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(54) Automatic recording system of events preceding and/or following a typical event in which a vehicle is involved

(57) An automatic recording system of a sequence of images preceding and/or following a certain event occurred to a vehicle as an aid in corroborating testimonies, includes at least a video camera permanently mounted on the vehicle, generating a digital stream of pixels data corresponding to images acquired at a certain frame rate; a circuit for compressing and encrypting said digital data stream; a video memory buffer storing in a FIFO mode said compressed and encrypted data of a video sequence composed of a certain number of images; at least a circuit commanding the start of the system, in a first frame rate mode when starting the engine of the vehicle; at least a circuit sensing an impact or collision and commanding a stop-and-block routine of the recording system to preserve crypted nonvolatily stored data of a last acquired sequence of pictures; means for unblocking and resetting the recording system by the issue of command codes; and a microprocessor interfaced through a control bus to said circuits and to said unblocking and resetting means and to programming means.

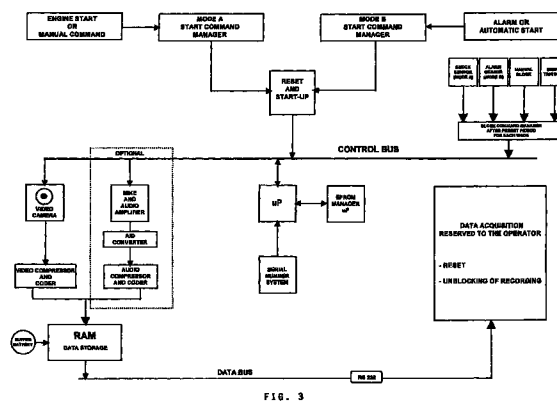


FIG. 3

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## Description

[0001] The present invention relates to an automatic recording system of events that precede or follow a certain event selected among a number of events definable as typical, usually an auto vehicle impact or collision or the triggering of the car alarm, and having altogether a "black box" function.

[0002] Compulsory car insurance policies represent a huge market, though insurance companies lament it being a "sufferent" one and annually seek premium increments significantly higher than the general nation rate.

[0003] Further burdening the bulk of liquidations that insurance companies must pay because of the enormous number of claims, are abuses by dishonest clients, whose claims are often difficult to contrast though the real circumstances of the accident were somewhat different from the ones that are represented

[0004] A large number of claims, deriving from minor accidents and based on an amicable certification of the parties involved, with or without witnesses, represent a large percentage of refund claims.

[0005] In countries where fully comprehensive insurance policies are still very expensive and/or rather uncommon, deceitful behaviours are more diffused whereby self inflicted damages are recuperated through the insurance companies with the complicity of a fellow insured who admits full or partial responsibility in causing the damage suffered by the vehicle or by the goods of the claimant.

[0006] Often, through the accident is not a fake, amicable certifications of the events that have caused the damages, for which claims for refund are filed, are deceitfully formulated to obtain the most conspicuous refund from the insurance company of one or the other party involved in the accident.

[0007] The investigation carried out by liquidators that audit the congruity of the denounced damages with sketches of the dynamics of the accident, giving an economic evaluation of the damages, is often an insufficient deterrent against unethical behaviours.

[0008] The expert has clear limits in contrasting the offered representation of the accident and of its effects in terms of damages to vehicles and goods and/or of injuries to people.

[0009] A quantification of the amount of money that the insurance system could spare, assuming an absolutely ethical behaviour when filing refund claims, is difficult to determine and perhaps known only to the analysts of insurance companies, however, it is assumed to be significative. A substantial recovery of those costs may improve the economics of this important sector and allow for a containment of premiums.

[0010] It has now been found and constitutes the object of this invention an automatic recording system of events that immediately precede and/or follow a certain specific event involving a sudden collision or an

effraction suffered by a vehicle. The system provides for a real and not manipulable documentation of the event corroborating a correct representation of the circumstances.

[0011] The system of the invention involves the installation on the vehicle of a relatively small and self contained apparatus, that may be easily mounted on board, in a functionally strategic position.

[0012] The apparatus contains functional parts of a video camcorder and optionally also of audio recorder and may be seen as constituting a sort of a "black-box".

[0013] The recorded information may be downloaded, duplicated, decrypted and eventually played-back only through appropriate decoding, decompressing and processing means of the recorded data that are strictly proprietary and securely held only by an authorized system operator (for a pool of insurance companies, if not by the insurance company itself), in order to check and/or verify the testified accounts of the accident.

[0014] The system allows for a real and certified verification of the dynamics of the accident or of any other predefined typical event, thus contrasting effectively any attempt to represent the accident or the particular event differently for deceitfully alter the responsibilities of the parties involved in order to obtain an undue or a more substantial refund from the insurance company.

[0015] The device of the invention is installable on the vehicle and may be produced at an acceptable cost, which could be born by both the insured client and the insurance company. The client could be motivated by a discount on the premium that otherwise would have to pay in full in case he refuses installation of the device, whereas the insurance company would benefit from the expected savings deriving from a diffused adoption of such a system which, besides its indubitable effectiveness represents also a formidable deterrent against the temptations of making deceitful claims.

