuracy, measure their speed, and originate information required for the operation of their local control unit.

[0017] Real-time processing of all the information acquired by the sensor (of the radar or IR type), filtering of said information and extraction of the information related to the vehicles present in the coverage area are performed by a high-performance DSP (Digital Signal Processor). Each unit also comprises a communications card which ensures transfer of the information acquired by the sensor to the central computer over the data transmission network of the highway, and uses a standard data exchange interface.

[0018] The central computer receives all the data originating from the sensor network and processes them, ensuring vehicle tracking among contiguous sections of the highway, so as to: provide appropriate

grouping thereof, generating the messages to be sent to the vehicles; providing the system supervisor, who works at the highway control center, with an "panoramic view" of all the traffic that is present on the sections covered by the sensors; and all the information useful for verifying that the system is operating correctly.

[0019] The central computer is essentially constituted by a rack which contains a series of microprocessor boards, communication boards required for data exchange with the field sensors and with the vehicles, and interface circuits for driving the monitor of the supervisor.

[0020] The vehicle-mounted console, characterized by small size and low cost, essentially consists of two sections, one for receiving the signals that arrive from the central computer and one which ensures their graphical presentation on a small display. The console is constituted by a low-consumption microprocessor unit which converts the data string received from the wireless data transmission network, generating a presentation which is formed by two parts: the first one is similar to the display of a short-range radar and the second one relates to the display of other information which is useful to the driver.

[0021] The innovations that derive from this invention are several and involve both drivers and road operators.

In fact: a) for drivers, it offers undeniable advantages in terms of safety, since it allows to "see", with considerable advance, the vehicles located ahead, which in poor visibility, typical of the winter season (with frequent possibility of fog, heavy rain, hail, et cetera) constitute potential causes of impact and loss of vehicle control. With respect to the latest generations of onboard anticollision devices, essentially based on onboard radar or laser sensors, the system, in addition to providing a larger coverage area, also allows to "see" the vehicles that precede the nearest ones. It is accordingly possible to brake in advance when approaching the rear end of a traffic jam or if stationary or slow-moving vehicles are reported ahead;

b) for traffic operators, the system allows remote and real-time monitoring of the highway stretches covered by the sensors and therefore allows continuous monitoring of the development of traffic and the immediate dispatching of rescue vehicles if accidents or vehicles stopped due to failures are detected. The nonintrusive nature of the sensors used in a further advantage of the system. With respect to conventional sensors, such as the electromagnetic induction coils widely used to detect vehicle traffic, they allow to: expand the area controlled by a single sensor to 1-2 km, whereas coils are, as is well-known, "point" sensors; install them without any interaction with the road surface and therefore without being susceptible to all the instal-

lation and maintenance problems typical of coils, which arise from their installation in the traffic lanes of the roadbed.

[0022] The present invention is therefore highly useful for drivers, providing the user with information on what is occurring in his direction of travel with good precision and considerable advance, in order to allow him to perform the maneuvers required in order to avoid possible accidents.

[0023] The above described characteristics and others will become apparent and evident from the following detailed description of some non-limitative examples of embodiment of the system in the accompanying four drawing sheets, wherein:

figure 1 is a general block diagram of the system;
figure 2 is a schematic perspective view of an installation with a radar device on a highway;
figure 3 is a plan view of figure 2;
figure 4 is a plan view of a highway with two radar devices with overlapping (redundant) coverage;
figure 5 is a plan view of a highway with two mutually opposite radar devices installed at the roadside;
figure 6 is a front view of a vehicle console equipped for a highway with three lanes plus an emergency lane and for additional auxiliary information;
figure 7 is a view of the console which displays the traffic in the direction of travel of the user.

[0024] The system for assisting and informing drivers of vehicles traveling on roads or highways (1) first of all uses, in the more dangerous stretches of road and/or on entire routes, particular equipment which is fixed (for example on poles 2), such as radars (3) and/or infrared sensors which are connected by means of a data transmission network to the control center, which in turn processes and transmits to the wireless data transmission center in order to communicate over a wireless link with the vehicle-mounted console (7).

