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PATENT REQUEST : STANDARD PATENT

I/We being the person(s) identified below as the Applicant(s), request the grant of a patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying standard complete specification.

Full application details follow:

[71/70] Applicant(s)/Nominated Person(s):

Ricoh Company, Ltd.

of

3-6, 1-chome Nakamagome, Ota-ku, Tokyo, Japan

[54] Invention Title:

Vehicle photographing apparatus

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Basic Convention Application(s) Details:

[31] Application Number	[33] Country	Code	[32] Date of Application
322252/92	Japan	JP	9 November 1992

DATED this FIFTH day of NOVEMBER 1993

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a member of the firm of
DAVIES COLLISON CAVE for
and on behalf of the
applicant(s)

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NOTICE OF ENTITLEMENT

We, **Ricoh Company, Ltd.**, the applicant/Nominated Person named in the accompanying Patent Request state the following:-

The Nominated Person is entitled to the grant of the patent because the Nominated Person derives title to the invention from the inventors by assignment.

The Nominated Person is entitled to claim priority from the basic application listed on the patent request because the Nominated Person made the basic application, and because that application was the first application made in a Convention country in respect of the invention.

DATED this FIFTH day of NOVEMBER 1993

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a member of the firm of DAVIES COLLISON CAVE for and on behalf of the applicant(s)

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VEHICLE PHOTOGRAPHING APPARATUS

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(57) Claim

1. A vehicle photographing apparatus having a stroboscopic light emitting portion for irradiating light in a photographing range of a photographing apparatus body arranged along a vehicle passing road, for emitting light to a running vehicle from said stroboscopic light emitting portion thereby to photograph said running vehicle by said photographing apparatus body when said running vehicle violates traffic regulations, said vehicle photographing apparatus comprising:

traffic information detecting means for detecting a passage of said vehicle running on said vehicle passing road;

reference information inputting means for setting a condition in which said passage of said vehicle running on said vehicle passing road violates the traffic ~~regulation~~ regulations;

judging means for comparing outputs of said traffic information detecting means and said reference information inputting means with each other thereby to generate a photographing starting command signal;

focusing means started by said photographing starting command signal from said judging means for moving a focusing lens of a photographing lens means so as to focus on an illegal vehicle violating the traffic regulations, said photographing lens means being arranged in said photographing

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apparatus body;

photographing direction changing means for moving an optical axis of said photographing lens means to a position of said illegal vehicle detected by said traffic information detecting means or a position of said illegal vehicle focused by said focusing means;

zooming means for changing a focal length of said photographing lens means in such a manner that said illegal vehicle can be photographed at a predetermined magnification within a photographing screen on a basis of said position of said illegal vehicle detected by said traffic information detecting means or a position of said illegal vehicle focused by said focusing means; and

photographing control means for controlling said focusing means, said photographing direction changing means, said zooming means, said photographing apparatus body and said stroboscopic light so as to relate to each other.

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COMPLETE SPECIFICATION

NAME OF APPLICANT(S):

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INVENTION TITLE:

Vehicle photographing apparatus

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vehicle photographing apparatus capable of reliably photographing an illegal vehicle disregarding and running through a red traffic signal light and an illegal vehicle running at a running speed exceeding a limiting speed.

2. Description of the Related Art

In a certain case, a vehicle running on a passing road for vehicles such as a public road disregards and runs through a red traffic signal light and goes into an intersection. In such a case, there is a proposed system for monitoring such a vehicle in an unmanned state. In this system, when this vehicle disregards and runs through the red traffic signal light, the vehicle is photographed and a warning is given to a driver, an owner, etc. of this vehicle later. Further, the driver, the owner, etc. are punished with a predetermined fine. Such a system is practically used. In this system, the vehicle

disregarding and running through the red traffic signal light and going into the intersection is monitored in an unmanned state. Further, a vehicle running at a running speed exceeding a predetermined limiting speed is also monitored in the unmanned state and is similarly photographed when this illegal vehicle is detected.

In the following concrete examples, the vehicle disregarding and running through the red traffic signal light and going into the intersection is monitored in the unmanned state and is photographed as an illegal vehicle.

For example, Japanese Utility Model Application Laying Open (KOKAI) No. 60-150531 shows one of such concrete examples. In this Japanese application, a photographing apparatus body is arranged in a position for taking the whole intersection in one view. A vehicle disregarding and running through a red traffic signal light is photographed as an illegal vehicle when this vehicle is detected by a suitable detecting means such as a pressure sensor, etc. buried into a road. In this case, three kinds of pictures are simultaneously taken at one time as one photograph.

In a first picture, the vehicle is photographed by using a photographing lens having a focal length of a telescopic system such that a number plate having a registered number for specifying the vehicle and a driver's face are clearly photographed at a large magnification.

In a second picture, the vehicle is photographed by using a photographing lens having a focal length of a wide angle system in a wide range including the illegal vehicle and vehicles therearound. This second picture is photographed since it is impossible to simply determine that all vehicles running through a red traffic signal light are illegal.

For example, when a vehicle goes into an intersection and then turns to the right or left, the vehicle goes into the intersection in the case of a green traffic signal light. When the vehicle goes out of the intersection, the vehicle runs along a red signal lane. Such a running state is legal.

The first picture is taken to photograph the number plate of this vehicle and the driver's face. Simultaneously, a surrounding portion of this vehicle is photographed as the second

picture. Thus, it is possible to judge whether or not the vehicle goes into the intersection and then turns to the right or left in a legal state.

In a third picture, data such as illegal day and hour, etc. are displayed. For example, such displayed data include data relative to the illegal time in which the traffic signal light is red at a certain time set by second, minute, hour, day, month and year and the vehicle goes into the intersection after several seconds irrespective of this red traffic signal light. Further, such displayed data also include data of a number for specifying a place for arranging the photographing apparatus, etc.

The above photographing apparatus is continuously operated for a long period in many cases. Accordingly, it is necessary to easily attach and detach constructional portions of the entire photographing apparatus requiring periodical maintenance.

Therefore, as shown in Japanese Utility Model Application Laying Open (KOKAI) No. 60-150529, it is desirable to detachably attach a shutter mechanism unit by screws, etc. since a periodical maintenance period of the shutter mechanism unit

is short.

Japanese Patent Application Laying Open (KOKAI) No. 63-58416 shows another vehicle photographing apparatus. This vehicle photographing apparatus judges whether a backlight state is set or not on the basis of brightness of a photographed body and luminosity of a surrounding portion thereof. When it is judged that no backlight state is set, the photographed body is photographed by natural light. In contrast to this, when it is judged that the backlight state is set, the photographed body is photographed in an illuminating state by using a stroboscope. In this vehicle photographing apparatus, a number plate of an illegal vehicle and a driver's face can be recorded even in the backlight state.

When a running vehicle is photographed, it is necessary to clearly photograph the number plate of the vehicle and the driver's face such that no images of the number plate and the driver's face are blurred. Accordingly, a high speed shutter time is used in this case. When brightness of the photographed body is low and no predetermined high speed shutter time can be secured, the vehicle is

photographed in many cases in an illuminating state by using a stroboscope.

The vehicle is photographed by stopping down a photographing lens to increase the depth of a photographing field even when a high brightness of the photographed body for providing the predetermined high speed shutter time can be set. Therefore, the vehicle is photographed by illuminating this vehicle by the stroboscope at any time.

In this case, when the photographing operation is performed by arranging the stroboscope in the same place as the photographing apparatus, a reference distance for setting a required amount of stroboscopic light must be set to be twice a distance from a position of the photographing apparatus to the photographed body as an illegal vehicle. Accordingly, a large amount of light is generally required for the stroboscope.

A large-sized stroboscopic light emitting tube and a main capacitor having a large capacity are required to satisfy the large amount of stroboscopic light so that life of the stroboscope is reduced.

Japanese Patent Application Laying Open (KOKAI) No. 61-217028 shows a stroboscopic structure. In this structure, a stroboscope is located in the vicinity of a photographed body as an illegal vehicle so that the length of an optical path of stroboscopic light is reduced and a required amount of stroboscopic light is thereby reduced. Thus, the size of a stroboscopic light emitting tube and the capacity of a main capacitor are reduced so that life of the stroboscope is increased.

In a general vehicle photographing apparatus, the photographing operation is performed by using a photographing lens having the focal length of a telescopic system so as to clearly photograph the number plate of the illegal vehicle and the driver's face at a large magnification. Further, the photographing operation is performed by using a photographing lens having the focal length of a wide angle system in a wide range including the illegal vehicle and vehicles surrounding this illegal vehicle.

Photographing screens are separately and independently constructed in these two kinds of photographing optical systems composed of the

telescopic and wide angle systems so that the construction of the entire vehicle photographing apparatus is complicated. Further, it is necessary to arrange expensive optical members having a high accuracy such as a reflecting mirror, a half mirror, etc. for synthesizing images of these optical systems. Furthermore, the number of adjusting operations of the optical members is increased.

In addition to the construction of the above two kinds of photographing optical systems, it is further necessary to arrange an optical system for simultaneously photographing data of illegal day and hour, etc. so that the above-mentioned problems become more serious.

Optical axes of the two kinds of photographing optical systems composed of the telescopic and wide angle optical systems are fixed in specified positions determined in advance. For example, when the vehicle photographing apparatus is arranged on a road having four lanes on one side thereof, the optical axes must be set in positions covering the four lanes so that one vehicle is photographed as a small vehicle.

