US4638289: Accident data recorder

Inventor(s): Zottnik; Edmund , Gerlingen, Germany

Applicant(s):
Licentia Patent-Verwaltungs-GmbH, Germany
News, Profiles, Stocks and More about this company

Issued/Filed Dates: Jan. 20, 1987 / Oct. 23, 1984

Application Number: US1984000676193

IPC Class: B60Q 11/00; G01P 15/125; G06F 15/50;

Class:
Current: 246/045; 073/514.02; 073/514.32; 340/436; 434/305; 701/035;
Original: 340/052.H; 073/517.R; 073/517.A; 364/426;

Field of Search: 340/22,52 R,52 H 073/517 R 364/426,424 377/16,20,26

Priority Number(s): Feb. 26, 1983 DE1983003306814
Feb. 17, 1984 DE1984003405757

Abstract:

An accident data recorder for short-time recordation and storage of data and events relating to an accident of motor vehicles, comprising pickups for sensing, for example, wheel revolutions to determine the travelled distance and speed of the vehicle. In addition to these wheel sensors, capacitance-based acceleration sensors are provided whose output signals along with the output signals of the wheel sensors and with other status data relating to the operation of the vehicle, are continuously recorded at storage locations of a fixed storage. For this purpose, an addressing logic is provided which operates in a closed counting loop and, as soon as a final address is reached, jumps back to the starting address to overwrite the initially stored data. This cyclic data storage is interrupted by the occurrence of a trigger event defining an accident, with the result that the last recorded data, including a predetermined after-travel time, are freezed.

Attorney, Agent, or Firm: McGlew and Tuttle;

Primary/Assistant Examiners: Rowland; James L.; Capati; Anne Marie F.

I claim:

1. A method of recording and storing vehicle data representing events and conditions relating to an accident of a motor vehicle having wheels that normally revolve with longitudinal travel of the vehicle and which is subjected to at least one of longitudinal, transverse and rotational acceleration during an accident, comprising:

- generating a wheel revolution signal corresponding to revolutions of a wheel of the vehicle;
- providing an acceleration sensor having at least three cantilever mounted tongues each acting as a movable plate of a capacitor, and a fixed capacitor plate for each tongue which is fixed with respect to the vehicle, two of said tongues lying in a common plane transverse to the direction of longitudinal travel of the vehicle, and the remaining tongue lying in a plane extending in the direction of longitudinal travel, said movable plates being movable toward and away from said fixed plates when the vehicle is subjected to longitudinal, transverse and rotational accelerations to change capacitance between said fixed and movable plates, said sensor including an oscillator circuit for each set of fixed and movable plates which produces frequency variation with a capacitance for each set of fixed and movable plates, said frequency variations comprising acceleration signals which are indicative of longitudinal, transverse and rotational accelerations of the vehicle;
- generating a plurality of additional data signals corresponding to additional conditions of the vehicle;
- continuously generating central timing pulses indicative of the absolute passage of time;
- subjecting said revolution signal and said acceleration signals to an analog-to-digital conversion to form digital revolution data and digital acceleration data corresponding to the revolution and acceleration signals;
- writing the digital revolution data, the acceleration data and the additional data signals into a sequence of data storing locations of a fixed storage at intervals timed by the central timing pulses, the locations being disposed in a primary storage loop having a beginning and an end, with the data being stored in sequential locations from the beginning to the end of the primary loop and then back into the beginning of the primary loop;
- generating a trigger event when an accident occurs; and
- after the occurrence of the trigger event, writing additional revolution data, acceleration data and data signals which occur after the trigger event, into a secondary loop of storage locations having a new starting address in the fixed storage so that data remains stored in the primary loop and additional data after the trigger event becomes stored in the secondary loop.

Background/Summary:

FIELD AND BACKGROUND OF THE INVENTION

The invention relates to an accident data recorder. When mounted in a motor

vehicle, accident data, recorders are intended to record and preserve for later use, data or conditions which were present or occur within a limited period of time before the accident and are relevant for investigating the accident. They are known in a variety of designs, substantially as mechanically operating short distance recorders.

