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[54] VEHICLE SPEED RECORDING AND REPRODUCING DEVICES

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[58] Field of Search: 346/33 M, 74 M; 179/100.2 CF, 179/100.2 S; 340/174.1 A

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[57] ABSTRACT

Recording devices with a recording medium which may be driven by the machine to be monitored and has a fixed frequency time track recorded on the medium. Also the recording medium can be driven at a fixed rate and the monitored device may drive a variable frequency generator which is magnetically coupled to the magnetic medium. Another modification provides mixing time reference signals and coupling the results to the magnetic medium.

1 Claim, 11 Drawing Figures

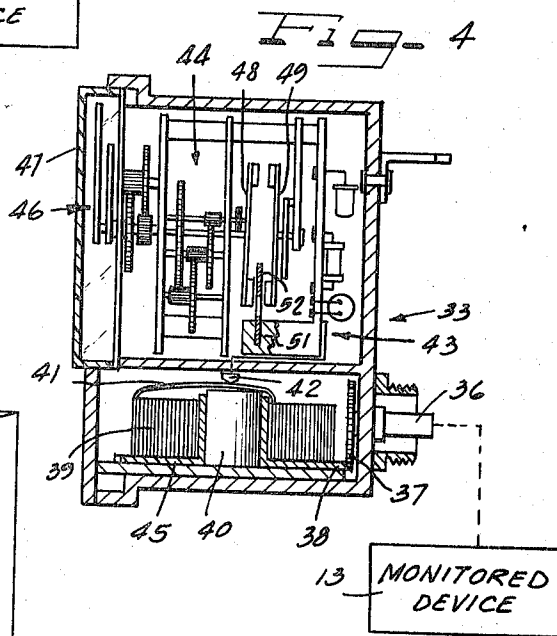
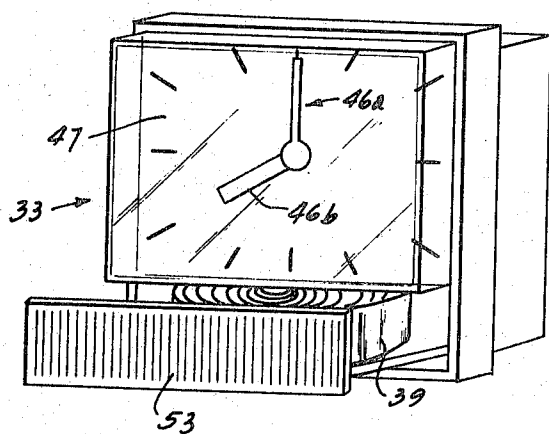
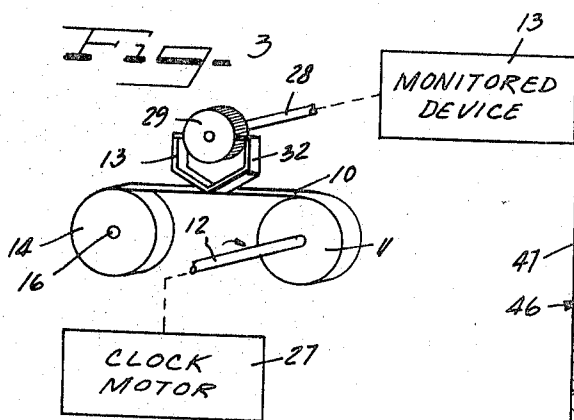
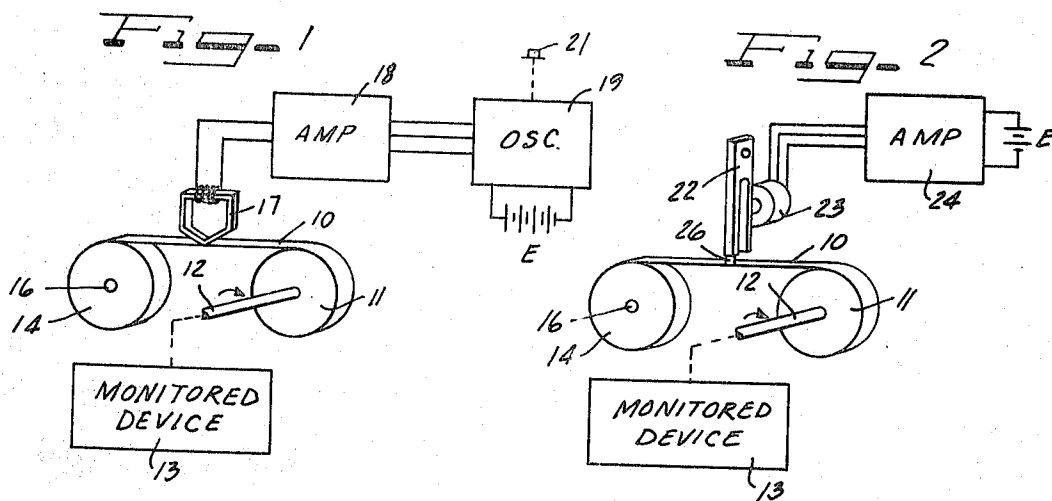