Accordingly, the number plate of an illegal vehicle and a driver's face are photographed at a small magnification so that visibility of each of the number plate and the driver's face is reduced.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a vehicle photographing apparatus in which, when a running vehicle violates traffic regulations and is photographed by a photographing apparatus body, a photographing magnification can be increased when only the illegal vehicle is photographed, and the photographing magnification can be decreased when the illegal vehicle and its surrounding portion are photographed. In this vehicle photographing apparatus, when a road is formed by a plurality of lanes, a photographing optical axis of the vehicle photographing apparatus can be set to be in conformity with a lane to be photographed.

In accordance with a first structure of the present invention, the above object can be achieved by a vehicle photographing apparatus having a stroboscopic light emitting portion for irradiating light in a photographing range of a

photographing apparatus body arranged along a vehicle passing road, for emitting light to a running vehicle from the stroboscopic light emitting portion thereby to photograph the running vehicle when the running vehicle violates traffic regulations. The vehicle photographing apparatus includes traffic information detecting means for detecting a passage of the vehicle running on the road, and reference information inputting means for setting a condition in which the detected passage of the vehicle violates the traffic regulations. Judging means is provided for comparing outputs of the traffic information detecting means and the reference information inputting means with each other thereby to generate a photographing starting command signal. The apparatus further includes focusing means started by the photographing starting command signal for moving a focusing lens of a photographing lens means so as to focus on an illegal vehicle violating the traffic regulations, which photographing lens means is arranged in the photographing apparatus body. Photographing direction changing means is provided for moving an optical axis of the photographing lens means to a position of the illegal vehicle detected by the traffic information detecting means or a position of the illegal vehicle focused by the focusing means. Further included are zooming means for changing a focal length of the photographing lens means in such a manner that the illegal vehicle can be photographed at a predetermined magnification within a photographing screen on a basis of the position of the illegal vehicle detected by the traffic information detecting means or a position of the illegal vehicle focused by the focusing means, and photographing control means for controlling the focusing means, the photographing direction changing means, the zooming means, the photographing apparatus body and the stroboscopic light so as to relate to each other.

In operation of the above apparatus, the illegal vehicle violating the traffic regulations is photographed at a predetermined photographing magnification by emitting light

to the vehicle from the stroboscopic light emitting portion for irradiating light in a photographing range of the photographing apparatus body arranged along the vehicle passing road.

When the road as an object is formed by a plurality of lanes, the vehicle is photographed by directing the optical axis of the photographing lens to the vehicle on a specified lane by the photographing direction changing means.

Further objects and advantages of the present invention will be apparent from the following description of the preferred embodiments of the present invention as illustrated in the

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accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the entire construction of a vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 2 is a plan view showing the relation between detecting lines of the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 3 is a flow chart showing an operation of the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 4 is a flow chart showing an operation of the vehicle photographing apparatus in accordance with one embodiment of the present invention and subsequent to the flow chart shown in Fig. 3;

Fig. 5 is a plan view showing the relation between lanes and switches of the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 6 is a view showing one example of a

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recorded picture obtained by the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 7 is a view showing another example of the recorded picture obtained by the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 8 is a flow chart showing an operation of the vehicle photographing apparatus in accordance with one embodiment of the present invention;

Fig. 9 is a circuit diagram showing detecting lines of the vehicle photographing apparatus in accordance with one embodiment of the present invention in association with another photographing example; and

Fig. 10 is a waveform diagram showing an output of a detecting circuit shown in Fig. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of a vehicle photographing apparatus in the present invention will next be described in detail with reference to the accompanying drawings.

In embodiments of the present invention, a

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pedestrian crossing is formed on the way on a straight road. A signal device is arranged in front of this pedestrian crossing. The present invention is applied to a case in which the driver of a vehicle disregards a red signal and violation of traffic regulations about an excess of a limiting speed is detected and the illegal vehicle is photographed in an arranging position of the signal device.

Fig. 1 is a block diagram showing the entire construction of a vehicle photographing apparatus in accordance with one embodiment of the present invention. A body 22 of the vehicle photographing apparatus has a traffic information detecting means 1, a reference information inputting means 2 and a judging means 3.

As shown in Fig. 2, a stopping line 20 is formed just before a pedestrian crossing formed on the way on a road having four lanes L_1, L_2, L_3 and L_4 on one side thereof. The vehicle photographing apparatus body 22 is arranged in a front position separated from a position of this stopping line 20. A stroboscopic light emitting portion 23 is arranged in front of the vehicle photographing apparatus body 22.

This traffic information detecting means 1 detects a passing state of a vehicle running on the above passing road. Concretely, switches SW1 to SW12 are disposed in the traffic information detecting means 1. The switches SW1 to SW4 are constructed by four pressure switches buried in a line in positions separated from the stopping line 20 by a predetermined distance d_0 such that the switches SW1 to SW4 cross the four lanes L_1 to L_4. The switches SW5 to SW8 are constructed by four pressure switches buried in a line in positions separated by a predetermined distance d_1 from the buried positions of the switches SW1 to SW4. The switches SW9 to SW12 are constructed by four pressure switches buried in a line in positions separated by a predetermined distance d_2 from the buried positions of the switches SW5 to SW8.

A forming line of the switches SW1 to SW4, a forming line of the switches SW5 to SW8 and a forming line of the switches SW9 to SW12 constitute three vehicle detecting lines for detecting a vehicle.

Two reference lines 24 and 25 are spaced from each other by a predetermined distance in front of the vehicle detecting line of the switches SW9 to

SW12 as a switch forming line. The two reference lines 24 and 25 are formed to judge a running amount of the vehicle when the vehicle is photographed.

Distances of the above plural (three) vehicle detecting lines are respectively set such that two vehicles are simultaneously located within each of the vehicle detecting lines. Further, the distances of the three vehicle detecting lines are set to be longer than a distance between front and rear wheel axles of a vehicle. These switches SW1 to SW12 are respectively turned on when upper portions of these switches are pushed by a wheel of the running vehicle.

Accordingly, turning-on and turning-off states of the switches SW1 to SW12 are obtained as output signals of the traffic information detecting means 1. The traffic information detecting means 1 calculates a running speed of the vehicle as described in detail later on the basis of the turning-on and turning-off states of the switches SW1 to SW12. Further, the traffic information detecting means 1 detects a turning-on state of a signal device 21 and outputs data indicative of this turning-on state to the judging

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means 3.

The reference information inputting means 2 outputs data of a condition of violation of traffic regulations about a passing state of the running vehicle to the judging means 3. For example, the reference information inputting means 2 outputs data of a limiting speed shown by km/hour to the judging means 3. Further, the reference information inputting means 2 outputs data of a condition of operational control methods of respective constructional portions of the entire vehicle photographing apparatus to a photographing control means 4 described in detail later. For example, the reference information inputting means 2 outputs conditional data for setting a shutter time and a film sensitivity to the photographing control means 4.

The above conditional data of the reference information inputting means 2 can be inputted to the judging means 3 and the photographing control means 4 by operating a keyboard switch and a touch-type switch, etc.

The judging means 3 compares outputs of the traffic information detecting means 1 and the reference information inputting means 2 with each

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other. When violation of traffic regulations is judged from the compared results, the judging means 3 generates and outputs a photographing starting command signal S to the photographing control means 4 at the next stage.

The photographing control means 4 generally controls an entire operation of the vehicle photographing apparatus. The photographing control means 4 is concretely constructed by a microcomputer and a memory.

A photographing direction changing means 5 is connected to this photographing control means 4. The photographing direction changing means 5 moves the optical axis of a photographing lens arranged in the photographing apparatus body 22 to the position of an illegal vehicle detected by the traffic information detecting means 1 or a focusing means 10 described later. When a road is formed by plural lanes such as four lanes L_1 to L_4, the photographing direction changing means 5 moves the optical axis of the photographing lens in the vehicle photographing apparatus 22 such that this optical axis is in conformity with a lane to be photographed.

A zooming means 6 is connected to the

photographing control means 4. The zooming means 6 changes a focal length of the photographing lens in the photographing apparatus body 22 such that the illegal vehicle is photographed at a predetermined magnification within a photographing screen on the basis of the position of the illegal vehicle detected by the traffic information detecting means 1 or the focusing means 10 described later.

A film supplying means 7 winds a film therearound at suitable timing on the basis of control of the photographing control means 4. If a screen size is set to a Leica size and a used film is constructed by an elongated film having a 35 mm width, several hundred frames can be photographed without film exchange by feeding a predetermined number of film perforations every one frame.

A data photographing means 8 records various kinds of data onto a film face. For example, these various data include data relative to violation of traffic regulations about disregard of a red signal light in which the traffic signal light is red at a time shown by second, minute, hour, day, month and year and a vehicle runs along

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one of the lanes L_1 to L_4 after several seconds in spite of the red signal light. The above various data also include data relative to violation of traffic regulations about a limiting speed in which the vehicle runs at a speed exceeding the limiting speed shown by km/hour when the signal light is green at a time shown by second, minute, hour, day, month and year. The above various data further include data such as a number for specifying a place for arranging the signal device 21.

A film exposure means 9 is disposed to suitably expose a film on the basis of commands from the photographing control means 4. The film exposure means 9 controls a stopping-down operation of a photographing lens and a shutter operation. A shutter time is normally set to about 0.001 second to record the running vehicle without blur.

The film exposure means 9 is used in a severe condition of a continuous operation for a long period in consideration of character of the entire photographing apparatus. Accordingly, the film exposure means 9 is constructed by a durable unit such that the film exposure means 9 is easily

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maintained.

