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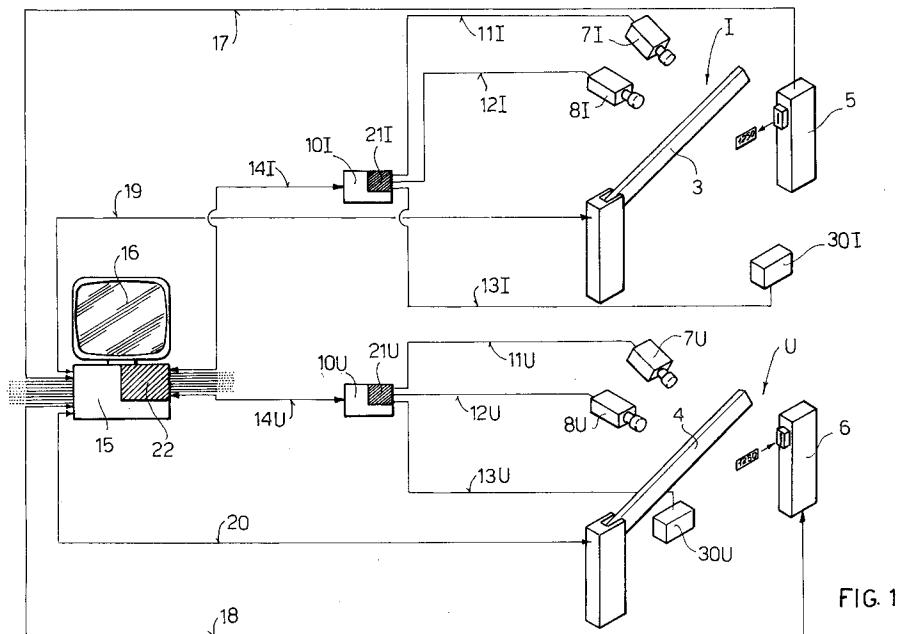
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System for the recognition of vehicles for car-parks and the like.

A system for the recognition of vehicles (9), by means of the comparison between data relating to the same, collected in correspondence with an entrance (I) and with an exit (U), for example of a car-park or the like, where a ticket dispenser (5) and a ticket reader (6) are respectively foreseen together with respective movable bars (3, 4), in which, in correspondence with each entrance (I) and with each

exit (U), at least two respective telecameras (7I, 8I; 7U, 8U) and a corresponding measuring device (30I; 30U) are foreseen, controlled by a respective Server computer (10I; 10U), which is connected by means of a local network (14I, 14U) to a console (15), connected to the said ticket-dispenser (5) and ticket reader (6) and to the said movable bars (3, 4), to make possible the opening of the same.



EP 0 565 014 A1

The present invention refers to a system for the recognition of vehicles, by carrying out a check on the same, for example at the entrance and at the exit from a car-park or the like.

Different types of checking are in existence in guarded car-parks.

In the majority of cases, the vehicle is checked at the entrance to the car-park by special security staff, who issue a ticket relating to the vehicle.

This document has a dual function: the first is that it proves the entering into a contract for guarding the vehicle, with the related guarantees, and the other is that it establishes the amount to be paid for the stay at the moment the vehicle leaves the car-park.

In more modern car-parks, human operators are replaced by ticket dispensing machines which, in addition to checking the length of the stay, calculate the amount due for the stay and enable the amount to be collected in coins or by deducting it from a subscription card.

Of course, these systems do not afford safety for the user, since, in large car-parks especially, where vehicles may remain for days even, as for example, in airport car-parks and the like, it is relatively easy to enter with a low-priced vehicle, perhaps stolen, and leave with another expensive vehicle, using the entrance ticket and possibly exchanging number plates, if the number plate has been recorded on entering.

Some more modern checking systems foresee recording the shape of the vehicle on entering on a video-tape. This image is played back at the exit and compared visually by the operator with that of the vehicle leaving the car-park. If the operator finds that the two images match, he manually permits its exit. Such a system is described e.g. in US-A-4 603 390.

