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(54) **System for monitoring and controlling the average speed of vehicles in transit, and surveying of traffic on roads and motorways**

(57) The system includes: in each of a number of local detection stations along the stretch of road under control: at least one infrared illuminator or equivalent (11), suitable for illuminating the rear three-quarters or rear of vehicles in transit; at least one telecamera (13) and optional directional microphone, for capturing the rear three-quarters or rear-view image of vehicles in transit and the relative sounds; a computer equipped with an electronic interface (15) suitable for receiving, processing and transmitting the signals of the telecamera and the microphones and temporarily storing images and noises (sounds) of the vehicles in transit, and performing the recognition and calculation of the average speed maintained along the stretch of road between two neighbouring stations; a chronometric and synchro-

nization device; a transceiver system (17) for sending and receiving data to/from the successive local station as well as sending to a remote station (5) only the photograms relative to vehicles that have exceeded the speed limit between the two neighbouring local stations. The remote station (5) includes: a transceiver system for dialoguing with the various local stations; one or more computers (51) suitable for receiving and printing the photograms that arrive from the local stations, relative only to those vehicles that have exceeded the speed limits; an operator is thus able to visually compare the data of offending vehicles, photographed repeatedly, and read the number plates, whatever their type or shape .

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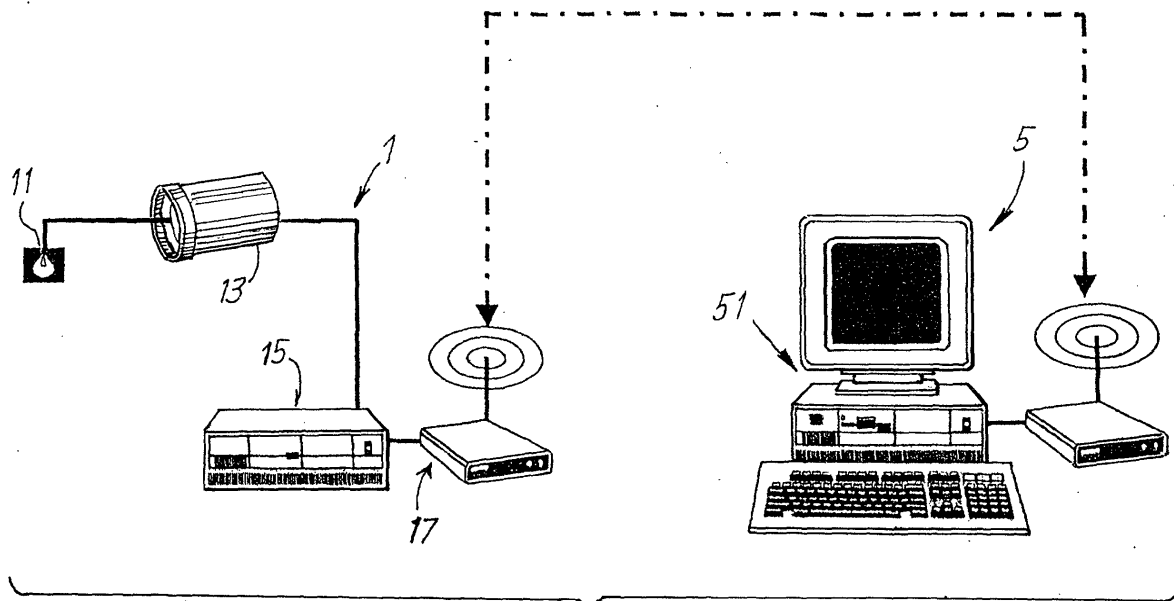


Fig. 1

Description

[0001] The invention relates to a monitoring and control system for a stretch of motorway or main or local road, varying in length from a few metres to a few kilometres, operating 24-hours-a-day (except in meteorologically prohibitive conditions), and suitable for calculating the average speed of vehicles that pass through the said stretch of road under control, for detecting offences and for additional measurements, controls and so on.