An operation of the focusing means 10 is started through the photographing control means 4 by the photographing starting command signal S outputted from the judging means 3. The focusing means 10 moves and focuses a focusing lens of the photographing lens arranged in the photographing apparatus body 22.

A stroboscopic light emitting means 11 has a stroboscopic light emitting portion 23 for irradiating light in a photographing range of the photographing apparatus body 22 arranged along the road having the four lanes L_1 to L_4. When a running vehicle violates traffic regulations, the stroboscopic light emitting portion 23 emits light and this vehicle is photographed by the photographing apparatus body 22.

An operation of the vehicle photographing apparatus in the present invention will next be described with reference to a flow chart of Fig. 3.

When a power source of the vehicle photographing apparatus is turned on in a step S0, an electric current is supplied to each of constructional circuit portions of the vehicle

photographing apparatus and it proceeds to the next step S1. In this step S1, a digital input-output circuit is reset and the other circuits are initialized. Then, it proceeds to the next step S2 for judging whether various kinds of conditions of the reference information inputting means 2 are already set or not.

These conditions include data about a limiting speed shown by km/hour on a lane. These conditions also include data for specifying a lane for judging violation of traffic regulations. In this case, for example, the specified data are inputted by a keyboard switch, a touch-type switch, etc. When these conditions are not set in the step S2, it proceeds to a step S3. In the step S3, the vehicle photographing apparatus is in a standby state until these conditions are inputted by the reference information inputting means 2.

In contrast to this, when the judgment in the step S2 is YES, it proceeds to a step S4 for judging whether a statistical mode for obtaining traffic amount data is set or not. When the judgment in this step S4 is YES, it proceeds to a step S6 for recording statistical data. In this

step S6, the statistical data are constructed by a passing amount of vehicles on each of the lanes L_1 to L_4 and time data and are recorded to a memory.

In contrast to this, when the judgment in the step S4 is NO, it proceeds to a step S5 for judging whether a photographing mode is set or not. The photographing mode is a mode for photographing a vehicle when the vehicle violates traffic regulations.

When the judgment in the step S5 is NO, it is returned to the step S4. In contrast to this, when the judgment in the step S5 is YES, it proceeds to a step S7 for judging whether a red signal is disregarded or not. When the judgment in the step S7 is NO. the vehicle photographing apparatus is in a standby state until the judgment in the step S7 is YES. In contrast to this, when the judgment in the step S7 is YES, a photographing starting command signal S is transmitted from the judging means 3 to the photographing control means 4.

An operation for judging the signal disregard in the step S7 will next be explained in detail.

An operating state of the signal device 21 is monitored by the traffic information detecting

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means 1 at any time. A change in signal light is detected simultaneously when red, green and yellow signal lights are changed. This change is inputted to the judging means 3. Turning-on and turning-off states of the switches SW1 to SW12 are checked by a scanning operation by the traffic information detecting means 1 for a very short period at any time and are inputted to the judging means 3.

Delay signal data are generated after a predetermined delay time has passed since the signal light of the signal device 21 was red. The delay signal data are also inputted as preset data from the reference information inputting means 2 to the judging means 3.

This delay time is included in data for judging the signal disregard. When the signal light is red, it cannot be simply judged that all vehicles running through the red signal light violate traffic regulations. There is actually a case in which no vehicles running through the red signal light violate the traffic regulations. Therefore, the delay time is included in the data for judging the signal disregard in consideration of such an actual case.

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For example, when a front vehicle is running very near a stopping line 20 at changing timing of the signal device 21 from green signal light to yellow signal light, there is a great fear of a rear-end collision of a subsequent vehicle when the front vehicle is suddenly stopped on the stopping line 20. Accordingly, in this case, it is safer to make the front vehicle run as it is in consideration of prevention of the rear-end collision. In this case, such a vehicle legally runs and does not violate the traffic regulations. Therefore, the delay time is set as follows such that this vehicle is not set to an illegal vehicle. Namely, the delay time is set to include a sufficient time for running the vehicle within a distance d_0 from a position provided at the instant time of a change in signal light of the signal device 21 from yellow to red to a position of the switch SW4 from the stopping line 20 at a predetermined limiting speed.

When the above conditions are respectively set and the signal disregard is judged by the judging means 3, processings in a second operating system provided in three steps S10, S11 and S12 and a first operating system provided in a step S8

are executed in parallel with each other.

In the step S8 constituting the first operating system, a film is fed and supplied and a shutter charging operation and a focusing operation are performed. Concretely, the film is wound by one frame by using the film supplying means 7 to prepare an exposure operation. The shutter charging operation is performed by using the film exposure means 9. The focusing operation is performed by the focusing means 10 to set a focusing state of the photographing lens.

The steps S10, S11 and S12 in the second operating system are completely executed until the film supplying operation and the shutter charging operation in the first operating system are completely performed.

In the step S10 in the second operating system, the vehicle photographing apparatus detects the position of a lane on which a vehicle disregards and runs through a red traffic signal light. A photographing optical axis of the photographing apparatus body 2 is set to be in conformity with a lane direction shown by a detected lane number. Simultaneously, in the step S11, a zooming operation of the photographing lens

is performed by using the zooming means 6.

This zooming operation is performed to photograph a number plate of the i.legal vehicle and a driver's face at a large photographing magnification.

When the above operations for taking a photograph are completely prepared, the vehicle photographing apparatus is set to be in a standby state until the illegal vehicle runs and the switch SW8 is turned on by a front wheel of this vehicle.

In a step S9, it is judged whether the switch S8 is turned on or not. When the switch S8 is turned on, it proceeds to a step S13 shown in Fig. 4 through a junction point ① and a first photograph is taken.

In this photographing operation, a focusing state of the photographing lens is set by using the focusing means 10. The optical axis of the photographing lens is changed by the photographing direction changing means 5 such that an arranging position of the switch SW4 on the lane L_4 is located at the center of a photographing screen. Further, a zoom driving ring of the photographing lens is moved by the zooming means 6 such that the

number plate of the illegal vehicle and the driver's face can be photographed at a large photographing magnification. Further, the film is suitably exposed by the film exposure means 9 in a state in which illuminating light is emitted to the vehicle from the stroboscopic light emitting portion 23 shown in Fig. 2 by the stroboscopic light emitting means 11. Thus, the number plate of the illegal vehicle and the driver's face are very clearly recorded.

In summary, when the switch SW2 is turned on by a front wheel of the illegal vehicle running on the lane L_2 shown in Fig. 5, the signal disregard is detected and preparing operations for taking a photograph are simultaneously started. A first photograph is taken and recorded when the illegal vehicle further runs and the switch SW6 is turned on by the front wheel of this vehicle.

As shown in Fig. 6, various kinds of data are recorded as a picture in a band-shaped region in an upper portion of the recording screen. These various data include time data of second, minute, hour, day, month and year when the signal light becomes red. These various data also include time data in which the switch SW2 has been turned on

after some seconds since the signal light was red. In other words, these time data show whether the vehicle runs until a detecting line in a position of the switch SW2 by the signal disregard, and further runs at a certain time shown by second, minute, hour until the next detecting line in a position of the switch SW6. The above various data further include an identification code for specifying peculiar data such as a place for arranging the photographing apparatus body 22, etc. Such various kinds of data are recorded in the above band-shaped region.

In a lower portion of a data recording section of the recording screen, the illegal vehicle running on the lane L_2 is photographed at a large photographing magnification in a position reaching the position of the switch SW6 through the position of the switch SW2. Thus, the number plate and the driver's face are clearly photographed.

Thus, after the first photograph has been taken, the steps S14 to S16 shown in Fig. 4 are executed. Processing contents in the step S14 are equal to those in the above step S8 shown in Fig. 3. Namely, the steps S15 and S16 are completely

executed until the film supplying operation of the film supplying means 7 and the shutter charging operation of the film exposure means 9 are completely performed.

The photographing optical axis of the photographing apparatus body 22 is set to be in conformity with a lane direction shown by the lane number detected in the above step S10 (see Fig. 3). Simultaneously, in the step S16, the zooming operation of the photographing lens is performed by using the zooming means 6. This zooming operation is performed to move the photographing lens on a wide angle side such that a wide range including a surrounding portion of the illegal vehicle is photographed.

When the preparing operations for taking a photograph are completely performed, the vehicle photographing apparatus is set to be in a standby state until the switch S10 is turned on by a front wheel of the illegal vehicle.

Namely, in a step S17, it is judged whether the switch S10 is turned on or not. When this judgment in the step S17 is YES, it proceeds to a step S18 for taking a second photograph. In this second photographing operation, a focusing state

of the photographing lens is set by using the focusing means 10. Further, the optical axis of the photographing lens is changed by the photographing direction changing means 5 such that a position of the switch S10 on the lane L_2 is located at a center of the screen. Further, in the second photographing operation, a wide range including the illegal vehicle and a surrounding portion thereof can be photographed by the zooming means 6. The second photographing operation is performed in a state in which illuminating light is emitted from the stroboscopic light emitting portion 23 to the vehicle, etc. by the stroboscopic light emitting means 11.

As shown in Fig. 7, in the second recorded photograph or picture, various kinds of data are recorded in a band-shaped region in an upper portion of the recording screen. These data include the same contents as the recorded photograph or picture explained and shown in Fig. 6. These data also include additional time data showing whether the illegal vehicle runs at a certain time set by second, minute and hour until the position of the switch S10. Such data are recorded in the band-shaped region.

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In other words, the recorded data show that the illegal vehicle runs on the detecting line in the position of the switch SW2 by the signal disregard and runs on the next detecting line in the position of the switch SW6 at a certain time set by second, minute and hour. Further, the recorded data also show that the illegal vehicle further runs on the next detecting line in a position of the switch SW10 at a certain time set by second, minute and hour.