This system is not very safe, especially since the operator is given the decision as to allowing a vehicle to leave, which also makes such operation slow.

EP-A-0 367 725 describes a system for the recognition of vehicles combining the outline of the body with the possible elements personalizing the vehicle, such as for example the antenna, the distance between the wheels, the type of bumpers, the lights etc. This data is associated with the number of a ticket the user takes at the car-park and are compared with the data detected on leaving the car-park. This system makes use of a single telecamera for filming the vehicle, normally from the rear of the same, or in any case of telecameras filming the whole outline of the vehicle, necessarily compressing all the details that must be extrapolated. This system is therefore neither completely satisfying nor reliable, since it can cause, in some cases, errors when comparing

the data of the vehicle on entering and leaving the car-park.

FR-A-2 570 528 describes a system for the identification of vehicles making use of two telecameras filming the vehicle: one records the moving vehicle in order to determine its speed, while the other, perpendicularly positioned with respect to the first one, films the outline of the vehicle through prisms which are used to compress the image.

This system is rather complex and not completely reliable.

The purpose of the invention is to eliminate the drawbacks described above by providing a system for the recognition of vehicles which is completely automatic and reduces to the minimum or even removes the possibility of unlawful exchange inside the car-park.

The system according to the invention comprises at least two telecameras positioned at each entrance to the car-park, and at least two telecameras positioned at each exit, one of said telecameras being capable of recording the outline and the other front number plate of the vehicle itself. In correspondence with each entrance and each exit it is further foreseen a respective measuring device, suitable for detecting at least one dimension of the moving vehicle. The telecameras and the measuring device at each entrance or at each exit are linked with a respective "Server" computer, which transforms the data relating to the vehicle, such as the outlines of the same, the particular shade of grey, the plate number and the data relating to the dimensions into digital ones. The various Server computers are connected on the local network to another "Master" computer into which is fed the data on the ticket issued to the user and which controls the whole system.

At the exit of each vehicle, actually, the Master control computer, provided with a special electronic card, compares the data concerning the vehicle which is leaving the car-park with the data of the corresponding vehicle on entering, including the identification numbers on the relevant entrance ticket, and, on the basis of such comparison, allows or does not allow the vehicle to leave the car-park.

Further characteristics of the invention will be explained more clearly in the detailed description given below, which refers to one of purely exemplary and therefore not restrictive embodiments, illustrated in the appended drawings, in which:

Figure 1 is a simplified diagram of the system for recognizing vehicles according to the invention, showing the entrance and the exit of a car-park;

Figure 2 is a diagrammatic side elevation, showing two telecameras, which film the vehicle from the front, at the entrance and at the exit from the

car-park;

Figure 3 is a plant diagrammatic view showing the functioning principle of an ultrasonic "meter" for detecting the length and width of a vehicle;

Figures 4 and 5 show in diagrammatic form an entrance or exit of the car-park, in the closed position and in the open position respectively, carrying the telecamera for low shots of the vehicle, particularly for filming the number plate of the same;

Figure 6 shows a possible viewing on the screen of the operator console in the event of a vehicle which has entered not corresponding with the one leaving.

With reference to figure 1, the reference letter I indicates an entrance to a car-park, and U indicates an exit, in correspondence to which are positioned respective movable bars 3 and 4 for stopping the vehicle, as well as a ticket dispenser 5 and a ticket reader 6 respectively.

On the basis of the dimensions of the car-park only one entrance I and only one exit U can be foreseen, or several entrances I1 ... IN and exits U1 ... UM.

In correspondence with each entrance I and with each exit U, at least two telecameras 7I, 8I and 7U, 8U are foreseen, which film the vehicle from the same angle. Particularly, as better shown in Figure 2, the telecamera 7I or 7U films the whole outline of a vehicle 9 from the front, while the telecamera 8I or 8U, positioned lower down, only films the portion of the front number plate of the same.

