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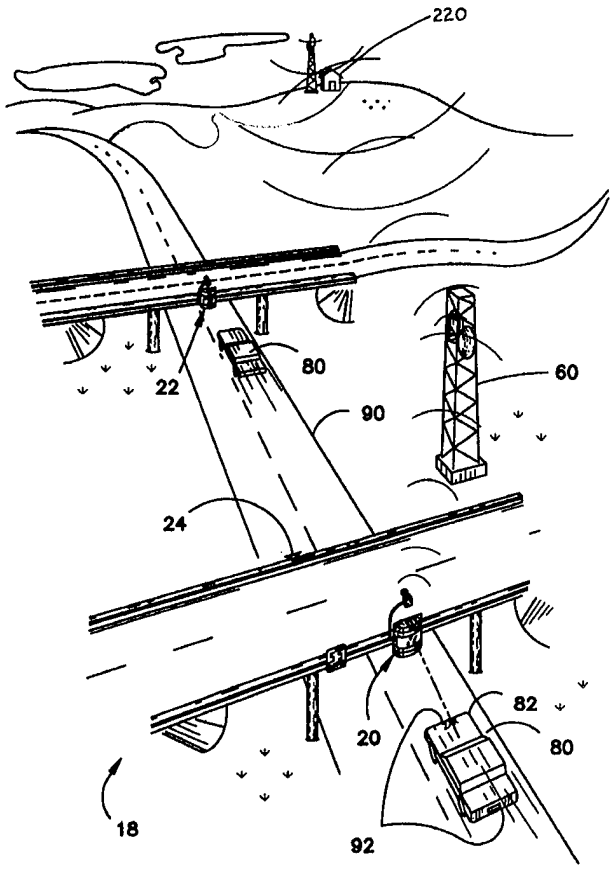
(54) Title: TRAFFIC LAW ENFORCEMENT SYSTEM HAVING DECOY UNITS

(57) Abstract

A traffic law enforcement system having one or more enforcement units and decoy units, and an engagement mechanism corresponding to each enforcement unit and decoy unit. The enforcement units are capable of vehicle speed detection and identification to enable enforcement of the speed limits by subsequent ticketing. The decoy units have an external appearance substantially indistinguishable from an enforcement unit. Both decoy units and enforcement units are preferably positioned in prominent, highly-visible locations throughout a traffic flow area. The engagement mechanism enables the substitution of enforcement units for decoy units, and vice versa. This enables routine and random exchanging of decoy units and enforcement units which increases the difficulty of a driver discriminating between enforcement units and decoy units, decreasing the number of enforcement units required in the system, and, therefore, the cost of the entire system. The invention provides a means of helping reduce the speed of drivers to safe limits while enabling more effective and safer enforcement of the traffic ordinances by requiring less police interaction and the dedication of fewer police resources, such as police cars and related enforcement equipment. Such a system will play an important role in permitting municipalities to dedicate police resources to the enforcement of more serious criminal laws, or, alternatively, to reduce the municipalities' traffic law enforcement costs.



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TRAFFIC LAW ENFORCEMENT SYSTEM HAVING DECOY UNITS

Background of the Invention:

This invention relates to traffic enforcement devices for use in enforcing traffic ordinances. More specifically, this invention relates to remotely operated enforcement devices having speed detection and recording means.

In the United States, the prevalent method of enforcing traffic laws is to utilize police officers who patrol the streets in police patrol cars in an effort to pursue, detain and ticket those persons who they observe to have violated the traffic laws. Typically, an officer will monitor vehicle speed by using a wide variety of alternative means to monitor vehicle speed, including the use of a radar gun (e.g., a Doppler radar), a laser beam, or sensing coils or pads placed on the roadway, as in U.S. Pat. No. 4,234,923. These alternative means require the involvement of at least one police officer, and a patrol vehicle including all equipment normally supplied a patrol vehicle, resources which are costly and are of limited supply. Further, the step of pursuing and detaining traffic ordinance violators can be dangerous to the police officer and the public at large. For example, an irate driver threatens the officer, the driver makes an effort to evade the officer, initiating a high speed chase, or the driver pulls over in an unsafe area on the highway, thus subjecting others to an unnecessary danger of collision.

Despite the dangers associated with the current methods of traffic ordinance enforcement, the benefits obtained outweigh the costs and dangers to the public. Proper enforcement results in the reduction in the number of traffic accidents and traffic fatalities, and a decrease in the costs to society of medical treatment and automotive and medical insurance. This was observed to have been the case when the national speed limit on interstate highways was reduced from 70 mph to 55 mph. In addition, the reduction of traffic accidents is highly correlated with a reduction in traffic congestion. When a patrol vehicle blocks even just one lane of a multi-lane highway, this may disproportionately decrease traffic through-flow, due to the need of accommodating merging traffic and to a phenomenon commonly known as "rubber-necking" (the tendency of persons who notice an accident or accident scene to slow down in order to better observe the accident scene).

Traffic enforcement devices, which provide a means for enforcement of the traffic ordinances without the direct involvement of a police officer or a patrol vehicle, have been in use for some time in Europe and in other regions of the world. U.S. Pat. Nos. 4,866,438 and 5,066,950 describe remotely located devices which include a radar device and means of automatically triggering a high resolution photographic camera when a vehicle passes within its field of detection. These systems require matching of the license plate number read from a photograph taken by the camera with a number in a database of registered vehicles in the state, region or nation. Upon identification, a traffic citation is issued and mailed to the registered owner of the vehicle in a non-confrontational manner

without utilizing a patrol vehicle or a police officer's time. Despite these advantages, citations issued by these systems are unenforceable in states in which an integral requirement of traffic ordinance enforcement is that there be a living human witness to the violation. In addition, because the location of the violation must be noted on the citation (if it is not readily apparent from the photograph taken by the device) and is almost always supplied to the driver, the public may soon become aware of the location of the devices. When this occurs, drivers will know that they must slow down at this location in order to avoid receiving a traffic citation. Although slowing traffic to safe limits is a purpose of these prior art devices, this purpose will only partly be accomplished (i.e., persons will obey the traffic ordinances within the field of detection of the device). An effective system of such devices, capable of enforcing the traffic ordinances within an entire urban area, will be prohibitively expensive, because the urban area which is to be monitored will require a sufficient number of these units to ensure that a majority of the streets in the area are, in fact, being monitored (by minimizing or eliminating any streets on which drivers having knowledge of each enforcement unit location can violate the traffic ordinances with impunity). This mandates that an effective system of enforcement be comprised of a large number of these units. Because each unit consists of relatively expensive and technologically sophisticated components, a system which blankets all drivable streets and highways is prohibitively expensive.

Therefore, what is needed is a system which enables effective, low cost enforcement of traffic ordinances without requiring that a police officer and patrol vehicle pursue and detain suspected traffic ordinance violators, while also providing a witness to the alleged violation in order to comply with the enforcement requisites of state laws.

Summary

The foregoing problems are solved and a technical advance is achieved by the provision of a traffic law enforcement system having one or more enforcement units and decoy units, and a releasable engagement mechanism corresponding to each enforcement unit and decoy unit. The enforcement units are capable of vehicle speed detection and identification to enable enforcement of the speed limits by subsequent ticketing. The decoy units have an external appearance substantially indistinguishable from an enforcement unit. Both decoy units and enforcement units are preferably positioned in prominent, highly-visible locations throughout a traffic flow area. The engagement mechanism enables the substitution of enforcement units for decoy units, and vice versa, thus increasing the difficulty of a driver to determine whether a given unit is active. This decreases the number of enforcement units required in the system to effectively reduce the frequency of speed limit violations by increasing the risk of driving in excess of the speed limit. Fewer units results in a lower cost and complexity for the entire system.

In a feature of the invention, the traffic law enforcement system includes one or more

containment housings (each containment housing being positioned at a predetermined location along a traffic flow route), one or more enforcement units releasably engageable into each containment housing; and a releasable engagement mechanism which engages and disengages the enforcement units from the containment housings.

In another feature of the invention, the traffic law enforcement system's containment housing effectively conceals the presence or non-presence of the enforcement unit, the containment housing itself becoming a decoy unit when the enforcement unit is removed.

In another feature of the invention, the containment housings receive a decoy unit of an enforcement unit which effectively conceals the presence or non-presence of the enforcement unit.

In another feature of the present invention, the enforcement unit includes a containment housing containing an inner assembly. The inner assembly includes a high resolution still camera, a speed detection system which generates an output signal, a first embeddor which embeds the output signal in a register, a second embeddor which embeds the contents of the register into a photograph of the high resolution still camera, a signal generator which generates an identifying signal (i.e., a signal which identifies the particular event -- a clock may suffice) and a third embeddor which embeds the identifying signal in a second register, a fourth embeddor which embeds the contents of the second register into a photograph of the high resolution still camera, a comparator trigger which processes sample output signals over time, such that, for example, when the sampled signals reach a maximum (e.g., when the slope of the outputs graphed against time becomes zero, the samples taken just prior to the slope becoming zero have a greater magnitude than the magnitude of the output signal when the slope is measured as zero, and where the absolute value of the magnitude of the output signal is greater then zero) and the maximum value of the output signal exceeds the posted speed limit by a predetermined margin, the high resolution still camera is triggered, and a hi-resolution photograph is taken of any vehicle within the field of view of the hi-resolution camera. When the camera is trained on the object whose measured speed triggered the hi-resolution camera, then the photograph taken by the hi-resolution camera will be of the vehicle corresponding to the measured speed.

In another feature of the invention, the enforcement unit includes a containment housing and an inner assembly received in the containment housing. The inner assembly includes a video camera, a high resolution still camera, a speed detection system which generates an output signal, a first embeddor which embeds the output signal in a video signal generated by the video camera and in a register, a second embeddor which embeds the contents of the register into a photograph of the high resolution still camera, a recorder which records the video signal, a signal generator which generates an identifying signal and embeds the identifying signal in the video signal and in a second register, and a third embeddor which embeds the contents of the second register into a photograph of the high resolution still camera.

In another feature of the invention, the enforcement unit includes a first video transmitter for

transmitting the video signal, a second receiver for receiving a command signal, a servo switch which controls the shutter of the high resolution still camera as commanded by the command signal, and a command station which receives the video signal and generates the command signal.

The traffic law enforcement system may also include within the inner assembly, a video mixer or title maker (a device known in the art for generating titles on video screens) which embeds the output signal into the video signal generated by the video camera; a signal generator which generates an identifying signal which the title maker embeds in the video signal. The command station includes a first video receiver which receives the video signal and demodulates the video signal, means for extracting the output signal of the speed detection system, a display monitor which displays the video signal and the output signal of the speed detection system, an operator-actuated switch which generates the command signal, a transmitter which modulates and transmits the command signal to the enforcement unit; and at least one decoy unit which has an external surface which is substantially visually indistinguishable from a said enforcement unit. In this feature of the invention, it is not necessary to include a video recorder within the enforcement unit.

In another feature of the invention, the traffic law enforcement system includes flashing lighting electrically and mechanically attached to the containment housings.

In another feature of the invention, a releasable engagement device having a rod with a first interface on either end. The first interface is releasably engageable with a second interface on a containment housing such that decoy units and enforcement units may be removed and installed thereby.

In another feature of the invention, the flashing lighting attached to the containment housing is selectively activated from a remote location via a receiver mounted in the flashing lighting, the receiver being responsive to signals from a remote sending unit.

In another feature of the invention, the decoy units emit a dummy radar or laser signal which further disguise the dummy units, making them indistinguishable from enforcement units.

In another feature of the invention, the decoy units are enforcement units which emit a dummy radar or laser signal. In this feature, the operator at the command center chooses which enforcement units to monitor, switching the dummy signal on in all units which he is not monitoring.

In a related feature of the invention, the flashing lighting of both the decoy units and the enforcement units is activated and deactivated in a substantially random fashion.

In another feature of the invention, the inner assembly further includes an opaque housing which conceals from view its interior so that when the assembly is releasably engaged with the containment housing, a third-party observer is unable to distinguish an enforcement unit from a decoy unit and vice versa.

In another feature of the invention, the containment housing includes a panoramic portal extending through an arc around the containment housing, the arc being of an angular magnitude

sufficient to enable the repositioning of the enforcement unit within a range of predetermined angular increments which will permit easy adjustment of the field of view of the components within the inner assembly, thus allowing the enforcement unit to target oncoming vehicles approaching the containment housing from a number of different lanes of a highway.

In another feature of the invention, the high resolution still camera creates a high resolution digital image which is transmitted to the command station to aid in the identification of an alleged traffic law violator.

In another feature of the invention, a video camera and a high resolution camera are used. The high resolution camera creates a high resolution digital image which is indexed and stored for later retrieval and identification of an alleged violator. This enables real-time transmission of the lower resolution video image, and transmission of larger high-resolution image files during off-peak hours via a telephone line.

In a related feature of the invention in which digital images are generated, either by a video camera or by the hi-resolution still camera, and the storage of these images is within the enforcement unit, then a modem (or a comlink in the case of a network connection) may be provided which transmits the images, which were stored during the course of a day, over the communications link between the command station and the enforcement unit at an appropriate time, such as during a period of low use (e.g., in the nighttime hours).

In another feature of the invention, a method is provided to enforce certain traffic laws. This method includes the steps of (a) enforcement of a segment of a street, comprising the steps of (i) using a video camera to generate a real-time video signal of an area within the field of view of a hi-resolution camera located within an enforcement unit and transmitting the image to a command station; (ii) using a speed detection system to generate an output signal of the speed of objects within the field of view of the video and hi-resolution cameras; (b) sampling the output signal using a sampling comparator trigger which processes sample output signals over time, such that, for example, when the sampled signals reach a maximum (e.g., when the slope of the outputs graphed against time becomes zero, the samples taken just prior to the slope becoming zero have a greater magnitude than the magnitude of the output signal when the slope is measured as zero, and where the absolute value of the magnitude of the output signal is greater then zero) and the maximum value of the output signal exceeds the posted speed limit by a predetermined margin, the high resolution still camera is triggered, and (c) embedding the maximum output signal in a video signal generated by the video camera and in a first register in the high resolution camera; (d) embedding the contents of the first register into a photograph of the high resolution still camera; (e) generating an identifying signal indicating, for example, the time and date the photograph was taken and embedding the identifying signal in the video signal, the identifying signal facilitating the matching of the portion of the video signal, generated with the video camera, with the high resolution photograph; (f) embedding the identifying

signal in the video signal and in a second register; (g) embedding the contents of the second register into a photograph of the high resolution still camera; (h) transmitting the video signal using a video transmitter; (i) receiving a command signal using a first receiver; and at a command station; (j) receiving the video signal using a second receiver; (k) monitoring the output of the enforcement system including displaying and selectively recording the video signal; (l) extracting the output signal of the speed detection system and displaying the output signal so that an operator may make a determination as to whether to record the alleged violation for ticketing; (m) generating and transmitting a command signal to the enforcement unit, the command signal generated by an operator which indicates the operator's determination whether a high resolution camera should be activated to take a photograph of an automobile within the field of detection of a speed detection device; and (n) recording an alleged violation of the traffic law using a video recorder and the high speed detection device.

In another feature of the invention, a high resolution video camera and video capture device are used. This permits capture of high resolution images directly from the video image, thus eliminating the need for a high resolution still camera. In order to facilitate this feature, a personal computer ("PC") is provided at the command station or within the enforcement unit, or both. The video image is captured into the storage system of this personal computer, for later retrieval or deletion.

In another feature of the invention, an infrared video camera is used, thus enabling capture of images at night or at low lighting conditions.

In another feature of the invention, closed-circuit communications cable (e.g., a computer networking cable) is used to provide a communications link between the enforcement unit and the command station, thus eliminating the ability of the communication signals to be jammed.

In another feature of the invention, the communications link between the enforcement unit and the command station is a telephone line.

In another feature of the invention, the signals generated by and between the command station and the enforcement unit may be transmitted across power lines, provided that authorization from the cognizant authorities is obtained.

In another feature of the invention, the signals generated by and between the command station and the enforcement unit are transmitted via a satellite relay.

In another feature of the invention, the containment housing is fabricated from "LEXAN", thus protecting the internal electronics from projectiles.

In another feature of the invention, the video camera, the speed detection system, and the high resolution still camera are mounted together on a frame in order that they may be preset to be trained on the same point. A remotely operated servo-controlled gimbal controls the targeting of the cameras according to the desire of the operator at the command station.

An advantage achieved with the present invention is that a system is provided which enables effective, low cost enforcement of traffic ordinances without requiring that a police officer and patrol vehicle pursue and detain suspected traffic ordinance violators. A further advantage of the present invention is that while also providing a witness to the alleged violation in order to comply with minimum enforcement requisites of state laws.

