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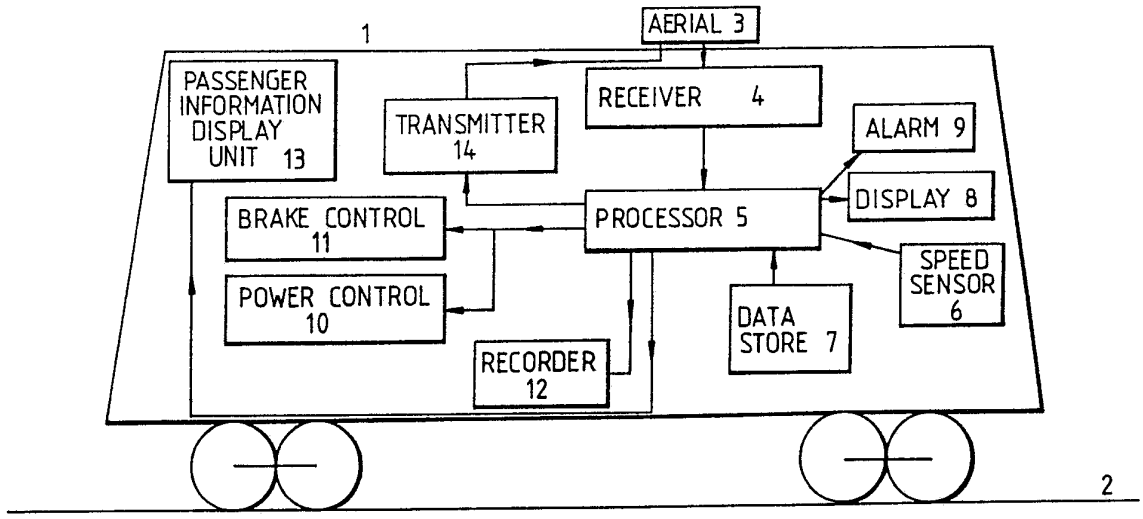
(54) Title: RAILWAY NETWORK MONITORING AND CONTROL



(57) Abstract

A railway network monitoring system monitors the position and speed of a train (1) on a track (2). An aerial (3) and receiver (4) receive signals from earth satellites of a global positioning system, for example the Navstar System. The signals are passed to a processor (5) which determines the location of the train (1). The speed of the train (1) is measured by a speed sensor (6) and the measured value is input to the processor (5). The processor (5) accesses a digitally coded information from a data store (7) of a map of the train's route and associated speed data. The processor (5) then compares the train's determined location with the map and compares the known speed of the train (1) with the maximum permissible speed programmed into the data store for that particular location. The train's location, speed and difference from the maximum allowed are displayed on a visual display unit (8). If the train (1) is exceeding the allowed maximum on alarm (9) is activated to warn the driver. If the train (1) is exceeding the speed limit by a predetermined margin the power is reduced and/or the brakes applied by a power control unit (10) and brake control unit (11) respectively.

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RAILWAY NETWORK MONITORING AND CONTROL

The present invention relates to the monitoring of vehicles on a rail network, in particular to the monitoring of location and speed.

A particular problem with rail networks is ensuring that vehicles do not travel faster than safe limits for the tracks. For the safe operation of the network it is necessary for the driver to be warned if the vehicle is exceeding the safe speed limit for that section of track.

At present speed limit indicators are positioned alongside the track and the driver monitors the vehicle speed. This presumes that the driver is alert at all times and also that he will not intentionally exceed the speed limit.

An alternative is to position speed sensors at positions along the track that measure the vehicle's speed and operate an alarm if it exceeds the speed limit. This requires equipment to be fitted along the tracks and if the network is large, much equipment will be required for effective coverage of the system. Track fitted equipment will also require regular maintenance and must be protected against the weather and possible damage. Thus installation and care of such a system can be very expensive.

The object of the invention is principally to provide a means of monitoring the speed of vehicles on a rail network.

A further object of the invention is to provide a means of monitoring the speed and location of vehicles on a rail network without the need for equipment to be fitted on or adjacent to the tracks.

The invention provides a means of monitoring a vehicle on a rail network comprising:

a) a location sensor;

b) a speed sensor;

c) a data store containing information relating to the rail network and to maximum speeds at a number of positions on the network;

d) comparator means to compare the sensed speed of the vehicle with the maximum speed for the vehicle location; and

e) means responsive to the output of the comparator means.

Preferably the location sensor includes a receiver responsive to global positioning information transmitted by earth satellites.

Preferably the location sensor includes means to determine the positional co-ordinates of the vehicle from the global positioning information. Conveniently the positional co-ordinates are derived in terms of the latitude and longitude co-ordinates.