[0002] In particular, the system is aimed at providing a deterrent for the purposes of discouraging the drivers of vehicles transiting through the monitored stretches from reaching speeds in excess of that permitted. A known system for this purpose, via identification of the number plate of a vehicle transiting through the various local stations, is capable of supplying documental evidence on the basis of which the relevant authorities can achieve the objective of being able to charge overspeeding offences, as the operator is able to read the number plate and additional data regarding the time, place and average speed when the speed limit is exceeded.

[0003] In this known system, reading the vehicle's registration number is sometimes difficult or at least uncertain, compromising the reliability of evidence. It is also hard to select the data relative to individual vehicles that arrives at the control centre, where the operators must read - with difficulty at times - the number plates.

[0004] The invention aims to eliminate the drawbacks of currently known systems.

[0005] For this object and other possible objects specified in the following, the system under discussion for monitoring and controlling the average speed of vehicles and possible traffic surveys on roads and motorways, substantially consists of, in each of at least two local detection stations situated along the stretch of road under control: at least one infrared illuminator or equivalent, suitable for illuminating the rear three-quarters or rear of vehicles in transit; at least one telecamera - either black and white or colour - suitable for capturing a rear three-quarters or rear-view image; a computer equipped with an electronic interface suitable for processing, transmitting and receiving the signals of said at least one telecamera and to store, at least temporarily, the images and other identification data of vehicles in transit and to calculate the average speed maintained over the stretch of road relative to a neighbouring station, with which each local station is capable of dialoguing for these functions and in particular for detecting whether the permitted speed limit has been broken; a chronometric and synchronization device for synchronising with the various local stations; a remote station suitable for receiving images and other identification data of specific vehicles from the local stations; selecting means suitable for only sending photograms and other identification data to the remote station for vehicles that have exceeded the

speed limits between two local stations.

[0006] For dialoguing and transmitting vehicle photograms and other useful data (speed, time and other information), communications between the various local stations, and between these and the remote station, can be provided by various transceiver systems (GSM, mobile phones in general, optical fibre cables, radio or similar).

[0007] In practice, the remote station can include one or more computers equipped with electronic interfaces suitable for receiving and printing the photograms and other data sent by the local stations relative only to those vehicles that have exceeded the permitted speed limits, which are then used by the operators, in particular for identification of the plate number from at least two transmitted photograms showing images of the same vehicle.

[0008] In fact, with this arrangement the remote station only receives data relative to vehicles for which an offence is to be charged, and an operator is able to examine at least two different photograms of the same vehicle, can easily read the number plate, and can store both this information, as well as the photograms in question and the data values (times, average speed and transit chronology) for preparing a valid ticket.

[0009] In accordance with an additional development, one or both of the telecameras, or at least each of the local detection stations is also equipped with a directional microphone suitable for detecting the sound of each vehicle in transit, and storage means are also provided for saving, at least temporarily, said sounds, as well as means for comparing the captured sounds in at least two local stations; this constitutes an additional auxiliary element of identification with respect to that obtained via the images.

[0010] From amongst the elements, i.e. the vehicle identification parameters from the telecameras, to be used for the comparative analysis of images (and photograms) subsequently acquired by neighbouring local stations, the following can be indicated by way of example: the size of the vehicle; the detected colours; the layout of marks, writing and the like; the layout of colours, and so on. It is extremely improbable that two vehicles transit in a brief period of time - necessary for passing between two neighbouring stations - with both having the same detected parameters and that - in addition - both vehicles exceed the speed limit (by the same amount). In conclusion, the system in question analyses the image of the vehicle, and possible the sound as well, and encodes certain parameters (particularly relevant for the image as a whole) that are characteristic and which permit the individuation and identification, obviously in statistical terms, of individual vehicles at individual local stations. In cases of infraction, this enables transmission of the photograms taken at different local stations - together with other data - to the remote station, which prints them so that the operator can perform a more detailed analysis, including reading the number plate that remains visible in the photograms, which are

also available for identification purposes.