Brief Description of the Drawings

Other objects and advantages of this invention will become readily apparent as the same is better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. **1** is a landscape view showing the basic components of the system of the present invention.

Fig. **2a** is a perspective view of an enforcement unit and a mounting structure of the system of the present invention.

Fig. **2b** is a perspective view of an alternate embodiment of the mounting structure of the system of the present invention.

Fig. **3a** is a schematic view of an enforcement unit of the system of the present invention.

Fig. **3b** is a hybrid schematic-flow diagram of an enforcement unit of the system of the present invention.

Fig. **3c** is a schematic view of a decoy unit of the system of the present invention.

Fig. **4** is a perspective view of an enforcement unit of the system of the present invention, mounted to the mounting structure shown in Fig. **2a**.

Fig. **5** is a hybrid schematic-flow diagram of an enforcement unit of the system of the present invention.

Fig. **6** is an exploded view of an enforcement unit and mounting structure of the system of the present invention.

Fig. **7** is a perspective view of a command station of the system of the present invention.

Fig. **8** is a hybrid schematic-flow diagram of an enforcement unit of the system of the present invention.

Fig. **9a** is a perspective view of a command station of the system of the present invention.

Fig. **9b** is a perspective view of a command station of the system of the present invention.

Fig. **10** is a hybrid schematic-flow diagram of an enforcement unit which interacts with the command station of Fig. **9a** or **9b**.

Fig. **11** is a flow diagram of a method of the present invention.

Fig. **12** is an exploded perspective view of a containment housing and enforcement unit of the present invention.

Fig. **13** is a flow diagram of an ancillary method of the invention.

Detailed Description of the Preferred Embodiment

Now referring to Fig. **1**, in which is shown a preferred embodiment of the system of the present invention, the traffic law enforcement system **18** includes an enforcement unit **20**, a decoy unit **22**, and a receiving interface **24** onto which either the enforcement unit or the decoy unit may be engaged.

In order to permit identification of a potential violator, identifying indicia **82** is placed on a visible portion of an automobile **80**, such indicia including a conventional license plate, inspection sticker, registration sticker, or alphanumeric symbols placed on the surface of the automobile.

The vehicle speed detection and image capturing capability of the traffic law enforcement system **18**, combined with the fact that motor vehicles **80** for use on freeways **90** have identifying license plates **92** with alphanumeric symbols of a size sufficient to be captured in a legible form, enables remote enforcement of the speed limits by ticketing the registered owner of the vehicle.

Now referring to Figs. **1** and **2a**, the decoy unit **22**, when engaged by a receiving interface **24a**, has an exterior appearance substantially visually indistinguishable from an operational enforcement unit **20**, thus effectively eliminating the ability of a driver on a highway or street **90** adjacent or below the decoy unit **22** to discern whether the unit is operational (i.e., capable of enforcing the traffic laws). This lack of knowledge creates a risk of being ticketed in the mind of the potential violator which may only be reduced to zero if he complies with the traffic ordinance. Thus, the psychological impact is greater compliance with the traffic laws. The decoy unit **22**, however, either has few or no electronic components, or need not be remotely monitored by an operator, thus substantially reducing the cost and/or complexity of the overall system.

The receiving interface **24a** and a mating interface **36** enable routine relocation of an enforcement unit **20** to other geographic locations, and the substitution of a decoy unit **22** in the place of an enforcement unit (or, alternately, the activation of one enforcement unit and the at least partial deactivation of another enforcement unit, the latter unit now acting as a decoy unit), thus increasing the difficulty of a driver discriminating between active enforcement units and decoy units, decreasing the number of active enforcement units required in the system, and, consequently, decreasing the complexity and cost of the entire system **18**.

Now referring to Fig. **2a** and **2b**, the enforcement unit **20** includes a mating interface **36**, shown in dashed lines, a housing **100**, an image capture device (e.g., a high resolution still camera **26**) and a speed detection system **30**. The receiving interface **24a** includes a mounting portion **32** and an interface end **34** which releasably engages with the mating interface **36** on either the enforcement unit **20** or the decoy unit **22**. The mounting portion **32** is specially fabricated to interface with and securely mount to a structure **40**, adjacent to or above a highway or street, using a locking device **43** to prevent tampering. The receiving interface **24a** and an alternate interface **24b** enables secure, precise and

repeatable attachment of an enforcement unit **20** or decoy unit **22** to various types of structures, such as a concrete railing, a sidewall of an overpass, or a dedicated support structure. A power and/or communications junction box **45**, and corresponding cable conduit **47** attach to the structure **40**. A power and/or communications cable **49** connects to the junction box **45**.

In another configuration, the receiving interface **24a** or **24b** includes a mounting frame **42** which is permanently affixed to the structure **40** using conventional fastening devices, such as bolts **44**. In the alternate configuration of the receiving interface **24b**, the mounting portion **32** has the form of a hanger having a clamping end **46** which affixes to a highway structure **40**, and an interface end **34** which releasably engages with either the enforcement or decoy unit **20** or **22**.

Referring now to Fig. **3a**, the housing **100** of the enforcement unit **20** further contains a strobe device **152**, a flash device **142** (used when the image capture device **26**, "ICD", is a still camera), a wiper device **156** and moisture or water-activated sensor **160**, a speed detection system **30**, a personal computer **120** ("PC"), and an XCVR **121**. The PC **120** includes RAM memory, hard disk storage, a video card, video ports, serial ports, input/output ports such as parallel ports, a network connector **123**, software, a power supply, and other components typically found in a personal computer. The image capture device **26** connects to the PC via a video port, for example. The speed detection system **30** connects to the PC via a RS-232 cable **125** and connections. The PC **120** connects to the XCRV **121** which receives and transmits (including necessary modulation and demodulation) transmissions between the PC and a central network computer (e.g., **350**, shown in Figs. **7**, **9a**, **9b**, and **10**) at a command station (e.g., **220** or **221**), as necessary, thus connecting the PC to a network which an operator **212** at the command station controls. The strobe device includes a light **152** connected to a flasher or strobe relay **153b** which in turn connects to and is controlled by the PC, via a parallel, i/o port.

Referring to an alternate embodiment of an enforcement unit of the system of the invention, as shown in Fig. **3b**, the housing **100** contains a high resolution still camera **26**, a speed detection system **30** ("SDS") which generates an output signal, a comparator trigger **102** ("CT"), a first register **104** ("R1") which embeds the output signal into an image **106** captured by the high resolution still camera, a clock **110** which embeds the time and date into the image **106**, a data input storage area **112** (abbreviated "DISA") into which is stored the location of the alleged violation and from which identifying information is embedded into the image **106**, and a personal computer ("PC") **114** having the usual components, such as a video card **116**, CPU **127**, ram memory **122** and hard disk storage **124**, software **126**, and a power supply **150**.

In addition, the PC **114** is IBM compatible computer having at least a 486 microprocessor (preferably a "PENTIUM" 133, or better), at least 16 MB of RAM memory, and a hard disk with at least 1 GB of available storage. Also, the PC **114** is loaded with "WINDOWS" 3.11 or better

("WINDOWS 95" OR "WINDOWS NT" is preferred).

The comparator trigger **102** processes sample output signals over time, such that, for example, when the sampled signals reach a maximum (e.g., when the slope of the outputs graphed against time becomes zero, the samples taken just prior to the slope becoming zero have a greater magnitude than the magnitude of the output signal when the slope is measured as zero, and where the absolute value of the magnitude of the output signal is greater then zero) and the maximum value of the output signal exceeds the posted speed limit (input from a register **103** along with a location code via a keyboard port when the enforcement unit was initialized) by a predetermined margin, the high resolution still camera **26** is triggered, and the video capture card **116** captures a high resolution image **106** of any vehicle **130** within the field of view **132** of the hi-resolution camera. The speed detection system **30** is trained on a point along a highway or street. The comparator trigger **102** operates when a vehicle **130** passes through this point in space at a speed in excess of a predetermined margin over the local speed limit (a value input from a register **103** which was initialized at the time the enforcement unit was installed, along with the location code). When the still camera **26** is trained on the object whose measured speed triggered the still camera, then the image **106** captured by the still camera will be of the vehicle **130** which triggered the comparator trigger.

The still camera **26** is a digital camera, having a zoom lens **134**. The zoom lens **134** creates a magnified, high resolution digital image **106** which is stored in hard disk storage **124** for later retrieval, to aid in the identification of an alleged traffic law violator. Suitable still cameras include the "FOTOMAN PIXTURA" by Logitech, capturing a 24 bit color image in a resolution as high as 768 X 512 pixels. When a "FOTOMAN FIXTURA" is used, the zoom lens is attached to the still camera **26** via a special frame (not shown). Alternatively, the still camera **26** may be of the type which includes a built-in zoom lens, such as "KODAK DIGITAL SCIENCE DC50 ZOOM" by Kodak, capturing a 24 bit color image in a resolution as high as 756 X 504 pixels with a built-in 3X zoom capability. In addition, the "PHASE ONE" model CB66 Digital Camera Cover and "HASSELBLAD" camera combination available from Phase One Company of Northport, New York, producing an image in a resolution as high as 5000 x 7142 pixels. However, it will be understood by those skilled in the art that, in order to enable effective and rapid manipulation of such large files, the PC should include sufficient RAM and have a microprocessor of sufficient speed (a 486 microprocessor is insufficient in this case -- a "PENTIUM PRO" 233 MHz machine having 32 MBytes of RAM is recommended).

The still camera **26** connects to the PC via an RS-232 connection. The still camera **26** automatically captures a digital image **106** of the objects **130** within its field of view **132** each time it is triggered by the comparator trigger **102**. A software program **126** running in RAM memory **122** and processed by the CPU **127**, controls the processing of the digital image **106**. The processing of the digital image **106** involves the steps of (a) downloading of a digital image **106** taken by the still

camera **26**; (b) editing the image **106** with characterizing data; (c) storing the image **106** in ram memory **122**; (d) editing or appending the image **106** to include characterizing information, such as the time input from the clock **110**, the speed input from the register **104**, the location and other identifying input from the DISA **112**; and (h) re-saving the edited photograph into memory for later retrieval via modem, network line data transfer, or manual removal. Optionally, the still camera **26** has a physical cross-hair or bulls eye-like marking (not shown), as in a rifle scope, positioned such that it substantially coincides with the point from which the speed detection system **30** receives its speed measurement. If such is not part of the image **106** captured by the still camera **26**, then the cross-hair graphic may be edited into the image **106** during the above editing stage.

The still camera **26** includes an infrared flash **140** mounted to the housing **100**. The infrared flash **140** has an infrared filter **142**, thus enabling the capturing of infrared images **106** of a moving vehicle **80** or **130** at night or day without startling, momentarily blinding or otherwise disturbing the driver. Alternatively, the infrared flash **140** may be a conventional flash having a filter which filters out most non-infrared light waves.

The speed detection system **30** is a laser-based system. The use of a laser enables precise selection of lanes of traffic to target, and minimizes the possibility that the output signal of the speed detection system **30**, which is edited into the digital image **106**, was not that of the vehicle **130** within the field of view **132** of the still camera **26**. Examples of suitable laser speed detection systems are the "PRO-LASER" system by Kustom Signals, Inc. of Lenexa, Kansas, and the "LTI 20-20 MARKSMAN" by Laser Technology Inc. of Englewood, California.

Referring again to Fig. **2a**, the housing **100** of the enforcement unit **20** further includes a panoramic portal **154** extending through an arc on the housing, the arc being of an angular magnitude sufficient to enable the retargeting of the still camera **26** within a range of predetermined angular increments which will permit easy adjustment of the field of view **132** of the components within the housing **100**, thus allowing the enforcement unit **20** to target oncoming vehicles **130** approaching the enforcement unit from a number of different lanes of a highway without requiring relocation of the enforcement unit. Retargeting of the still camera **26** may be performed by the operator **212** at the command station or by randomly selecting lanes to target from x, y, and z coordinates which are pre-selected in a setup procedure. The random selections are made by the PC **120** with the aid of a random number generator and corresponding computer program. The physical repositioning of the camera **26** and speed detection system **30** is accomplished through a servo-controlled 2 axis pan-and-tilt worm gear drive **210**, described in more detail below in connection with Fig. **6**.

The wiper device **156** mounts above the portal **154**. The wiper device **156** includes a moisture or water-activated sensor **160** which causes the wiper to wipe moisture from the portal **154** at predetermined intervals.

The housing **100** further includes handles **162** mounted on the housing to facilitate the process of substituting an enforcement unit **20** for a decoy unit **22** and vice versa.

In addition, built-in blowers **164** and a heater **166**, together with a thermostat **170** and circuit **170** are provided to avoid temperature extremes beyond the operational limits of the enforcement unit **20**.

Referring now to Fig. **3c**, the decoy unit **22** of the present invention includes a housing **100**, an optional emitter **31** ("E") which emits radar waves or a laser beam of sufficient strength to trigger any radar or laser detectors which a passing vehicle may utilize. The emitter **31** is powered by a power supply **150** ("PS") which also supplies power to (1) optional flashing lighting **152** which is fastened to the housing **100** for the purpose of increasing the difficulty in distinguishing between a decoy unit **22** and an enforcement unit **20**, and/or (2) an optional nonfunctional wiper assembly **156a**. Further, a flash device **142** optionally connects to the emitter **31** such that when the beam or wave emitted by the emitter **31** is broken, the flash device is automatically triggered. These features give the decoy unit **22** the appearance of an active, powered-up enforcement unit **20** by creating outward characteristics which are similar or identical to an enforcement unit.

In another feature of the invention, a method is provided to enforce the traffic law which requires a minimum of manpower, and relative simplicity. This method includes the steps of (a) making it known to the driving public, at least in part through ticketing for offenses recorded by the traffic law enforcement system, that a prominently displayed, stationary, enforcement unit **20** having a particular appearance is capable of recording an image **106** of a vehicle **130** which is violating the traffic laws, the image being of sufficient detail to identify the vehicle (and, where a video camera is used, a witness may be able to testify against the violator in court, thus making it likely that any tickets issued to the violator will be enforceable); (b) distributing modular, interchangeable devices having the appearance of these enforcement units **20** throughout a traffic flow area of a region, these devices including both fully functioning enforcement units **20** and essentially nonfunctioning decoy units **22** (i.e., units incapable of actually recording an image **106** of a vehicle **130**); (c) substituting (either randomly, using a random number generator, in a periodic fashion, or as maintenance is required) enforcement units **20** for decoy units **22** and vice versa, such that it becomes difficult for any individual member of the public to learn from experience which unit is an enforcement unit **20** and which is a decoy unit **22,** (d) utilizing enforcement units **20** to identify and subsequently ticket violators of the traffic ordinances, and optionally, (e) monitoring performance of the system **18** to maximize its benefits and determine the optimum ratios of enforcement units **20** to decoy units **22** in light of other variables, such as the frequency with which the location of the enforcement units is changed.

An advantage achieved with the present invention is that a system **18** is provided which

enables effective, low cost, simple enforcement of traffic ordinances without requiring that (1) a police officer and patrol vehicle pursue and detain suspected traffic ordinance violators, or (2) that each unit of the system be fully functional.

In a first alternative embodiment of the invention, depicted in Figs. **4** and **5**, the image capture device further includes a video camera **202**, a register **204** ("R") which receives the output signal of the speed detection system **30** and embeds the output signal in a video signal generated by the video camera. A high quality video camera is used with this system. Outdoor cameras require automatic backlight compensation to obtain good performance since the lighting range from bright sunlight to darkness is much more severe outdoors than it is indoors. Optionally, the video camera **202** also may have a zoom lens **135**. The zoom lens **135** is an Auto Iris Motorized Zoom Lenses which is designed to work with automatic light compensation. This zoom lens **135** further has remote electronic zoom capabilities using a remotely operated joystick controller. In order to better understand the strength of this lenses, at 8mm the camera sees approx 50' width at 100' distance. At 48mm the camera sees approx 10' width at 100'. At 160mm the camera sees a 3' width. This is sufficient to enable a closeup of a persons face at 100'.

Now referring to Fig. **5**, the enforcement unit **20** further includes a first video modulator **222** for modulating the video signal, a first video transmitting device **224** for transmitting the video signal over a communications path **226**, a receiving dish **50** for receiving a command signal over a communications path **230**, a demodulator **232** for demodulating the command signal, a storage area **234** ("SA") in which the communications signal is stored, and a command station **220** (shown in Fig. **7**) which receives the video signal and generates the command signal.