[0016] Essentially, the device installed on board of the vehicle comprises at least an analog or preferably a digital (CCD) micro video camera, permanently mounted on the vehicle, outputting a digital data stream of pixels corresponding to a sequence of images, gathered at a certain frame rate; a compressor/encoder circuit of the digital pixel stream into a digital data stream; a memory buffer of said compressed and encoded data, for a temporal sequence composed of a certain number of images scanned in succession, functioning in a FIFO mode (first picture-in-first picture-out), according to which the data relative to an older image are overwritten by the data of a new image; a circuit generating command pulses to start the system to a first frame rate upon starting the engine; and a second circuit generating command pulses to trigger a stop-and-block routine of the image recording system upon the occurrence of a collision; means for unblocking and resetting the recording system through a code or password; a system microprocessor interfaced through a control bus to the circuits and to the means for unblocking, resetting and

programming means.

[0017] Optionally, the system may be started automatically upon activating an alarm system installed on the vehicle. If the system is started by activating an alarm, the system will record images at a reduced frame rate compared to the frame rate of when the system is started by starting the engine.

[0018] For particular applications like in taxis, buses or even trams and underground carriages, the start-up of the recording system may be manually commanded by the driver or the conductor in case of need.

[0019] The self contained module installed on the vehicle contains into an antitamper enclosure the functional sensors and circuits and one or more buffer batteries capable to preserve the recorded data in the memory buffer, which may be a common RAM memory.

[0020] The module has a transparent window through which the video camera of the module captures the images.

[0021] The module is preferably installed inside the passenger compartment, for example near the rear window, with the camera objective aimed through the windscreen, thus capturing images of the front part of the passenger compartment and of the space in front of the vehicle through the windscreen.

[0022] The module may have a normal serial port (rs232) to download the recorded data when it becomes necessary or opportune.

[0023] The permanent block of any further recording and thereby the preservation of data in an encrypted form relative to a sequence of images immediately preceding an event that has triggered the stop-and-block routine and immediately following such an instant, may be determined by the triggering of a collision sensor, for example by the triggering of the same collision sensor that causes the airbag inflation, or by any similar sensor or by one of several sensors whose triggering threshold may be adjusted so to be even lower than the threshold that causes the inflation of the airbag.

[0024] The system of crypted recording of the images captured by the videocamera at certain frame rate uses as a password or cryptation code an individual code of the module installed on the vehicle. This individual code identifies to the system operator decoding means the insured party and the vehicle on which the apparatus is installed.

[0025] Besides the (optional) possibility of arranging for an automatic start of the recording system, at a reduced frame rate, for example upon activating an alarm system (when the vehicle is left in an unguarded parking lot), in order to exploit the information provided by the system even in cases of thefts or tamperings, the system may also include a microphone and a relative circuitry of amplification, analog/digital conversion, compression and coding, to implement a simultaneous recording on a RAM buffer also of an audio sequence, lasting the entire period covered by the stored sequence of images.

[0026] The video RAM buffer and optionally also the audio RAM buffer have a capacity that allows for the recording of compressed data relative to an adequate number of successive images and of compressed data of a corresponding audio sequence, that follow a specific event that causes the stop-and-block routine of the automatic recording system.

[0027] The writing of data relative to images and eventually relative to a corresponding audio sequence, in respective buffers organised in the RAM memory, is controlled by a microprocessor and implemented in a First-in-First-out (FIFO) mode for images and audio sequences; when all the locations in the respective buffers are filled (immediately after the system start-up) the incoming new blocks of data are recorded in the position of the relatively "older" blocks of image data and of audio data, overwriting the content with the new data.

[0028] Therefore the RAM, except during the first start-up instants, eventually following a reset that may be automatically performed upon starting the system, will contain a sequence of a predefined number of images and eventually also a corresponding audio sequence, covering an interval of time that includes a period immediately preceding and a period immediately following the instant of the occurred impact or of any other triggering event.

[0029] The occurrence of a predefined typical event, such as the triggering of a impact sensor-that may be included inside the system's module (eventually in integrated form) or external, or even pre-existing on the vehicle (for example, with eventual adjustments of the triggering threshold, it may be possible to use the signal generated by the impact sensor that is commonly installed on the vehicle for releasing the airbag), the automatic recording system continues to record few more images and eventually also a similarly protracted audio sequence for a correspondingly predefined interval of time and then sets itself in a blocked state, retaining in its memory a series of images and eventually also a corresponding audio sequence covering instants immediately preceding and immediately following the impact.

[0030] The data so recorded in a nonvolatile manner by virtue of the buffer battery that supplies the system's RAM, may be read and/or downloaded at any subsequent time, by establishing a serial data link to a service computer of the operator (e.g. the insurance company), which, through a dedicated software decrypts, decompresses and eventually displays the stored images and eventually decrypts, decompresses and reproduces the recorded audio sequence.

[0031] Of course, either for reading the data permanently recorded by the system installed on the vehicle or for resetting a system that may have been accidentally blocked, the computer, or more precisely, the proprietary decrypting software of the operator remains the only means that may unblock the system and render it operative again.