[0011] The transmission of data relative to the number of vehicles in transit can also be provided, for the purposes of possible traffic surveys with relative travelling times.

[0012] Additional applications for the equipment in question can also be provided.

[0013] The principle informing the invention is illustrated, by way of example, in the drawing.

[0014] Figure 1 schematically shows the components of one of the local detection stations and the remote station, and

[0015] Figure 2 shows the installation on a two-lane motorway.

[0016] On one or both carriageways, and also on each of the lanes of one or both carriageways C1 and C2 to be controlled, a minimum of two local detection stations 1 and 2, with a distance between them that can even reach several kilometres, are required; station 1 is situated upstream and station 2 downstream with respect to the lane's direction of the traffic F. Each local detection station, as for station 1 in Figure 2, includes (see Figure 1) an infrared (IR) illuminator 11 or equivalent, possibly of the directional type, suitable for illuminating the rear three-quarters or rear part of vehicles V in transit; IR illumination cannot be detected by drivers, even at night. Item 13 indicates a black and white or colour telecamera; more than one telecamera can be provided. Each of the local stations can also be equipped with one or more directional microphones, not illustrated. The telecamera is suitable for systematically taking the rear three-quarters or rear image of vehicles in transit in the available lane(s); the optional directional microphone is capable of capturing the sounds. Item 15 indicates the computer equipped with an electronic interface for the real-time processing of signals from the telecamera(s) - and from the optional microphone(s) - and for temporarily storing images and sounds of the vehicles in transit, and also for receiving data from a neighbouring local station for calculating the average speed of vehicles on the stretch of road between the two stations. A chronometric and synchronization device for synchronising with the various local stations, as well as a transceiver system 17 (GSM, mobile phones in general, cables, optical fibres, radio or similar) suitable for transmitting data between the various local stations and especially between neighbouring stations, are also provided.

[0017] The arrangement of the local stations is suited to permit photograms of vehicles that have exceeded the permitted speed limits along the stretch of road between the two local stations, together with the average speed and other data, especially chronological, to be sent to the remote station.

[0018] Item 5 indicates the remote station, which is destined to dialogue with at least one pair of local stations 1 and 2 or more subsequent local detection stations, positioned along the stretch of road to be controlled. This remote station 5 includes (Figure 1) one or

more computers equipped with an electronic interface 51 suitable for receiving and printing the photograms and other data sent by the local stations, which only regard vehicles that have exceeded the permitted speed limits, and a transceiver system 53 capable of dialoguing with the systems 17 of the local stations.

[0019] As synchronisation is provided for the chronometric equipment on the various local stations along the stretch of road under control, it is possible for the various local stations to calculate the average speed of each vehicle in the said stretch and identify the vehicles that have exceeded the permitted limit. The remote station can thus receive from the various local stations only the photograms and other data - speed, chronometric and so on - relative to vehicles that have committed an offence. The remote station only prints and saves photograms and other useful data for bringing charges for an offence. Once the photograms are printed onto paper, an operator can easily use these photograms (at least two) to check the number plate and other data-time, place and average speed - relative to the vehicles for which the remote station has received the data from the local stations, while images and other acquired data relative to vehicles observing the law can be deleted directly from the memories of the local stations.

[0020] In practice, the local stations are required to store, at least temporarily, the data acquired via the telecamera(s) and/or microphone(s), and to perform the necessary processing to calculate the average speed, when the permitted limits are exceeded; it is also possible to count the vehicles in transit and the average transit times.

[0021] From the above description, it emerges that it is possible to carry out a control that is not of the customary type, on-the-spot and temporary, or occasional as is currently performed, but one that can be extended to monitor an entire stretch of road between multiple local stations and with continuous operation (even 24-hours-a-day), such that to remain within the law, the driver of a vehicle must keep an average speed within the permitted limits at all times and for the entire travelling distance between the various local stations; an average speed above the permitted limit within the controlled stretch of road (between two local stations) indicate that unlawful speeds have been reached.