Now referring to Fig. **6**, the video camera **202** (NTSC capable), the speed detection system **30**, and the high resolution still camera are preset to be trained on the same point and then fixed in place on a common frame **206**. A remotely operated servo-controlled 2 axis pan-and-tilt worm gear drive **210** attached to the frame **206**. The gear drive **210** controls the position of the frame **206** and therefore the targeting of the cameras **26** and **202** according to the desire of the operator **212** at a command station **220**. Suitable pan-and-tilt worm gear drives **210** include that used on "SLUG VIDEO" by Computer Engineering of Santa Cruz, California. Another suitable pan-and-tilt worm-gear drive is a component of the "PRO WEATHERPROOF VIDEO SURVEILLANCE SYSTEM", part no. HAS-7696, available from by Home Automation Systems, Inc., at http://www.techmall.com/smarthome/opkit3.html.

A receiving dish **50** and a transmitting device **52** are affixed to the mounting frame **42** of the receiving interface **24** via a stanchion **54** and a mounting gimbal assembly **56**, and are undisturbed when the enforcement unit **20** or the decoy **22** is removed from the receiving interface **24**. This permits one-time targeting of the receiver **50** and the transmitter **52** to its associated line-of-sight cell,

hub or router **60**. In this arrangement, the subsequent interchange of an enforcement unit **20** with a decoy unit **22** does not disturb the targeting of the receiver **50** or the transmitter **52**.

Now referring to Fig. **7**, the command station **220** includes a first video receiving dish **240** which receives the video signal, a first video demodulator **242** which demodulates the video signal, a display monitor **246** which displays the video signal and the embedded output signal of the speed detection system **30**, a recorder **250** which records the video signal, an operator-input device **252** which generates the command signal, a second modulator **254** which modulates the command signal, a second transmitting device **256** which transmits the command signal to the enforcement unit **20** over the communications path.

When an image **106** is captured, the CPU **127** samples the contents of the SA **234**. When a fresh command signal is received from the command station **220**, this provides the input which determines whether the digital image **106** of the photograph will be edited for identifying inputs and stored for transfer to the command station **220** or deleted so as to make room in computer memory storage **124** for another image. This is accomplished in conjunction with a commonly available video capture board **129** in the PC **120**. A system software program **260** operates on the CPU **127** and controls the editing of the digital images **106**, and involves the steps of: (a) taking a high resolution digital photograph **106**; (b) storing the photograph **106** in ram memory **122**;(c) awaiting a command signal from the command station **220**, the receipt of which identifies the operator **212** and confirms that the operator had witnessed the violation; (f) transmitting the inputs over the communications path to the enforcement unit **20**; (g) receiving the inputs; (h) taking the inputs from the operator **212** and associating the inputs with the photograph **106** in, for example, a database record structure; (h) and saving the associated inputs and photograph **108** into hard disk storage **124** (as photograph **108**, for example) for later retrieval via modem, network line, data transfer, wireless, or manual removal.

If a confirmation is not received then the image **106** is discarded. However, when the identifying signal from the witness/operator **212** is received, the image **106** is stored.

The images **108** of the still camera **26** which were stored during the course of a day are transmitted across the communications path between the command station **220** and the enforcement unit **20** at an appropriate time, such as during a period of low use or low noise (e.g., in the nighttime hours). If the communications path is a telephone line, then the image **108** is transmitted via modem to the PC at the command station, the PC having corresponding to answer and communicate with the PC at the enforcement unit (in a similar manner as that of a Bulletin Board System). This enables real-time transmission of the lower resolution video image, and transmission of larger high-resolution image files during off-peak hours via a telephone line. However, whenever the communications link permits, the transfer should take place immediately over the network line via a comlink.

The first alternate embodiment used a slightly different method to identify the violator. This

method includes the steps of (a) enforcement of a segment of a street, comprising the steps of (i) using a video camera **202** to generate a real-time video signal of an area within the field of view **132** of a still camera **26** located within the housing **100** of an enforcement unit **20**; (ii) using a speed detection system **30** to generate an output signal of the speed of objects **130** within the field of view of the video camera **202** and still camera **26**; (b) sampling the output signal using a sampling comparator trigger **102** which $$processes sample output signals over time, such that when the sampled signals reach a maximum (e.g., when the slope of the outputs graphed against time becomes zero, the samples taken just prior to the slope becoming zero have a greater magnitude than the magnitude of the output signal when the slope is measured as zero, and where the absolute value of the magnitude of the output signal is greater then zero) and the maximum value of the output signal exceeds the posted speed limit (input from a register **103** which received its input during initialization of the enforcement unit) by a predetermined margin, the still camera **26** is triggered, and (c) embedding the maximum output signal in a video signal generated by the video camera **202** and in a register **104**; (d) embedding the contents of the register **104** into a photograph **106** of the high resolution still camera **26**; (e) embedding the contents of the DISA **112** (for example, the location, and local speed limit) into the digital photo **106**, (f) reading the clock **110** for date and time and embedding this reading into the video signal; (g) modulating the video signal using a first video modulator **222**; (i) transmitting the video signal over the communications path using a video transmitter **224**; (j) receiving a command signal over the communications path using a first receiver **50**; (k) demodulating the command signal using a first demodulator **232**, and at a command station **220**; (l) receiving the video signal over the communications path using a second receiving dish **240**; (m) demodulating the video signal using a second demodulator **242**; (n) monitoring the output of the enforcement unit **20** including displaying the video signal so that an operator **112** may make a determination as to whether to record the alleged violation for ticketing; (o) inputting the ID of the operator **212**; (p) generating, modulating and transmitting a command signal to the enforcement unit **20** over the communications path, the command signal generated by an operator **212** which indicates the operator's determination whether a photograph taken by the still camera **26** of an automobile **130** within the field of detection of a speed detection device **30** should be edited and stored or discarded to take a photograph; and (q) recording an alleged violation of the traffic law using a video recorder **250** and the speed detection device **30**.

In a related feature of the invention in which digital images **106** are generated by the digital still camera **26**, and the storage of these images is within the enforcement unit **20**, a modem may be provided which transmits the images, which were stored during the course of a day, over a communications path between the command station **220** and the enforcement unit **20**, at an appropriate time, such as during a period of low use (e.g., in the nighttime hours). This feature will be

particularly useful where the digital images captured are very large, as those which are generated by the "HASSELBLAD" camera described above.

Although this embodiment is not as simple as the preferred embodiment, an advantage of this first alternate embodiment of the present invention is that it also provides a witness **212** to the alleged violation who has the capacity to testify against the violator in a court of law, thus complying with certain state laws which require a witness to the violation for enforceability.

A further advantage of this embodiment is that one operator **212** may monitor and ticket several drivers within a short period of time, because it is no longer necessary that a police officer flag down, stop and query the driver prior to securing sufficient information for ticketing. The enforcement system **18** of the present information permits a image **108** of the violation to be recorded automatically, for later identification at a more convenient time. In addition, when the system program **268** displays the image output of several enforcement units **20** on a split screen, several locations may be monitored by the same operator **212**, thus expanding the geographic coverage of the system as compared to a single officer using a patrol car.

It should be understood that in all the embodiments described herein, the location of the PC or PCs is not critical, as the same can be located within the enforcement unit, at the command station, or one PC each at both locations.

As is evident from the description of the preferred embodiment and the first alternate embodiment, the image capture device used in the invention may be one of several alternative capture devices. One such capture device is a camera **26**. Another such capture device, utilized in a second alternate embodiment of the invention shown in Figs. **8-10**, includes a video camera **300** connected via wireless link with a video capture device **302** located at the command station.

The video camera **300** is a digital, high resolution video camera having a motorized zoom lens **304** (e.g., part no. HAS-7696A, 8 - 48mm motorized zoom lens or part no. HAS-7696B, 16 - 160mm, motorized zoom lens, available from Home Automation Systems, Inc.). Two examples of compatible cameras are the "PANASONIC" black and white video camera, part no. HAS-7695A (380 Lines 0.3 Lux Auto Backlight Compensation), or the "TOSHIBA" COLOR video camera, part no. HAS-7695B(330 Lines 3 Lux Auto Backlight Compensation), both available from Home Automation Systems, Inc.

One video capture device **302**, also know as a frame grabber, is Model No. HRT-512, available from High-Res Technologies. The High-Res Technologies frame-grabber ("High-Res board") has a board which mounts in the PC and a resident software development support system which enables the writing of applications which access the High-Res board directly so that the image, a single frame of video, may be captured with a minimum of programming development time. Because the on-board memory captures a single frame of moving video, each frame represents a time interval of

1/30th of a second, thus permitting good resolution images of moving objects, such as moving vehicles. The HRT-512 is a video capture card which plugs into a bus inside the PC. Another suitable video capture device **302** is the "SNAPPY" available from Play, Inc. of Rancho Cordova, California. The "SNAPPY" is is an external device which attaches to the parallel port of the PC and which is fully software programable such that it may be instructed by a program to grab an image when a certain event occurs, such as a speed detection system detecting a speeding vehicle **130**. In addition, the "SNAPPY" captures images of very high resolution. Still another suitable image capture device is the AI "GOTCHA", which has the additional capability of capturing video clips.

Referring now to Fig. **8**, as in the preferred embodiment, the speed detection system **30** connects to a register **104** and to the comparator trigger **102**. In a manner similar to that of the preferred embodiment, the register **104** embeds the measured speed in real time in an image **310** of the video camera **300**. In addition, the comparator trigger **102** connects to the register **103.** However, unlike the preferred embodiment, the comparator trigger **102** connects to a modulator **312**, rather than to a camera. In addition, the modulator **312** connects to a transmitting device **314**.

Referring now to Fig. **9a**, a command station **221** is shown. A receiver **316,** tuned to receive the signals transmitted by the transmitter **314**, connects to a demodulator **320**. The demodulator **320** connects to the High-Res Board **321** ("VCD"). The High-Res board **321** is integrated, via software and hardware, into the PC **350**, such that when the system program (e.g., **260, 268**) detects a violation, an image is automatically captured, and is stored on the condition that the operator **212** confirm his witnessing of the violation through an input device, such as the keyboard **252** or a mouse **253**. At any point in time, however, the capture may be initiated by the operator **212** through the mouse **253**, simply by clicking on a screen icon **255**. This is particularly useful when enforcing non-speed-related violations such as occupancy on an HOV lane.

Referring again to Fig. **8**, the video camera **300** connects to an embeddor **332**. The embeddor **332** embeds input signals from the register **104**, the register **334**, a register **335** (which stores information received from the command station **221** which identifies the operator **212**), and the clock **110,** into the image **310** in real-time. The embeddor **332** connects to a modulator **336**, which is in turn connected to a transmitting device **340**.

Referring again to Fig. **9a**, a receiving dish **240**, tuned to receive the video signals transmitted by the transmitter **340**, connects to a demodulator **342**. The demodulator **342** connects to the video capture device **302**. The video capture device **302** ("VCD") connects, via a video capture interface board, to a printer switchbox **344** ("SW") via a parallel cable **346**. The switchbox **344** connects to an output device, such as a high resolution printer (not shown), via cable **347**. The non-physical, software/communications interconnections are performed digitally. Software detects a "save image" command from the operator over the network. The image is then saved in a database together with

identifying information such as the local speed limit, the location and time of the violation, and the vehicle speed.

Referring now to Fig. **9b**, a command station **221** is shown which used the "SNAPPY" video capture device. A receiver **316**, tuned to receive the signals transmitted by the transmitter **314**, connects to a demodulator **320**. The demodulator **320** connects to an actuator **322**. The actuator **322** is powered through a 110V AC-to-9V DC converter **324**, which also powers the video capture device **302**. The actuator **322** has a plunger **326** which the actuator activates when an actuation signal is received by the receiver **316**. The plunger **326** is adjacent an actuation button on the video capture device **302**. The converter **324** connects to the video capture device **302**. A frame **330** rigidly connects the actuator **322** and the video capture device **302** together. In addition, the plunger **326** may be manually activated by the operator **212**.

Referring again to Fig. **8**, the enforcement unit **20** has a keyboard port **354** which connects to the register **334**. The register **334** connects to the embeddor **310**. A 500W Infrared ("IR") illuminator **356** connects to the housing **100**, and includes a light sensor switch **360**. This illuminator provides infrared lighting that is virtually invisible to the human eye (only 0.01% of visible spectrum is transmitted) but visible to video cameras sensitive to the IR spectrum above 700nm. The illuminator **356** includes a 500W lamp, thus allowing illumination as far as 400ft in total darkness. The light sensor switch **360** is a photocell which automatically turns unit on at night and off at dawn. A housing **362** houses a PC which has a central processing unit **364**, memory (not shown), and a power supply **366**, as well as other components typically found in a PC.

Referring now to Fig. **10**, the PC **350** includes a power supply **370**, a video card **372**, the parallel printer port **346**, a key board port **374**, a monitor port **376**, a CPU **380**, other typically present components, and all associated enclosures, connecting cables and power lines. The PC **350** is loaded with an operating system, an optional graphics program, a customized video capture ("VC") program, and a system program **358**. The operating system is either "WINDOWS 3.11" or "WINDOWS 95" PC. The VC program, the graphics program and the video card **372** enable processing of the video image **310** after capture, if desired. The graphics program may be one of a number of compatible programs, including "FAUVE MATISSE", "COREL DRAW", and "MICROSOFT IMAGER," all commonly available at software retail outlets.

The system program **358** includes menu bars, input and output prompts, and a layout identifying the traffic law enforcement system **18** which facilitate use for the specific application of remotely monitoring and recording violations of the traffic laws for later enforcement through ticketing.

Without requiring input from the operator **212**, the video capture device **302** captures a digital image **310** of the objects **130** within the field of view of the video camera **300** whenever the video

capture device is triggered by the comparator trigger **102**. The operator **212** then has a 10 second period following capture to decide if the image **310** should be saved for later retrieval for ticketing. If the operator **212** does not respond within this period, the image **310** is deleted. Of course, the period may vary from the preferred period of 10 seconds, but should be short enough to ensure that the operator **212** was close enough to the monitor **246** to have been able to witness the violation.

The time, date, location, local speed limit, supplemental graphics such as intersecting horizontal and vertical cross-hairs corresponding to the laser beam's contact point on the vehicle, and the actual recorded speed are captured as part of the video image **310** or stored separately. The identifying indicia of the witness/operator **212** of the violation is received from a register **382** which is embedded in the image **310** after the capture of the image, or stored in the database.

The processing of the video images **310** is performed by the system program **358**, and involves (a) displaying the image together with identifying information, time, location of the violation, local speed limit, and vehicle speed when the remote unit senses that a vehicle having a speed which exceeds a predetermined limit; (b) beginning a count down of 10 seconds; (c) concurrently awaiting an input from the operator **212** that he witnessed the violation; (d) deleting the captured image **310** at the end of the count down, UNLESS the input indicating that the operator **212** witnessed the violation is received; (e) if the input is received, saving and printing the edited image **384** for ticketing.

The system program **358** further permits the operator **212** to trigger the video capture device **302** at will, thus enabling him to record the scene at an accident within his field of view **384**, or to capture images **310** of violators of the traffic ordinances which do not involve exceeding the speed limit (e.g., utilizing a HOV lane improperly, or carrying cargo which is improperly fastened or flagged, driving without headlights on between dusk and dawn, etc.).

This second embodiment encompasses all the advantages of the preferred and first alternate embodiment of the present invention. However, this embodiment, like the first alternate embodiment, is more complex than the preferred embodiment, and generally does not permit the capturing of images having a resolution as high as that of the first alternate embodiment. However, a further advantage of this embodiment as compared to the first alternate embodiment is that this embodiment permits the capture of high resolution images directly from the video image, thus eliminating the need for a separate still camera.

In another feature of the invention, identifying indicia is placed on a visible portion of an automobile, such indicia including a conventional license plate, inspection sticker or registration sticker. If necessary, a specially designed license plate, inspection or registration sticker painted with infrared reflective material, or having sufficiently large letters for the enforcement unit to identify, may be used. This enhances the clarity of the image captured, and enables the use of lower resolution video cameras, or zoom lenses having lower magnification capabilities.

The high resolution, digital video camera includes an infrared illuminator which provides

powerful infrared lighting that is invisible to the human eye, yet visible to the video camera, thus enabling the capturing of infrared images of a moving vehicle at night or day without startling or disturbing the driver. The illuminator is mounted to the housing, and includes a built-in photocell which automatically turns the illuminator on at night and off at dawn. Built-in blowers are also provided to keep the illuminator cool. A suitable illuminator, in wide-angle and narrow angle versions is, part no. HAS-7698A, and HAS-7698B, respectively, available from Home Automation Systems (URL: http://www.techmall.com/smarthome/7690.html). In addition, the still camera has an infrared filter.

It should be understood that the communications path described in the embodiments above may be comprised of any of a number of different paths, including UHF/VHF, microwave, cable, network line, telephone line, optical fiber, cellular wireless, line-of-sight wireless, satellite, a laser link, or powerlines.

