Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2250823 C 2006/01/03

(11)(21) 2 250 823

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1997/04/01
(87) Date publication PCT/PCT Publication Date: 1997/10/09
(45) Date de délivrance/Issue Date: 2006/01/03
(85) Entrée phase nationale/National Entry: 1998/09/30
(86) N° demande PCT/PCT Application No.: NL 1997/000163
(87) N° publication PCT/PCT Publication No.: 1997/037242
(30) Priorité/Priority: 1996/04/01 (1002751) NL

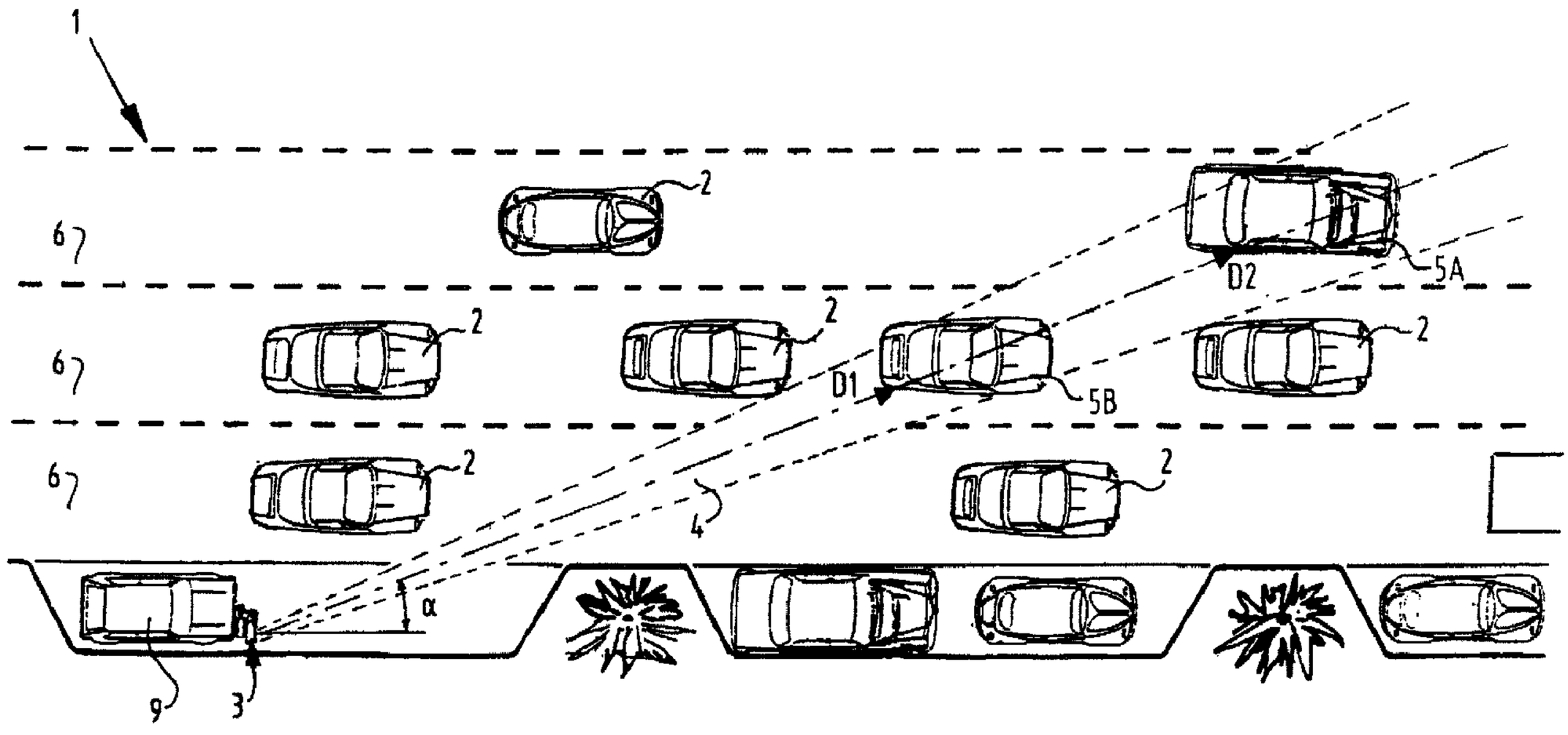
(51) Cl.Int.^{7}/Int.Cl.^{7} G01S 13/92, G01S 13/58

(72) Inventeur/Inventor:
GATSONIDES, TOM, NL

(73) Propriétaire/Owner:
GATSOMETER B.V., NL

(74) Agent: FETHERSTONHAUGH & CO.

(54) Titre : PROCEDE ET APPAREIL PERMETTANT DE DETERMINER LA VITESSE ET LA POSITION D'UN VEHICULE
(54) Title: METHOD AND APPARATUS FOR DETERMINING THE SPEED AND LOCATION OF A VEHICLE



(57) Abrégé/Abstract:
The invention relates to a method for measuring the speed of a vehicle by transmitting a wave beam directed at the vehicle, receiving a part of the wave beam reflected by the vehicle, comparing the reflected beam part with the transmitted wave beam and deriving from this comparison the speed of the vehicle, wherein during the speed measurement the position of the vehicle is also determined. A vehicle committing an offence can thus be identified unambiguously in a recording which is made after detection of the speeding offence. The speed of the vehicle can be determined from a difference in wavelength detected during the comparison between the reflected beam part and the transmitted wave beam, while the position of the vehicle is determined from a time lag detected during the comparison between the moment of transmitting and the moment of receiving the reflected beam part. The invention also relates to an apparatus for performing this method.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
G01S 13/92, 13/58

A1

(11) International Publication Number: **WO 97/37242**

(43) International Publication Date: 9 October 1997 (09.10.97)

(21) International Application Number: PCT/NL97/00163

(22) International Filing Date: 1 April 1997 (01.04.97)

(30) Priority Data:
1002751 1 April 1996 (01.04.96) NL

(71) Applicant *(for all designated States except US)*: GATSOMETER B.V. [NL/NL]; Tetterodeweg 8, NL-2051 EE Overveen (NL).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: GATSONIDES, Tom [NL/NL]; Bentveldweg 10, NL-2116 EH Bentveld (NL).