The speed sensor may be of any appropriate type. Conveniently speed readings may be derived from an on-vehicle sensor such as a normal speedometer. Alternatively the speed can be calculated, either using computing means, from the time taken to travel between two points determined by global positioning information, or measured by the receiver as velocity.

Preferably the information relating to the rail network contained in the data store is stored in the form of maps of the network with details of maximum speed permissible over the network. Conveniently each route has a corresponding map and the data store is suitable for storing the desired number of maps which could be all the maps relating to the network or the map relating to a specific route for the vehicle, or to a plurality of possible routes.

The maps are conveniently stored in digital form and may be stored on magnetic disks to enable an appropriate disc to be selected for any particular vehicle.

Preferably the comparator means to compare the sensed speed of the vehicle with the maximum speed for the vehicle location, is a microprocessor programmed to compare the vehicle speed read from the speed sensor with speed information given by the route map stored in the data store for the position of the vehicle as determined by the speed sensor.

Conveniently the means responsive to the output of the comparator is an alarm which is operated if overspeed is indicated. Alternatively it may be a display, visible to the driver, which indicates the vehicle speed and the difference from the maximum speed. The display may also include location information for the driver. Another alternative is for automatic removal of power to the engine or application of braking in the event of overspeed being indicated. One or a combination of these response means may be used.

Advantageously the invention may include one or more additional features such as a "black box" to record locations and speeds for accident analysis if necessary.

Inclusion of a facility to enable the location and speed information

to be transmitted back to a central network control point allows the system to be used to assist in the overall control of the routes and the network.

The invention can easily be extended to include an autopilot facility such that the vehicle speed can be controlled over the route travelled. This can be used to provide optimum utilisation of the network and vehicles.

A further addition could be an information unit for passengers, triggered by the sensed location point. This unit could include a data store with information on the location, estimated times of arrival etc triggered by the sensed location of the vehicle. The information could be presented visually or orally.

The invention will now be described by way of example with reference to the drawings of which:

Figure 1 shows a schematic diagram of a vehicle location and speed monitor according to the invention for a train on a rail network; and

Figure 2 shows a monitor as shown in Figure 1 with additional features.

Figure 1 shows a representation of a train 1 on a track 2. An aerial 3 and receiver 4 receive signals from earth satellites of a global positioning system, for example the Navstar System. The signals are passed to a processor 5 which determines the location of the train 1. The speed of the train 1 is measured by a speed sensor 6 and the measured value is input to the processor 5. The processor 5 accesses a digitally coded information from a data store 7 of a map of the train's route and associated speed data. The processor 5 then compares the train's determined location with the map and compares the known speed of the train 1 with the maximum permissible speed programmed into the data store for that particular location.

The train's location, speed and difference from the maximum allowed are displayed on a visual display unit 8. If the train 1 is exceeding the allowed maximum on alarm 9 is activated to warn the driver. If the train 1 is exceeding the speed limit by a predetermined margin the power is reduced and/or the brakes applied by a power control unit 10 and brake control unit 11 respectively.

Whilst the train is in service the location and speed data from the

processor 5 are recorded in a recorder 12 for later analysis if required.

Figure 2 shows the system of Figure 1 with additional features. A passenger information display unit 13 responds to information from the processor 5. The unit 13 can be used to give passengers a visual display of location background, features, history etc as well as information on the train speed, estimated times of arrival and so on.

The system also includes a transmitter 14 which transmits the location and speed information derived from the processor 5 back to a central positioning station, thus allowing overall monitoring and control of the rail network from a central control point.

The invention provides a versatile and effective speed and location monitoring system for rail networks which also has the facility of being extended to include various additional features. The system lends itself to use on rail networks in particular as each vehicle can be given a unique identifying number and each route timetable requirement is individual.

In particular the invention assists in making optimum use of vehicles on the network and also increases safety by ensuring that vehicles do not travel at dangerous speeds.

CLAIMS

1. A means of monitoring a vehicle on a rail network characterised in that it comprises:

a) a location sensor including a receiver responsive to global positioning information transmitted by earth satellites;

b) a speed sensor;

c) a data store containing information relating to the rail network and to maximum speeds at a number of positions on the network;

d) comparator means to compare the sensed speed of the vehicle with the maximum speed for the vehicle location; and

e) means responsive to the output of the comparator means.

2. A means of monitoring a vehicle on a rail network according to claim 1 characterised in that the location sensor includes means to determine the positional co-ordinates of the vehicle from the global positioning information.

3. A means of monitoring a vehicle on a rail network according to claim 2 characterised in that the positional co-ordinates are derived in terms of the latitude and longitude co-ordinates.

4. A means of monitoring a vehicle on a rail network according to any one preceding claim characterised in that the information relating to the rail network contained in the data store is stored in the form of maps of the network with details of maximum speed permissible over the network.