[0032] If the system is accidentally blocked by the proprietor of the vehicle and subscriber of the relative insurance policy, the unblocking of the system is effected by the operator, following to the signing of a document that waives any retrospective claim at the date of requesting the unblocking and resetting of the system by the owner of the vehicle.

[0033] The downloading, decrypting and/or unblocking of the automatic recording system installed on the vehicle by means of a specific command that can be issued exclusively by the operator's computer may be organised through a serial cable connection, by disassembling or extracting the module from its location on board of the vehicle and by bringing it physically to any of the operator's premises equipped with a computer for reading, decrypting and eventually unblocking the system.

[0034] Preferably, the installation of the module on board of the vehicle may be organized in a way of including a docking platform fixedly mounted on the vehicle and having adequate connectors, on which a module containing the functional parts of the automatic recording system will be easily installed and disinstalled as needed.

[0035] Eventually, in consideration of the opportunity to inspect further the records during a damage liquidation proceeding, the module may be physically retained by the operator (insurance company) as a source of objectively primary proof, and a new module, properly programmed with the identification data, may be given to the client in substitution of the module retained, and so forth according to convenience and practicability.

[0036] Alternatively, the automatic recording system module may be permanently installed on the vehicle and include a duplicated data storage support in form of an extractable support, for example a Flash-EPROM card or similar nonvolatile mass storage support, which will be written in parallel with the same data that are written on a fixed RAM equipped with a buffer battery to retain the data activated, as a conclusive operation of the blocking routine of the system.

[0037] The module may contain even a second buffer battery for ensuring the operation of the system during the instants following the predefined triggering event, should the event (collision) interrupt the normal power supply provided by the vehicles battery.

[0038] The Flash-EPROM card or alternatively a self-supplied SRAM-card with a speed comparable to that of the fixed RAM, or any other equivalent mass storage support, constitutes a handy and mobile data storage support (a duplicate of the data stored in the fixed RAM of the module), that may be extracted from the module and easily despatched to the operator for decrypting and inspection of the recorded data (a copy of which remains safely stored in the fixed RAM inside the automatic recording system installed on the vehicle until its eventual unblocking and resetting). Even in this case, it will be possible to obtain a new Flash-EPROM card or

SRAM-card in exchange of the one retained by the operator.

[0039] By specifically writing it in a crypted form, such a mobile data storage support may also constitute a handy carrier of the unblocking command code for the system when, written by the operator, is reinserted in the specific module on board of the vehicle.

[0040] The different aspects and functions of the automatic recording system of the invention will become even more evident from the following description of several embodiments and by referring to the attached drawings, in which:

Figure 1 is a basic scheme of the system of invention;

Figure 2 is an alternative scheme of the system according to an optional architecture based on the use of a RAM Card to transfer data to and from an operator site;

Figure 3 is a functional block diagram of the system of invention;

Figure 4 is a flow chart showing the functioning of the system of Figure 3;

Figure 5 is a timing scheme of an automatic recording of images according to an embodiment of the invention.

[0041] Figure 1 schematically shows an architecture of the automatic recording system of the invention. The means for decrypting, reading, decoding and unblocking of the module may be represented by a normal PC equipped with a specific software.

[0042] Figure 2 shows an alternative embodiment that considers a substantially fixed on board module (black box) furnished with means for writing and reading an extractable Flash-EPROM card (or alternatively a self-powered SRAM-card) usable as a carrier of information (and/or of unblocking commands) to and from the operator's premises.

[0043] Figure 3 is a functional block diagram of the system of invention.

[0044] In the example shown is also present an optional audio recording system including a microphone, an audio amplifier, analog/digital conversion circuits and compression and crypting circuitry (i. e. the functional blocks traced inside the dash-line box.)

[0045] The upper part of the diagram includes the sensors and circuitry that generate reset and start-up commands for the automatic recording system as well as the sensors and circuitry that trigger the routine that stops the recording system after a certain prefixed period of time upon the occurrence of a certain event.

[0046] Such sensors and circuitry, or parts of them, may be external to the module containing the picture

and optionally sound sequences acquisition and recording system, and command signals may reach the functional circuits contained inside the module through connectors that may be organised in a customary way in the docking platform of the module, in case it is of a removable type.

[0047] A microprocessor commanding the acquisition of images at an appropriate rate and optionally the acquisition of corresponding audio sequences interfaces with a control bus of the system and provides the compression and coding circuitry with the data streams relative to the images produced by a digital micro video-camera (CCD) and the data streams relative to the audio sequences, the code (password) for crypting the digital before recording them in respective memory buffers.

[0048] The individual passwords and/or codes are resident in a ROM (they univocally identify the unit to the operator), while the different scanning and blocking modes for a given typical event are permanently programmed in the EPROM.

[0049] The compressed and encrypted data, may be accessed through a data bus and a download serial port RS232.

[0050] The functional circuits of the video-camera, for pixels data compression and coding and optionally also for converting the audio signals originating from an ambient microphone installed in the module to digital audio data and for effecting a compression and coding to store them in the memory, may be of any type known or commercially available and normally used for these functions.