For example, short distance recorders (manufacturer Kienzle) or color disc tachographs (Company Hasler AG) comprise a drive from the transmission through a flexible shaft for graphically/mechanically recording the rotation of the drive wheels. What can be recorded is only the speed before the accident without any additional data, and it proved particularly problematic with such mechanical short distance recorders recording the travelled distance or the speed, for example, by scratching a curve into an ink-coated disc, that no data can be obtained after the wheels got locked, thus just when a thorough data recording is needed.

Further known are so-called tachographs with an electro-mechanical data storage, using plastic films in the form of a circle and capable of recording a great amount of data due to an arrangement of discs one above the other. Here again, no values are recorded after the wheels are locked.

It may also be considered known to store data in a short time recorder electromagnetically or in a purely electrical way, by using a preferably multitrack endless magnetic tape driven in response to travel, or continuously, and storing pulses or speed-dependent signals, or by using a counter for electronically evaluating pulses delivered from a wheel-driven transmitter and storing the pulse times.

In any case, in all short time recorders having to perform some mechanical movement, the problem arises that no unperturbed operation can be ensured through a sought minimum operating time, and that, on the other hand, short time accident data recorders intrinsically must be designed to continuously receive a great amount of data which practically must exceed the capacity of the recorder and become superfluous after the predetermined period of time if no accident occurs. In consequence, an accident data recorder must operate continuously but be so designed that from a certain point of time, which simply cannot be predicted and may be will never occur, data concerning an event and relating to a preceding period of time are made available for evaluation.

Finally, a device is known for registering operating data of a vehicle (German Pat. No. 23 22 299) working as an accident data recorder and eventually storing the data in digital form in at least one intermediate memory. This prior art device comprises a not particularly specified acceleration meter for lengthwise accelerations and an acceleration meter for transverse accelerations, and is designed to pick up wheel rotation by means of an inductive sensor and after amplification, convert the detected values to a digital signal. The acceleration meters are followed by amplifiers for high and low gain, so that altogether four analog measured acceleration values are obtained which are supplied, through an analog multiplexer and an intermediate sample-and-hold circuit, to a single analog-to-digital converter and therefrom, under the control of the corresponding multiplexed control signal transmitter, to two shift registers for accelerations, in a manner such that a first register contains the data for small acceleration, and the

other register the data for high acceleration. A third shift register receives the pulses of the travelling speed of the vehicle. Upon supplying new data to the shift registers, which is effected in a sequence that is timed by the control signal generator, the respective oldest data are automatically lost. The prior art device thus starts from the assumption that with a sufficiently large amount of shift register stages, upon a collision signal and failure of the timing pulses, still a satisfactory amount of digital data remains in the registers, relating to the period before the collision signal. This, however, requires extremely high storage capacity, for unfavorable accident situations (high speeds). The collision signal is obtained in an acceleration detector by comparing the lengthwise and transverse acceleration signals which are always a little amplified.

In a development of the prior art device, a fixed storage may be connected through switches to the shift registers, for nonerasably storing the data contained in the shift registers. Then, upon an impact signal obtained in the acceleration detector, the fixed storage initially takes up the contents of a first shift register by closing the connecting switch, for a period of time extending somewhat beyond the instant of the impact, so that even after-accident data may become stored. In this connection, however, a problem arises with the prior art device, that after-accident data supplied to the other provided shift registers, can on no account any longer be taken over into the fixed storage, since the control signal generator prevents further data from being stored in the registers which are not connected to the fixed storage. The accident, however, happens in real time and the registration must take place as the data comes in. That is why all the after-accident data which have not been supplied to the first shift register, get lost.

Another problem with the prior art device is that nothing specific is taught about the construction of the acceleration sensors, so that it must be assumed that they do not operate with a satisfactory sensitivity. Lack of sensitivity can also be assumed in view of the necessary analog-to-digital conversion, which assumption seems further to be justified by the association, deemed necessary, of each of the acceleration meters with two analog amplifiers having unequal gains.