(74) Agent: BARTELDS, Erik; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).

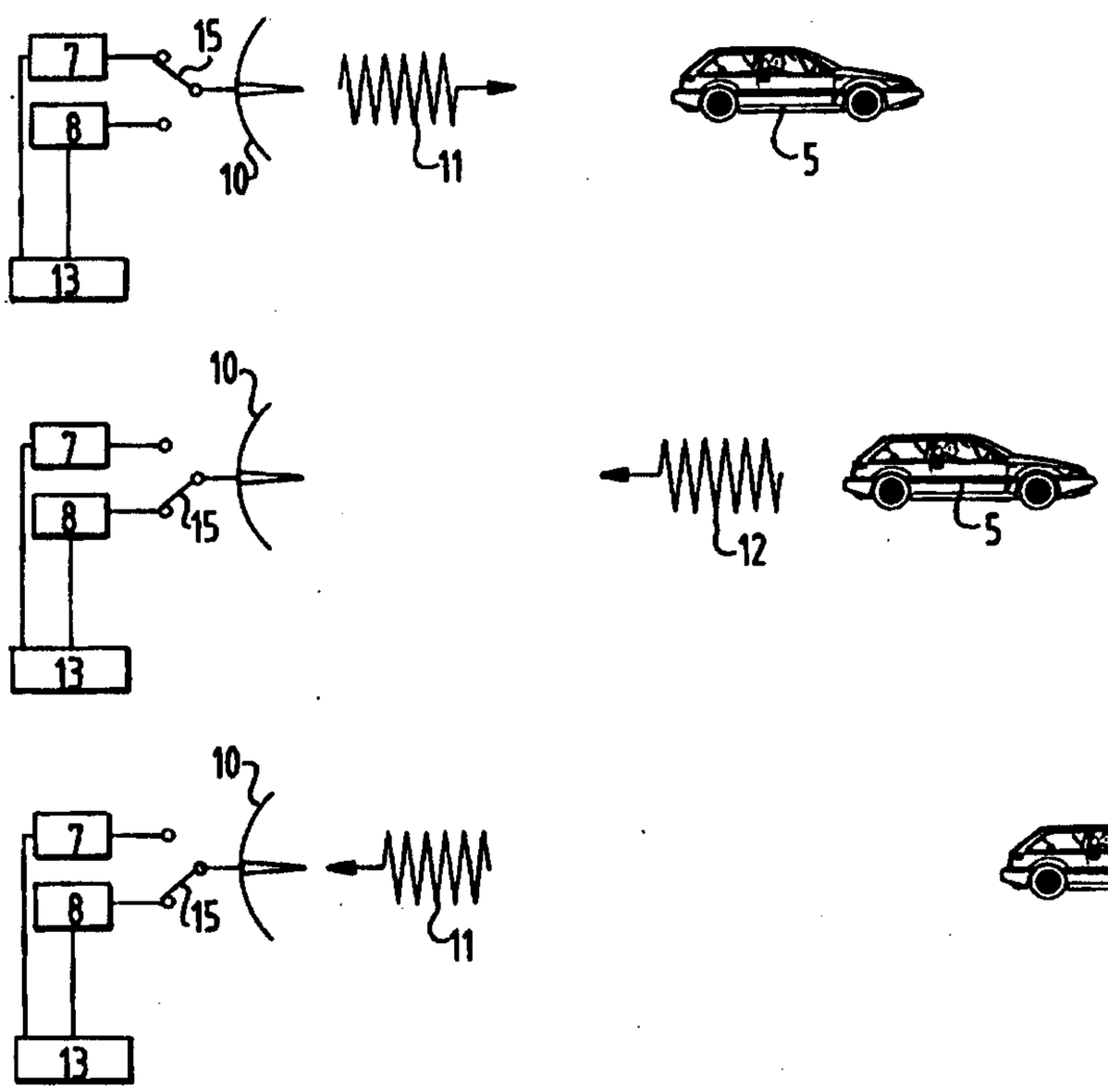
(81) Designated States: CA, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Dutch).

(54) Title: METHOD AND APPARATUS FOR DETERMINING THE SPEED AND LOCATION OF A VEHICLE

(57) Abstract

The invention relates to a method for measuring the speed of a vehicle by transmitting a wave beam directed at the vehicle, receiving a part of the wave beam reflected by the vehicle, comparing the reflected beam part with the transmitted wave beam and deriving from this comparison the speed of the vehicle, wherein during the speed measurement the position of the vehicle is also determined. A vehicle committing an offence can thus be identified unambiguously in a recording which is made after detection of the speeding offence. The speed of the vehicle can be determined from a difference in wavelength detected during the comparison between the reflected beam part and the transmitted wave beam, while the position of the vehicle is determined from a time lag detected during the comparison between the moment of transmitting and the moment of receiving the reflected beam part. The invention also relates to an apparatus for performing this method.