[0051] Figure 4 is a flow sheet of the automatic recording system of the invention relative to an embodiment that contemplates the possibility to exploit the functions of the automatic system of the invention also when the vehicle is left parked with an alarm system activated.

[0052] If the automatic recording system is activated upon activating the alarm system, the rate at which the system acquires the pictures is reduced in respect to the frame rate set when the automatic system is activated by starting the engine.

[0053] As schematically shown in figure 5, according to an embodiment of the invention, and considering the ability of human eye to observe without sensing an excessive flickering sequences with a frame rate of at least 25 pictures per second, the automatic recording system of the invention may reasonably set the frame rate to about 5 photograms per second, when resetting and starting the system by starting the engine, thus considering an interval of about 4/100 of a second, between successive pictures, whereas if the system is started by activating the car alarm, the frame rate may be adequately reduced to about one picture per second.

[0054] Depending on the ratio of data compression, which for the purposes of the system may be relatively high, at the expense of a certain loss of picture definition, a video memory buffer of a reasonably low cost

may have a capacity of a total number of about 60 pictures. This corresponds to a coverage of about 12 second, if the system is functioning at high frame rate and of about 60 seconds if the system is functioning at the reduced frame rate.

[0055] The system may be programmed so that the recording will continue, from the instant of sensing an event triggering the blocking of the system, for several seconds, for example for at least two seconds, if the system is in a high frame rate mode or for little less than sixty seconds if the system is in a low frame rate mode.

[0056] In this way, the informative content that is permanently and securely recorded in the data storage support following the blocking of the system will comprise a certain sequence of pictures preceding and following the event that stopped the system.

[0057] Naturally, the basic system of automatic recording of pictures of the invention lends itself to be realized even in different forms, especially as far as the manner in which the transfer of data to and from the decrypting and resetting apparatuses of the operator that manages the service is concerned.

[0058] A link established by way of a common cellular telephone, using DTFM coding techniques, may be used to simplify the unblocking of a recording system accidentally jammed and eventually to download the recorded data from the memory buffer of the on-board module to the computer in the premises of the operator.

[0059] More than one videocamera, may be installed in the on board module. Infrared cameras and/or orientable mirrors may be also installed.

[0060] The automatic recording system with "black-box" functions of the invention may also have secondary or different applications. For example, in particular applications like in taxis, buses and trams, on subway carriages, etc., the system may be started and blocked manually by the driver or conductor when the situation may call for it.

[0061] In these special applications the system may be used to store a complete sequence before blocking it manually or to acquire and permanently store single pictures that may be useful for the identification of individuals.

[0062] These optional functions are schematically illustrated in the diagram of Figure 3 wherein, beside the blocks that generate the reset and start commands either in a A or B mode, there are also blocks for manually commanding the reset and start up of the system and/or the acquisition of single pictures on command.

[0063] The programming of the system contained in the module installed on board of the vehicle may contemplate that, in the case of a manually commanded acquisition and storage of single pictures, the stored data relative to such images may not be overwritten by the system until a partial unblocking of the relative sectors of the RAM is effected. The normal sequential overwriting of picture data will occur cyclically with the same modality for the remaining sectors of the RAM, margin-

ally reducing the temporal interval covered by the video sequence which will no longer be of a complete number of pictures, but of a reduced number because of the partial block of the sectors containing the data of the single pictures acquired by manual command.

**[0064]** The automatic recording system of the invention contained in the on board module (black box) may also comprise acquisition circuits of other data useful to the interpretation of the video and optionally also audio recorded event. For example, in parallel to the periodic acquisition of pictures, the system may sample and record digital instantaneous values of the speed of the vehicle, of the state of light switches, of directional light switches, of stop lights, etc. The relevant signals may be coupled to the sampling and acquisition circuitry of the module through multiconductor connectors.

**[0065]** These additional signals will be sampled at the same instants of acquisition of the pictures, digitized and stored in specific RAM buffers. In this way the analysis of the recorded data by the operator will benefit of the knowledge of a wealth of important information on the driving at the time of the accident.

## Claims

1. An automatic recording system of a sequence of images preceding and/or following a certain event occurred to a vehicle as an aid in corroborating testimonies, including

at least a video camera permanently mounted on the vehicle, generating a digital stream of pixels data corresponding to images acquired at a certain frame rate;

a circuit for compressing and encrypting said digital data stream;

a video memory buffer storing in a FIFO mode said compressed and encrypted data of a video sequence composed of a certain number of images;

at least a circuit commanding the start of the system, in a first frame rate mode when starting the engine of the vehicle;

at least a circuit sensing an impact or collision and commanding a stop-and-block routine of the recording system to preserve crypted non-volatilely stored data of a last acquired sequence of pictures;

means for unblocking and resetting the recording system by the issue of command codes;

a microprocessor interfaced through a control bus to said circuits and to said unblocking and

resetting means and to programming means.