[0025] The sensors can be installed in various ways, according to technical and application requirements and to the requirements of the terrain. The installations can be unidirectional, bi-directional (3), or mutually opposite at the roadside (5). In the latter two cases, the coverage areas can mutually overlap partially (6) or completely (6.1) or be affected by a single sensor (6.2).

[0026] The console (7) displays, in the upper and lower part (11), in the various frames, the information related to exit/access junctions, distance from toll stations, and alarms related to traffic jams, accidents, roadwork, et cetera. The central part of the screen displays the traffic lanes (8) of the highway and the emergency lane, highlighting (9) the lane in which one's own vehicle is traveling. The presence of vehicles ahead is indicated

by lighting the corresponding distance segments, whereas their color identifies the relative speed class of one's own vehicle with respect to said vehicles. Furthermore, it is possible to display on the screen (10) in various scales the traffic and the emergency situations on the various lanes.

Claims

1. A highway assisted-driving system for car drivers, characterized in that the stretch of road or highway (1) or the entire route is equipped with fixed sensing devices such as radars (3 and 5) and/or infrared devices capable of detecting and transmitting over a data transmission network to the control center, where said signals are processed and transmitted to the wireless data transmission center and are transferred over a wireless link to the vehicle-mounted console of the vehicle traveling on the route thus equipped.

Transmission of the processed signals allows, by virtue of the onboard console, to inform the driver visually and/or acoustically as to the situation of the traffic ahead of his vehicle, on his travel lane and/or on the adjacent lanes (parameters such as distance, relative speed of the vehicles, stationary or slow-moving vehicles, approach to exit/access junctions, service stations, highway restaurants, warning related to roadwork, traffic jams, fog, heavy rain, hail, snow, accidents, sudden obstacles, et cetera). The same data processed by the control center regarding the traffic conditions can also be used by traffic operators for remote and real-time monitoring of the development of traffic along the routes covered by the IR and/or radar sensors.

2. A highway assisted-driving system according to claim 1, characterized in that the installations of the sensors used along the road or highway sections are of the unidirectional type.

3. A highway assisted-driving system according to claim 1, characterized in that the installations of the sensors used along the road or highway sections are of the bi-directional type.

4. A highway assisted-driving system according to claim 1, characterized in that the installations of the sensors used along the road or highway sections are located mutually opposite at the roadside.

5. A highway assisted-driving system according to claim 1, characterized in that the network for detecting and signaling the vehicles that are traveling or stationary on the stretch of road or highway is pro-

vided by using in combination various types of radar and/or infrared sensors and/or other equivalent devices, even based on other technologies, which are suitable for the purpose.

to similar data networks; a radio receiver.