A suitable wireless video communications system is the "CC2001" available from Command Corporation of East Granby, Connecticut. The "CC2001-1", a one watt system, transmits and receives an FM video signal having a maximum line-of-sight range of 10 miles. This permits a 20 mile enforcement diameter, centered on the location of the command station, in which enforcement units **20** may be positioned and yet still enable communications with the command station. A repeater may also be employed to maximize the range of communication. This would allow a single command station to service an area which would be sufficient for cities ranging in size from the smallest to the largest in the world.

Another suitable wireless video communications system includes a network comprised of 2.4 Gigahertz microwave band network transmitters, capable of transmitting video signals. line of sight, a distance of two to three miles. For applications which require greater range, 8 Gigahertz network transmitters, matched to corresponding receivers. Detailed specifications for this network system, and generally with respect to other electronic components described in this disclosure, as such may be required, are available from Blackbox Corporation of Lawrence, Pennsylvania.

In addition, Cellular Vision of Brighton Beach, New Jersey, has successfully operated a wireless cellular TV system using high frequency signals transmitted by cells which are about 100 times smaller than conventional cellular telephone cells. The receiving dishes, using a fixed- phased-array technology, are only about 4 inches in diameter, and the transmitting devices deliver 49 channels from a one inch omnidirectional device on a small box, about the size of a suitcase. These transmitters can send video signals and other information through a conventional point-to-point microwave link.

Alternatively, using fragments of an AM frequency band between 2.5 and 2.7 Gigahertz, closed circuit video images may be transmitted using the "MICROBAND" system, available from Microband Corporation of New York City, New York. The "MICROBAND" system has a sixteen

channel capacity, permitting a single operator at the command station to monitor at least 4 enforcement units **20** simultaneously (with the aid of a split screen and a large monitor or multiple monitors). Radio signals carrying the video signals are transmitted over short distances between small cells, hubs and routers, available from SynOptics Communications, Inc. and Cisco Systems, Inc. Because a high frequency results in a small antenna and a light system and such characteristics are important factors for mobile products such as the enforcement unit, a high frequency is preferred.

Still other wireless methods of transferring high resolution video images are available. For example, cellular wireless communications using an access method called Code Division Multiple Access ("CDMA"), pioneered by Qualcomm, Inc., may be utilized. Rather than compressing each cell into between three and ten tiny time division multiple access (TDMA) slots in a 30-kilohertz cellular channel, Qualcomm's CDMA technology transmits a wide (1.25 megahertz of the cellular spectrum) and weak radio signal which can handle voice, data and video, all at the same time, between minicells mounted on poles, in alleys, and elevator shafts. With CDMA, each cell requires very little power (approximately two milliwatts, compared with 600 milliwatts and higher for most other cellular systems). The lower the power consumption, the smaller the cell, and the quieter it becomes. It is thus less likely to interfere with a neighboring cell, and is has the characteristics which favor use in specialized applications, such as in a dedicated network of enforcement units **20** spread throughout a city.

A new minicell, known as the Steinbrecher System, uses a high dynamic range digital radio to down-convert and digitize the entire cellular band to a digital bit stream, including TDMA, CDMA, analog cellular, video, voice or data, in any combination. The DSPs then sort out the TDMA and CDMA signals from the analog signals and reduce each to digital voice. The minicell replaces a rigid structure of giant analog mainframes with a system of wireless local area networks.

Where closed-circuit communications cable (e.g., a computer networking cable) provides the communications path between the enforcement unit and the command station, simple equipment can be used.

In operation, enforcement units **20** and decoy units **22** are interchanged according to a schedule which is unpredictable to an ordinary driver. The change-outs may be made for maintenance purposes or according to a substantially random schedule. The inability of a driver to distinguish an enforcement unit **20** from a decoy unit **22**, or to learn the location of enforcement units **22** creates a substantial risk of being ticketed if the driver exceeds the speed limit. This helps control the driver's driving habits, having the net result of increasing adherence to the speed limits. When the driver attempts to "beat" the system by slowing only in areas which he thinks to be within the field of view of an enforcement unit, the network of enforcement units cooperate together to determine the driver's speed so that he may be ticketed. This subroutine is described in more detail below, in connection with Fig. **13**.

In another feature of the invention, a split screen and a large monitor, or multiple monitors, are used, thus enabling the monitoring of two or more locations concurrently. When the comparator trigger send a signal to the "SNAPPY" program to capture the image, a boarder around the particular image flashes, the operator merely touches the frame and the image is saved and printed.

In another embodiment, the boarder surrounding the frame, or a dot in a corner of the frame, changes colors in a random fashion every 5 seconds. The operator is asked to identify the color of the last frame. If the identification is correct, and the response is registered within 10 seconds, only then is the image saved and printed. This ensures that the operator actually witnessed the violation, and that the split screen of four different images was not too distracting.

In another embodiment of the present invention, this embodiment enhancing the operation of all embodiments described in this specification, a specially designed license plate, inspection or registration sticker painted with infrared reflective material, or having sufficiently large letters for the enforcement unit to identify, may be used. This enhances the clarity of the image captured, and enables the use of lower resolution video cameras, or zoom lenses having lower magnification capabilities.

Referring now to Fig. **12**, in another embodiment of the invention, the traffic law enforcement system **18** includes a containment housing **100'** which securely affixes to a highway structure **40** via fasteners **102'** at a predetermined location along a traffic flow route. The containment housing **100'** includes a body porion **101'**, and a lid **103'**, which is hinged to the body portion. An enforcement unit **20'** includes a housing **206'** which releasably engages each containment housing **100'** by means of a releasable engagement support **34'** and receiver **36'**. The housing **206'** includes a cylindrical enclosure **105'** having a transparent portal **154'** and a handle **162'** attached to a top portion of the housing to aid in removing or releasably installing the enforcement unit **20'** in the containment housing. Essentially, in this embodiment, the containment housing **100'** functions as the receiving interface **24** of the preferred embodiment. However, in this embodiment, the containment housing **100'**, unlike the receiving interface **24** of the preferred embodiment, effectively conceals the presence or non-presence of the enforcement unit **20'**, thus enabling the containment housing itself to become a decoy unit **22** when the enforcement unit is removed or is not otherwise enabled.

In this feature, the housing **206'** of the enforcement unit **20'** houses the internal components of the enforcement unit such as the frame **206**, the speed detection system and the camera or cameras. In addition, the enforcement unit **20'** is an opaque housing which conceals from view its interior when it is releasably engaged with the containment housing **100'**, thus preventing a third-party observer, during a change-out from an enforcement unit to a decoy unit **22** and vice versa, from being able to distinguish whether a decoy unit **22** or an enforcement unit is being received within the containment housing.

An alternative embodiment of the present invention utilizes pressure sensors embedded in the

road surface which sense when the wheels of a vehicle pass over them. The signal is sent to a CPU which compares the distance between wheels with the prior reading while it records the time between these signals as well. These inputs are used to calculate the speed of the vehicle. At an interval between these two readings, a camera or video recording device records an image of the vehicle.

In the operation of removing the enforcement unit **20** or decoy unit **22**, a releasable engagement device or key (not shown) is used which includes a rod with a first interface on its end. The first interface is releasably engageable with a second interface on a containment housing such that decoy units **22** and enforcement units **20** may be unlocked, removed or installed and locked thereby. Handles **162** and **162'** attach to the housing to aid in the installation or removal process.

An alternate embodiment of the present invention utilizes sensors which record when two laser beams are broken by an object passing through them in order to calculate the speed of the object passing through the beams. The laser beams are mounted at the same elevation and at different, predetermined intervals along the path of the objects whose speed is to be measured.

In another feature of the invention, the containment housing is fabricated from "LEXAN" available through DuPont Engineering Plastics, Inc. This will help protect the contents of the housing from the random acts of vandals.

In another feature of the invention, the flashing lighting attached to the containment housing is selectively activated from a remote location via at least one receiver mounted in the flashing lighting, the receiver being responsive to electromagnetic signals from a remote sending unit.

In a related feature of the invention, the flashing lighting of both the decoy units **22** and the enforcement units **20** is activated and deactivated in a substantially random fashion.

In another feature of the invention, the decoy units and enforcement units are painted in the colors of the cognizant enforcement authorities, so as to make them more visible to the driving public. It is further suggested that these units be mounted adjacent large, highly visible speed limit signs, so as to remind the public of the acceptable local speed limit prior to their coming into the operational range of an enforcement unit.

In another feature of the invention, the emitter **31** in the decoy unit **22** emits a dummy radar or laser signal which further disguises the unit, making it indistinguishable from an enforcement unit.

In another feature of the invention, the decoy units are enforcement units which emit a dummy radar or laser signal. In this feature, the operator at the command center chooses which enforcement units to monitor, switching the dummy signal "on" in all units which he is not monitoring. Thus, the enforcement units **20** or **20'**, which are not turned "on", function in a manner similar to decoy units in that they prevent a driver from distinguishing them from an enforcement unit which is being monitored.

Further, it should be understood that the speed of the violator and other identifying information need not be embedded in the image or photograph taken of a violator; rather, they may be transmitted

to the command station separately or in a form which may be appended or otherwise associated with the photograph, such that the photograph, the speed information and the identifying information do not overlap, but are serially stored for subsequent printing. Of course, once printed, the physical prints are stored together. In a simpler form, the image and speed information may be transmitted to the command station, and printed out immediately. The operator then initials a printout of the image, identifying himself and verifying that he did witness the violation. Optionally, a network computer at the command station may link to a database of vehicle registration numbers, and search the number identified on the vehicle. The results of the search can also be appended to the photograph and file. This alternate embodiment, which utilizes a method, the steps of which are described below and in Fig. **11**, simplifies the system by eliminating the need for more complex electronic components, such as a title maker or video mixer, thus improving reliability and reducing costs as well.

The simplified method **400** involves the steps which follow: (1) in step **402**, monitoring and measuring vehicle speed; (2) in step **404**, when the speed of a vehicle exceeds the local speed limit by a predetermined amount, triggering a device which captures an image of a violator in sufficient resolution to enable identification of the vehicle in which the violator drove; (3) in step **406**, contacting a human monitor and prompting the monitor for information, such as (a) whether the monitor would like to store the image for subsequent ticketing; (b) identifying information about the human monitor and the violation, such as the human monitor's name, the time and location at which the violation took place, the local speed limit, and the vehicle speed; and (c) whether the human monitor witnessed the violation (optionally, asking the human monitor to identify a number, color flag or other symbolic device which appeared in view of the human monitor during a short time interval which includes the point in time in which the image was taken); (4) in step **408**, associating the speed of the vehicle, the local speed limit, and selected information received from the above prompting, with the image; and (5) in step **410**, storing the information such that it can be later accessed to ticket the violator, and for later access in the event that the evidence must be presented in a court proceeding.

Optionally, instead of saving the image in a file appended with the speed and identifying information, the image may be saved in a database which has a record structure such as that which follows:

field names:	description:
Time:	date:
Speed:	location of enforcement unit:
digital image:	

This option avoids the need to edit the image, thus preempting an argument by the violator's defense counsel that the image has been tampered with, should the violator challenge the citation in court.

A further simplification of the present invention is possible by substituting a conventional film-based camera for the high resolution digital camera. Although making this substitution would require

that the film be manually retrieved at each enforcement unit, the amount of electronics required would be reduced.

In another feature of the invention, as shown in Fig. **13**, a method which ensures that drivers of vehicles **130** are less likely to be able to defeat the system of the invention, involves the following steps. In a first step **500**, using optical character recognition equipment and techniques known in the art, enforcement units **20** routinely read license plates of passing vehicles **130**. The location, time, and a license plate number of each vehicle **130** is transmitted to the command station **220** or **221** and stored in ram memory for a limited period of time. In a second step **502**, a subroutine continuously compares the license plate numbers received in memory. When the subroutine reads the same license plate number, the enforcement unit captures an image of the vehicle **130**, and the additional data is accessed. In a third step **504**, the subroutine uses the time difference and the minimum paved distance between the enforcement units (information which the subroutine accesses from cartographic information which is stored in computer storage on a PC at the command station **220** or **221**) to calculate an average speed. In a fourth step **506**, if this average speed exceeds that of a vehicle **130** passing along the shortest path between the enforcement units **20**, then the command station **220** or **221** immediately sends a signal to the enforcement unit **20** which sent the most recent signal, instructing the PC in the enforcement unit to transmit the captured image of the vehicle **130** for subsequent ticketing. The measuring of the average discourages acceleration between enforcement units **20**, and then slowing down when the driver believes he is within their enforcement range.

Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. In addition, for the purposes of this disclosure, whenever the term decoy unit **22** is used, it is intended that the term be construed to broadly refer to enforcement units **20** which are intentionally not capable of enforcing the traffic ordinances, but not to refer to enforcement units which may have malfunctioned, unless such an interpretation is internally inconsistent. For example, a decoy unit **22** may be an enforcement unit **20** that an operator **212** at the command station **220** or **221** has not chosen to activate, yet which is still acting as a decoy unit in the sense that drivers are not able to ascertain whether such is capable of enforcing the traffic ordinances. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

Industrial Applicability

The invention is applicable industrially as a means of reducing the speed of drivers to safe limits while enabling more effective and safer enforcement of the traffic ordinances (by requiring less police interaction and the dedication of fewer police resources, such as police cars and related

enforcement equipment). Such a system will play an important role in permitting municipalities to dedicate police resources to the enforcement of more serious criminal laws, or, alternately, to reduce the municipalities' traffic law enforcement costs.

What is claimed is:

1. A traffic law enforcement system comprising:

(a) at least one enforcement unit;

(b) at least one decoy unit; and

(c) attachment means which enable an enforcement unit to be replaced by a decoy unit and vice versa.

2. The traffic law enforcement system of claim 1 wherein:

the enforcement unit comprises a housing, an inner assembly received in the housing, the inner assembly comprised of a camera, a speed detection system which generates an output signal, means of associating the output signal with an image captured by the camera, means for generating an identifying signal and associating the identifying signal with the image, a controller which compares the output signal of the speed detection system with a predetermined value such that when the predetermined value is exceeded, the controller triggers the camera, thus capturing the image of objects in the field of view of the camera.

3. The traffic law enforcement system of claim 2 wherein:

the enforcement unit further comprises a video camera, a video transmitter for transmitting the video signal to a command station, a receiver for receiving a command signal from the command station, the command signal initiating the storage of the image for later access, as needed.

4. The traffic law enforcement system of claim 3 wherein the inner assembly further comprises:

(a) means for associating the output signal of the speed detection system with a video signal generated by the video camera;

(b) means for generating an identifying signal and associating the identifying signal with the video signal, the command station further comprising:

(a) a video receiver for receiving the video signal;

(b) means for associating the output signal of the speed detection system with the video signal,

(c) a central display monitor which displays the video signal and the output signal of the speed detection system,

(d) an operator-actuated switch which initiates the command signal, and

(e) a second transmitter which transmits the command signal to the enforcement unit.

5. The traffic law enforcement system of claim 4 wherein the command station further comprises a video recorder for recording the video signal.

6. A traffic law enforcement system comprising:

(a) at least one containment housing, each containment housing being positioned at a predetermined location along a traffic flow route;

(b) an enforcement unit releasably engageable into each of the containment housings; and

(c) releasable engagement means whereby the enforcement units may be releasably engaged

with the containment housings.

7. The traffic law enforcement system of claim 6, including flashing lighting electrically and mechanically attached to the containment housings.

8. The traffic law enforcement system of claim 7 wherein the flashing lighting is selectively activated from a remote location, via electromagnetic signals received from a remote sending unit.

9. The traffic law enforcement system of claim 6 wherein the containment housing effectively conceals from view its contents, making it difficult to determine whether an enforcement unit is presence, thus enabling the containment housing to act as a decoy unit when the enforcement unit is removed.

10. The traffic law enforcement system of claim 6 wherein at least one of the containment housings receives a decoy unit, the decoy unit effectively concealing the presence or non-presence of an enforcement unit.

11. The traffic law enforcement system of claim 6 further comprising at least one decoy unit, and wherein the decoy unit is interchanged with an enforcement unit, and vice versa, in a fashion which is unpredictable to an ordinary driver.

12. The traffic law enforcement system of claim 11 wherein the flashing lighting of both the decoy units and the enforcement units are activated and deactivated in a substantially random fashion.