Fig. 5

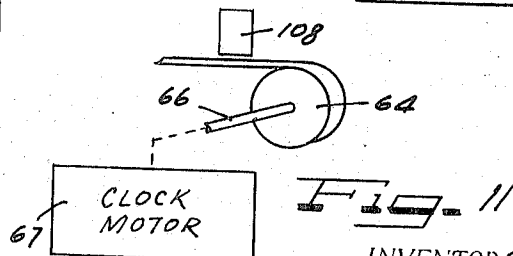
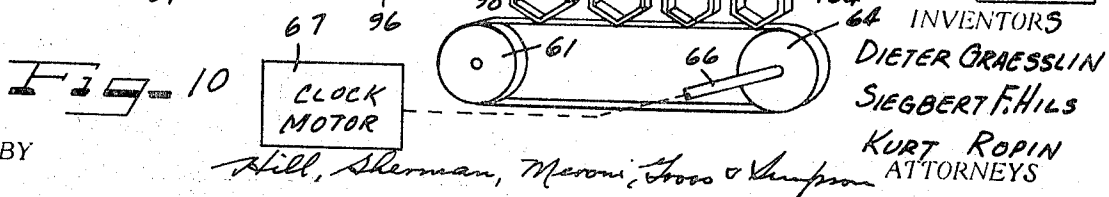
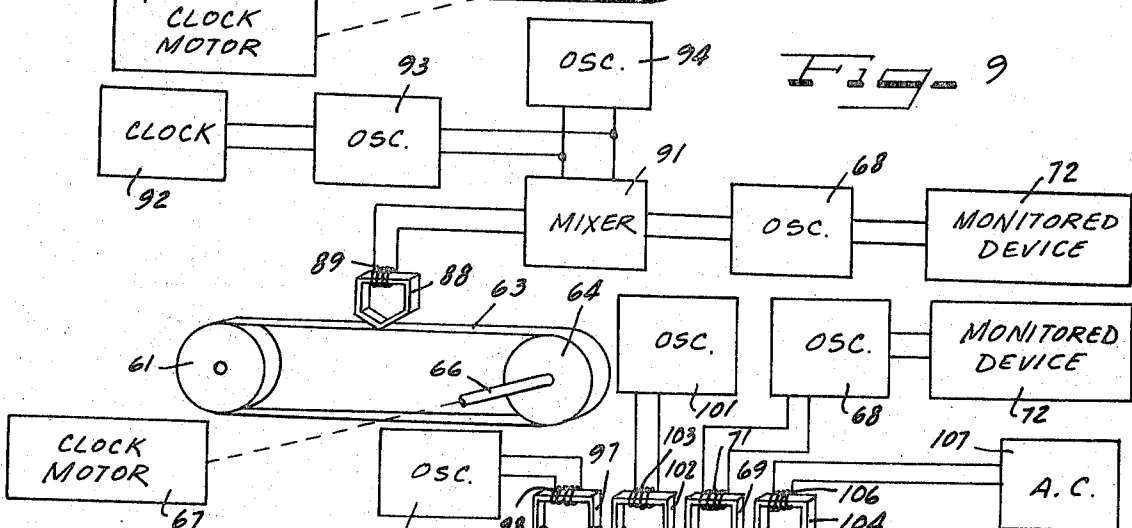
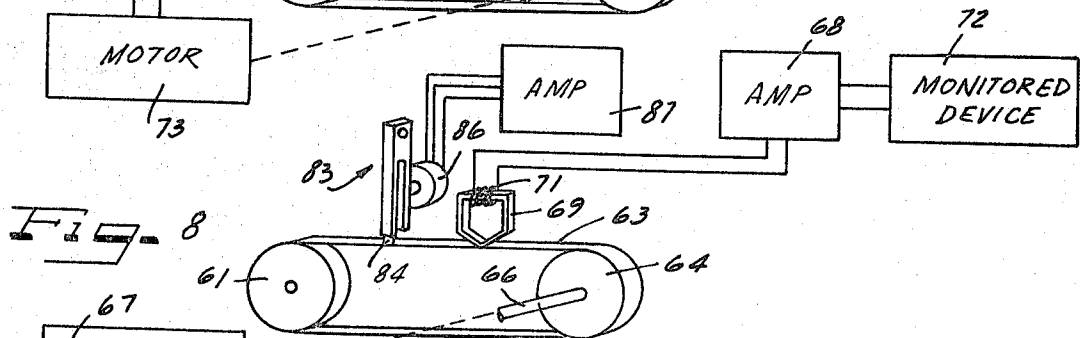
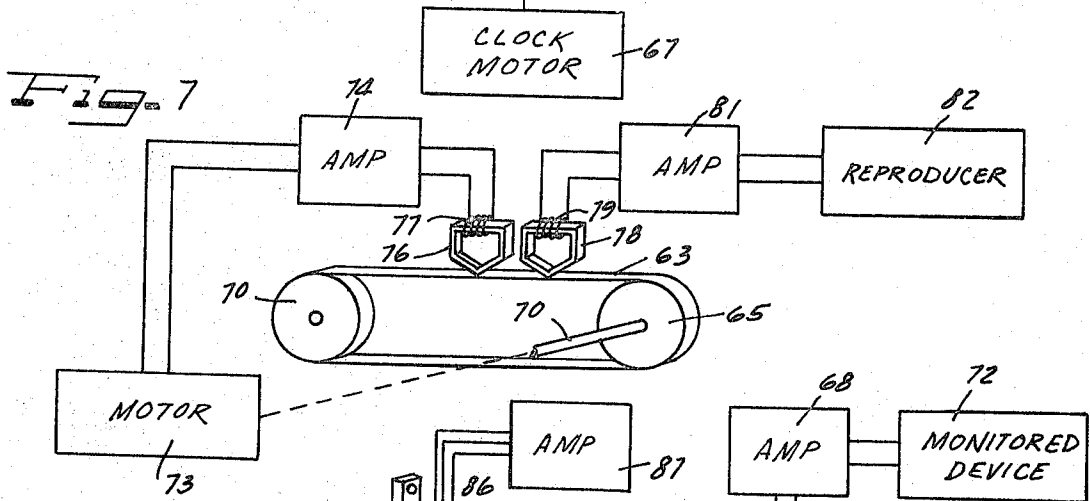
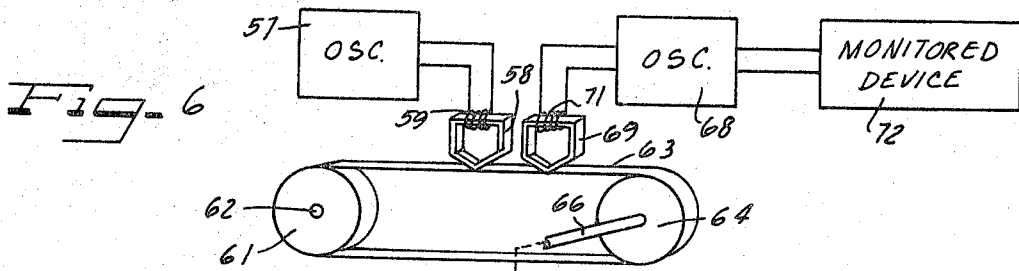


Fig. 6

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VEHICLE SPEED RECORDING AND REPRODUCING DEVICES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to recorders for monitoring factors as a function of time and in particular to recorders for vehicles and machinery so as to obtain a continuous time record of the devices.

2. Description of the Prior Art

Recording devices for measuring the variation of parameters as a function of time have been previously known, for example, recorders wherein a recording medium moves in a plane, or in a cylindrical curve about a cylinder have been known. Also, disks and tapes which are endless belts or of finite length have been known. In a particular prior art recording device for monitoring operating machinery in industry, a mechanical scribing mechanism is driven by a flexible shaft which is connected to the shaft of the machinery to be monitored. The connection may be directly made or through a suitable transmission. Circular storage disks driven by mechanical clocks and in which the disks are covered with wax coating and having the scribing needles guided radially are also known. For example, the rotary velocity of a drive shaft or the number of revolutions may be recorded by this means. Such apparatus requires inspection and service from time to time by trained personnel. Such mechanisms often do not give the resolution of the data which is desired.