A wide range including the illegal vehicle and a surrounding situation thereof is photographed in a lower portion of a data recording section of the recording screen. In this case, the wide range is photographed in a state in which the illegal vehicle running on the lane L_2 reaches the position of the switch SW10 sequentially through the positions of the switches SW2 and SW6.

Reference lines 24 and 25 in front of a vehicle detecting line as a forming line of the switches SW9 to SW12 are also photographed so that it is easy to accurately know states of vehicles in front of the illegal vehicle.

In summary, a first photograph is taken and

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recorded when the switch SW6 is turned on by a front wheel of the illegal vehicle running on the lane L_2 shown in Fig. 5. Preparing operations for taking a second photograph are started immediately after the first photograph is recorded. The second photograph is recorded when the illegal vehicle further runs and the switch SW10 is turned on by the front wheel of this illegal vehicle.

Thus, after the second photograph has been taken, it proceeds to a step S19. In the step S19, various kinds of data of the above first and second photographs are recorded onto a recording medium such as a magnetooptic disk, etc.

As shown by the flow chart of Fig. 3, the preparing operations for taking a photograph are started at a photographing starting timing in the above operational explanation when the signal disregard is detected in the step S7. The first photograph is taken and recorded when the illegal vehicle further runs and the switch SW6 is turned on by the front wheel of the illegal vehicle. The second photograph is taken and recorded when the illegal vehicle further runs and the switch SW10 is turned on by the front wheel of the illegal vehicle. However, the first photographing

operation may be started by predetermining a time t_1 sufficient to completely prepare all of the film supplying operation, the shutter charging operation, the focusing operation, the zooming operation and the photographing direction changing operation as in steps S100 and S101 shown by broken lines in Fig. 3. In this case, a timer starting timing about this time t_1 is set to a time point at which the signal disregard is detected in the step S7. The first photographing operation is started when it is detected in the step S101 that the time t_1 has passed.

Starting timing of the second photographing operation may be set to be similar to the starting timing in each of the steps S100 and S101.

In the above-mentioned operations, two photographs can be recorded when the signal disregard is detected. An operation of the vehicle photographing apparatus will next be explained when the running speed of a vehicle violately exceeds a limiting speed.

In this case, the step S7 shown in Fig. 3 is replaced with steps S20 to S24 shown in Fig. 8. Further, a switch SW0 is buried in a position of the stopping line 20 shown in Fig. 2. Namely, in

the step S20, the switch S0 is turned on at a certain time by a front wheel of a vehicle running on one of lanes L_1 to L_4. This time is stored to a memory in a unit of millisecond (mSec) with high accuracy. It then proceeds to the next step S21. In this step S21, a standby state of the vehicle photographing apparatus is maintained until the switch SW2 is turned on. When the switch SW2 is turned on at a certain time by the front wheel of the vehicle, this time is recorded to a memory in a unit of millisecond (mSec) with high accuracy. It then proceeds to the next step S22.

In this step S22, the vehicle photographing apparatus calculates a time difference t between a turning-on time point of the switch SW0 in the step S20 and a turning-on time point of the switch SW2 in the step S21. Further, it is judged in this step S22 whether this time difference t exceeds a predetermined reference time t_0 or not.

A running speed of the vehicle is provided by dividing a distance d_0 between positions of the switches SW0 and SW2 by the time difference t. If a limiting speed is transformed to the reference time t_0, the reference time t_0 is equal to a distance between positions of the switches SW0 and

SW1 divided by the limiting speed. If the running speed and the limiting speed are thus set, it is possible to judge whether the running speed of the vehicle exceeds the limiting speed or not by comparing the time difference t and the reference time t_0 with each other.

The limiting speed is desirably set to a high speed to a certain extent in consideration of errors in operations of arithmetic circuits and response delays of the switches SW0 to SW12, etc.

When the judgment in the step S23 is YES, data about an excessive running speed of the vehicle are recorded to a memory in the next step S24. These excessive speed data include data about an excess of the running speed (shown by km/hour) of the vehicle running on one of the lanes L_1 to L_4. These excessive speed data also include data about a running time set by second, minute, hour, day, month and year and relative to the excessive speed.

Simi'ar to the above signal disregard, when it is judged that the running speed of the vehicle is an excessive speed, preparing operations for taking a photograph are started when the switch SW2 is turned on by a front wheel of the illegal

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vehicle running on the lane L_2 shown in Fig. 5. A first photograph is taken and recorded when the illegal vehicle further runs and the switch SW6 is turned on by the front wheel of this illegal vehicle. A second photographing operation begins to be prepared immediately after the first photographing operation. The second photograph is taken and recorded when the illegal vehicle further runs and the switch SW10 is turned on by the front wheel of the illegal vehicle.

The above traffic information detecting means 1 is constructed by a switch of a pressure sensor type to detect existence and nonexistence of the vehicle. However, the existence and nonexistence of the vehicle may be detected by a photoelectric means. An example of this photoelectric means will next be explained with reference to Fig. 9. In this example, only the lane L_1 is used to simplify an explanation of the photoelectric means.

A detecting line P is constructed by a light emitting diode 31 and a light receiving transistor 32 opposite to this light emitting diode 31 as a pair. A detecting line Q is constructed by a light emitting diode 33 and a light receiving

transistor 34 opposite to this light emitting diode 33 as a pair. The light emitting diodes and the light receiving transistors are arranged such that the two detecting lines P and Q cross the lane L_1 and are spaced from each other at a predetermined distance.

When a vehicle 100 passes and crosses the detecting line P, this passage is detected by a detecting circuit 35. Similarly, when the vehicle 100 passes and crosses the detecting line Q, this passage is detected by the detecting circuit 35. These detective information are inputted to a judging means 3 as an output of the traffic information detecting means 1 shown in Fig. 1.

A signal P1 shown in Fig. 10 is an output signal of the detecting circuit 35 obtained when the vehicle 100 crosses the detecting line P. A signal P2 shown in Fig. 10 is an output signal of the detecting circuit 35 obtained when the vehicle 100 crosses the detecting line Q.

The existence of the vehicle is detected by using two references. In the case of a first reference, the existence of the vehicle is detected in a front portion thereof. In the case of a second reference, the existence of the

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vehicle is detected in a rear portion thereof.

When the front portion of the vehicle is set to a reference for detecting the vehicle, it is sufficient to use a time difference T_F between a crossing time point of the vehicle on the detecting line P and a crossing time point of the vehicle on the detecting line Q. In contrast to this, when the rear portion of the vehicle is set to a reference for detecting the vehicle, it is sufficient to use a time difference T_R between uncrossing time points of the vehicle on the detecting lines P and Q after the vehicle has respectively crossed the detecting lines P and Q.

At this time, when the front portion of the vehicle is set to the vehicle detecting reference, a running speed of the vehicle can be calculated by dividing a distance between positions of the detecting lines P and Q by the time difference T_F. In contrast to this, when the rear portion of the vehicle is set to the vehicle detecting reference, the running speed of the vehicle can be calculated by dividing a distance between positions of the detecting lines P and Q by the time difference T_R.

A legal or illegal vehicle can be judged by judging whether the running speed of the vehicle

thus calculated exceeds a limiting speed or not.

In the above explanation, the vehicle is photographed by judging violations of the excessive running speed and the signal disregard. however, it is also possible to detect parking violation and one-way passing violation. For example, the detection of the parking violation is judged as follows.

When the vehicle crosses the detecting lines P and Q shown in Fig. 9, it is judged that the vehicle exists in a detecting position on the basis of an output of the detecting circuit 35 and outputs of the switches SW1 to SW12 shown in Fig. 7. The parking violation is detected by judging that no vehicle reaches the next detecting position even when a predetermined time has passed since the existence of the vehicle was judged.

When the vehicle runs in a direction opposite to a one-way passing direction, this illegal vehicle is detected as follows. Namely, in this case, when the vehicle crosses the detecting lines P and Q shown in Fig. 9, the running direction of this vehicle is judged as an opposite direction when no generating order of an output of the detecting circuit 35 and outputs of the switches

SW1 to SW12 shown in Fig. 7 is a predetermined order.

However, when a plurality of vehicles are running in an approaching state, it is necessary to disregard a signal generated from a rear detecting line when this signal is obtained before a signal is obtained from a front detecting line.

The present invention is not limited to the above embodiments, but may be changed in various kinds of modifications within the scope of the features of the invention.

For example, in the above embodiments, a detecting line is formed in the vicinity of a signal device arranged on the way on a straight road. A first photograph is taken and recorded when violations of signal disregard and an excessive running speed are detected. A second photograph is taken and recorded when the vehicle reaches the next detecting line. However, the detecting line may be formed in the vicinity of an intersection to detect violations of turning to the right and left in addition to the violations of the signal disregard and the excessive running speed. Further, no-passing violation can be judged by comparing running speeds of plural

vehicles running in parallel with each other on plural lanes.

Forms of illegal date and hour, etc. recorded to a recording picture can be arbitrary set suitably in accordance with necessity.

The focusing means moves and focuses the photographing lens every photographing operation. However, a photographing position showing the distance of a photographed body can be specified in advance. Accordingly, data for specifying the photographing position may be stored to a memory as preset data. In this case, the focusing means is preset and operated in accordance with the photographing position.