Method and apparatus for determining the speed and location of a vehicle

The invention relates to a method for measuring the speed of a vehicle by transmitting a wave beam directed at the vehicle, receiving a part of the wave beam reflected by the vehicle, comparing the reflected beam part with the transmitted wave beam and deriving from this comparison the speed of the vehicle. Such a method is generally known and is frequently used by police in the form of radar speed measurements.

In the known method a radar beam is transmitted at an acute angle to a road axis from a fixed, generally concealed position along the road. When a vehicle passes through the beam a part of the beam is reflected. This reflected part is received at the measuring point and the frequency of the reflected beam is compared with the (exact) frequency of the transmitted beam. Because the beam is reflected by a moving vehicle it will undergo, as a result of the Doppler effect, a frequency change which is a measure for both the speed of movement and the direction of movement of the vehicle. When it is found from the comparison of the transmitted and received frequency that the speed of the vehicle exceeds the maximum allowed speed at that location a warning signal is generated. This signal is generally used to activate a camera whereby a recording is made of the vehicle committing the speeding offence. This recording then also shows the relevant data such as date and time of the recording and the measured speed.

Problems occur in the known method when it is applied on roads with a number of traffic lanes, such as

motorways. Here several vehicles may pass through the measuring beam simultaneously. If one of these vehicles commits a speeding offence it is often not possible to determine indisputably which vehicle this was. When the speed measurement is combined with making a recording, complicated and time-consuming processing of the recording is required in order to determine the offender therefrom on the basis of secondary indications.

Embodiments of the invention provide a method of the above described type, wherein this drawback does not occur. This is achieved according to the invention in that during the speed measurement the position of the vehicle is determined. By determining not only the speed but simultaneously also the position of the vehicle, it is still possible to identify with certainty the vehicle which committed the offence, also when a number of vehicles passes through the beam.

Accordingly, in one aspect of the present invention, there is provided a method for measuring a speed of a vehicle by transmitting a wave beam directed at the vehicle, receiving a reflected beam part of the wave beam reflected by the vehicle, comparing the reflected beam part with the transmitted wave beam, deriving from this comparison both a measured speed and a position of the vehicle, comparing the measured speed with a maximum allowed speed, and generating a warning signal when a speeding offence is determined, wherein said wave beam is transmitted over a road having a number of traffic lanes at an acute horizontal angle(α) to the direction of the lanes and the position is used to determine in which of said traffic lanes the vehicle is travelling.

In a second aspect of the present invention, there is provided a speed measuring apparatus for measuring a speed of a vehicle provided with means for generating and transmitting a directed wave beam, means for receiving a reflected wave beam part reflected by the vehicle, means for comparing the reflected beam part with the directed wave beam that was transmitted and means for deriving both a measured speed and a position of the vehicle from this comparison, means for comparing the measured speed with a maximum allowed speed and for generating a warning signal when a speeding offence is determined, and a camera controlled by the speed measuring apparatus for making a recording when a speeding offence is determined, wherein the camera is arranged for showing the measured speed and position of the vehicle in said recording.

An efficient manner of position determination is achieved when the position of the vehicle, as well as the speed thereof, is determined by comparing the reflected beam part with the transmitted wave beam. The speed of the vehicle can advantageously be determined from a difference in wavelength detected during the comparison between the reflected beam part and the transmitted wave beam, and the position of the vehicle can be determined from a time lag detected during the comparison between the moment of transmitting and the moment of receiving the reflected beam part. Both the speed and the position of the vehicle are thus determined with a single measurement. It will further be apparent that instead of the difference in wavelength the frequency change which after all is associated therewith could also be measured.

The wave beam is preferably transmitted in pulse form. By using separate wave pulses the time which has lapsed between the moment of transmission and the moment of reception can be determined unequivocally.

When during the speed measurement the direction of travel of the vehicle is also determined, even more certainty is obtained concerning the identity of the offending vehicle.

The wave beam is preferably transmitted at an acute angle to the direction of movement of the vehicle. A reliable measurement is thus obtained which can be performed from a concealed position.

The invention also relates to an apparatus for performing the above described method. According to the invention such an apparatus, which is provided with means for generating and transmitting a directed wave beam, means for receiving a part of the wave beam reflected by a vehicle and means for comparing the reflected beam part with the transmitted beam and deriving the speed of the vehicle from this comparison, is characterized by means for determining the position of the vehicle during the speed measurement.

Preferred embodiments of the apparatus according to the invention form the subject-matter of the dependent claims 8 to 12.

The invention is now elucidated on the basis of an embodiment, wherein reference is made to the annexed drawing, wherein:

fig. 1 shows a top view of the use of the apparatus according to the invention in a speed measurement,

fig. 2A to 2C show a schematic view of the measuring method according to the invention,

fig. 3 shows a front view of the beam generating and transmitting means of the apparatus shown in fig. 1, and

fig. 4 shows a cross section along the line IV-IV in fig. 3.

In order to measure the speed of vehicles 2 travelling on a multi-lane highway 1 (fig. 1) a speed measuring apparatus 3 according to the present invention is disposed along the road. The apparatus 3 can herein be

incorporated in a vehicle 9, for instance an inconspicuous police patrol car. The apparatus 3 transmits a wave beam 4, for instance a radar beam, over the road 1 at an acute angle α of for instance 20° to the direction of movement of vehicles 2. When a vehicle 5A or 5B passes through the beam 4, a part of beam 4 is reflected. By comparing the frequency of the reflected part of the beam with the transmission frequency, the speed of vehicle 5A or 5B can be determined using the Doppler effect.

Because the road 1 has a number of traffic lanes 6 it is conceivable that, as shown, a number of vehicles 5A and 5B pass through the beam virtually simultaneously. In order to still be able to determine indisputably in these cases which of vehicles 5A or 5B is committing a speeding offence, the position of the vehicle, in this case its distance from measuring apparatus 3, is determined simultaneously with its speed.