5. A means of monitoring a vehicle on a rail network according to claim 4 characterised in that each route has a corresponding map and the data store is suitable for storing the desired number of maps.

6. A means of monitoring a vehicle on a rail network according to claim 4 or claim 5 characterised in that the maps are stored in digital form.

7. A means of monitoring a vehicle on a rail network according to any one

preceding claim characterised in that the comparator means to compare the sensed speed of the vehicle with the maximum speed for the vehicle location, is a microprocessor programmed to compare the vehicle speed read from the speed sensor with speed information given by the route map stored in the data store for the position of the vehicle as determined by the speed sensor.

8. A means of monitoring a vehicle on a rail network according to any one preceding claim characterised in that the means responsive to the output of the comparatoris an alarm which is operated if overspeed is indicated.

9. A means of monitoring a vehicle on a rail network according to any one of claims 1 to 8 characterised in that the means responsive to the output of the comparator is a display, visible to the driver, which indicates the vehicle speed and the difference from the maximum speed.

10. A means of monitoring a vehicle on a rail network according to claim 9 characterised in that the display includes location information for the driver.

11. A means of monitoring a vehicle on a rail network according to any one of claims 1 to 7 characterised in that the means responsive to the output of the comparator causes automatic removal of power to the engine or application of braking in the event of overspeed being indicated.

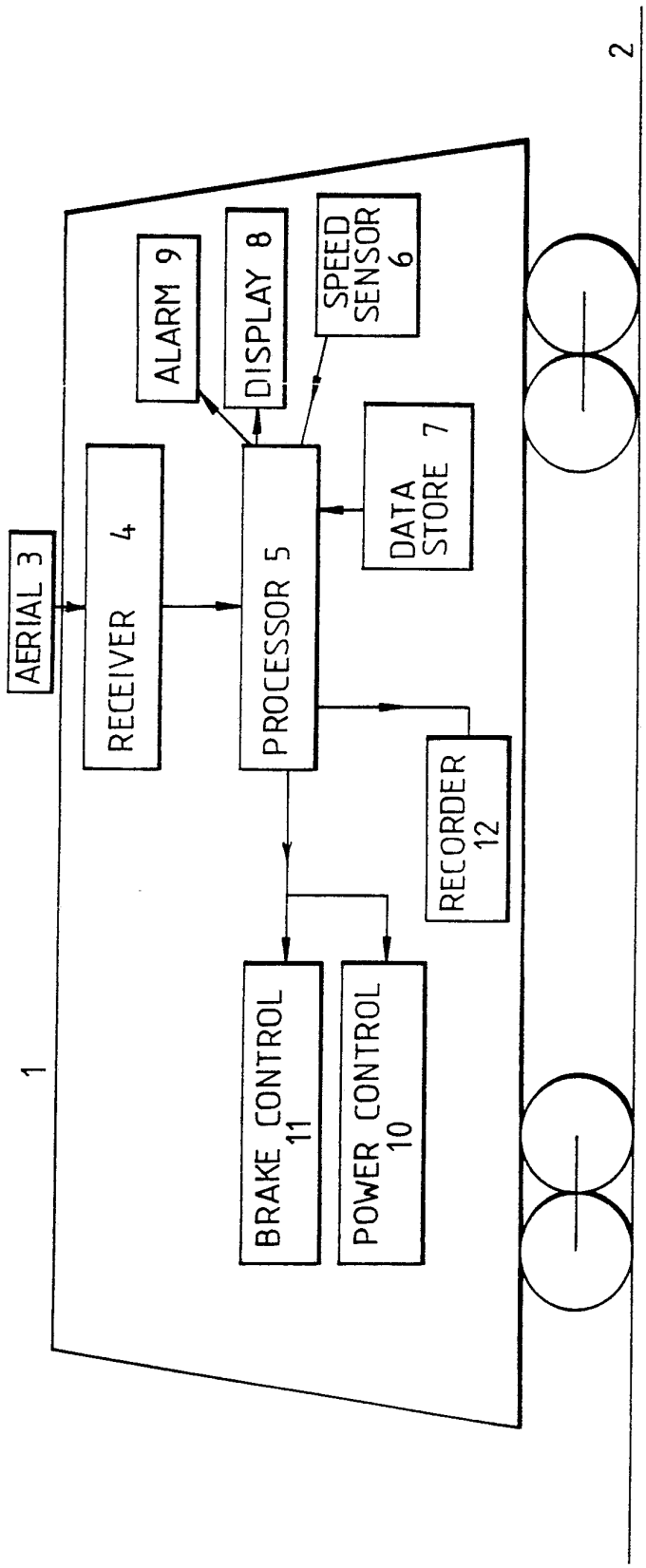
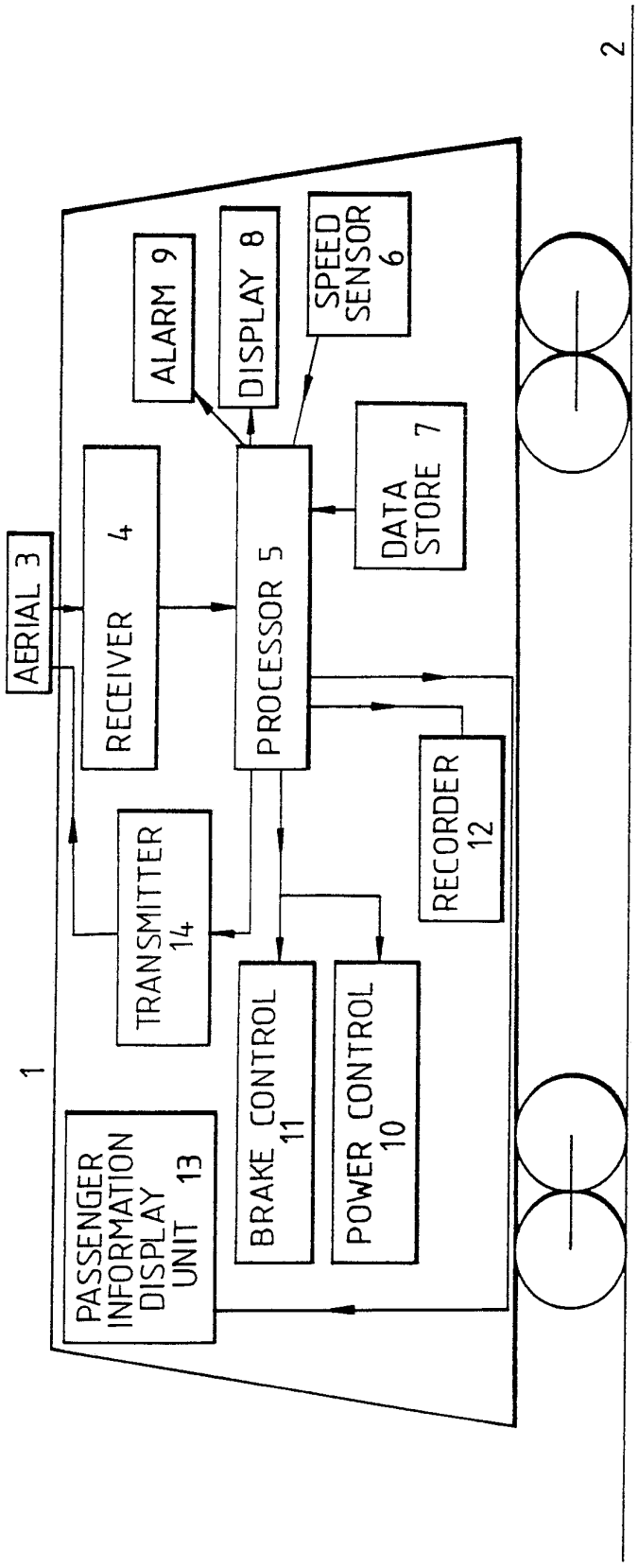