The photographing direction changing means and the zooming means are driven every photographing operation. Accordingly, no final driving positions of the photographing direction changing means and the zooming means can specified. However, driving amounts of the photographing direction changing means and the zooming means can be minimized if an initial driving position of each of these means is located in an intermediate position between one side driving end portion and the other side driving end

portion. Accordingly, a rapid response of the vehicle photographing apparatus can be realized. The same contents can similarly hold true in the case of the focusing means and the stopping-down means in addition to the photographing direction changing means and the zooming means.

In the above embodiments, an order of the photographing direction changing operation, the zooming operation, the focusing operation and the stopping-down operation is set to an arbitrary order. Accordingly, these operations may be performed in parallel with each other.

As mentioned above, in the vehicle photographing apparatus of the present invention, a running vehicle is photographed by a photographing apparatus body when a traffic violating state of the running vehicle is attained and detected. In this case, a photographing magnification can be increased when only the illegal vehicle is photographed. In contrast to this, the photographing magnification can be reduced when a surrounding portion of the illegal vehicle is also photographed. Further, when a road is formed by a plurality of lanes, a photographing optical axis of the vehicle

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photographing apparatus can be set to be in conformity with a lane to be photographed. Accordingly, it is possible to obtain a recorded picture with very high reliability.

The two kinds of photographing optical systems are composed of a telescopic optical system and a wide angle optical system. Screens in these two systems are not separately and independently constructed, but are constructed by using a zoom lens. Accordingly, the entire construction of the vehicle photographing apparatus is simplified and the number of adjusting operations thereof can be reduced.

For example, when the vehicle photographing apparatus is arranged on a road having four lanes on one side thereof, optical axes of the photographing optical systems can be directed to one of the four lanes on which the illegal vehicle is located. Accordingly, only a required portion of the illegal vehicle can be enlarged and photographed at its maximum so that a judging state of a recorded vehicle image can be preferably provided.

Many widely different embodiments of the present invention may be constructed without

departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.

Throughout this specification and the claims which follows, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A vehicle photographing apparatus having a stroboscopic light emitting portion for irradiating light in a photographing range of a photographing apparatus body arranged along a vehicle passing road, for emitting light to a running vehicle from said stroboscopic light emitting portion thereby to photograph said running vehicle by said photographing apparatus body when said running vehicle violates traffic regulations, said vehicle photographing apparatus comprising:

traffic information detecting means for detecting a passage of said vehicle running on said vehicle passing road;

reference information inputting means for setting a condition in which said passage of said vehicle running on said vehicle passing road violates the traffic ~~regulation~~ regulations;

judging means for comparing outputs of said traffic information detecting means and said reference information inputting means with each other thereby to generate a photographing starting command signal;

focusing means started by said photographing starting command signal from said judging means for moving a focusing lens of a photographing lens means so as to focus on an illegal vehicle violating the traffic regulations, said photographing lens means being arranged in said photographing apparatus body;

photographing direction changing means for moving an optical axis of said photographing lens means to a position of said illegal vehicle detected by said traffic information detecting means or a position of said illegal vehicle focused by said focusing means;

zooming means for changing a focal length of said photographing lens means in such a manner that said illegal vehicle can be photographed at a predetermined magnification within a photographing screen on a basis of said position of said illegal vehicle detected by said traffic information detecting means or a position of said illegal vehicle focused

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by said focusing means; and

photographing control means for controlling said focusing means, said photographing direction changing means, said zooming means, said photographing apparatus body and said stroboscopic light so as to relate to each other.

2. A vehicle photographing apparatus according to Claim 1, wherein said position of said illegal vehicle focused by said focusing means is a position to be focused at a photographing starting time point of said illegal vehicle.

3. A vehicle photographing apparatus according to Claim 1, wherein said traffic information detecting means detects that said vehicle is located on each of a plurality of vehicle detecting lines spaced from each other at predetermined distances on and along said passing road, while detecting said passage of said vehicle running on said vehicle passing road, and wherein said photographing control means controls said focusing means, said photographing direction changing means and said zooming means thereby to completely prepare a photographing operation when said vehicle is located on one of said plural vehicle detecting lines and said photographing control means controls said photographing apparatus body and said stroboscopic light so as to perform said photographing operation when said vehicle is located on the next vehicle detecting line to said one of said plural vehicle detecting lines.

4. A vehicle photographing apparatus according to Claim 2, wherein said traffic information detecting means detects that said vehicle is located on each of a plurality of vehicle detecting lines spaced from each other at predetermined distances on and along said passing road, while detecting said passage of said vehicle running on said vehicle passing road, and wherein said photographing control means controls said focusing means, said photographing direction changing means and said zooming means thereby to completely prepare a

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photographing operation when said vehicle is located on one of said plural vehicle detecting lines, and said photographing control means controls said photographing apparatus body and said stroboscopic light so as to perform said photographing operation when said vehicle is located on the next vehicle detecting line to said one of said plural vehicle detecting lines.

5. A vehicle photographing apparatus substantially as hereinbefore described with reference to the drawings.

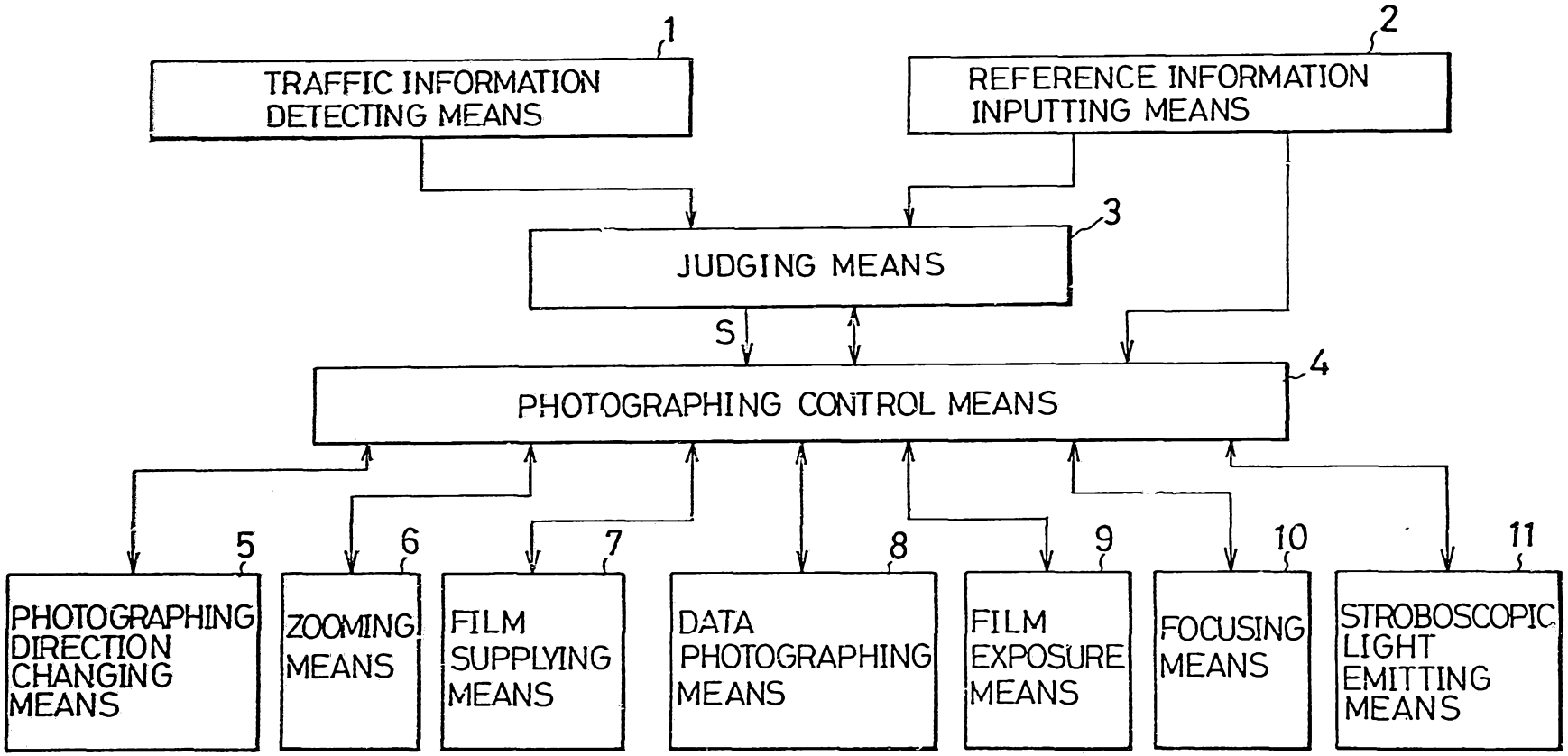
Dated this 9th day of February, 1995

RICOH COMPANY, LTD.
By its Patent Attorneys
Davies Collison Cave

ABSTRACT OF THE DISCLOSURE

In a vehicle photographing apparatus, a traffic information detector detects traffic information data of a position and a running speed of a vehicle. A reference information inputting device sets data of a running speed condition for violation of traffic regulations. A judging device compares the traffic information data and the speed conditional data with each other. When the judging device judges the violation of the traffic regulations, the judging device generates and outputs a signal to a photographing controller. A film is supplied and a photographing lens is focused on the basis of control of the photographing controller started by this signal so that a photographing operation is completely prepared. A zooming device changes a focal length of the photographing lens so as to record a number plate of the illegal vehicle and a driver's face at a large photographing magnification. Simultaneously, a photographing direction changing device changes an optical axis of the photographing lens such that the vehicle is located at the center of a screen. When the illegal vehicle reaches a predetermined position in such a state, stroboscopic light is emitted to the vehicle to perform the photographing operation.