Figures 4 and 5 illustrate a possible installation of a telecamera 8I or 8U lower down for filming the front number plate of vehicle 9. In particular, such camera is mounted on a stopping bar 3, 4 at the entrance or at the exit of the vehicles.

In correspondence with each entrance I and each exit U a respective ultrasonic meter type measuring device 30I, 30U is positioned, suitable for detecting at least one dimension of the vehicle 9.

Figure 3 schematically shows such a measuring device 30I or 30U for detecting the length and the width of the vehicle 9. It comprises two ultrasonic sensors S1, S2, positioned on a longitudinal axis x, and two further sensors S3, S4 positioned on a transversal axis y. The sensors S1, S2 are positioned at a distance L1 and the sensors S3, S4 are positioned at a distance l1. When in the space delimited by the sensors S1-S4 a vehicle 9 is interposed and the sensors are activated, each one - due to the emitted waves which stop against the body of the vehicle - allows measuring the distance separating them from the vehicle 9. Therefore the length L and the width l of the vehicle are calculated by difference: $L = L1 - L2 - L3$ and $l = l1 -$

l2 - l3.

The telecameras 7I, 8I and the measuring device 30I are connected, by means of respective cables 11I, 12I, 13I to a computer 10I, while the telecameras 7U, 8U and the measuring device 30U are connected by means of cables 11U, 12U, 13U to a computer 10U. Computers 10I and 10U are in turn connected by means of local networks 14I, 14U to another computer 15 with a corresponding video 16, which makes up the operator console, and which is connected, by means of data lines 17, 18, to a ticket dispenser 5 and to the ticket reader 6 respectively, and by means of connection lines 19, 20 to the actuators of the movable bars 3, 4 of the entrance and exit respectively.

The computers 10I, 10U control in practice the corresponding entrance I and the corresponding exit U. They will also be called "Server" and have a special card 21I, 21U for piloting the telecameras 7I, 8I or 7U, 8U and the measuring device 30I or 30U.

On the other hand, the computer or "Master" 15 is provided with a graphic card 22, suitable for reproducing the images of the vehicle on the monitor screen 16.

The way the system according to the invention works is as follows.

At the entrance I to the car-park the user takes a numbered ticket 23 from the dispenser 5. The number of the ticket 23 is memorized in the console 15, which effects the opening of the stop bar 3, and at the same time, by means of the Server 10I, effects the switching of the telecameras 7I, 8I and activates the measuring device 30I. The data of the telecameras 7I, 8I relating to the outline or shape of the vehicle 9, to its shade of grey and to its registration number are memorized in digital form in the Master 15, together with the data relating to dimensions L and l.

After this the vehicle enters the car-park and begins its stay, at the end of which it moves to the exit U and stops in front of the movable bar 4. At this point, the user will insert the ticket 23 in his possession into the reader 6, which will send the relative number to the console 15 by means of the data lines 18. At the same time, the telecameras 7U and 8U are activated, which respectively film the outline and number plate of the vehicle, at the same angle as that of the telecameras at the entrance 7I and 8I, and the relevant data, including the shade of grey, are sent to the Server 10U, together with the dimensional data coming from the measuring device 30U, also activated in the meantime. The data is acquired by the Master 15 which checks whether it matches with the data which was memorized when the vehicle 9 entered the car-park, and if it finds that such data coincide, including the data relating to the number of the ticket 23

therein contained, it authorizes, by means of the connection line 20, the opening of the exit bar 4. The vehicle 9, then, can leave the car-park, and when the bar 4 is lowered, the data relating to such vehicle is erased from the electronic memory in the Master 15.

In the event of there not being a perfect match between just one of the data recorded at the entrance with the corresponding one at the exit, the system warns the operator, who will be able to carry out the operation which he considers most suitable, for example, visually checking the matching of the data on the screen 16, or carrying out a direct check on the vehicle at the exit, and deciding to allow the vehicle to leave the car-park manually, by means of a switch on the console 15 or by going directly to the exit. Alternatively, the operator can prevent exit by operating the appropriate switches on the console 15.