[0022] The length of the stretch of road can vary significantly whilst still maintaining the same performance quality, with distances that could even extend to a few kilometres. The shorter the stretch of road between the two local stations, the more precise the speed-reading will be.

[0023] More stations in series can cover any stretch of road.

[0024] A fundamental prerogative of the system in question is that it can: reduce the volume of data converging on the remote station because only photograms and other pertinent data regarding vehicles for which the local stations have detected an offence are sent; facili-

tate the operator in identifying the number plate data as at least two photograms and a large time span are available; operate 24-hours-a-day. As monitoring is performed via a telecamera, also capable of taking pictures at night, on condition that the telecamera's field of observation is illuminated by infrared illuminators or similar, readings in certain prohibitive meteorological conditions are to be excluded. Particular situations can also result in the exclusion or inclusion of sound data.

[0025] The system in question can operate in a completely automated manner, with the exception of evaluating the photograms, which must be performed by an operator, who will have at least two photograms on hand, one each from two neighbouring stations, for each vehicle that is considered to have committed an offence.

[0026] Even from the viewpoint of autonomy, there are no limits to continuous 24-hour-a-day operation as, considering that the devices can be mounted on existing electrified structures, such as traffic lights, lampposts, illuminated signboards, or other objects generally present on roads and motorways, the system is to be powered via the industrial mains. Obviously, this is all possible except in cases of force majeure.

[0027] The computer equipped with the electronic interface 15 of any local station connected to the telecamera 13 that observes the passage of vehicles (with the possibility of being equipped with directional microphones) is capable of dialoguing with a neighbouring local station, acquiring and temporarily storing the passage of the vehicles, performing identification, calculating the average speed and - should the permitted speed limits be exceeded - sending only the data and photograms pertaining to those vehicles that have committed an offence to the remote station.

[0028] To guarantee reliability in measurement of the average speed, the chronometric and synchronisation system must be able to correct possible misalignments between the clocks of the various local stations, so that possible time variances between the various local chronometric devices do not have repercussions on the calculation.

[0029] A certain tolerance is considered in any case, which serves to cover systematic errors and is generally expressed as a percentage of the calculated average speed. For example, if the system has a tolerance of 5%, this means that for a speed limit of 60 km.p.h., speeds above 63 km.p.h. will be considered as offences. It should also be considered that - under a certain aspect - the greater the distance between the various local stations, the more precise is the measurement of average speed, as even misalignments of a few seconds between the chronometric devices will have a minimal impact on the average speed calculation.

[0030] When a speeding offence is detected between two neighbouring local stations, they autonomously transmit the photograms (together with other data) to the remote station for the purposes of providing documented evidence, so that, once the photograms are printed

onto paper, the operator at the remote station can easily read the registration number, the time, place and average speed, and only for those vehicles that have committed an offence. Whatever its shape may be, the number plate can be read on at least two transmitted photograms.

[0031] For motives of space in the computer's memory, after the images relative to the offences to be charged have been sent to the remote station, all other images and data relative to vehicles passing by the local stations that observe the speed limits are deleted.

[0032] In conclusion, the images and sounds acquired locally by the various local stations are only stored for the time that is necessary for the local stations to perform the average speed calculation, when it is higher than the permitted limits, after which the temporarily stored images and sounds are deleted, whilst information regarding the number of vehicles in transit and the time of transit is permanently stored. This information can also be deleted when it is no longer of use.

[0033] Traffic flow calculations over specific periods of time and specific times of day and/or specific days of the week and so on, always based on the acquired data, chronologically selected and counted, and possibly acquired by only one of the two local stations, can easily be provided.