Fig. 1



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50472/93

Fig. 2

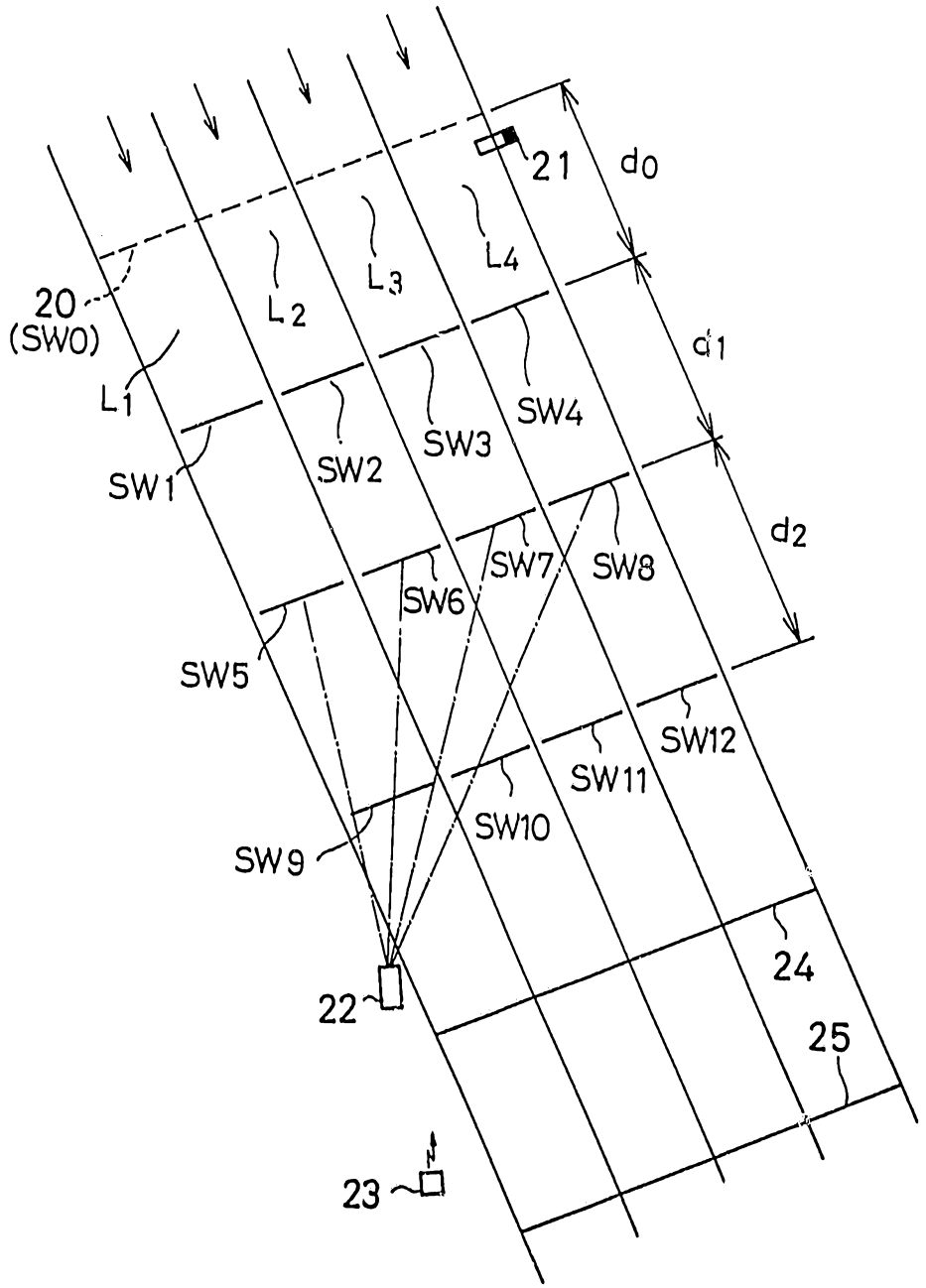
21
d0
L4
L3
L2
20
(SW0)
L1
d1
SW4
SW3
SW2
SW1
d2
SW8
SW7
SW6
SW5
SW12
SW11
SW10
SW9
24
22
25
23

Fig. 3 (i)

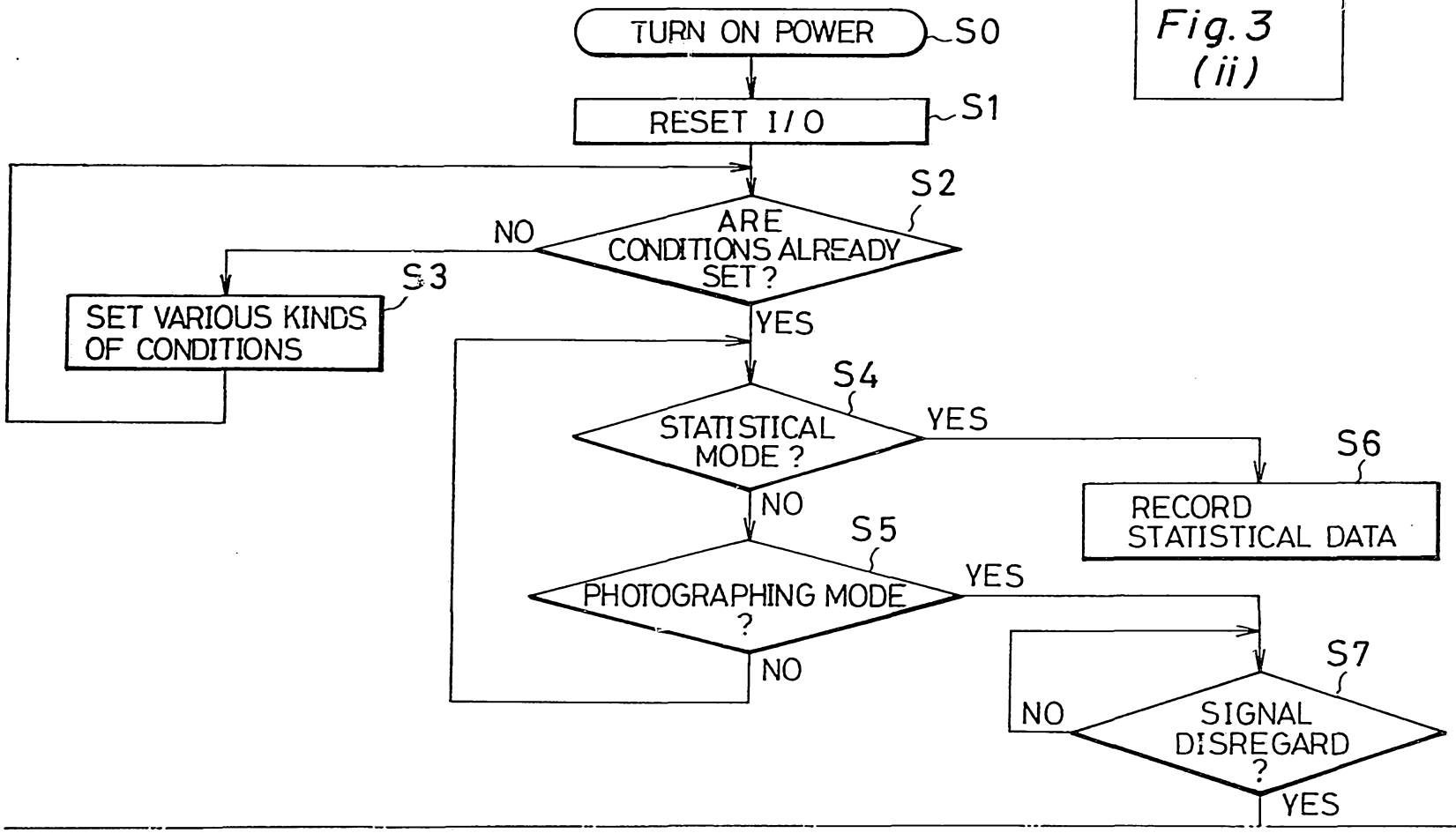

Fig. 3 (i)

Fig. 3 (ii)

Fig. 3 (ii)