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6. A highway assisted-driving system according to claim 1, characterized in that the processed or raw signals of the sensors are transmitted to the control center over a radio or a satellite link.
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7. A highway assisted-driving system according to claim 1, characterized in that the network for connecting the sensors to each other and to the central computer can be of the fiber-optics type; on a telephone or coaxial cable; a wireless data transmission network; a radio network; a satellite network.
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8. A highway assisted-driving system according to claim 1, characterized in that the network for connection between the central computer and the center for transmission to the vehicles can be of the fiber-optics type; on a telephone or coaxial cable; a wireless data transmission network; a radio network; a satellite network.
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9. A highway assisted-driving system according to claim 1, characterized in that the network for connection between the central computer and the vehicle-mounted console can be: a wireless telephone network; a wireless data transmission network; a radio network; a satellite network; an infrared network; a microwave network.
25
10. A highway assisted-driving system according to claim 1, characterized in that said system is used without any vehicle-mounted console purely to use the data for traffic monitoring and control.
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11. A highway assisted-driving system according to claim 1, characterized in that the alarm signals are also used to activate visual indicators arranged along roadways (for example lamps, flashing lights, traffic lights, variable-message panels, et cetera).
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12. A highway assisted-driving system according to claim 1, characterized in that if the vehicle-mounted console is not used, the alarm signals are used to activate visual indications arranged along the roads (for example lamps, flashing lights, traffic lights, variable-message panels, et cetera).