SUMMARY OF THE INVENTION

The present invention comprises a recording device with a magnetic recording medium which allows accurate and continuous recording and reproduction of a record or various variables. For example, the speed versus time characteristic of a vehicle can be monitored so as to have an accurate record of the speed and distance travelled at all times. Since distance travelled can be obtained by integrating the distance, a complete record of the vehicle may be maintained for logging and traffic purposes. Many other machines such as production machines for testing and use in metal processing, the textile industry or in testing fields such as electronics or electrical engineering, may also be monitored to record the operating speed of machines or conveyances. The present invention may be used in such applications to produce an accurate record.

It is an object of the present invention to provide an inexpensive maintenance-free monitoring device which is more accurate than presently used mechanisms. In some applications the recording medium is driven at a speed proportional to the monitored device and in other applications the recording medium is driven by a clock motor and the monitored device is coupled magnetically to the recording medium.

Either electronic oscillators or mechanical oscillators such as tuning forks are used in different embodiments. In certain embodiments reference time signals are also magnetically provided on the recording medium which may be used to synchronize a reproducing device and to remove any fluctuations in the clock motor mechanism which drives the recording medium.

Other objects, features and advantages of the invention will be readily apparent from the following

description of certain preferred embodiments thereof taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of apparatus for making a recording of the operation of a monitored device;

FIG. 2 is a modification of the invention;

FIG. 3 is a further modification of the invention;

FIG. 4 is a sectional view taken through apparatus for practicing the invention;

FIG. 5 is a perspective view of the apparatus of FIG. 4;

FIG. 6 illustrates a modification of the invention;

FIG. 7 illustrates a reproduction system of the invention;

FIG. 8 illustrates a modification of the invention;

FIG. 9 illustrates a further modification of the invention;

FIG. 10 illustrates a modification of the invention; and

FIG. 11 illustrates a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates the invention comprising a magnetic recording medium 10 which is supported on reels 14 and 11. Shaft 12 drives reel 11. Reel 14 is mounted on shaft 16 and is spring-biased so as to maintain the tape 10 taut. A monitored device 13 is connected to shaft 12 and drives it at a speed proportional to the condition of the monitored device. For example, if speed is being monitored, shaft 12 will be driven by the device 13 proportional to the speed. The tape 10 is driven past a magnetic head 17 which receives the output of an oscillator 19 through an amplifier 18. The oscillator 19 has a shaft 21 for adjusting its output frequency and receives an input from a power supply as for example the battery, E.

The output of the oscillator 19 is recorded on the tape 10 as it is driven by the monitored device 13 such that the magnetic record on the tape 10 will be a record of the monitored device 13 as a function of time. The tape 10 may be reproduced on a suitable magnetic reproducing device.

FIG. 2 illustrates a modification of the invention wherein the electronic oscillator 19 is replaced with a mechanical oscillator, as for example, a tuning fork 22 which carries a magnet 26 on one of its legs which is spaced closely adjacent the tape 10. A solenoid 23 drives the tuning fork 22 and is provided with an electronic feedback circuit to an amplifier 24 which energizes the solenoid 23 at the resonant frequency of the tuning fork. The monitored device 13 drives the tape 10 as in FIG. 1 and the results is a magnetically recorded record of the operation of the monitored device as a function of time.

FIG. 3 is another modification of the invention wherein a clock motor 27 drives the shaft 12 to move the tape 10 at a constant rate. The monitored device 13 is connected to a shaft 28 which drives a notched toothed wheel 29 of magnetic material that is supported between two magnetic yoke members 31 and

32. Members 31 and 32 have an air gap adjacent the tape 10 such that the speed of the notched wheel 29 will determine the spacings of the magnetic record on the tape 10.