[0034] The installation can also permit a selection between vehicles of the heavy and industrial type and light vehicles like cars, on the basis of an acquired dimension, height or width for example; in this way, selective calculations for statistical and other purposes can be made.

[0035] It is understood that the drawing does not illustrate anything other than an exemplification, given purely as a practical demonstration of the invention, the forms and arrangements of which may vary without leaving the scope of the concept informing the invention. The possible presence of reference numbers in the attached claims has the purpose of facilitating reading thereof with reference to the description and to the table of drawings, and in no way limits the sphere of protection represented by the claims.

45 Claims

1. A system for monitoring and controlling the average speed of vehicles in transit, and possible surveying of traffic on roads and motorways, utilizing local detection stations along the stretch of road to be controlled, **characterized by** the fact that it includes:

- in each of at least two local detection stations at some distance from each other: at least one infrared illuminator (11) or equivalent, suitable for illuminating the rear three-quarters or rear of vehicles in transit; at least one black and white or colour telecamera (13) suitable for cap-

- turing a rear three-quarters or rear-view image; a computer (15) equipped with an electronic interface suitable for processing, transmitting and receiving the signals of at least one other local station, and storing at least temporarily the images and other data regarding the vehicles in transit, and calculating the average speed maintained along the stretch of road relative to a neighbouring station with which each local station is capable of dialoguing for at least detecting the breaking of the permitted speed limit; a chronometric and synchronization device for synchronising with the various local stations;
- a remote station suitable for receiving images and other identification data of specific vehicles from the local stations; and
 - suitable means for selecting and sending to the remote station only the photograms and other identification data relative to vehicles that have exceeded the speed limits between two local stations.
2. The system as in Claim 1, **characterized in that** it includes means for dialoguing between the various local stations and between these and the remote station, chosen from transceiver systems (GSM, mobile phones in general, optical fibres, radio or similar) that are also suitable for transmitting photograms of vehicles, as well as other useful data (speed, times and so on).
3. The system as in Claims 1 or 2, **characterized in that** the dialogue between local stations is limited to a number of characteristic data items of a vehicle image, to permit recognition by the receiving station, while the remote station receives complete photographic images of each vehicle for which an offence has been detected, as well as other useful data for bringing charges .
4. The system as in Claims 1 or 2 or 3, **characterized in that** the remote station includes one or more computers equipped with electronic interfaces suitable for receiving and printing the photograms and other data sent by the local stations relative only to those vehicles that have exceeded the permitted speed limits; wherein said photograms can be compared by the operators and used also for identifying the registration number.
5. The system as in any of the previous Claims, **characterized in that**: each of the telecameras or in any case each of the local detection stations is also equipped with a directional microphone suitable for detecting the sounds of the each vehicle in transit; and that means are provided for the storage, at least temporarily, of the said sounds, as well as means for comparing the sounds captured by at least two local stations.
6. The system as in at least one of the previous Claims, **characterized in that** the vehicle identification parameters - for the comparative analysis of images (and photograms) successively captured by neighbouring local stations - include: the dimensions of the vehicle; the detected colours; the layout of marks, writing and the like; the layout of colours; optionally, the noises and sounds.
7. The system as in at least one of the previous Claims, **characterized in that** it includes means of calculating the number of vehicles in transit, for possible surveys on traffic and relative travelling times.
8. The system as in at least one of the previous Claims, **characterized in that** it included means of differentiating between light and heavy vehicles in function of one or more characteristic dimensions, and means of counting the consequently differentiated vehicles .
9. The system for monitoring and controlling the average speed of vehicles in transit, and possible surveying of traffic on roads and motorways; the whole as described above and represented in the drawing provided by way of exemplification.