In these cases of "anomalies", all the data relating to the exit operations, including the images, the number plates and the dimensions of the vehicle, the ticket numbers and the choices made by the operator, will be recorded in the Master 15 and will be able to be examined afterwards by the car-park supervisor or transferred e.g. via modem.

In Figure 6 a possible case is shown of non-coinciding entrance data and exit data of a vehicle, as appear on the monitor 16 of the console 15. In particular, the data relating to the ticket coincide, but the outlines of the two vehicles do not match, and neither do their relative shades of grey or their number plates, nor their dimensions.

This corresponds with the case in which the user enters the car-park with one vehicle and leaves with another, without even effecting the exchange of the relative number plates.

All the "historic records", that is the recordings of the exits where an anomalous situation has been detected (non-coinciding number plates or outlines of the vehicles, or an unknown ticket) are recorded in the Master 15 to which only the authorized staff will have access by means of a special pass-word.

The system according to the invention foresees, in addition, the automatic periodic filming over each twenty-four hours of the colour of the background without the vehicle 9, so as to allow each Server 10I, 10U to equalize the shades of grey of the vehicle to be checked.

From what has been described it seems obvious that the solution according to the invention, which combines the plate number with the image of the vehicle, with its shade of grey and the dimensions of the same, as well as the verification of the number on the ticket, affords an excellent system for the prevention of exchanging one vehicle with another inside the car-park.

Further, foreseeing a plurality of Servers 10I, one for each entrance, and a plurality of Servers 10U, one for each exit, parallelly operating and independently one from the other, makes the functioning of the system possible even in the case when a damage in one or more of these devices occurs: e.g. when an exit is disconnected, the remaining exits can correctly operate.

Further, in case the backing memory of the system is digital, and therefore all information and images are in digital form, which allows their processing by means of different physical means, compression, graphic print and transmission e.g. via modem.

According to the present invention, a further detection of the outline of the vehicle 9 can be foreseen, by means of a microwave reflection radar technique and an electronic image superimposable on the monitor screen 16 with the one filmed by the telecameras 7I, 8I or 7U, 8U.

The illumination of the vehicle 9 to be filmed is obtained by means of focalized light, with a stroboscopic system, or with a lighting source of the laser type.

Claims

1. A system for the recognition of vehicles (9), by means of comparison of the data relating to the same collected at an entrance (I) of a plurality of entrances (I1 ... IN) and at an exit (U) of a plurality of exits (U1 ... UM) of the car-park or the like, where a ticket dispenser (5) and a ticket reader (6) respectively are foreseen, comprising at least one telecamera at the entrance (I) and at least one telecamera at the exit (U) for filming the vehicle (9) from substantially the same angle, as well as means for making a comparison between the images of the telecameras positioned at the entrance and at the exit, and between the number of the ticket (23) issued from the dispenser (5) and the number of the ticket inserted into the reader (6), for allowing, when the result is positive, the exit of the vehicle (9), characterized in that in correspondence with each entrance (I) and each exit (U) at least two respective telecameras (7I, 8I) and (7U, 8U) are foreseen, one (7I, 7U) positioned higher up for filming the shape of the vehicle and the respective shades of grey, and the other (8I, 8U) for filming the portion of its front plate number, as well as respective measuring devices (30I) and (30U) for detecting at least one dimension of the vehicle, in that at each entrance (I) and each exit (U) a corresponding Server computer (10I or 10U) is foreseen for controlling said telecameras (7I, 8I or 7U, 8U)