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13. A highways assisted-driving system according to claim 1, characterized in that the information displayed on the vehicle-mounted console is integrated with the information that can be supplied by other devices, such as for example a GPS navigation system; a map storage system; a cellular telephone; a CD player; a connection to the Internet or
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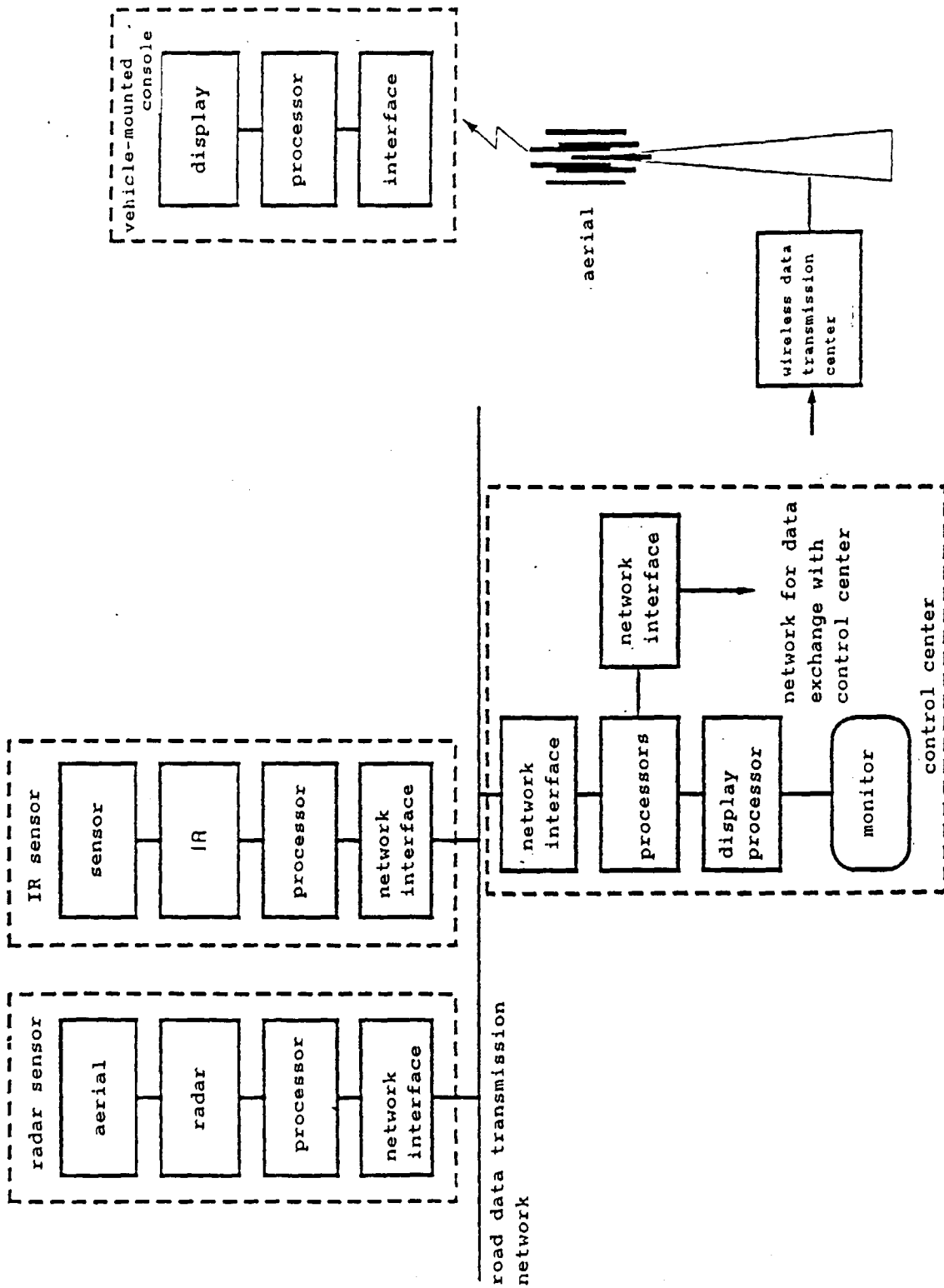
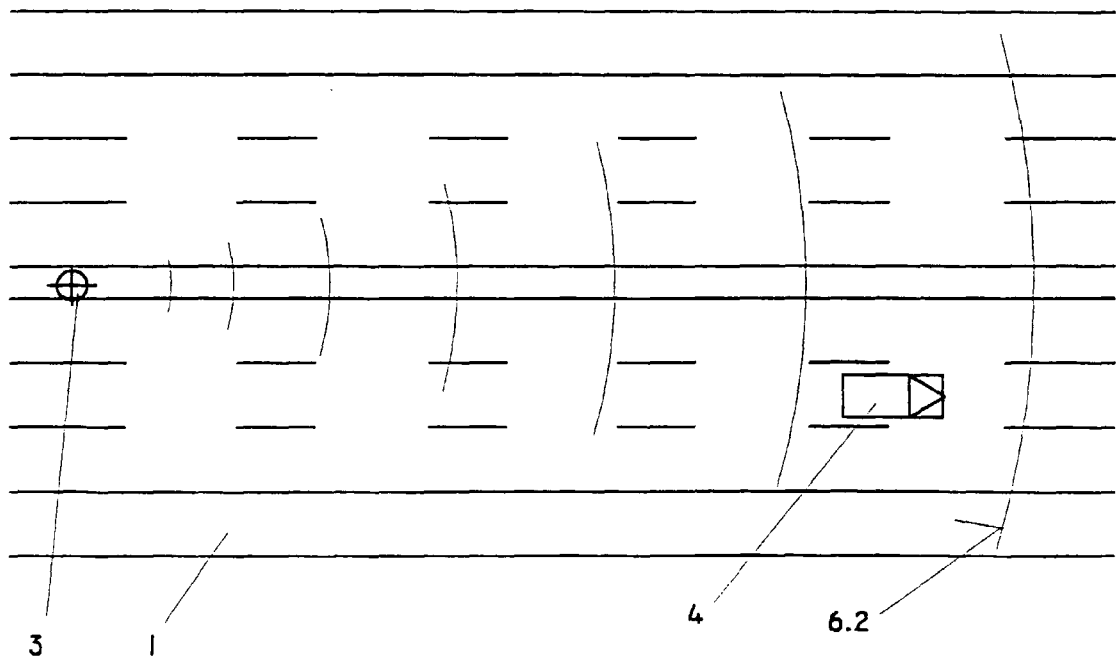
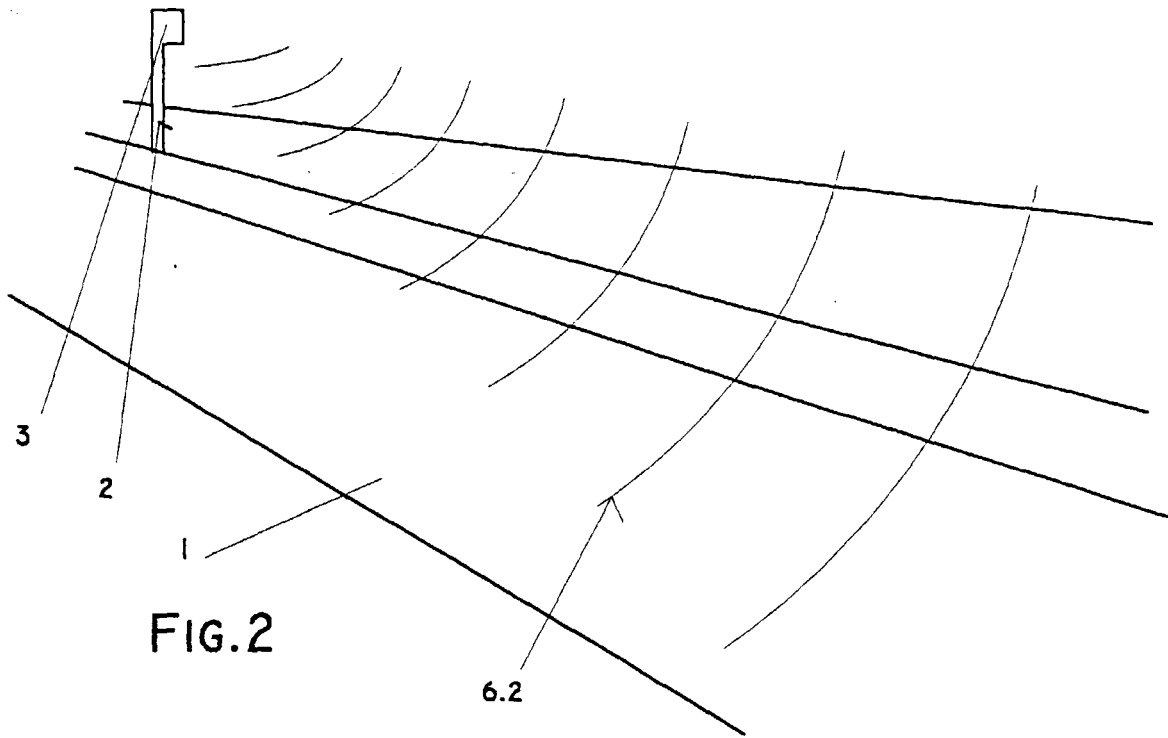
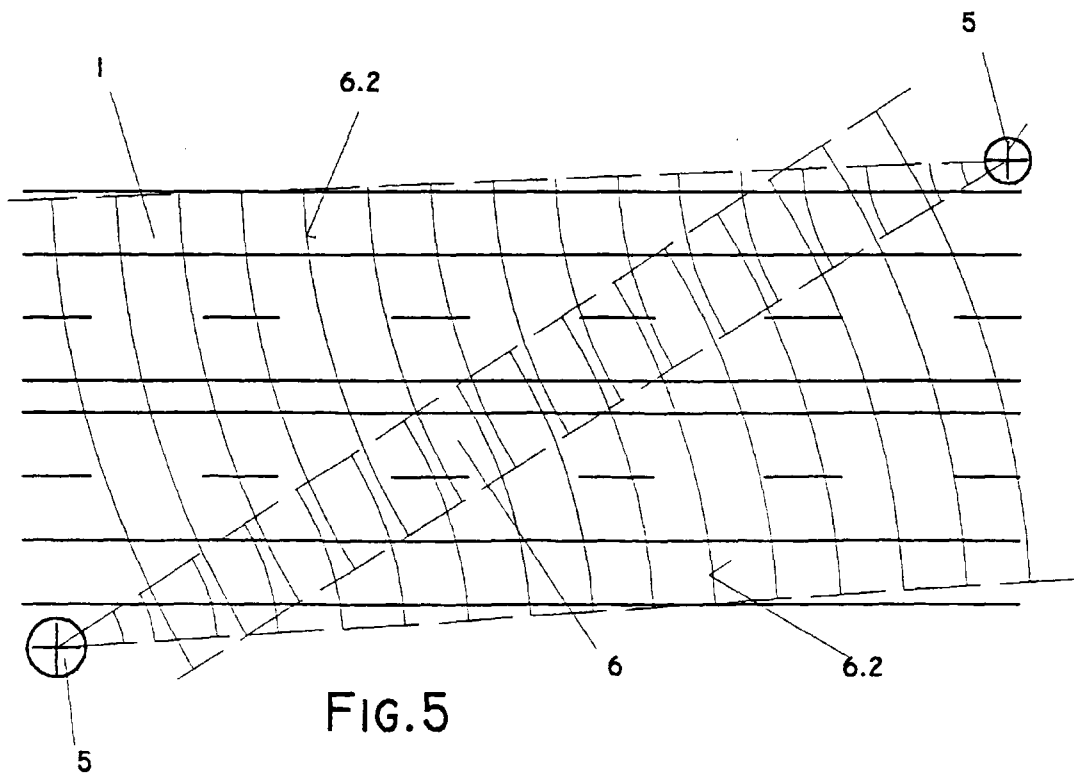
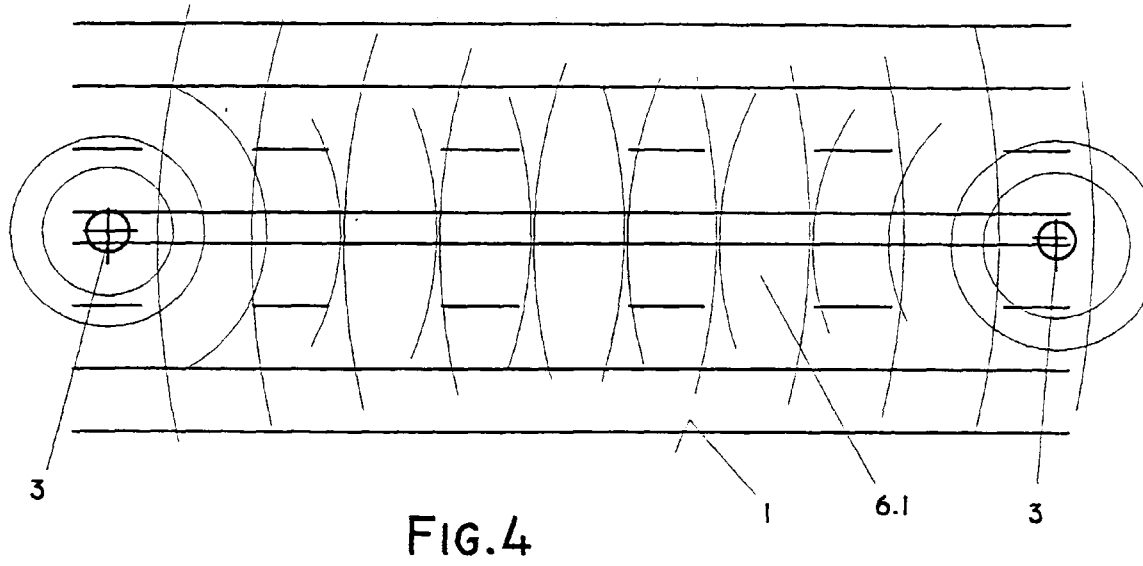