FIGS. 4 and 5 illustrate apparatus for making a record of a monitored device. A housing 33 has a transparent face 47 through which the hands 46a and 46b of a clock mechanism may be seen. A drawer 53 is mounted in the bottom of the housing 33 and carries a reel 45 mounted on a supporting pin 40. Magnetic tape 39 of the endless type is mounted on the reel 45 and has a portion 41 which extends from the inner turn to the outer turn as in conventional tape magazines. The specific details of moving the tape from the inner turn to the outer turn is not illustrated but is well known to those skilled in the art.

The reel 45 has a toothed flanged portion 38 which meshes with a gear 37 that is driven by a shaft 36 connected to the monitored device 13. Thus the tape reel 45 is driven at a speed determined by the monitored device. A magnetic head 42 receives an input from an electronic amplifier 43 which is energized by magnetic pickup 52 that is magnetically coupled to a magnetic balance wheel comprising the disks 48 and 49 which carry magnets on their faces and which are driven by the clock motor 44. Thus, the head 42 produces a fixed frequency output which is recorded on the tape 39 as the clock motor runs. The speed of the reel 45 is controlled by the monitored device and thus the tape carries a time proportional record of the monitored device for a period equal to the length of the tape 39.

Such a recording device may be used as a record for monitoring a truck, train, airplane or automobile, for example. The tape 39 may be provided with a supply for 48 hours and periodically the tape may be replaced. If the tape is not replaced it will continuously monitor the last 48 hours of operation.

Such a device allows the speed of the vehicle to be continuously monitored and can be used to determine that traffic regulations have not been violated. The magnetic head 42 may contain an erasing head such that a continuous record is maintained for a fixed time and with such apparatus it is not necessary to continuously change the magnetic medium 39 since only the last 48 hours will be recorded.

Alternatively, the reel 45 may be removed and the tape 39 stored for future references.

The shaft 36 may be coupled to the tachometer drive or other drive equipment of a vehicle, for example, and the face of the housing 33 may be mounted on the dashboard of the vehicle so that it may be used as a clock by the operator.

In apparatus wherein the monitored device directly drives the tape medium, it is possible under certain conditions that widely fluctuating speeds occur resulting in rapid accelerations and decelerations of the monitored device. This can result in a fluctuation in the advance speed of the magnetic drive. For such loads and conditions a modification of the invention as illustrated in FIGS. 6-11 may be utilized.

Jarring and abrupt acceleration and deceleration of direct current miniature motors which are often used as the drive for endless tape cartridge machines results in breakdown and failure due to the adverse conditions.

It is also desirable when the magnetic tape is removed from a machine that the time and operating position of the tape relative to the machine at that particular time should be maintained. This requires a marked stationary reference point in the apparatus and on the tape so that the reproduction may be measured from this reference. It is also desirable that the placing of the reference will not impair the reuse of the tape so that repeated use may be made.

The present invention provides a cheap and accurate system which provides for the time proportional advance of the tape independently of the drive and also provides that removal of the tape from the device may be effected with a reference so that the stored time intensity measurement values are accurately maintained and reproduced.

To accomplish this, the time reference electrical signal is produced by a standard frequency source and recorded on the tape along with a recording which varies as a function of the monitored device. Thus, by controlling a playback machine with the standard frequency recorded on the tape, it may be driven at a fixed rate to accurately reproduce the record of the monitored device. It is also, of course, possible to directly compare the recording on the tape from the monitored device with the recorded standard frequency on the tape.

The standard frequency may be formed by an electronic oscillator which is applied with a magnetic head to the tape so that a double track is formed on the tape, one of which carries the standard frequency and the other which carries the output of the monitored device. Instead of an electronic oscillator the standard frequency may also be produced with a vibrating quartz, a tuning fork or other reference source. When recording with the system of the invention, a reproduction of the response of the monitored device will be made even under extreme accelerating and decelerating conditions as for example when braking occurs prior to an accident. The reaction of the person driving as well as the operational state of the brakes over the recorded braking interval may also be determined.

In the invention, a standard frequency may be superheterodyned on the frequency controlled by the monitored device with an electronic mixing circuit.

FIG. 6 illustrates a magnetic medium 63 which may be continuous tape, for example, that passes about the rollers 61 and 64 mounted respectively on the shafts 62 and 66. A clock motor 67 drives the shaft 66. The magnetic head 58 has a winding 59 which is energized by an oscillator 57 to provide a fixed reference frequency on the tape 63. A second track on the tape 63 is energized by a second magnetic head 69 which has a winding 71 that is connected to an oscillator 68 whose frequency is controlled by a monitored device 72.