The breaking down of the data by the input analog multiplexer results in a displacement in time. Even if an integration should follow, such an integration may be effected in each instance only over one quart of the available timing period, so that already in the data conversion, provided at the analog multiplexer associated with four data inputs as mentioned, three quarters of the data are lost.

Even though that is not disclosed in detail, the detection of a trigger event (impact signal) by the acceleration detector can be defined only as exceeding fixedly predetermined values of the lengthwise or the transverse accelerations. In consequence, because of the omitted differentiated evaluation of the acceleration data, such as a computation of values resulting from a lengthwise and transverse acceleration, most accidents do not trigger a response, for example in instances of disregarded overtaking where an impact produces only minimum transverse accelerations, no lengthwise acceleration, but significant angular accelerations, especially if the friction between the wheel and the road is reduced. However, since the timing signal is interrupted only upon the occurrence of an impact signal, the significant data may get lost in many cases, particularly in accidents where

people are involved.

The following is another example of the disadvantages of the prior art device. Since only the lengthwise and the transverse acceleration are recorded, two-dimensional movement of the vehicle cannot be determined. During a skid, a vehicle turns about its vertical axis, and the lengthwise accelerations turn into a transverse one. Only by including the angular acceleration about the vertical axis into the computation, can the determination of an erroneous locus be avoided.

Since only instantaneous values spaced by the selected timing rate are available for the evaluation, and with the differential variations of the accelerations being considerable (breaking-impact), the values cannot give any information on the average acceleration which is wanted for the computation. It must rather be assumed that the stored values are related to the actual ones only fortuitously.

A further problem is that no critical time considerations, such as a correlation with the absolute time, are taken into account, so that in the event of a hit-and-run accident, for example, no interrelations in time can be proved. Also, a storage of disturbances in the system is not provided, tampering with the power supply, failure of the sensors or signal lines cannot be recorded; there is no proper safety against sabotage. The same goes for complex functions such as self testing, self adjusting, etc.

SUMMARY OF THE INVENTION

The present invention is based on the finding that a chronological breakdown of a complex collision in order to assign the culpability is imperative, and includes also the effects produced by acceleration. This is a requirement which cannot be satisfied by a travel responsive recording alone, since in such instances, the blank periods between recordings, which may be caused by wheel locking, for example, are more important than the recorded ones. It is further of primary importance to obtain the recordal in real time, since this both makes sure that the recorded data will be directly interconnected and related in time, and serves as the sole remaining conclusive circumstantial evidence of any complicity if more recordings are available.

As compared to the prior art, the inventive accident data recorder having the features according to the basic claim has the advantage that the entire sequence of motions of the vehicle during a sufficiently long period of time before the occurrence of the accident is accurately recorded and becomes non-erasably stored at the instant the accident occurs. The design is focused not only on the speed of the vehicle which may be determined by measuring the wheel revolutions, but also on picking up and storing highly accurate acceleration data and evaluating them at the same time as a basis for computing the instant at which an accident occurred.

All the stored information and data are referred to a time base which is provided at a reference input independent of the road and traffic. The time base furnishes both timing pulses for a time counter, and the clock rate for the entire system of data acquisition and storage.

The invention accident data recorder is so designed that all the events occurring

within a period of time between an instant sufficiently preceding an accident and an adequately later instant following the accident are recorded in all details with a high accuracy, and so narrowly quantized that a gapless representation of a sequence of counts both before and after the accident can be obtained and correspondingly evaluated.

The decision on whether the data which normally continue to be overwritten in a continuous cycle are to be preserved is independent of any contemplation by the driver, of course; on the basis of the conditions supplied by the external sensors, the accident data recorder ascertains that an accident occurred and freezes the data belonging thereto; at the same time, upon the expiration of an additional-travel period, a new secondary loop is defined for filling storage locations in a fixed storage, thus a standby time is made available for monitoring the critical time after a collision.

It is further advantageous that a certain sequence of so-called status conditions A is monitored and stored in recurrent short time intervals, such as every 100 ms, while other status conditions B are registered in longer intervals, such as every 500 ms, to save storage locations.

With the provisions covered by the dependent claims, advantageous developments and improvements of the accident data recorder defined in the basic claim are obtained.