FIG. 1





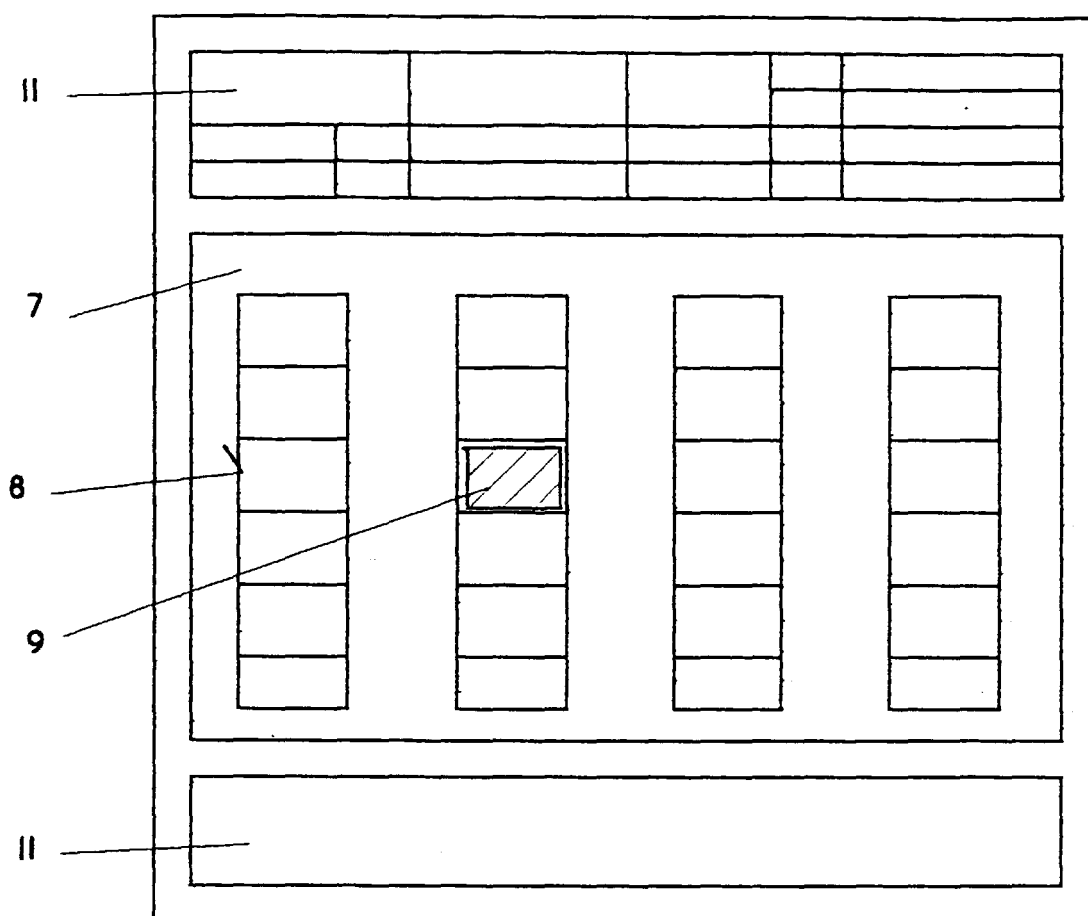


FIG. 6

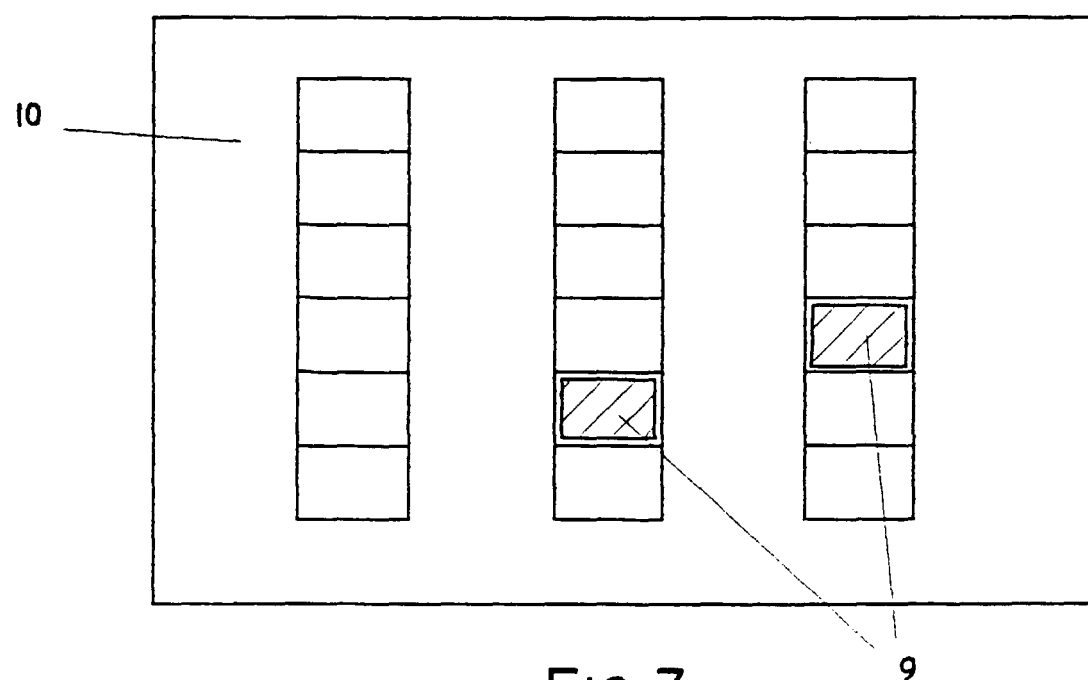


FIG. 7