- and said measuring device (30I or 30U) and in that said Server computers (10I, 10U) are connected with a Master computer (15) which memorizes the data coming from the same, effects the comparison of the data and controls all the entrances (I) and the exits (U).
2. A system according to claim 1, characterized in that the said Master computer (15) is provided with a screen (16) and is connected to the said ticket dispenser (5) and ticket reader (6), as well as respective movable bars (3, 4) foreseen in correspondence with the said entrance (I) and with the said exit (U). 10
 3. A system according to claim 1 or 2, characterized in that said telecamera (8I or 8U), positioned lower down, is placed on the corresponding bar (3, 4) in order to film only the number plate of the vehicle (9). 15
 4. A system according to any one of the previous claims, wherein said telecamera (7I or 8I) periodically films the background, so as to allow the corresponding Server computer (10I or 10U) to equalize the shades of grey of the vehicle (9) to be checked. 20
 5. A system according to claim 1, characterized in that said measuring device (30I or 30U) is an ultrasonic meter making use of pairs of sensors (S1, S2; S3, S4) for detecting a corresponding dimension (L, I) of the vehicle (9) by means of the difference between the respective distance (L1; I1) and the distances of each sensor from the body of the vehicle (L2, L3; I2, I3). 25
 6. A system according to any one of the previous claims, characterized in that the said Server computer (10I, 10U) contains a card (21I, 21U) for the transformation of the outline, the shade of grey, the registration numbers and the dimensions of the vehicle (9) into digital data suitable for being memorized by the Master computer (15) and further that said Master computer (15) contains a graphic card (22) for visualizing the shapes of the vehicles (9) on a screen (16) with the various shades of grey, together with the data relating to them. 30
 7. A system according to any one of the previous claims, in which there is foreseen in the Master (15) the memorizing of historic records, relating to the exits of the vehicles (9), in which an anomalous situation is discovered, such as for example, non-matching of the number plates, of the images of the vehicles or of the relative 35
 8. A system according to any one of the previous claims, characterized in that said Server computers (10I, 10U) operate parallelly and independently one from the other. 40
 9. A system according to any one of the previous claims, in which a further survey of the shape of the vehicle (9) is foreseen with microwave reflection radar technique and with an electronic image which can be superimposed on the one filmed by the telecameras (7I, 8I; 7U, 8U) on the monitor screen (16). 45
 10. A system according to any one of the previous claims in which the illumination of the vehicle (9) to be filmed with the telecameras (7I, 8I; 7U, 8U), is obtained with focalized light, with a stroboscopic system or with a laser-type lighting source. 50