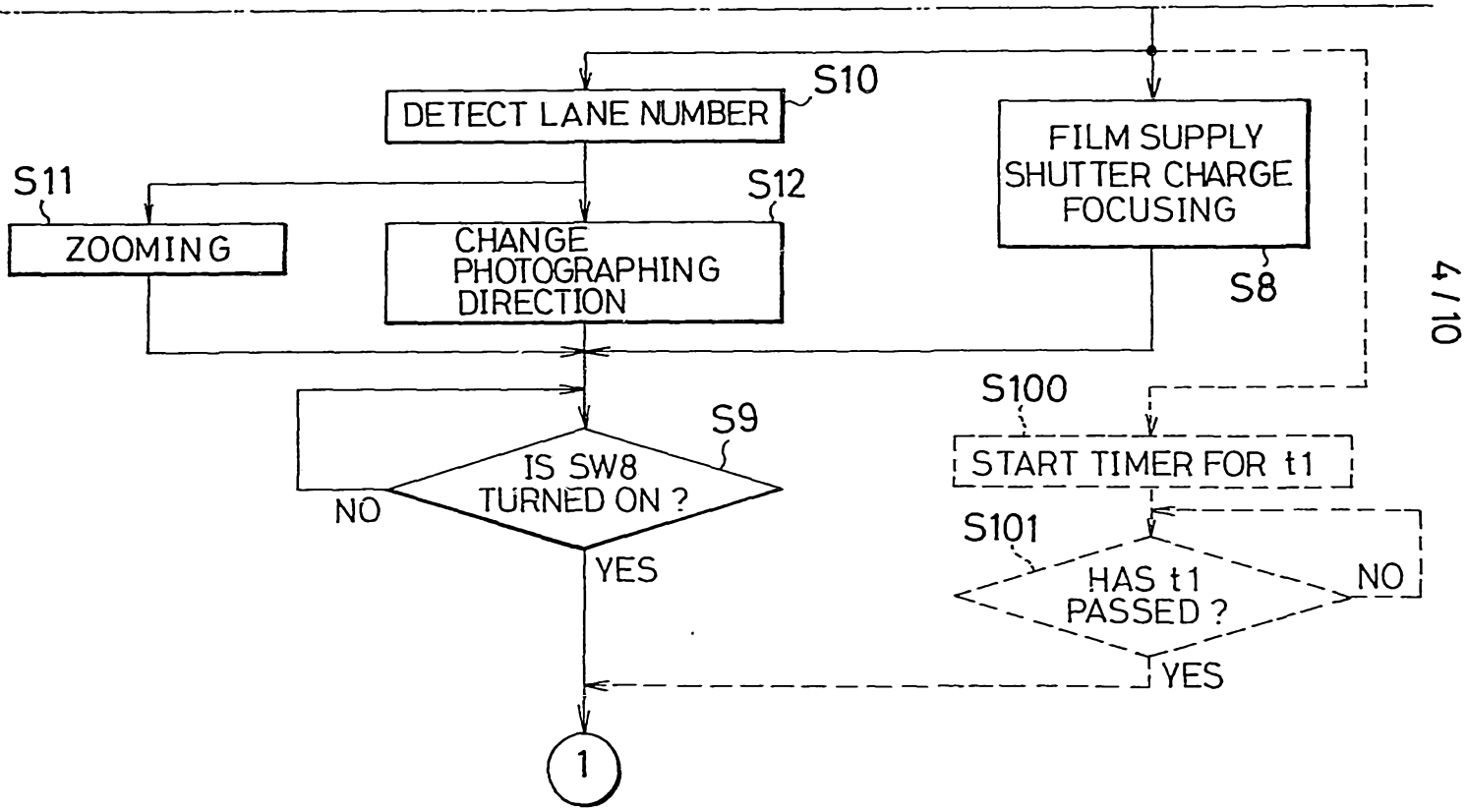
DETECT LANE NUMBER
S10
FILM SUPPLY
SHUTTER CHARGE
FOCUSING
S8
S11
ZOOMING
S12
CHANGE
PHOTOGRAPHING
DIRECTION
S9
IS SW8
TURNED ON ?
NO
YES
S100
START TIMER FOR t1
S101
HAS t1
PASSED ?
NO
YES
1

Fig. 4

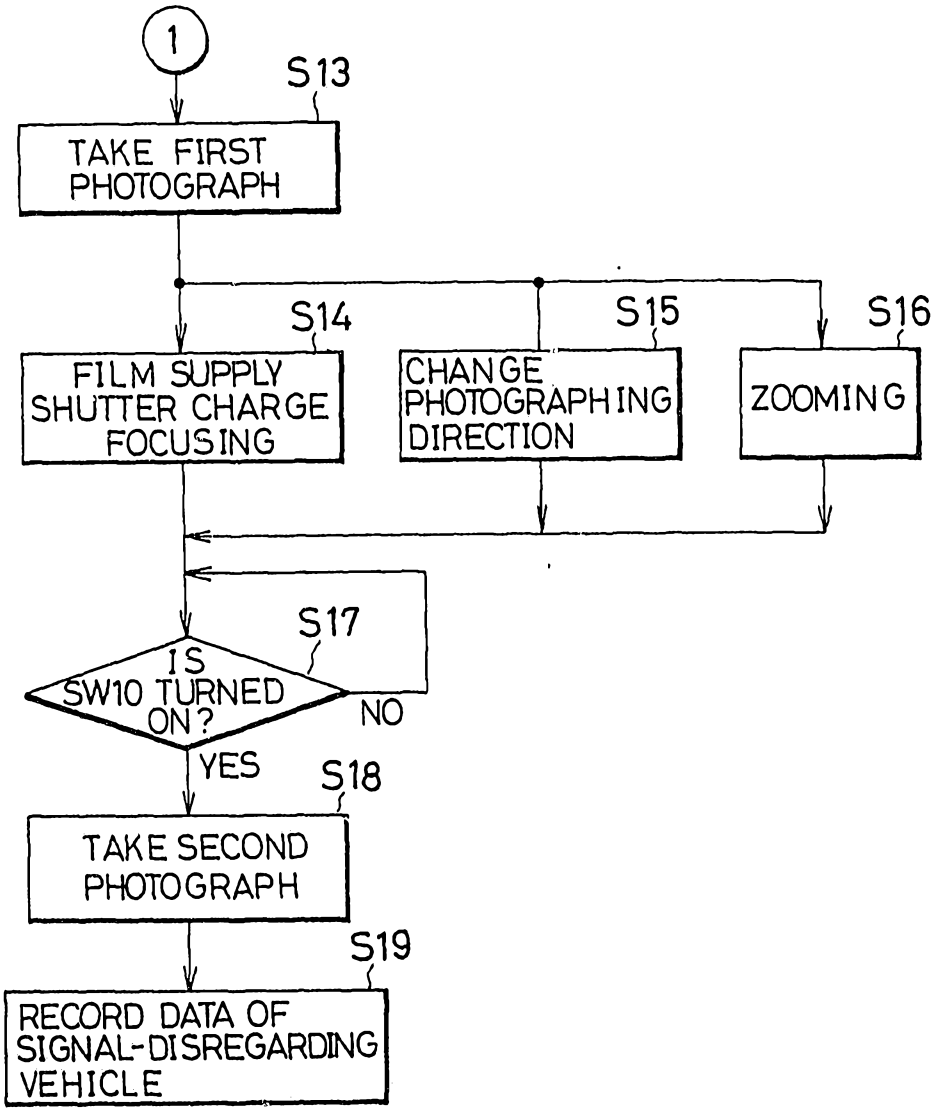
1
S13
TAKE FIRST PHOTOGRAPH
S14
FILM SUPPLY SHUTTER CHARGE FOCUSING
S15
CHANGE PHOTOGRAPHING DIRECTION
S16
ZOOMING
S17
IS SW10 TURNED ON?
NO
YES
S18
TAKE SECOND PHOTOGRAPH
S19
RECORD DATA OF SIGNAL-DISREGARDING VEHICLE

Fig. 5

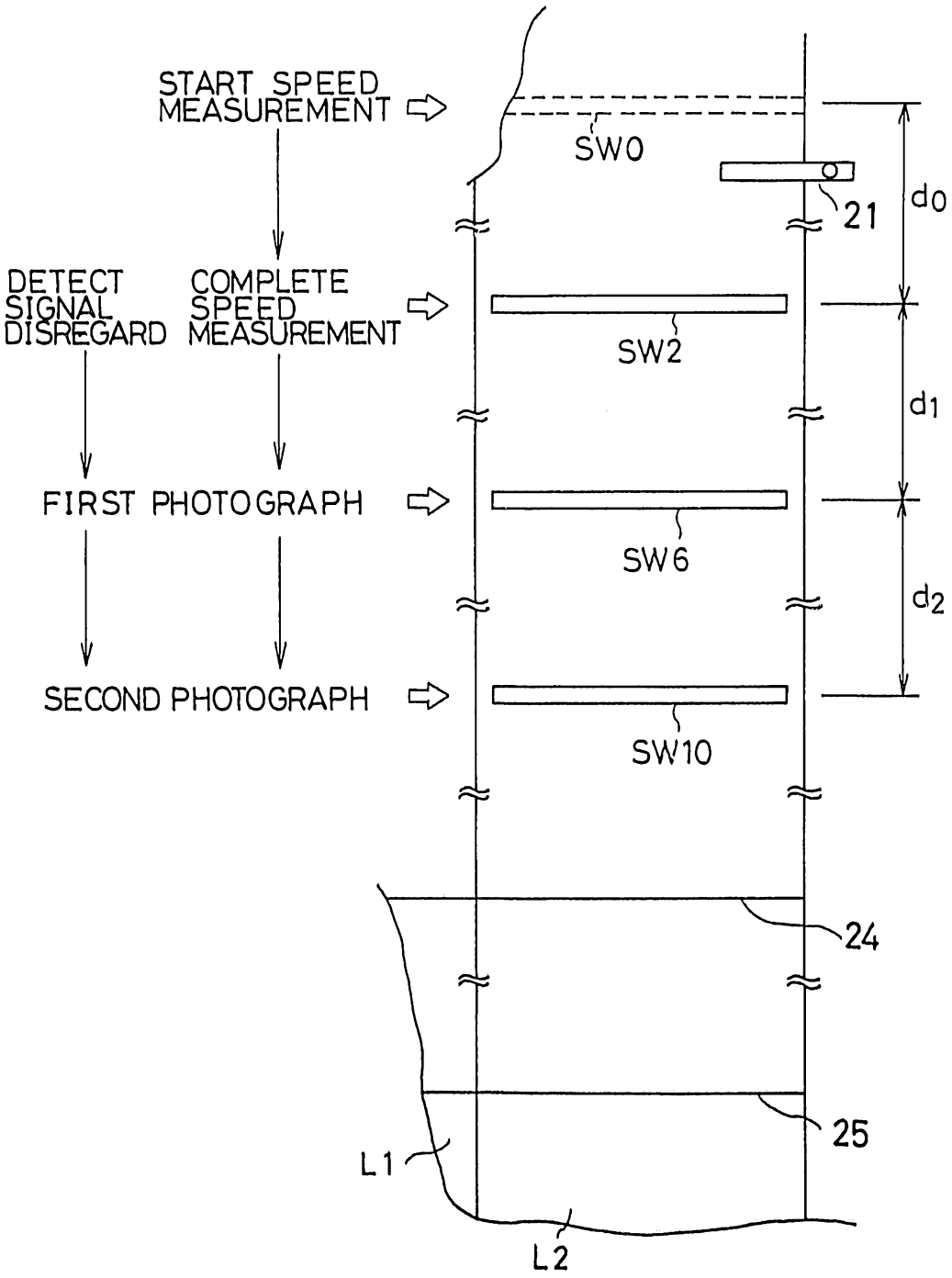
START SPEED MEASUREMENT
SW0
21
d0
DETECT SIGNAL DISREGARD
COMPLETE SPEED MEASUREMENT
SW2
d1
FIRST PHOTOGRAPH
SW6
d2
SECOND PHOTOGRAPH
SW10
24
25
L1
L2