FIG. 7 illustrates a playback system wherein the tape 63 is mounted on reels 70 and 65. The tape is driven by shaft 70 from a motor 73 which is controlled by the output of an amplifier 74 connected to a winding 77 on read head 76. The read head 76 detects the first track on the tape which comprises the output of the standard oscillator 57 illustrated in FIG. 6, and drives the motor 73. A second read head 78 has a pickup winding 79 that is connected to an amplifier 81 that supplies an output to reproducer 82. Since the standard frequency

signal is utilized to drive the motor 73, the tape 63 will be driven at a rate so that the output of the reproducer from the second track will be proportional to the operation of the monitored device as a function of time.

FIG. 8 is a modification of the invention of FIG. 6 wherein the oscillator 57 has been replaced by a tuning fork 83 which has a magnet 84 mounted on one of its legs. The tuning fork 83 is driven by a solenoid 86 which has a feedback arrangement with an amplifier 87 to energize the tuning fork at its resonant frequency. The magnet 84 will make a reference time track on the tape and the second track will be produced by the write head 69 from the monitored device 72 as in FIG. 6.

FIG. 9 illustrates a modification of the invention wherein the tape 63 is driven by a clock motor 67 and a write head 88 has an energizing winding 89 that is connected to the output of a mixer 91. The mixer 91 receives an input from an oscillator 68 whose frequency is varied as a function of the monitored device 72. Mixer 91 also receives an input from an oscillator 94 and also an input from an oscillator 93 which has a different frequency from the oscillators 94 and 68, and which is controlled by a clock 92 so that periodically a time reference is reproduced on the tape 63. In other words, the clock 92 periodically turns the oscillator 93 on such that at certain predetermined times, as for example, each hour or every twelve hours or at any desired interval, a time reference signal is produced on the tape 63.

In order to mark and identify the operating position of the tape in the case of removal of the tape from the recorder, the apparatus of FIG. 10 may be utilized which provides an erasing head 104 which is energized by winding 106 from an A.C. source 107 and a write head 97 which is energized by winding 98 from an oscillator 96. The write head 97 is aligned with the erase head 104 such that the tape 73 continuously has between the heads 97 and 104 a third track which provides for indexing of the tape relative to the recording machine. The write head 69 is coupled to oscillator 68 which is controlled by the monitored device 72 and the write head 102 receives the output of oscillator 101 and provides a standard reference signal on the tape.

FIG. 11 illustrates a modification of the invention of FIG. 10 wherein the erase head 104 has been replaced by a permanent magnet 108 so as to erase the third track generated by the oscillator 96 on the tape.

The advantages of the present invention are that the load and adverse influences on the drive for advancing the tape which can cause a variation in the speed of the tape is eliminated by the recording of the standard frequency. Also, the standard frequency on the tape can be used as a synchronizing signal in the playback

device.

Also the provision of a marking signal on the magnetic tape provides clear indexing of the tape with respect to a fixed point on the recorder and may be used as a reference for the monitored device.

Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

What we claim is:

1. Recording and reproducing devices wherein said recording device comprises:

- an endless belt storage medium;
- a pair of rollers supporting said storage medium;
- a constant speed motor connected to one of said rollers to drive said belt storage medium at a constant speed;
- a fixed standard frequency electronic oscillator;
- a first recording head, a first winding mounted on said first recording head and connected to said fixed frequency electronic oscillator so that said first recording head records a constant frequency track on said storage medium;
- a variable frequency oscillator;
- a second recording head, a second winding mounted on said second recording head and connected to said variable frequency oscillator so that said second recording head records a variable frequency track on said storage medium;
- a vehicle connected to said variable frequency oscillator to vary its frequency as a function of the speed of said vehicle, wherein said reproducing device comprises:
 - a pair of reels over which said belt storage medium is received;
 - a first read head, a third winding mounted on said first read head and mounted to read the track on said medium produced by said first recording head as it passes over said pair of reels;
 - an electric motor connected to receive the output of said third winding on first read head and connected to one of said reels to drive said belt storage medium;
 - a second read head, a fourth winding mounted on said second read head and mounted to read the track on said medium produced by said second recording head as it passes over said pair of reels; and
 - a reproducer means connected to said fourth winding on said second read head to produce a record output indicative of the speed of said vehicle as a function of time.

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