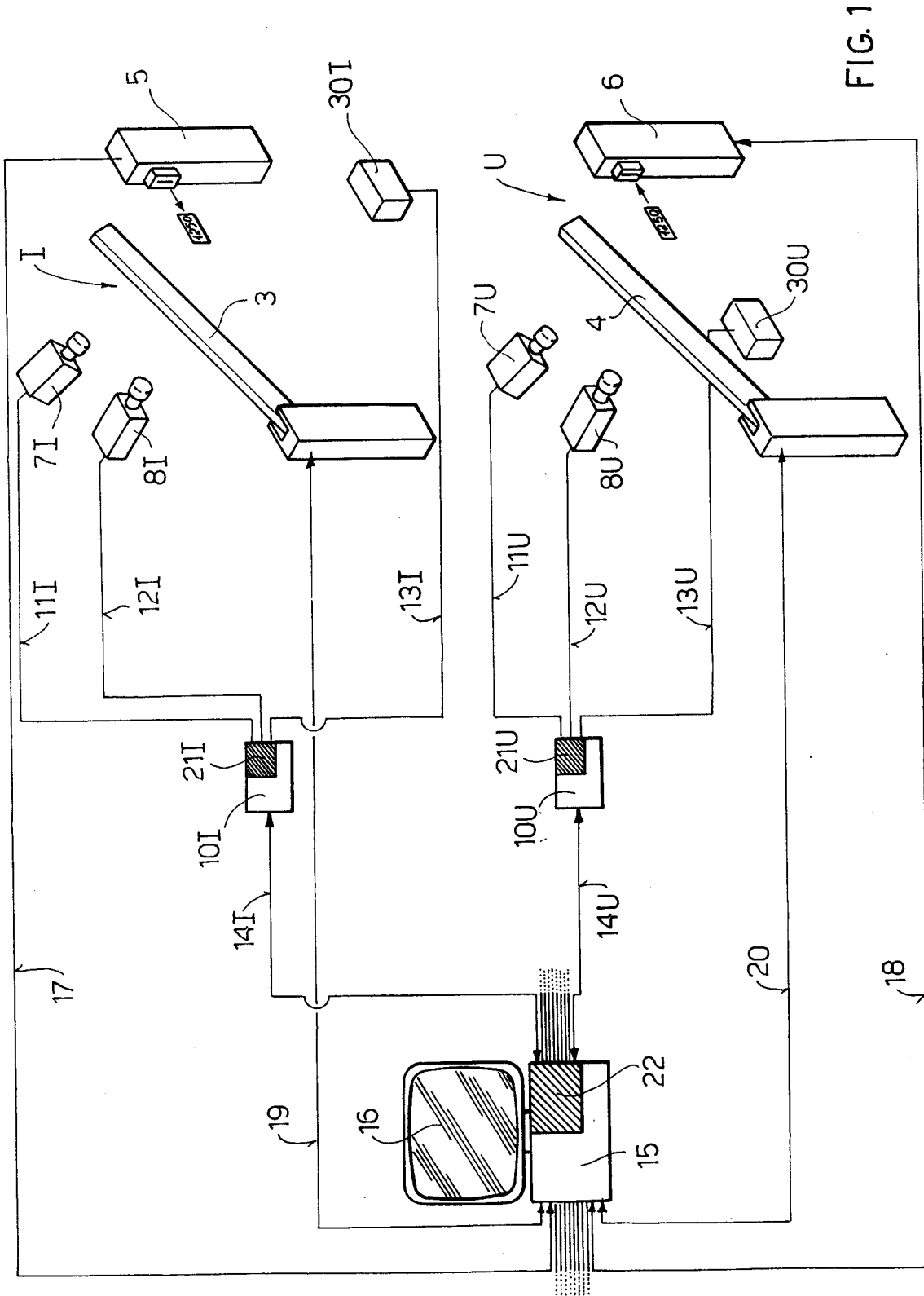


FIG. 1