13. A traffic law enforcement system comprising:

(a) an enforcement unit, the enforcement unit comprises a containment housing and an inner assembly, the inner assembly being received in the containment housing and comprising a video camera, a speed detection system which generates an output signal, means for associating the output signal of the speed detection system with a video signal generated by the video camera, means for generating an identifying signal and associating the identifying signal with the video signal, the identifying signal including pertinent information such as the identity of the operator, the time and location of the violation, the local speed limit and the measured speed, a video transmitter for transmitting the video signal, a comparator trigger which automatically triggers the capture of an image of a vehicle within the field of view of the enforcement unit, when the speed of the vehicle exceeds the posted speed limit by a predetermined margin, a transmitter which transmits pertinent information and the video signal to a command station, and a receiver for receiving a command signal from the command station, the command signal triggering the storage of the image; and

(b) the command station comprising a second receiver, a central display monitor which displays the video signal and the output signal of the speed detection system, an operator-actuated switch which generates the command signal, and a second transmitter which transmits the command signal to the enforcement unit.

14. The traffic law enforcement system of claim 13, further including a video recorder which records the video signal.

15. A traffic law enforcement system of claim 13, further comprising:

(a) a high resolution still camera which captures an image of a vehicle when triggered by a program in the enforcement unit,

(b) means for associating identifying information and the output signal of the speed detection system with an image generated by the high resolution still camera.

16. The traffic law enforcement system of claim 13 wherein the inner assembly is further comprised of an opaque housing which conceals from view its interior when the assembly is releasably engaged with the containment housing, thus preventing a third-party observer during a change-out from an enforcement unit to a decoy unit and vice versa, from being able to distinguish the inner assembly from a decoy unit inner assembly.

17. A containment housing for a unit of a traffic law enforcement system wherein the housing includes a panoramic portal extending through an arc around the containment housing, the arc being of an angular magnitude sufficient to enable the repositioning of a camera within a range of predetermined angular increments which will permit easy adjustment of the field of view of the components within the inner assembly, thus allowing the enforcement unit to target oncoming vehicles approaching the containment housing from a number of different lanes of a highway.

18. The traffic law enforcement system of claim 13 wherein the high resolution still camera creates a high resolution digital image which is transmitted to the command station to aid in the identification of an alleged traffic law violator.

19. The traffic law enforcement system of claim 13 wherein the high resolution camera creates a high resolution digital image which is indexed and stored for later retrieval and identification of an alleged violator.

20. A method to enforce the traffic law comprising:

(a) enforcement of a segment of a street, the enforcement comprising the steps of:

i. using a video camera to generate a real-time video signal of an area within the field of view of the camera;

ii. using a speed detection system to generate an output signal and associating the output signal with a video signal generated by the video camera and with a photograph of a high resolution camera;

(b) generating an identifying signal indicating, for example, the time and date the photograph was taken and associating the identifying signal with the video signal and the photograph of the high resolution still camera, the identifying signal facilitating the matching of the portion of the video signal with high resolution photograph,

(c) transmitting the video signal using a video transmitter,

(d) receiving a command signal using a first receiver,

and, at a command station,

(e) receiving the video signal using a second receiver,

(f) selectively, and at various times according to the desire of an operator, monitoring the output of the enforcement system including displaying and selectively recording the video signal;

(g) displaying the output signal of the speed detection system so that an operator may make a determination as to whether to record the alleged violation for ticketing, and

(h) generating and transmitting a command signal to the enforcement unit, the command signal generated by an operator which indicates the determination of the operator as to whether a high resolution camera should be activated to take a photograph of an automobile within the field of detection of a speed detection device, and, optionally, that the operator witnessed the violation,

21. The traffic law enforcement system of claim 20, further including the step of recording an alleged violation of the traffic law using a video recorder.

22. A traffic law enforcement system capable of (1) associating data of vehicles which exceed speed limits by recognizing a vehicle at two different locations along a traffic flow route and utilizing cartographic information, together with an elapsed time and information about the speed limit between the two points to determine an average speed of the vehicle; and (2) comparing this with a similarly calculated maximum permissible speed of the vehicle to determine whether the vehicle has violated the maximum average speed limit.

23. A traffic law enforcement system having multiple enforcement units, each having a camera which is selectively viewable according to the desire of an operator at a command station, any units which are not being viewed by the operator transmitting a dummy signal which simulates a signal of a speed detection system, thus making it difficult for a driver to discern whether an operator is monitoring a particular enforcement unit.

24. The traffic law enforcement system of claim 23 wherein the dummy signal is a radar signal.

25. The traffic law enforcement system of claim 23 wherein the dummy signal is a laser beam.

(e) receiving the video signal using a second receiver,

(f) selectively, and at various times according to the desire of an operator, monitoring the output of the enforcement system including displaying and selectively recording the video signal;

(g) displaying the output signal of the speed detection system so that an operator may make a determination as to whether to record the alleged violation for ticketing, and

(h) generating and transmitting a command signal to the enforcement unit, the command signal generated by an operator which indicates the determination of the operator as to whether a high resolution camera should be activated to take a photograph of an automobile within the field of detection of a speed detection device, and, optionally, that the operator witnessed the violation,

21. The traffic law enforcement system of claim 20, further including the step of recording an alleged violation of the traffic law using a video recorder.

22. A traffic law enforcement system capable of (1) associating data of vehicles which exceed speed

limits by recognizing a vehicle at two different locations along a traffic flow route and utilizing cartographic information, together with an elapsed time and information about the speed limit between the two points to determine an average speed of the vehicle; and (2) comparing this with a similarly calculated maximum permissible speed of the vehicle to determine whether the vehicle has violated the maximum average speed limit.

23. A traffic law enforcement system having multiple enforcement units, each having a camera which is selectively viewable according to the desire of an operator at a command station, any units which are not being viewed by the operator transmitting a dummy signal which simulates a signal of a speed detection system, thus making it difficult for a driver to discern whether an operator is monitoring a particular enforcement unit.

24. The traffic law enforcement system of claim 23 wherein the dummy signal is a radar signal.

25. The traffic law enforcement system of claim 23 wherein the dummy signal is a laser beam.

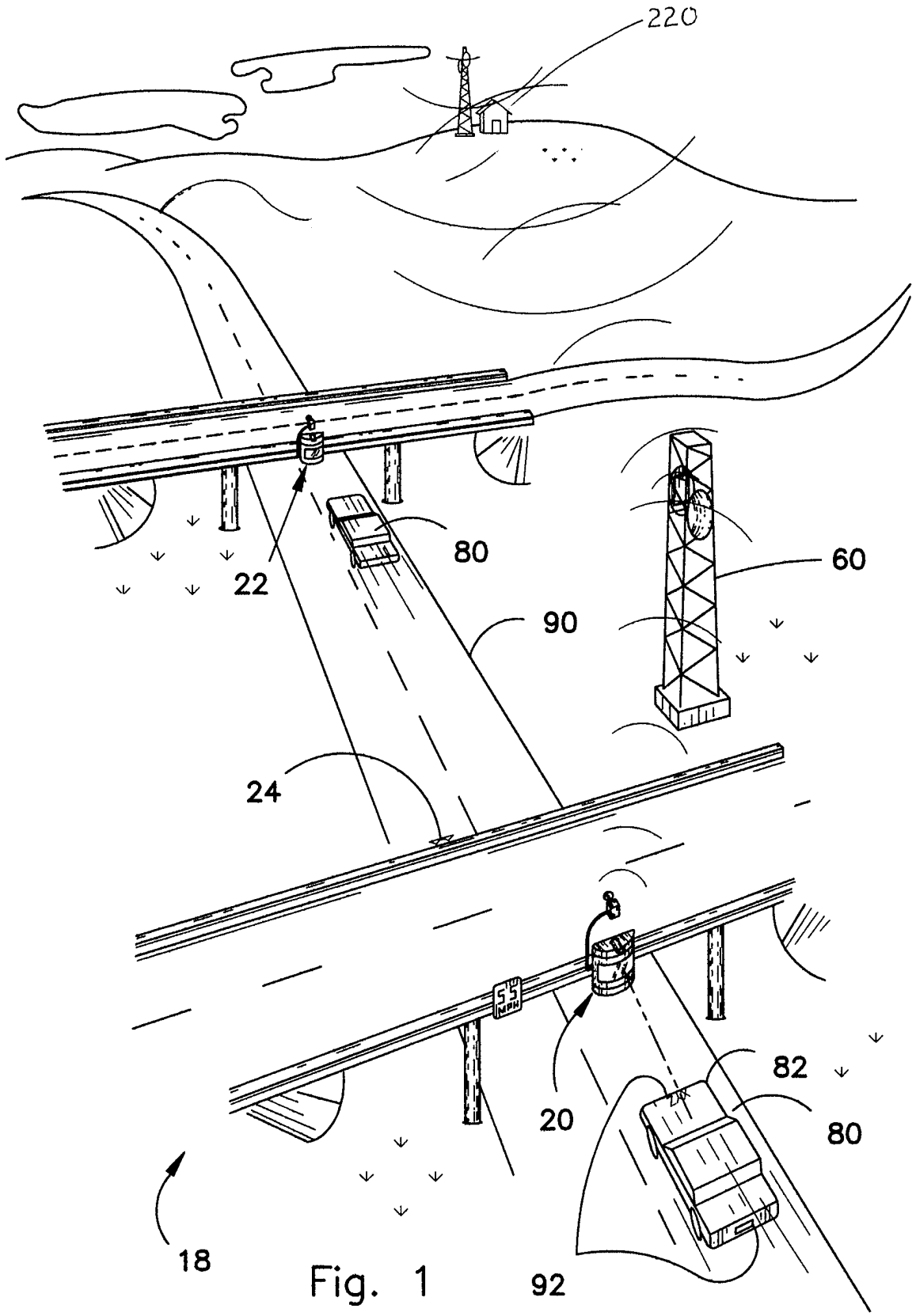
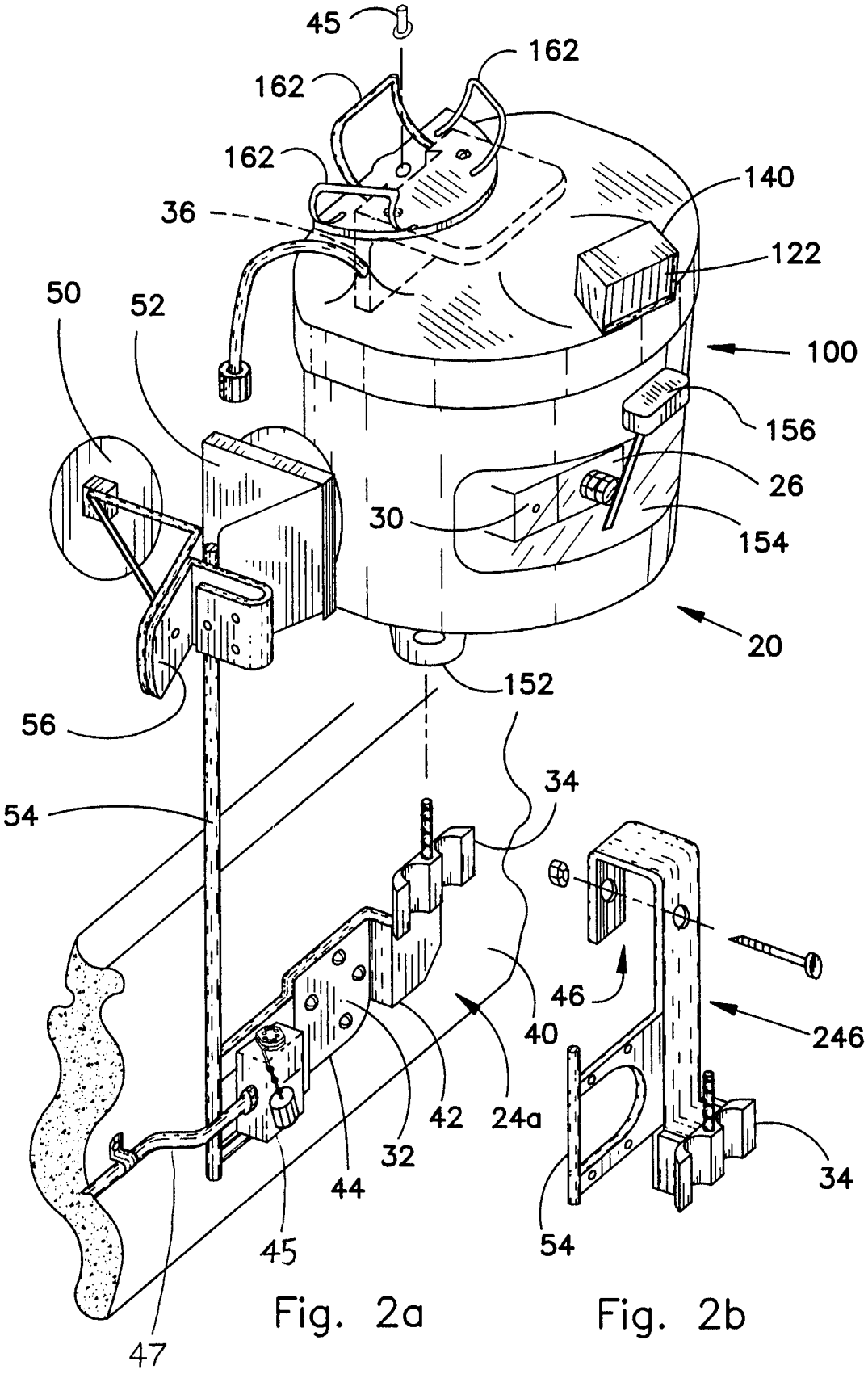


Fig. 1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26
30
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24a
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54
34
47

Fig. 2a Fig. 2b

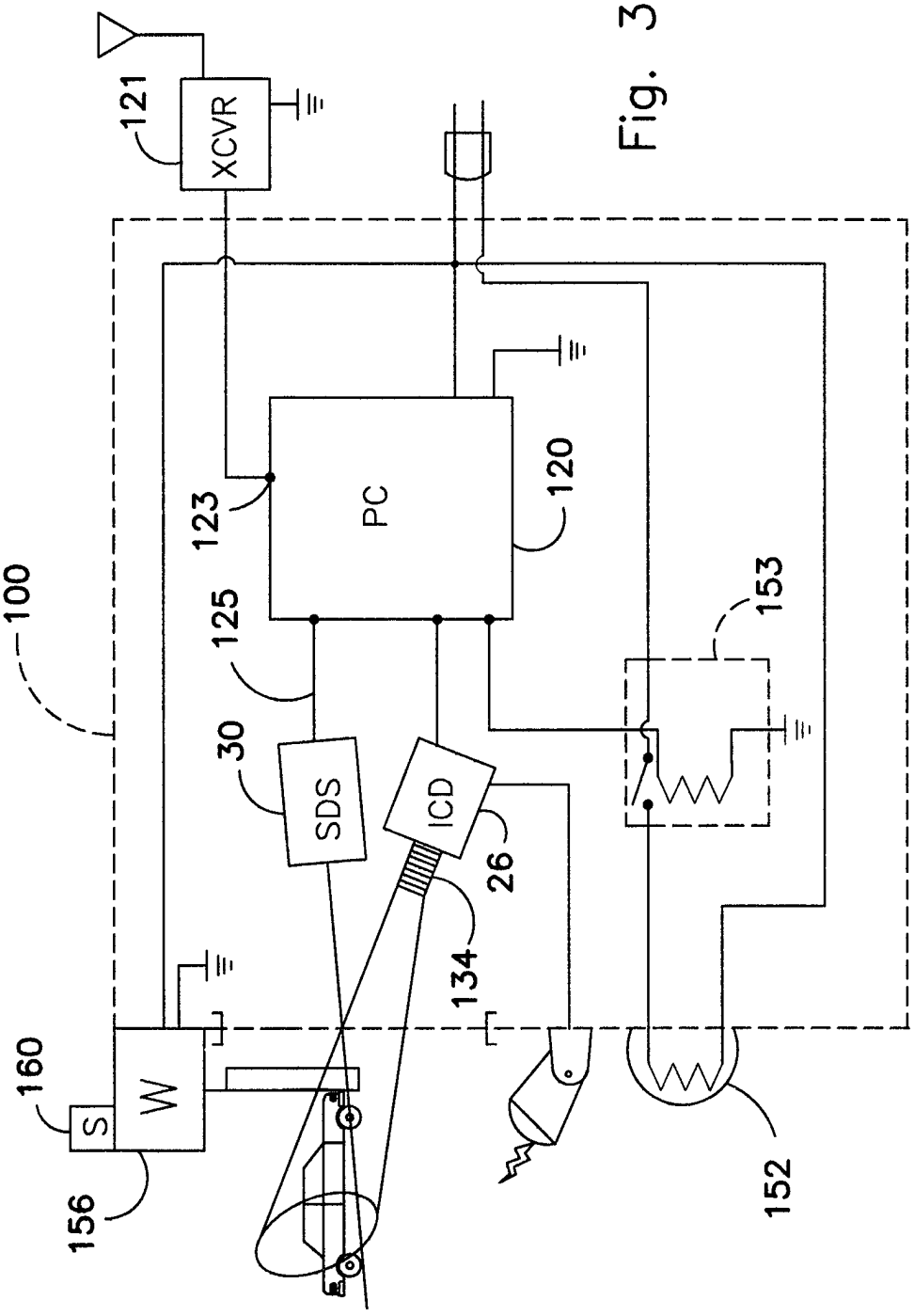
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Fig. 3a