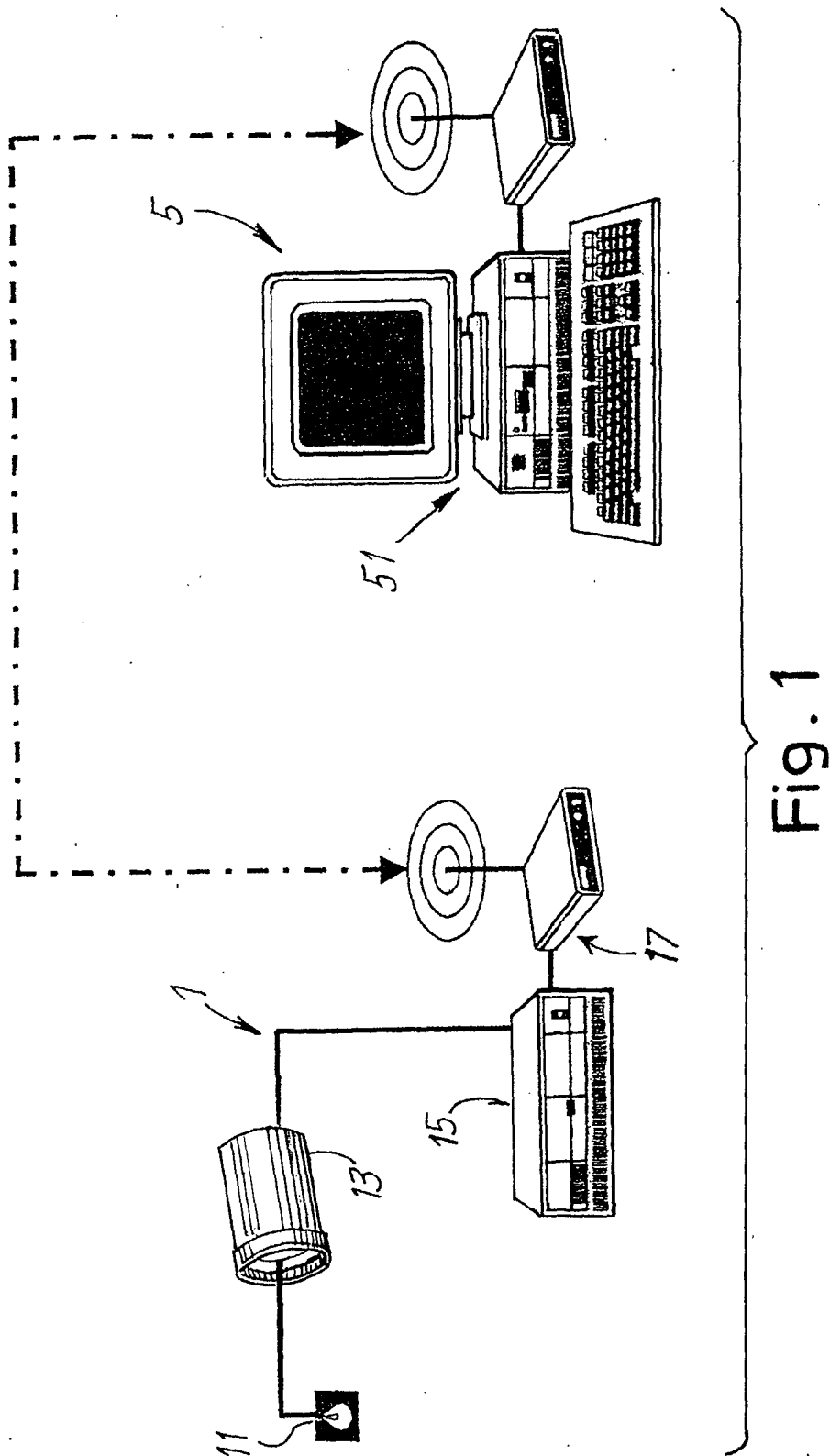
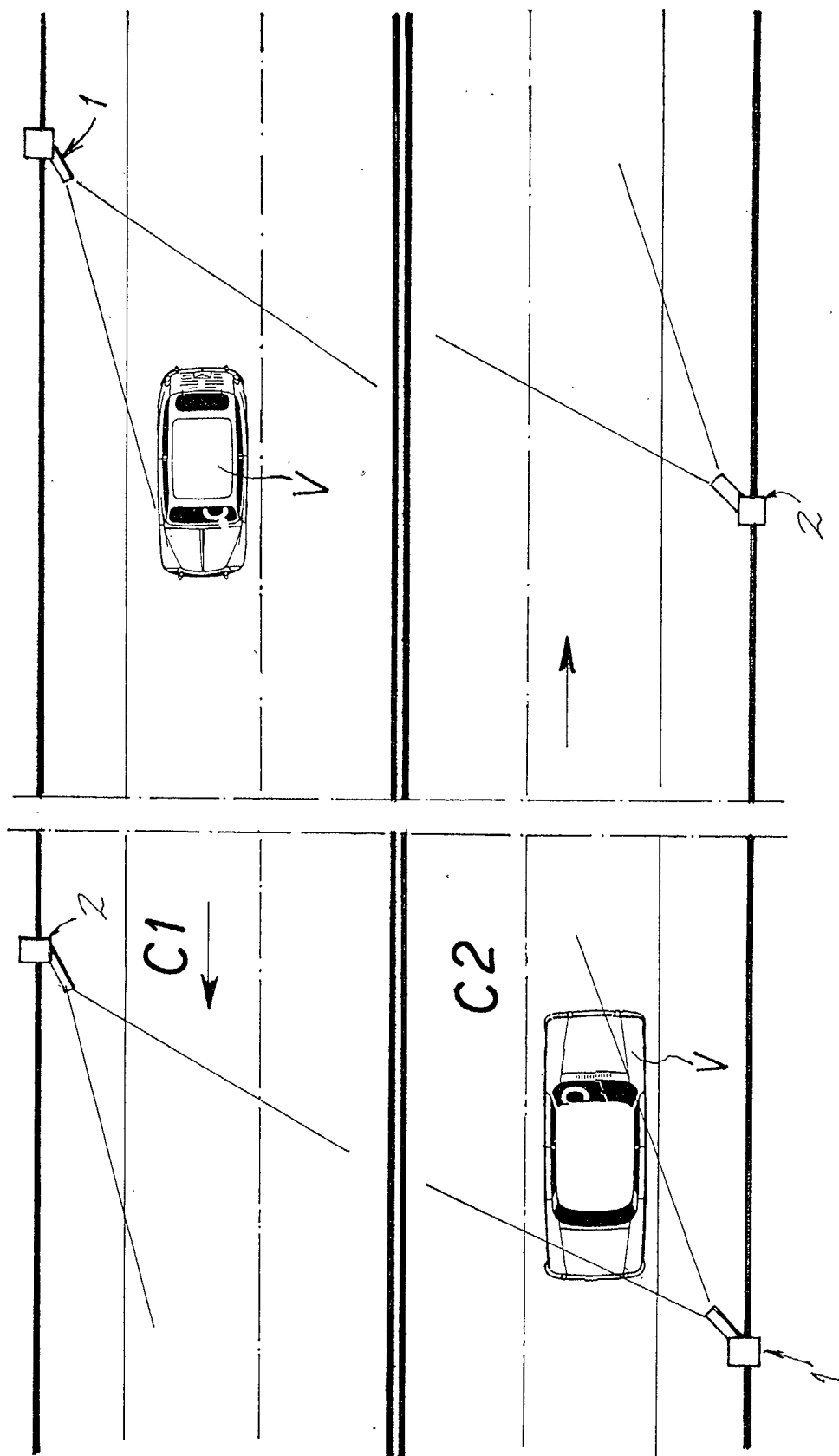


Fig. 1

Fig. 2





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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5438

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 10 September 2002	Examiner Heß, 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			

EPO FORM 1503 03 82 (P04C01)



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EUROPEAN SEARCH REPORT

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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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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