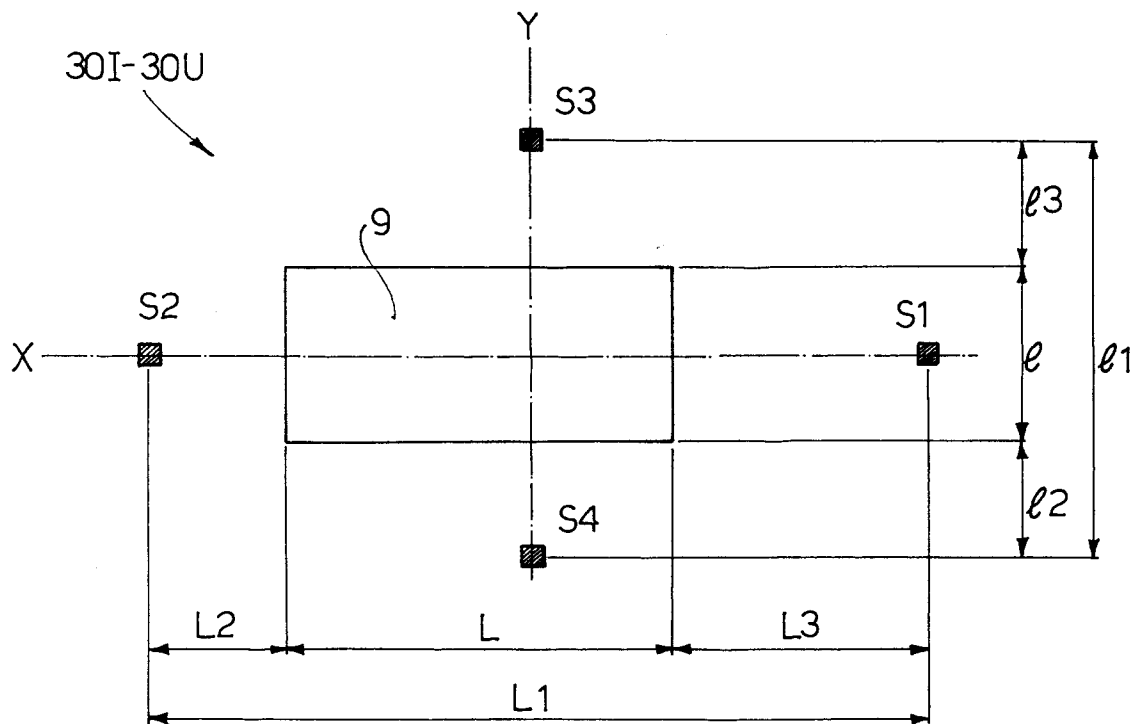
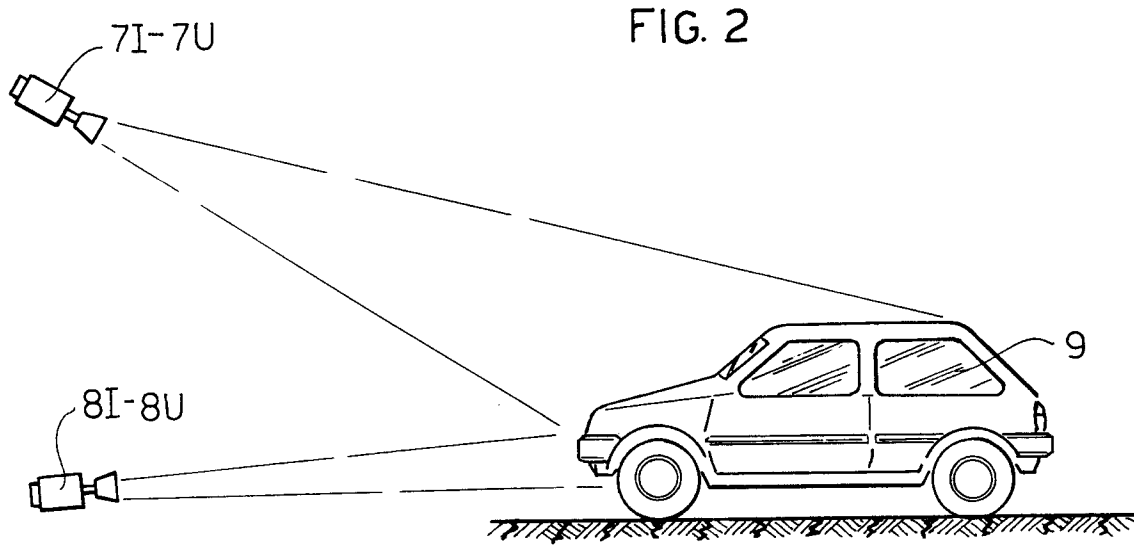