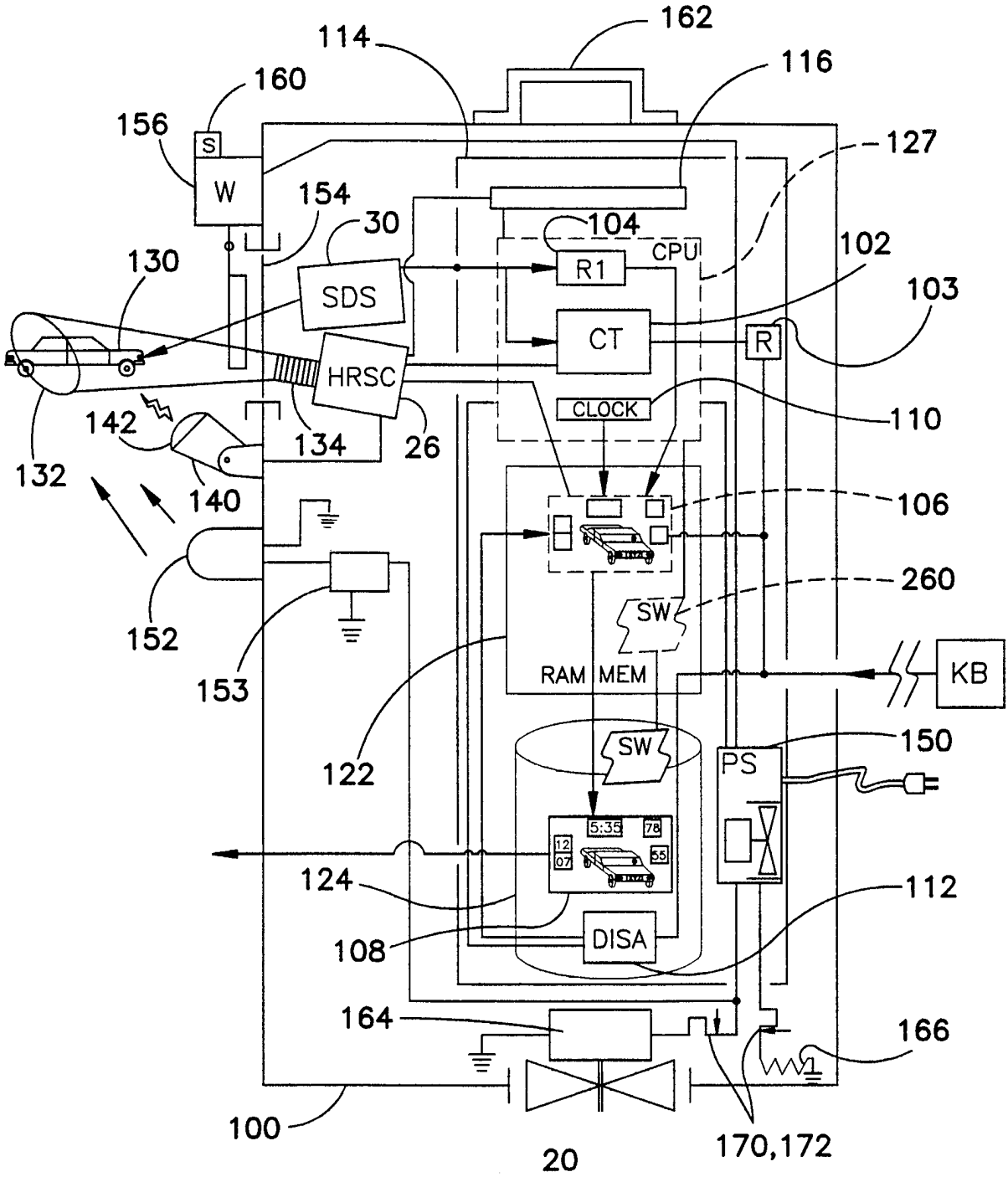
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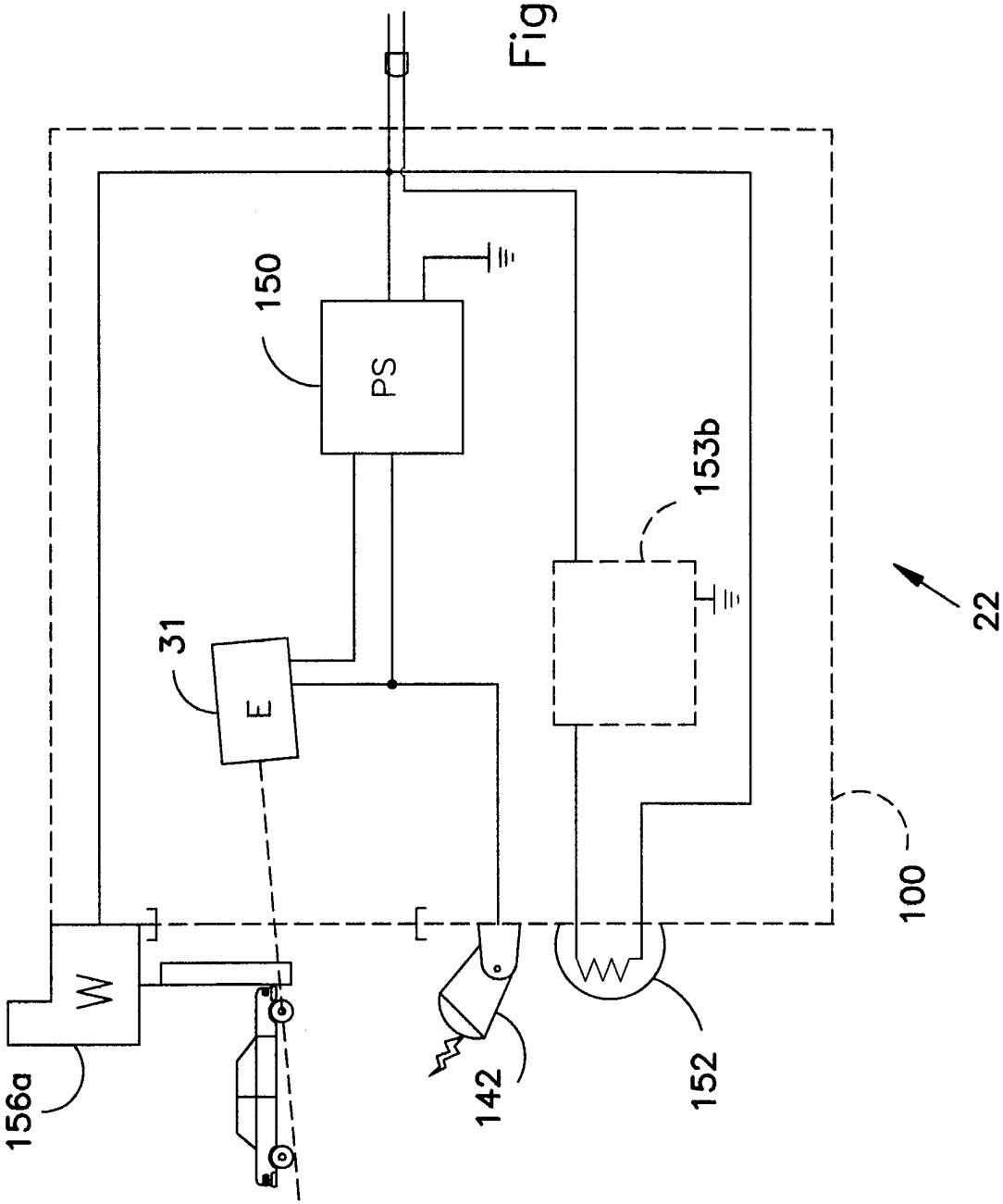
Fig. 3b

Fig. 3c



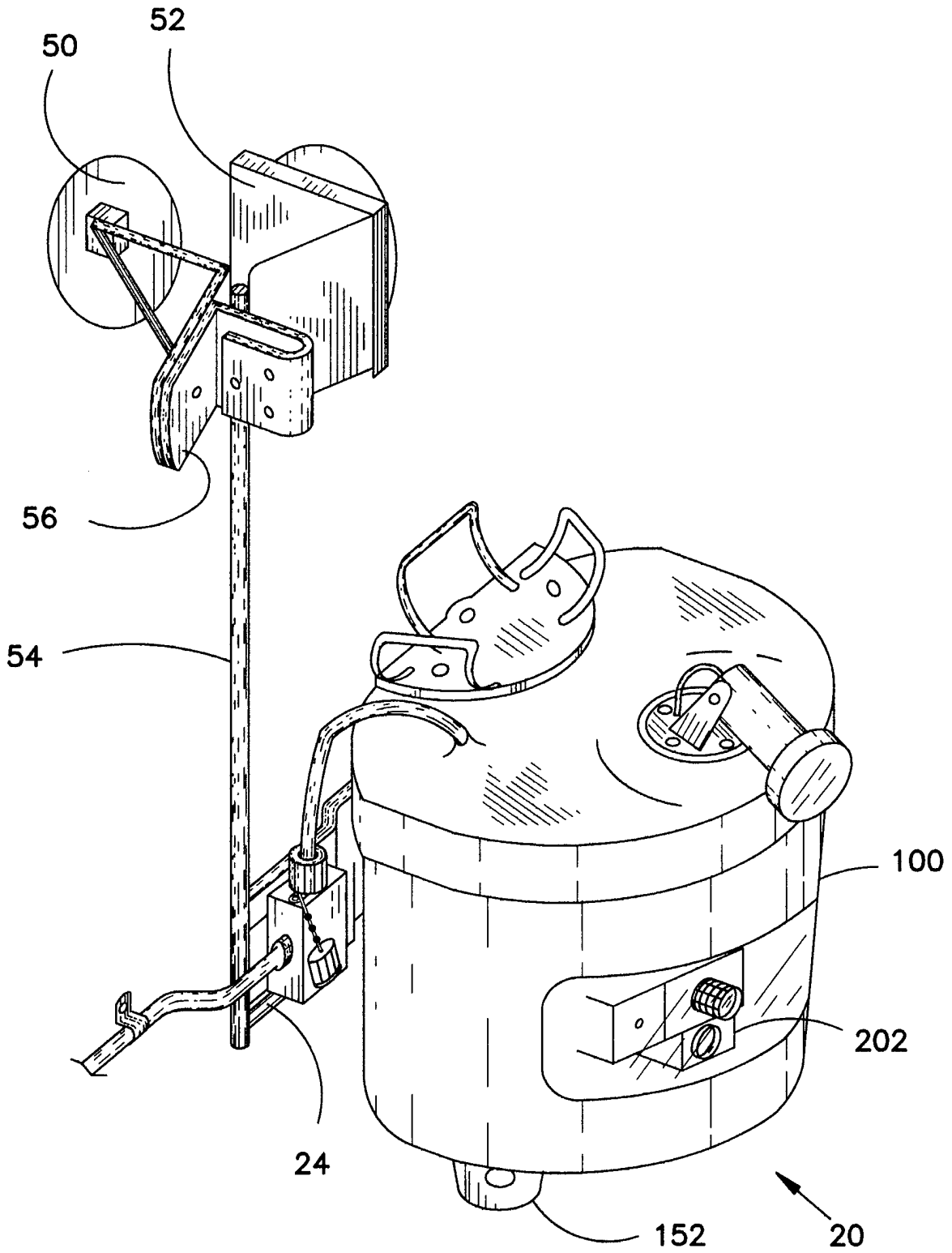
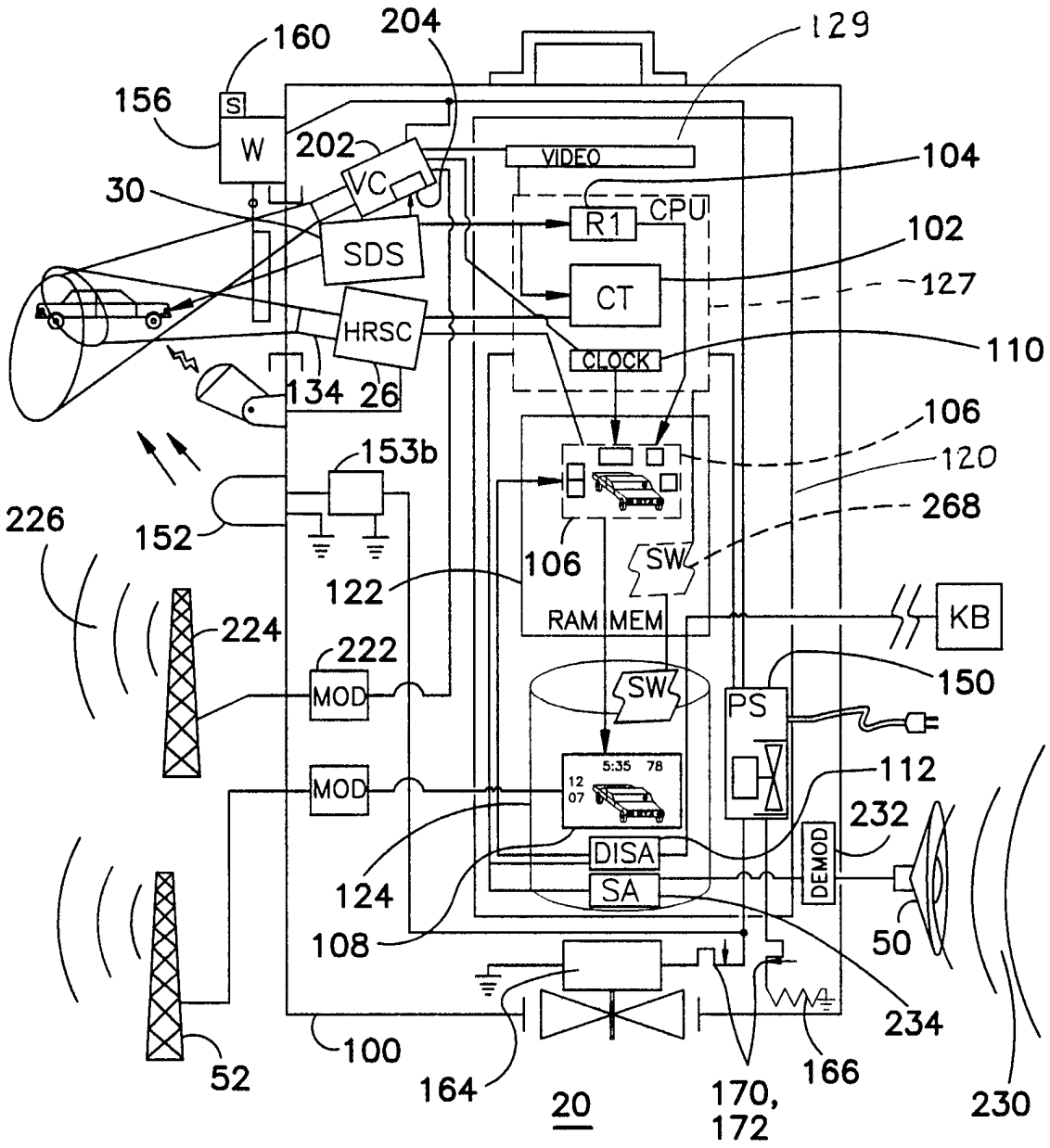


Fig. 4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152
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Fig. 5