For this purpose the wave beam is transmitted in pulse form and the time is measured between the moment that such a wave pulse 11 is transmitted by the beam generating and transmitting means 7 (fig. 2A) and the moment that a part 12 of this wave pulse, which is reflected by a passing vehicle 5 (fig. 2B), is received again by receiving means 8 (fig. 2C). Because use is made of separate wave pulses, of which the moment of transmission is known in each case and which are therefore as it were "recognized" by the receiving means, the distance from the measuring apparatus 3 of the vehicle 5 by which the wave pulse is reflected can be determined without difficulty. Transmitting means 7 and receiving means 8 herein make use, with interposing of a selector switch 15, of a collective antenna 10, which is shown here schematically. Transmitting means 7 and receiving means 8 are each further connected to a central control unit 13, in which are arranged the means for comparing the frequency or wavelength of the transmitted and reflected beam and for measuring the time which has lapsed between transmitting

and receiving. The central control unit 13 also contains the means for determining from this comparison the speed and direction of travel of the vehicle 5 as well as its distance from measuring apparatus 3. The starting point for determining the speed and travel direction of the vehicle 5 are per se known relations between the frequency change and the speed of the reflecting vehicle 5 resulting from the Doppler effect. The distance of the vehicle 5 from the measuring apparatus is simply determined by multiplying the measured time by the known propagation velocity of the wave beam.

When a speeding offence is determined, a warning signal is generated. Herein is indicated how great the measured speed is and what is the distance of the vehicle from the apparatus. The detected direction of travel can also be indicated. This warning signal can be used to activate a camera, whereby a recording is made. The speed and distance can be shown in the recording. From the distance can also be directly determined in which lane the offender is travelling. The comparing means can further be programmed such that they ignore reflected beams which are received within a determined time of the moment of transmitting. To this end the measured time is compared with an adjustable lower threshold value. The speed measurement can thus be limited for instance to the left-hand lane, which is after all the furthest removed from measuring apparatus 3 and in which the highest speeds will generally be reached. By also comparing the measured time with an upper threshold value, a measuring window can be adjusted whereby the measurement can be limited to one of the middle lanes. When the measurement is limited to the left-hand lane, reflections from oncoming traffic in the other lanes can also be filtered out in this manner. This same effect can be achieved by determining the travel direction of the vehicle, which follows simply from the nature of the measured frequency change (frequency increase or decrease).

In order to direct wave beam 4 at an acute angle over the road 1 without having to rotate the entire measuring apparatus 3 through this angle, use is made of an antenna 10 with a large plurality of slots 14, 14', ..., 14n (fig. 3), a so-called slotted array antenna. Integrated in antenna 10 are the transmitting means 7 which take the form of an oscillator 19, which is connected over a mixing block 16 to an elongate wave guide 17, in which are arranged the slot-like transmitting apertures 14, 14', ..., 14n. The wave guide 17 is arranged in a dish 18 of horn-shaped cross section which forms the actual antenna (fig. 4). The distribution of the slots 14, 14', ..., 14n over the length of wave guide 17 and their specific orientation, in the shown example at an angle of approximately 60 degrees to the longitudinal axis of the wave guide, allows the wave beam to be transmitted at an angle α relative to the normal of antenna 10 (fig. 1). This is of particular importance when, as in the shown example, measuring apparatus 3 is incorporated in a vehicle 9, since the required installation space is considerably limited thereby.

CLAIMS:

1. A method for measuring a speed of a vehicle by transmitting a wave beam directed at the vehicle, receiving a reflected beam part of the wave beam reflected by the vehicle, comparing the reflected beam part with the transmitted wave beam, deriving from this comparison both a measured speed and a position of the vehicle, comparing the measured speed with a maximum allowed speed, and generating a warning signal when a speeding offence is determined, wherein said wave beam is transmitted over a road having a number of traffic lanes at an acute horizontal angle(α) to the direction of the lanes and the position is used to determine in which of said traffic lanes the vehicle is travelling.

2. The method as claimed in claim 1, wherein said warning signal is used to activate a camera for making a recording, and the measured speed and distance of the vehicle are included in the recording.

3. The method as claimed in claim 1 or 2, wherein the speed of the vehicle is determined from a difference in wavelength detected during the comparison between the reflected beam part and the transmitted wave beam and the position of the vehicle is determined from a time lag detected during a comparison between a moment of transmitting and a moment of receiving the reflected beam part.

4. The method as claimed in claim 3, wherein the time lag detected is compared with a threshold value selected from the list consisting of: a lower threshold value; both a lower and an upper threshold value; and an upper threshold value, and the speed of the vehicle is only determined if

the time lag is within a measuring window defined by the threshold value.

5. The method as claimed in any of claims 1 to 4, wherein the wave beam is transmitted in pulse form.

6. The method as claimed in any of claims 1 to 5, wherein a direction of travel of the vehicle is also determined.

7. A speed measuring apparatus for measuring a speed of a vehicle provided with means for generating and transmitting a directed wave beam, means for receiving a reflected wave beam part reflected by the vehicle, means for comparing the reflected beam part with the directed wave beam that was transmitted and means for deriving both a measured speed and a position of the vehicle from this comparison, means for comparing the measured speed with a maximum allowed speed and for generating a warning signal when a speeding offence is determined, and a camera controlled by the speed measuring apparatus for making a recording when a speeding offence is determined, wherein the camera is arranged for showing the measured speed and position of the vehicle in said recording.