FIG. 3

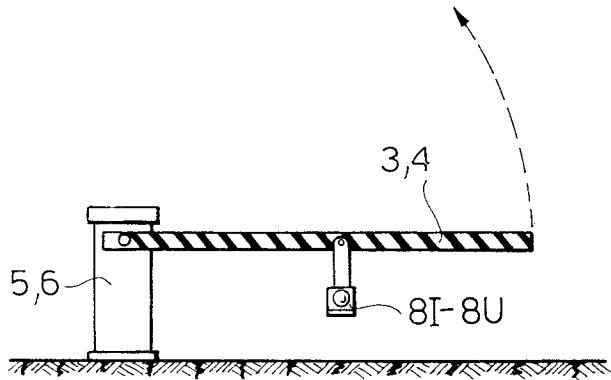


FIG. 4

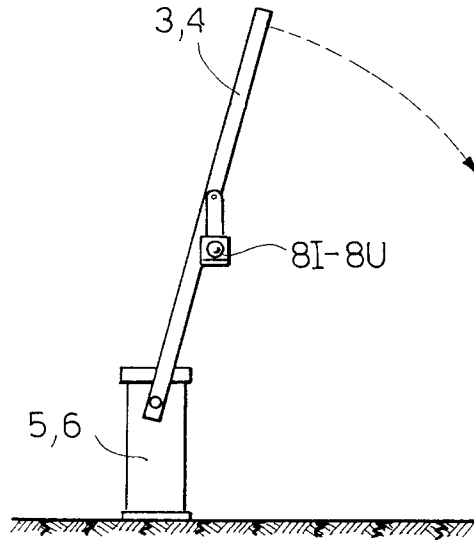
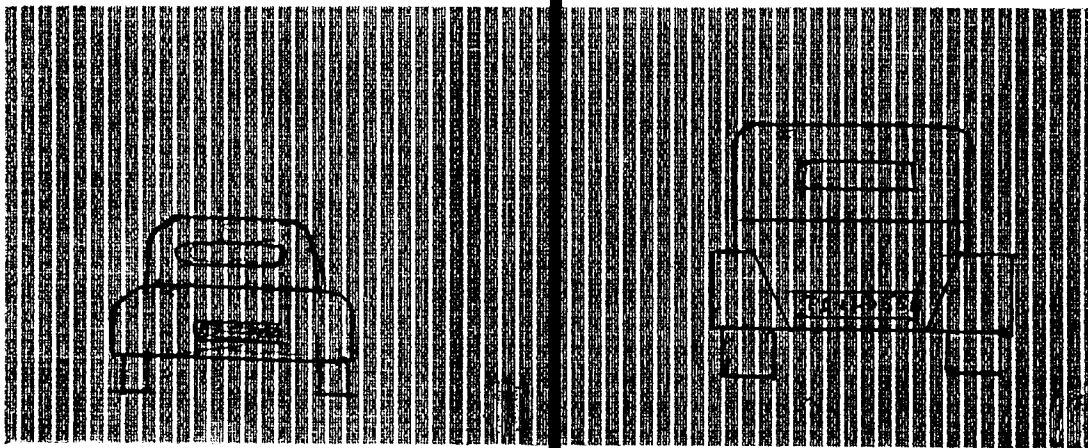


FIG. 5

FIG. 6



Entrance:01 10.04.92 08:15:30

Registration No. MI-123456

Ticket No. 1250

Exit:02 10.04.92 09:30:00

Registration No. TO-123556

Ticket No. 1250

Correspondence of images : NEGATIVE

Correspondence of number plates : NEGATIVE

Correspondence of dimension : NEGATIVE



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y,D	FR-A-2 570 528 (INSTITUT PO TECHNITSCHESKA KIBERNETIKA I ROBOTIKA) * page 9, line 6 - page 10, line 36; claims; figures *	1-3,6,8	G07B15/04
Y	FR-A-2 566 942 (MILLON) * page 3, line 13 - page 5, line 17; figures *	1,8	
Y,D	EP-A-0 367 725 (OBERHÄNSLI) * column 1, line 23 - column 5, line 23; claims; figures *	2,6	
A,D		1,3,7,9, 10	
Y	PATENT ABSTRACTS OF JAPAN vol. 13, no. 524 (P-964)22 November 1989 & JP-A-12 13 778 (OMRON TATEISI ELECTRON) 28 August 1989 * abstract *	3	
A	FR-A-2 606 572 (FAIVELEY ENTERPRISES) * abstract; claims; figures *	1,5	
A	WO-A-8 808 910 (GRUHL) * page 2, line 25 - page 5, line 23; figures *	1-4	
A	US-A-4 789 941 (NUNBERG) * abstract; claims; figures *	1,5	
A	US-A-4 603 390 (MEHDIPOUR) * abstract; figures *	1	
A	GB-A-2 160 688 (EMI)		
A	CH-A-677 703 (BALLMOOS)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 JUNE 1993	Examiner MEYL D.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			