2. The system of claim 1, characterised in that said frame rate is at least of 5 pictures per second.
3. The system of claim 1, characterised in that comprises a circuit commanding the start of the system at a lower frame rate than said first frame rate, when a car alarm system of the vehicle is activated and a circuit sensing the triggering of said alarm and commanding a stop-and-block routine of the recording system to preserve crypted nonvolatilely stored data of a last acquired sequence of pictures.
4. The system of claims 1 or 3, characterised in that said sensing circuits commanding the stop-and-block routine cause the continuation of the acquisition and recording of images for a certain time after the instant of sensing depending on the frame rate.
5. The system according to claim 1, characterised in that it comprises at least a second mass storage support in which a duplicate of the same data contained in said first memory buffer are written, said second mass storage support being an extractable memory card.
6. The system according to any of the preceding claims, characterised in that said means for unblocking and resetting the recording system comprise means for reading and/or downloading the data stored in the memory buffer of a blocked system by a proprietary processing system of the operator capable of decrypting, decompressing and elaborating the data for playing back the stored sequences and of issuing unblocking and resetting command to the automatic recording system on board of the vehicle.

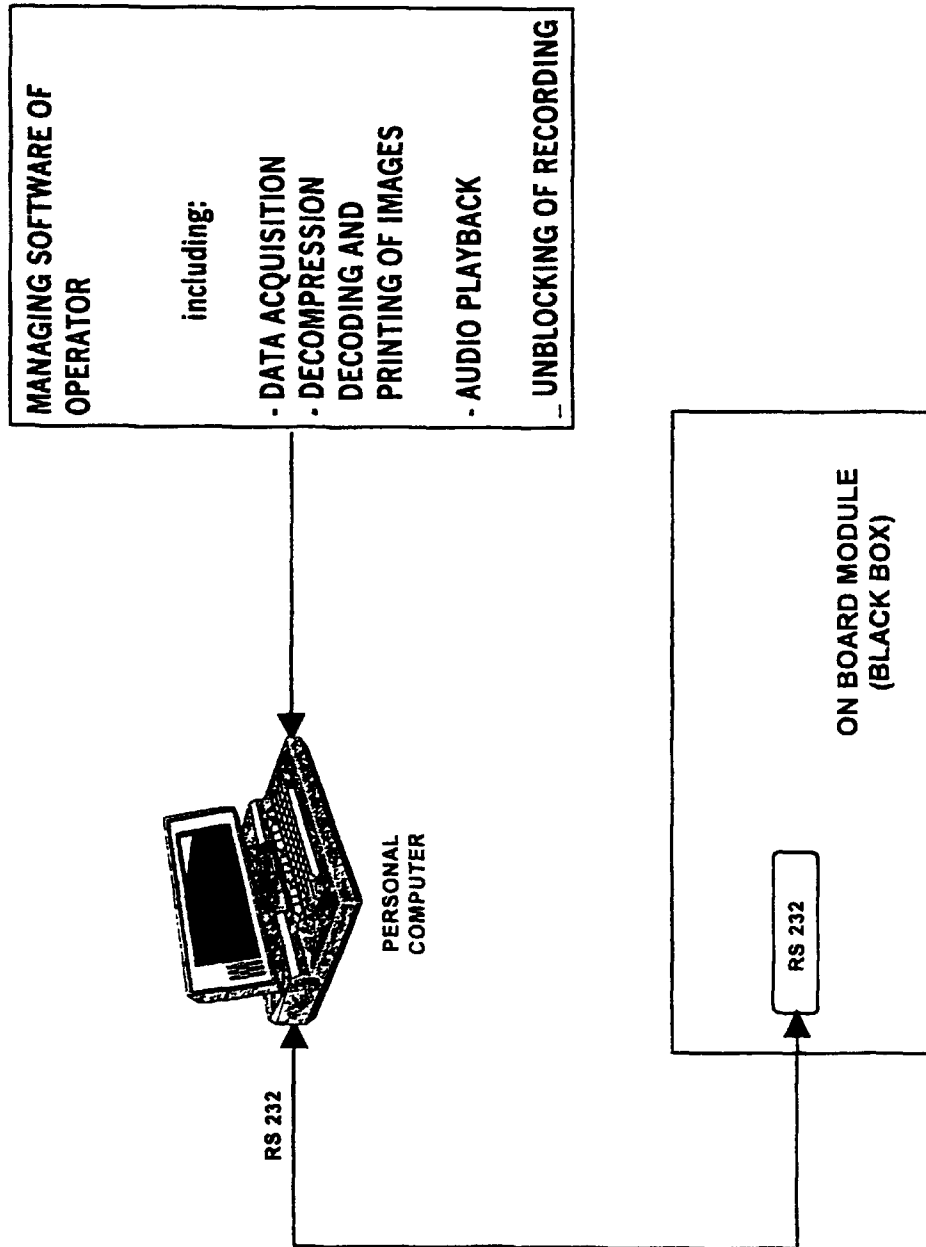


FIG. 1

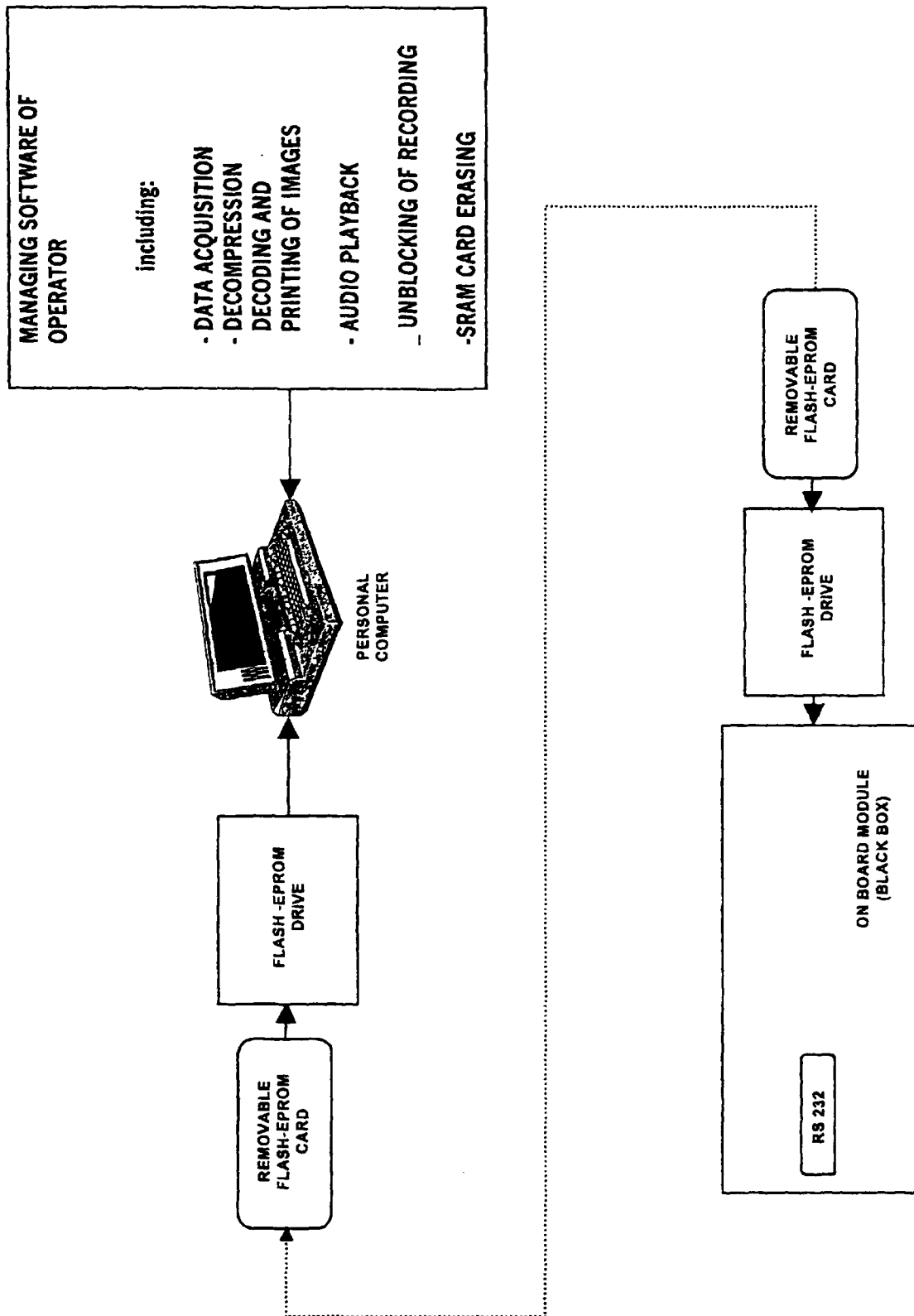


FIG. 2



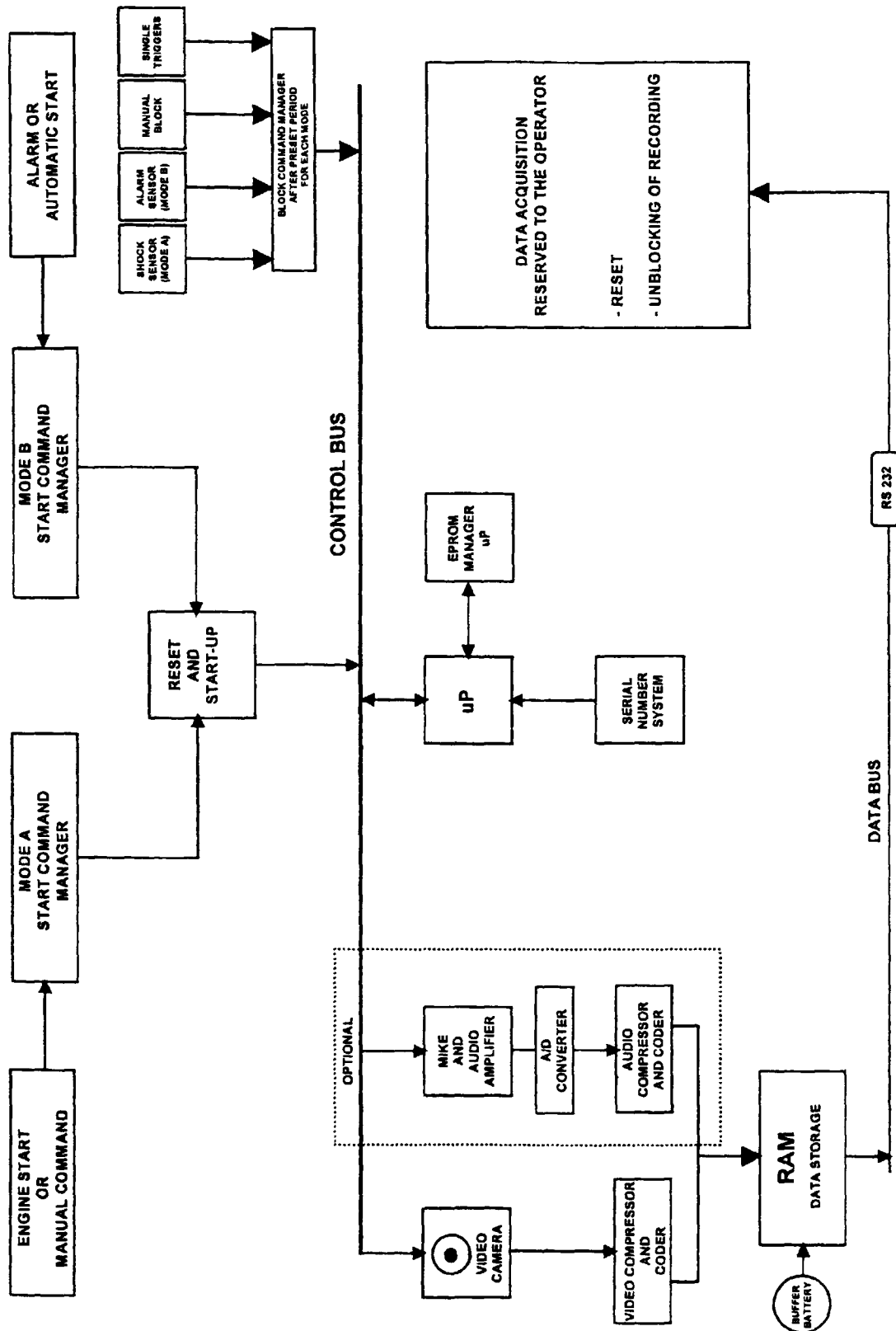
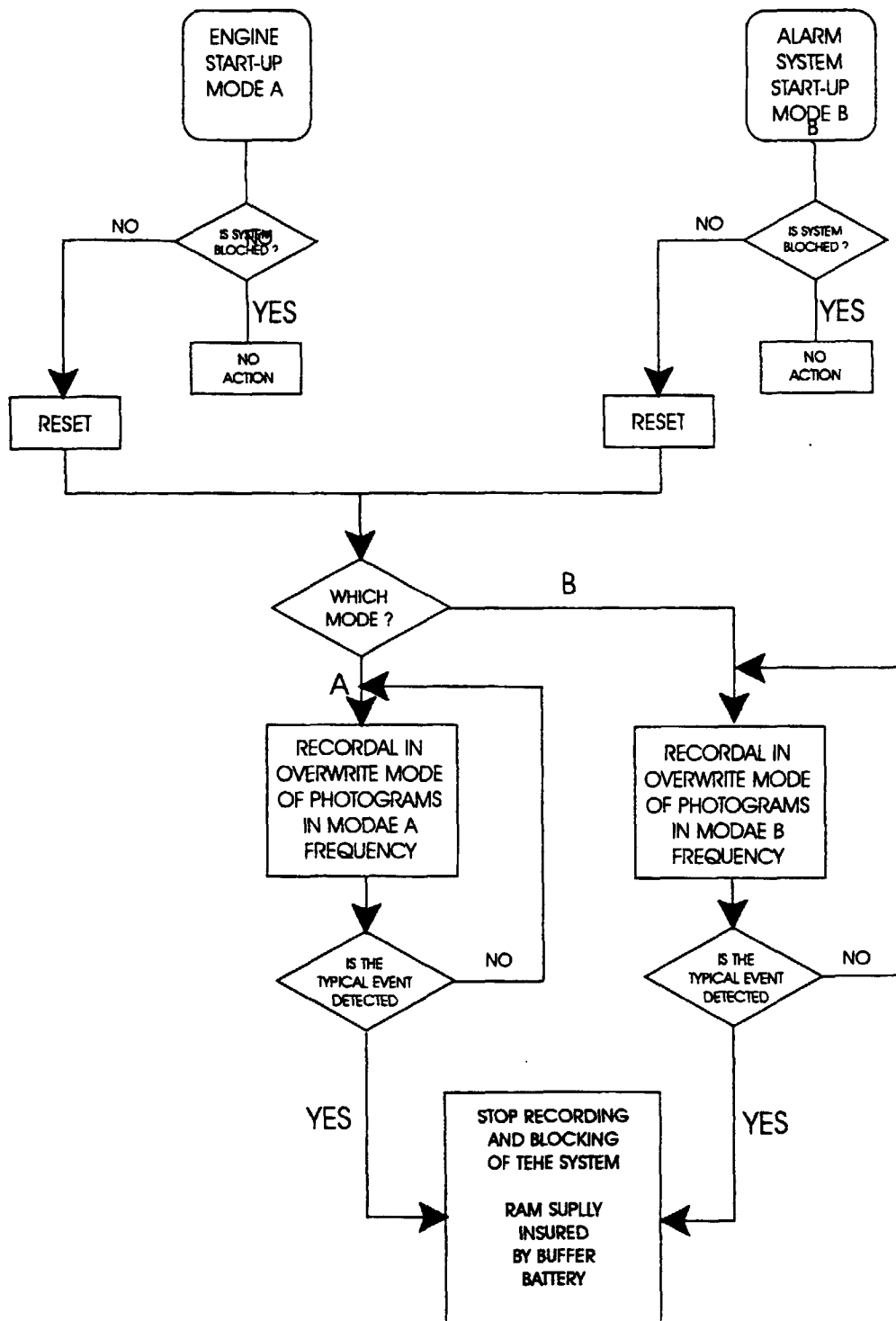