8. The speed measuring apparatus as claimed in claim 7, wherein the means for comparing are adapted to compare a wavelength of the reflected beam part with that of the directed wave beam that was transmitted, to measure a time lag between a moment of transmitting and a moment of receiving the reflected part of the directed wave beam and to derive the speed of the vehicle from a detected difference in wavelength, and the means for deriving are adapted to derive the position of the vehicle from a measured time lag.

9. The speed measuring apparatus as claimed in claim 8, wherein the means for comparing are arranged for comparing the measured time lag with a threshold value selected from the list consisting of: a lower threshold value; an upper threshold value; and both a lower and an upper threshold value, said threshold value defining a measuring window, and for ignoring reflected beams which are received outside said measuring window.

10. The speed measuring apparatus as claimed in any of claims 7 to 9, wherein means for generating and transmitting are adapted to generate and transmit the directed wave beam in a form of a pulse.

11. The speed measuring apparatus as claimed in any of claims 8 to 10, wherein the means for comparing are adapted to derive a direction of travel of the vehicle from the detected difference in wavelength.

12. The speed measuring apparatus as claimed in any of claims 7 to 11, wherein means for generating and transmitting comprise an antenna provided with slots for transmitting the directed wave beam at an acute angle to a direction of movement of the vehicle.

FETHERSTONHAUGH & CO.
OTTAWA, CANADA
PATENT AGENTS

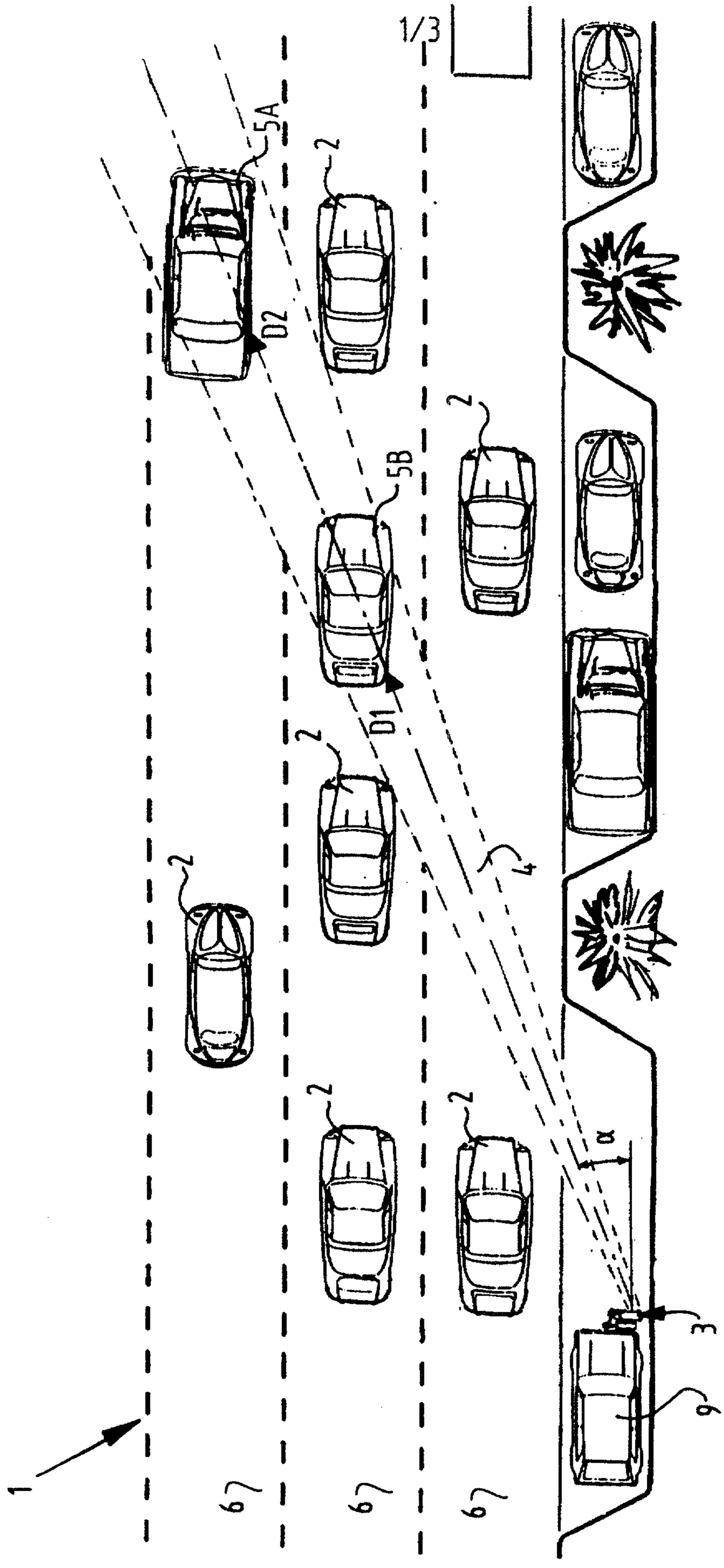


FIG.1

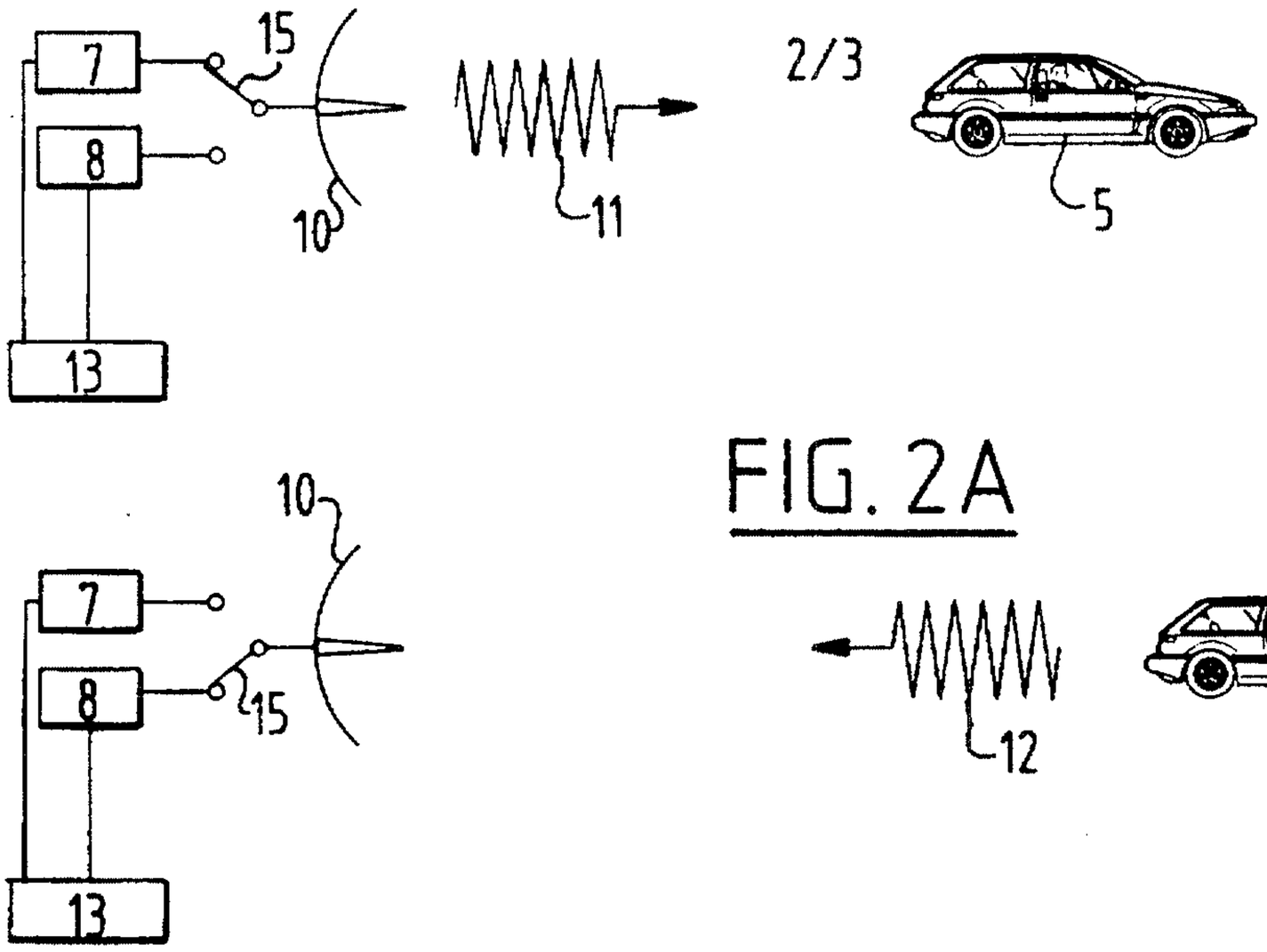


FIG. 2A

FIG. 2B

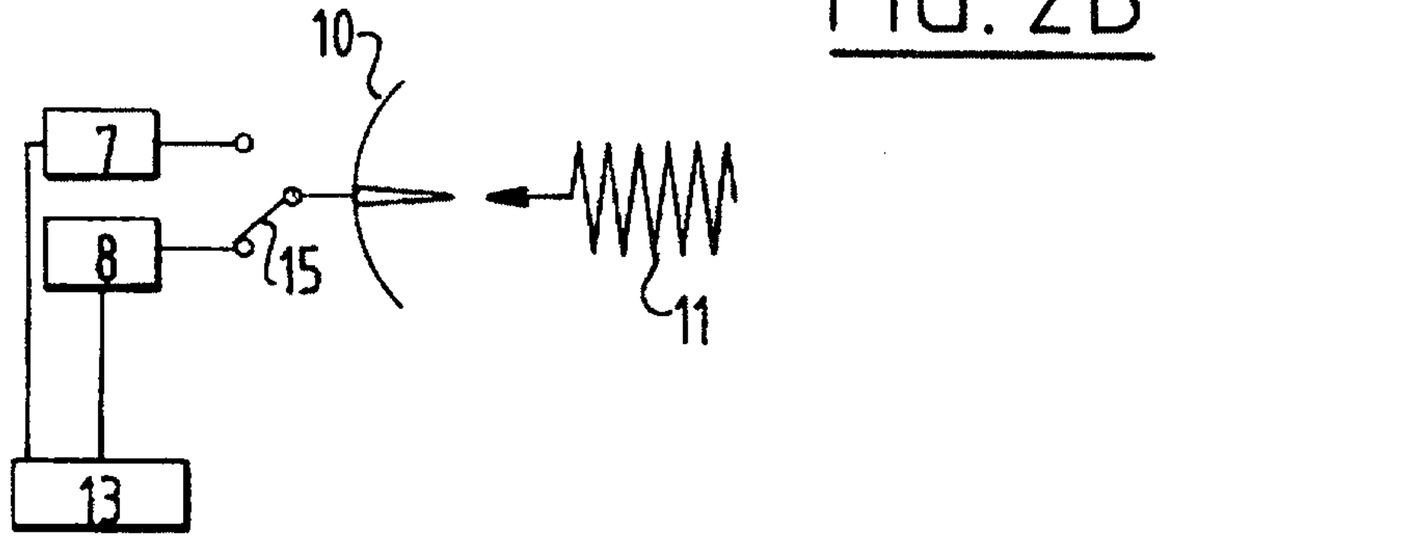


FIG. 2C

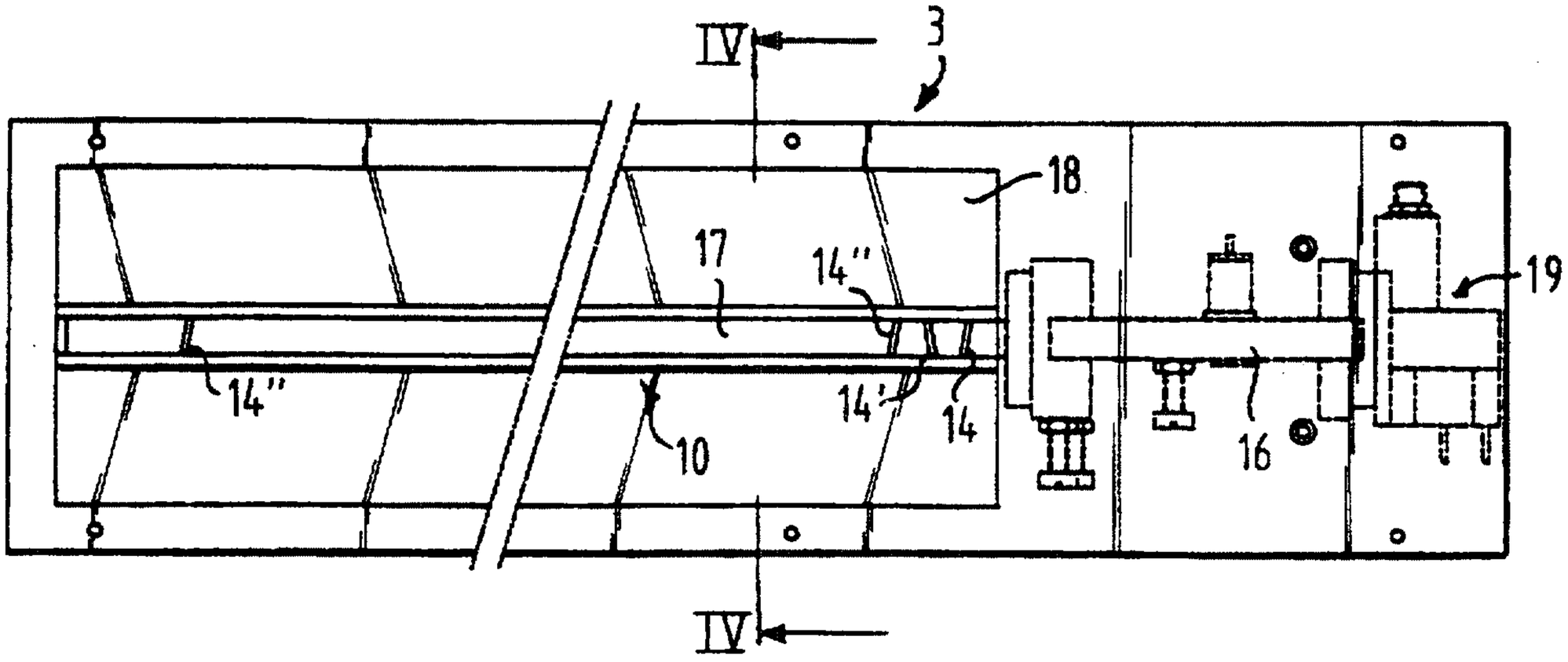


FIG. 3

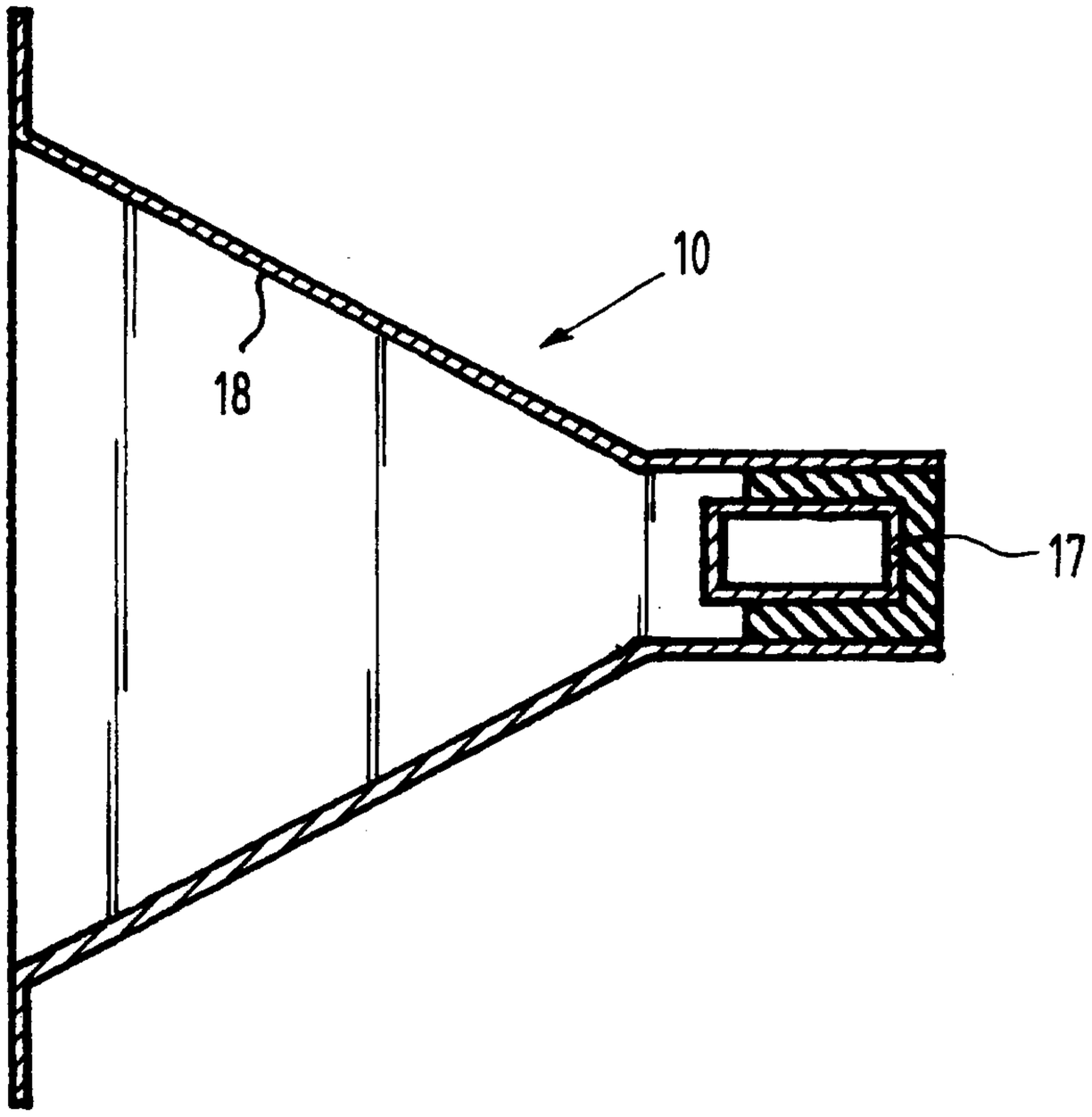
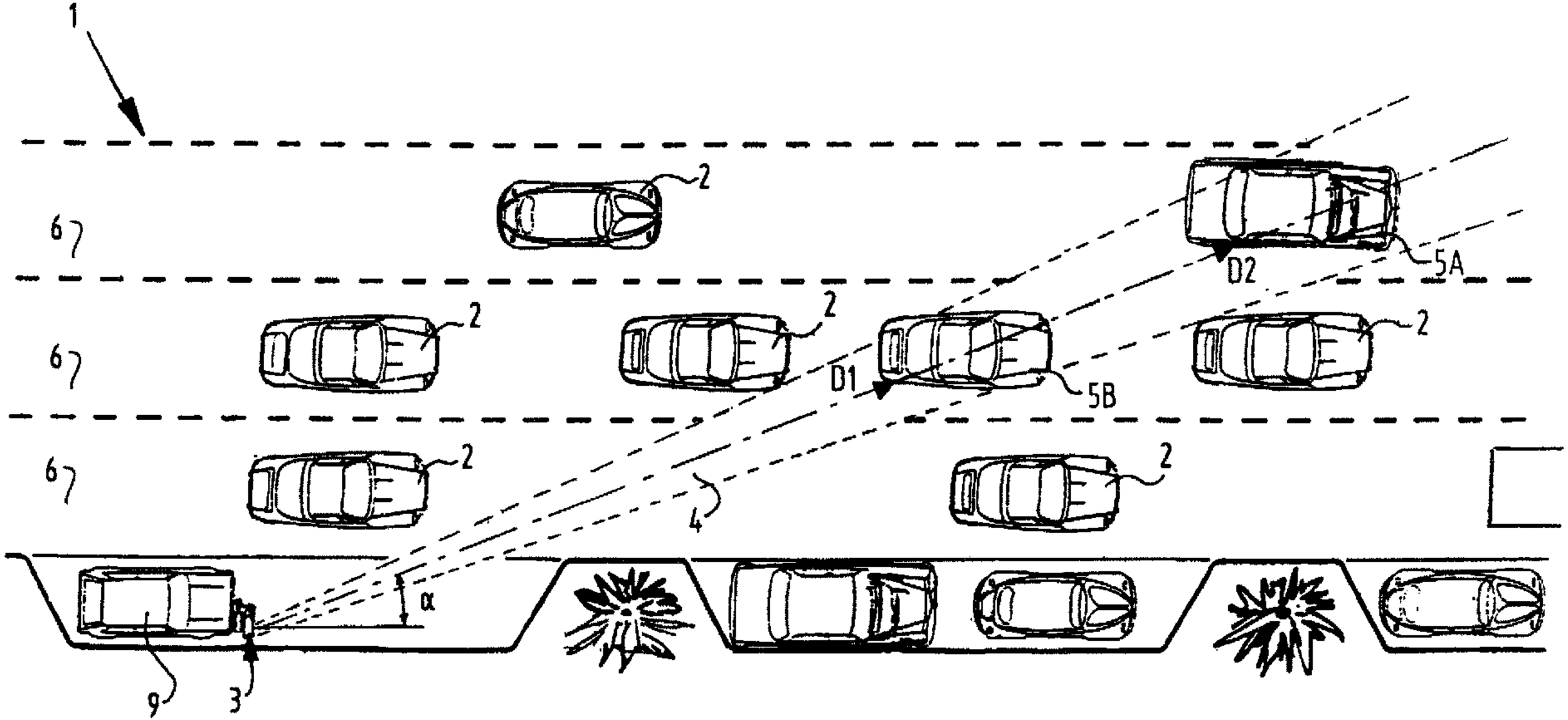


FIG. 4


1
2
6
D2
5A
D1
5B
4
α
9
3