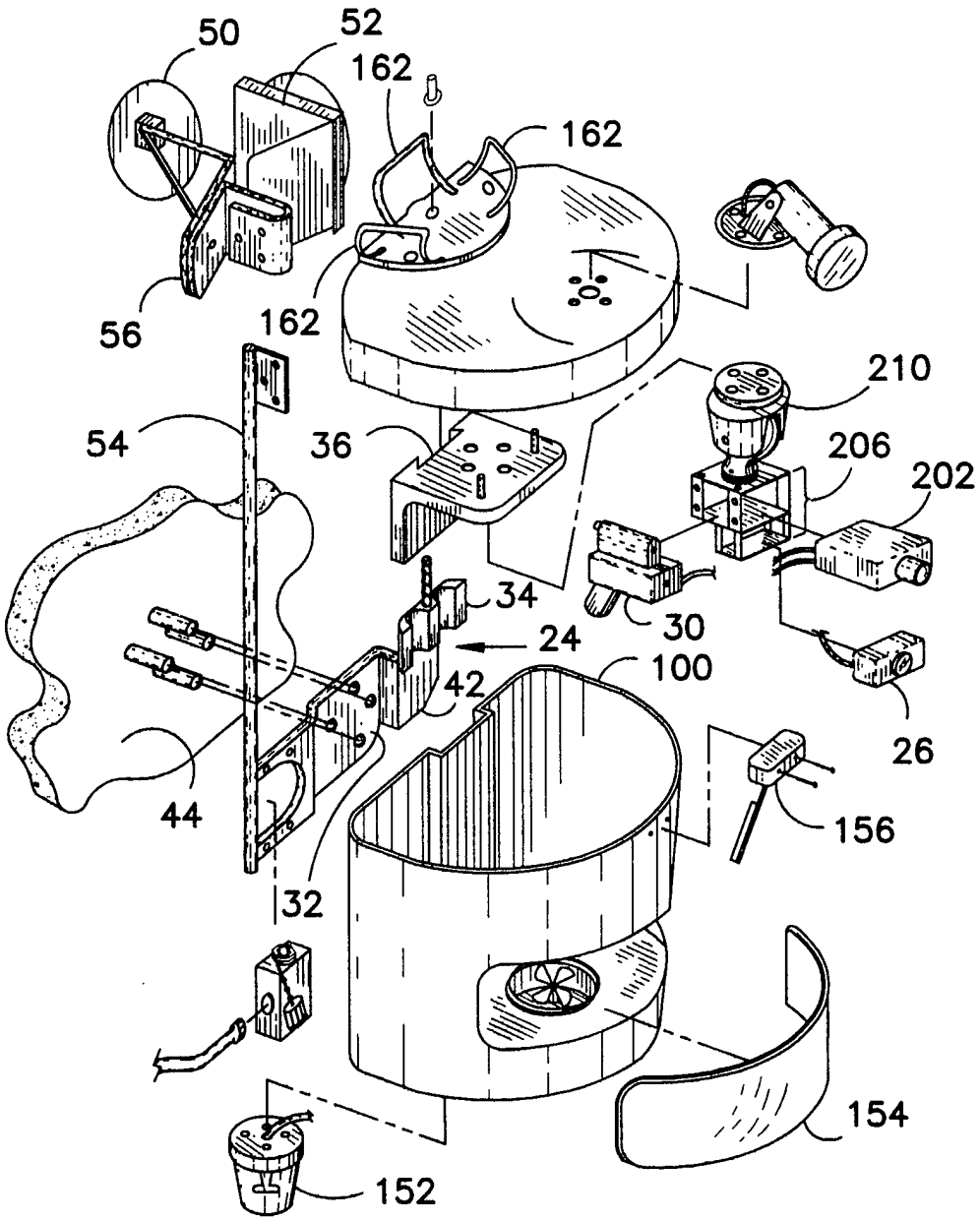
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Fig. 6

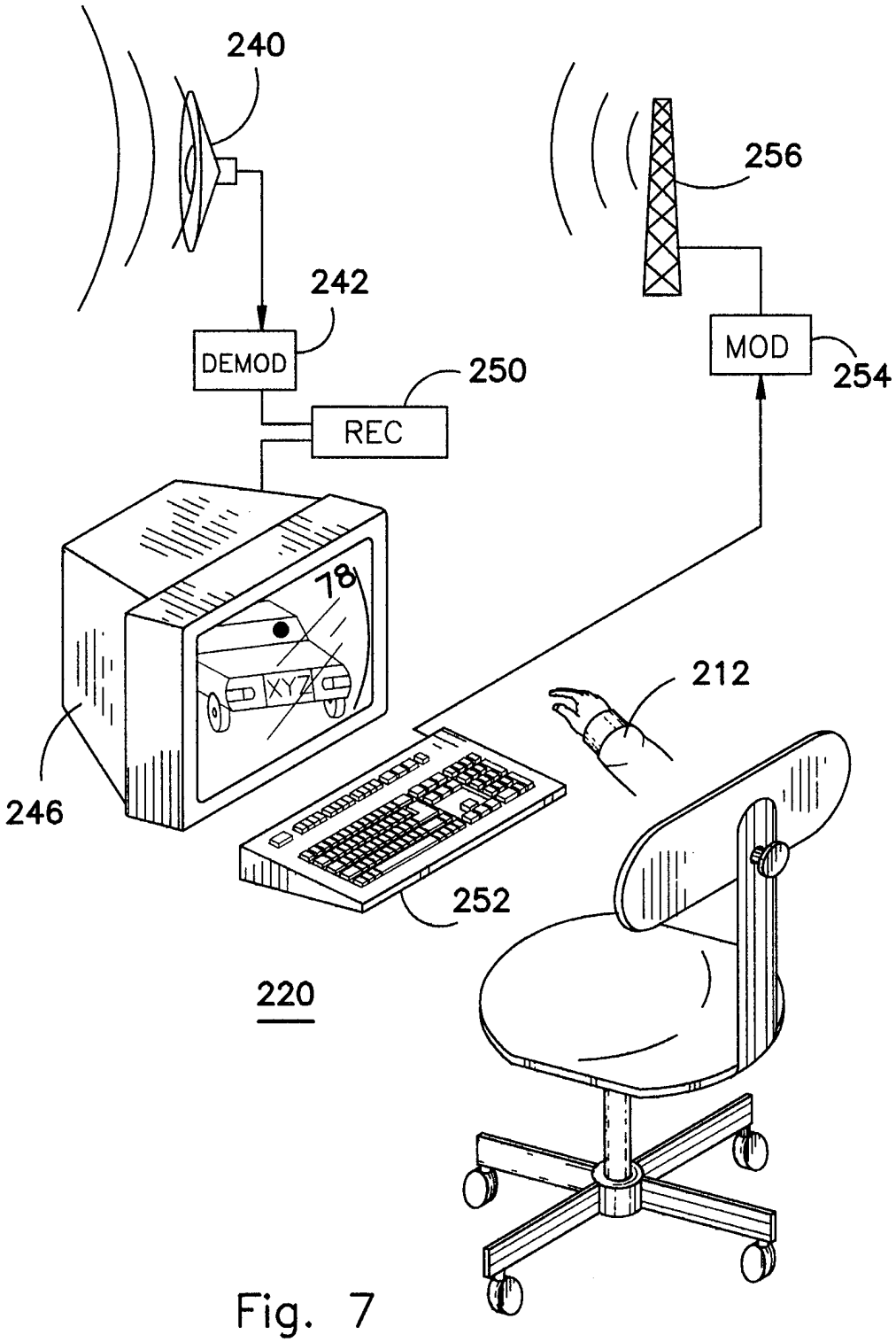

Fig. 7

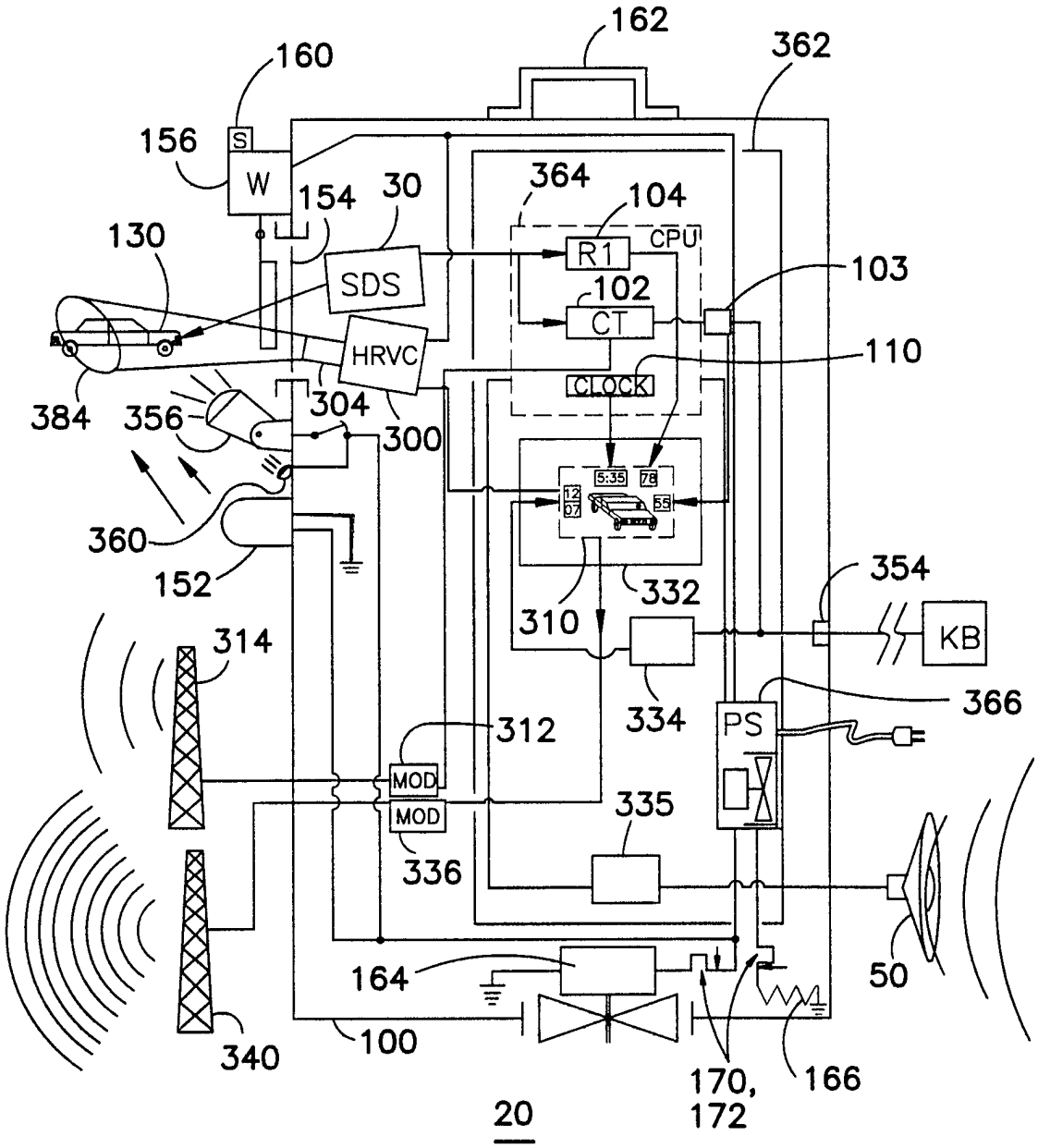
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Fig. 8

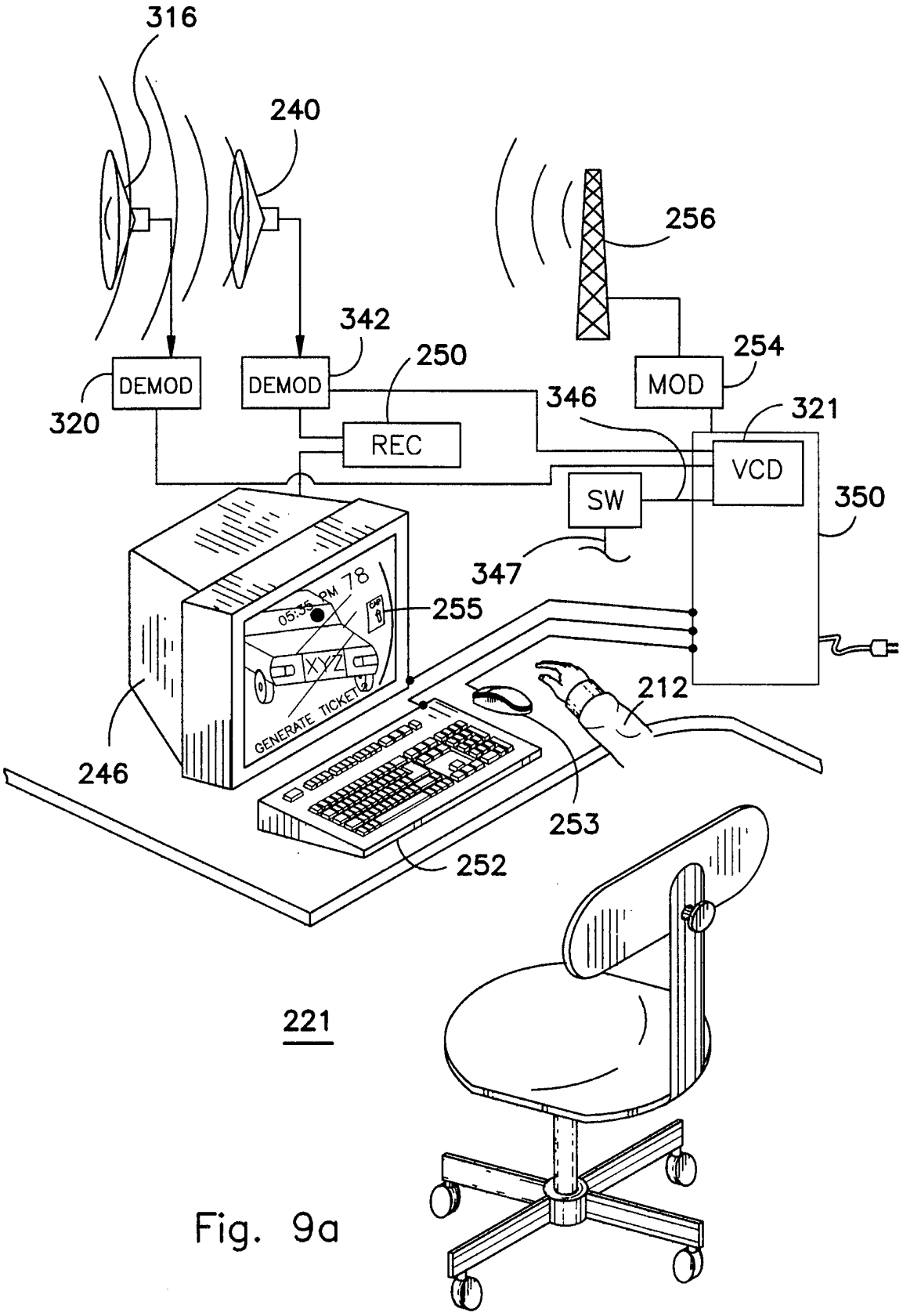
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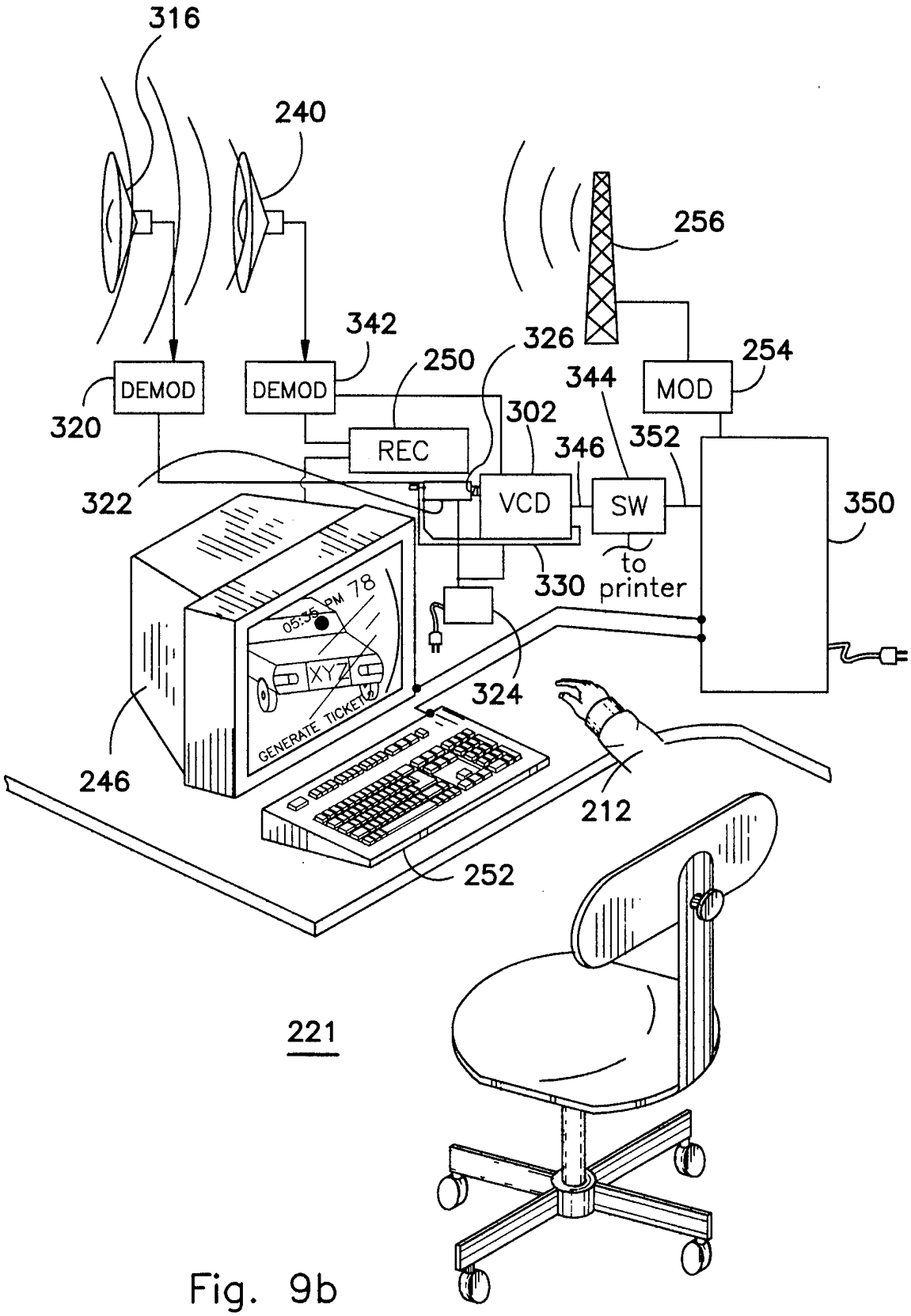
Fig. 9a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printer
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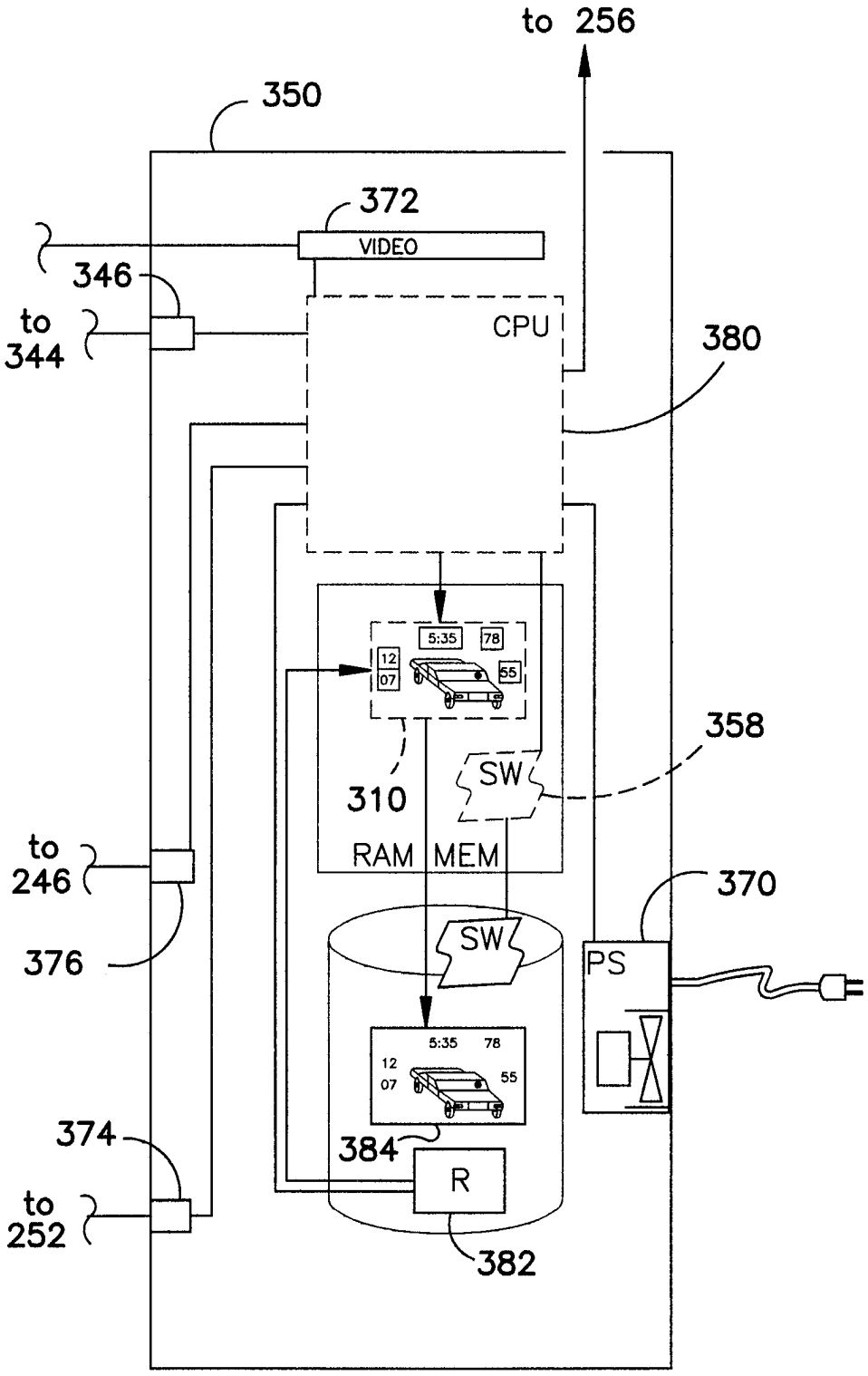
Fig. 9b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376
SW
PS
5:35
78
12
07
55
374
384
R
to
252
382
20