AERIAL 3
RECEIVER 4
PROCESSOR 5
DATA STORE 7
SPEED SENSOR 6
DISPLAY 8
ALARM 9
RECORDER 12
BRAKE CONTROL 11
POWER CONTROL 10
1
2

Fig.1

Fig.2


2
1
AERIAL 3
RECEIVER 4
PROCESSOR 5
DATA STORE 7
ALARM 9
DISPLAY 8
SPEED SENSOR 6
TRANSMITTER 14
RECORDER 12
BRAKE CONTROL 11
POWER CONTROL 10
PASSENGER INFORMATION DISPLAY UNIT 13

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/01067

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 61 L 3/00; B 61 L 25/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 61 L; G 01 S

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No [13]
Y	US, A, 4181943 (MERCER Sr et al.), 1 January 1980, see the whole document --	1-11
Y	DE, A, 3227547 (MÜLLER) 2 February 1984, see abstract; figure --	1-11
A	DE, A, 2156811 (SCHUBERT) 24 May 1973, see the whole document	1,4-11

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* Special categories of cited documents: [10]

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17th March 1989	10 APR 1989
International Searching Authority: EUROPEAN PATENT OFFICE	Signature of Authorized Officer: P C G VAN DER PUTTEN

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8801067 SA 25907

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 05/04/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4181943	01-01-80	None	
DE-A- 3227547	02-02-84	GB-A,B 2126040	14-03-84
		FR-A,B 2532078	24-02-84
		DE-A- 3310111	27-09-84
DE-A- 2156811	24-05-73	None	