FIG. 3

## BASIC FLOWSHEET OF ON-BOARD SYSTEM

FIG. 4

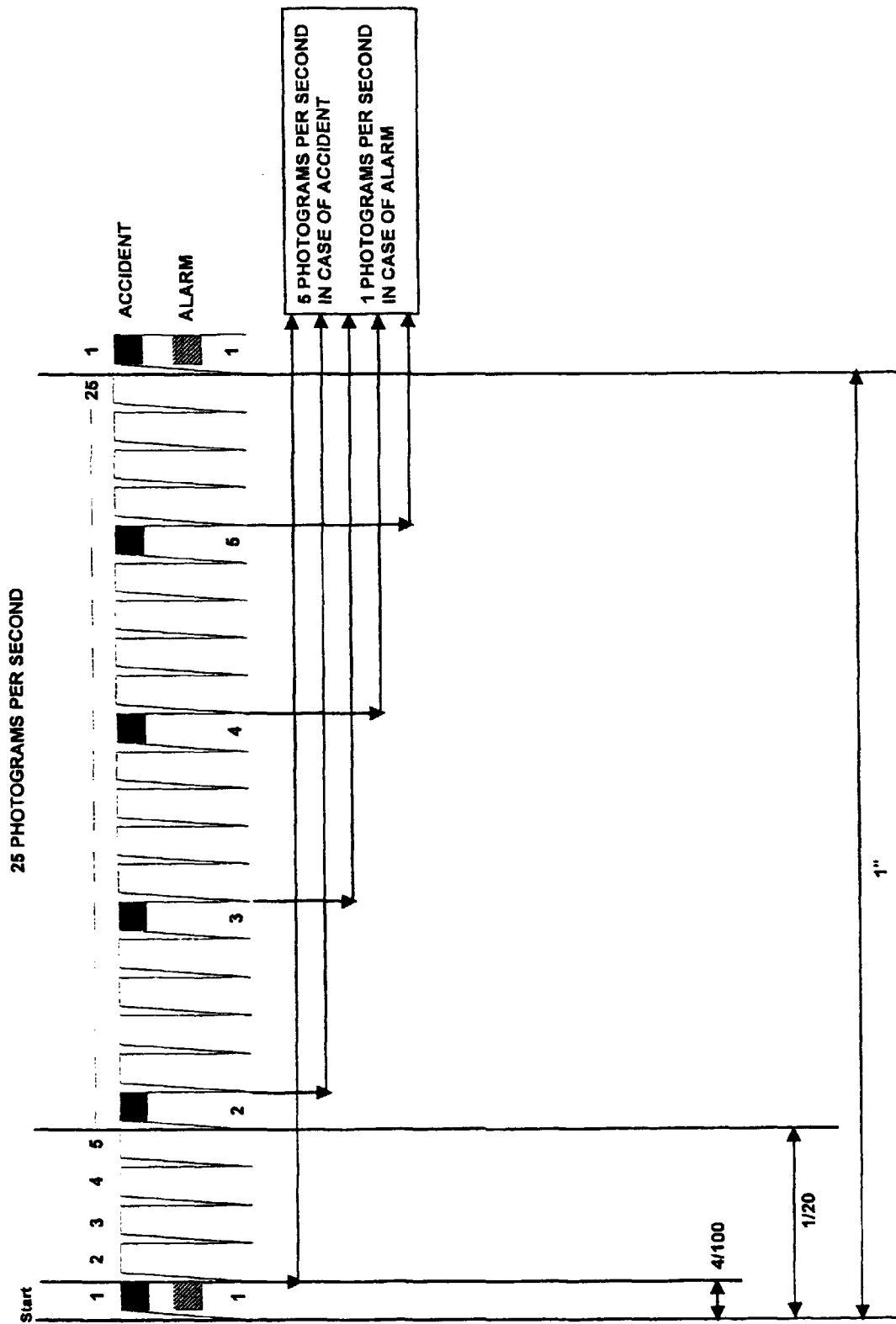


FIG. 5



European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 20 1011

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The present search report has been drawn up for all claims			
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 99 20 1011

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