Fig. 10

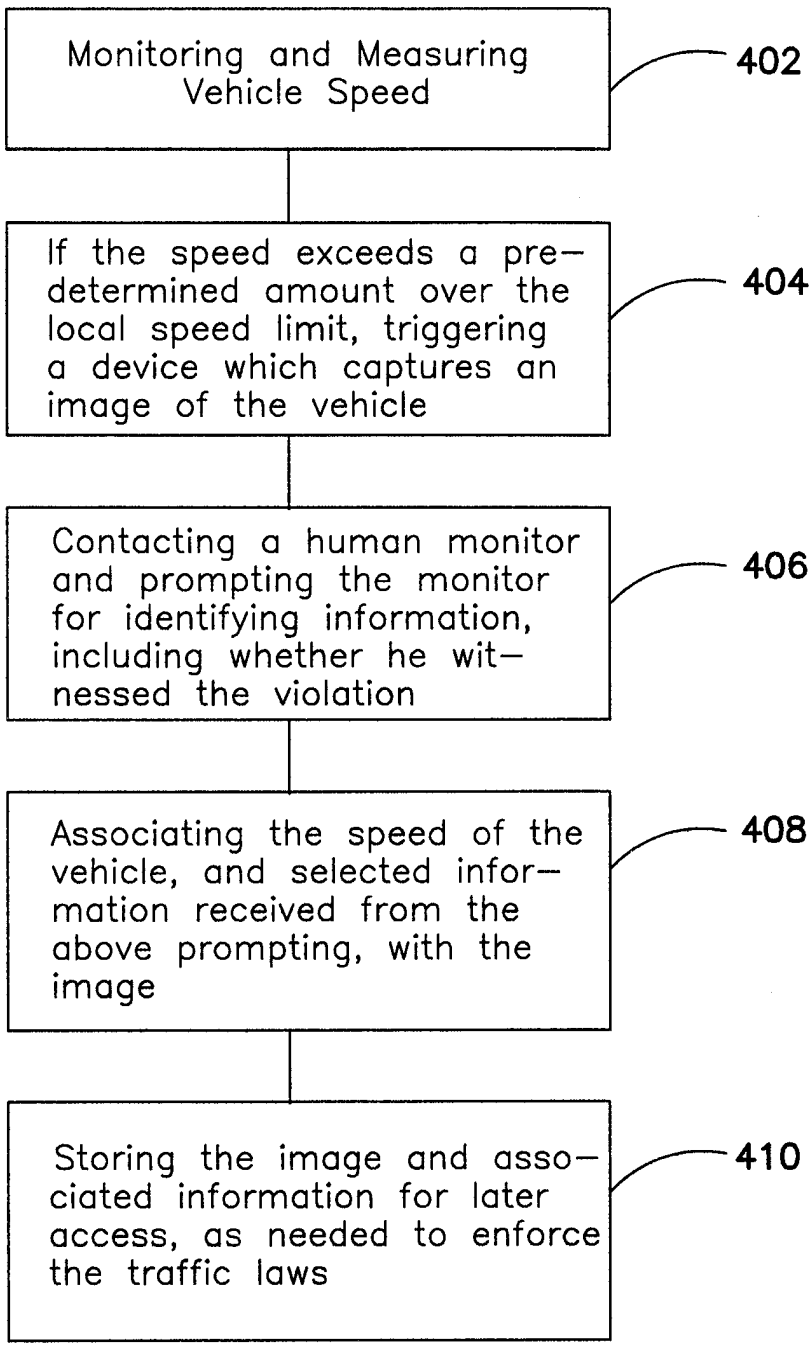
Monitoring and Measuring Vehicle Speed
402
If the speed exceeds a predetermined amount over the local speed limit, triggering a device which captures an image of the vehicle
404
Contacting a human monitor and prompting the monitor for identifying information, including whether he witnessed the violation
406
Associating the speed of the vehicle, and selected information received from the above prompting, with the image
408
Storing the image and associated information for later access, as needed to enforce the traffic laws
410

Fig. 11

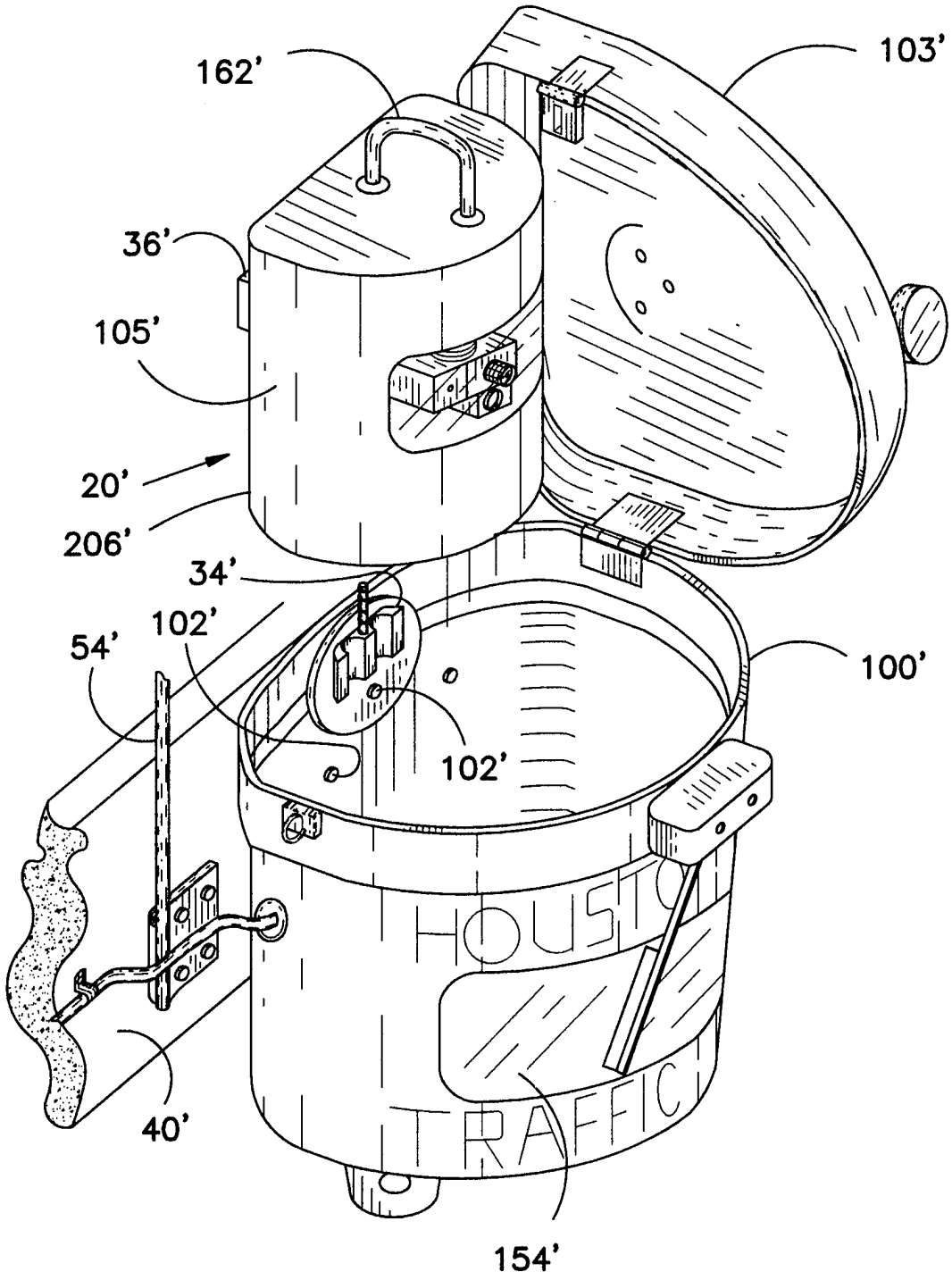

Fig. 12

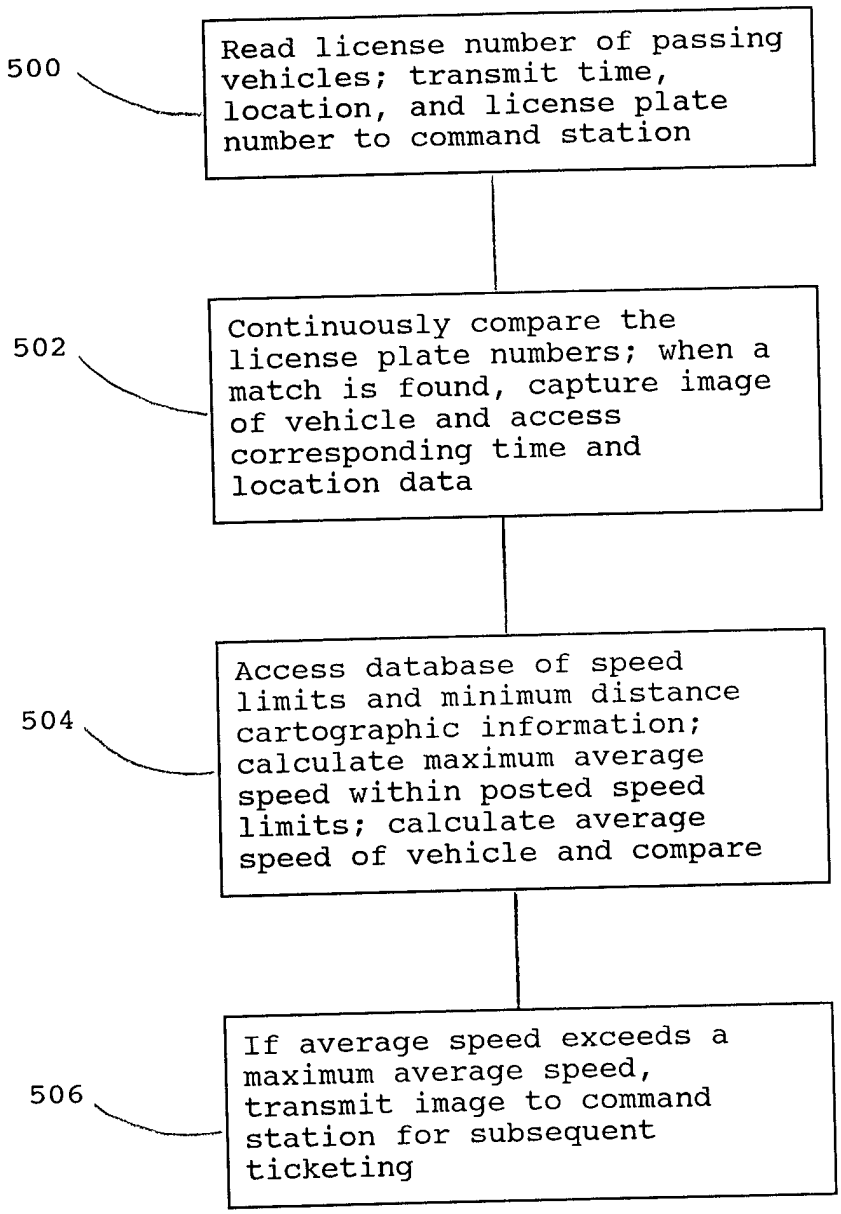
500
Read license number of passing vehicles; transmit time, location, and license plate number to command station
502
Continuously compare the license plate numbers; when a match is found, capture image of vehicle and access corresponding time and location data
504
Access database of speed limits and minimum distance cartographic information; calculate maximum average speed within posted speed limits; calculate average speed of vehicle and compare
506
If average speed exceeds a maximum average speed, transmit image to command station for subsequent ticketing

Fig. 13