Fig. 6

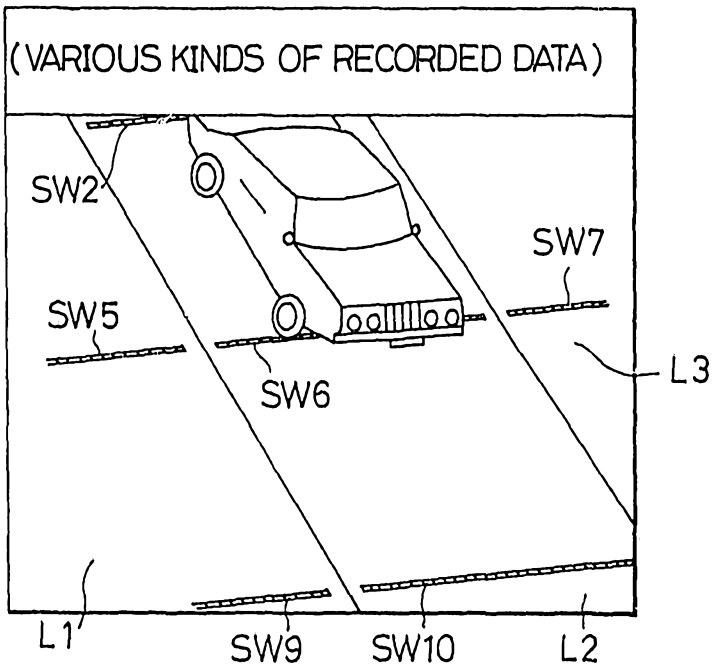
(VARIOUS KINDS OF RECORDED DATA)
SW2
SW7
SW5
SW6
L3
L1
SW9
SW10
L2

Fig. 7

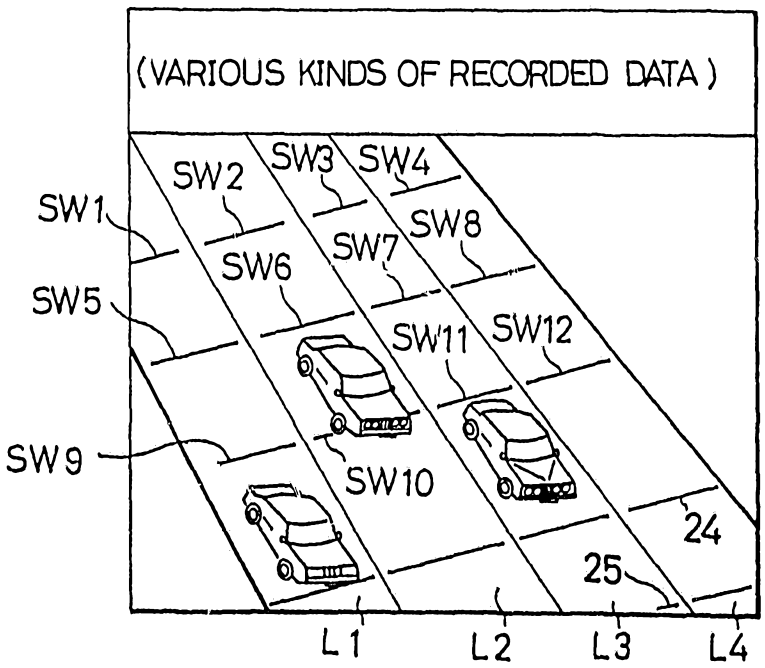
(VARIOUS KINDS OF RECORDED DATA)
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
SW12
24
25
L1
L2
L3
L4

Fig. 8

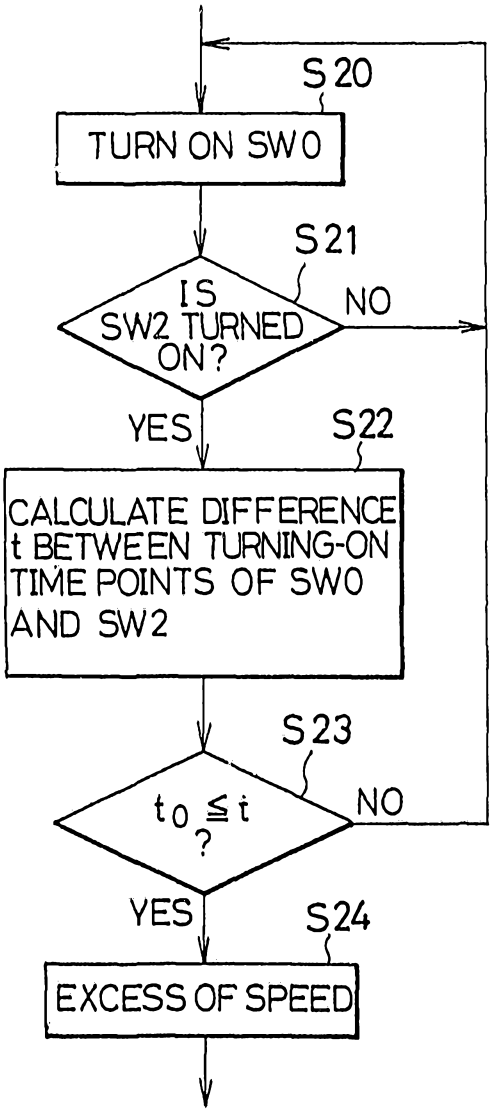
S20
TURN ON SW0
S21
IS SW2 TURNED ON?
NO
YES
S22
CALCULATE DIFFERENCE t BETWEEN TURNING-ON TIME POINTS OF SW0 AND SW2
S23
$t_0 \leqq t$?
NO
YES
S24
EXCESS OF SPEED

Fig. 9

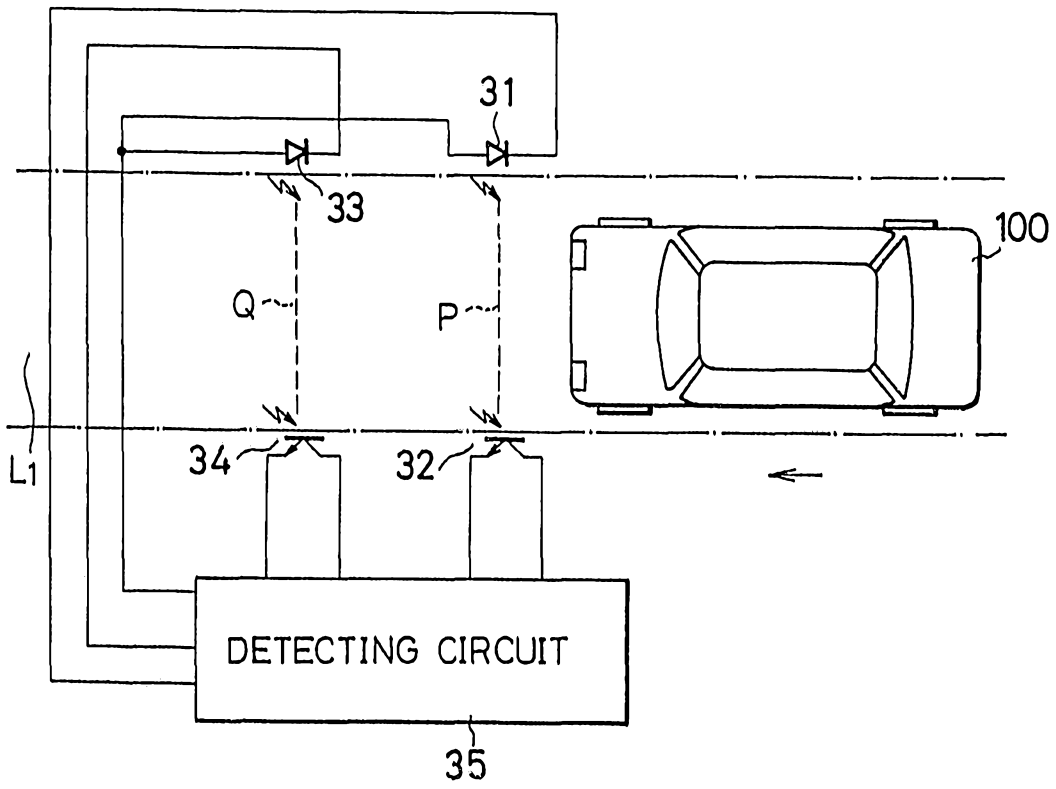

Fig. 10

