SPRUSON & FERGUSON

SPECIFICATION ACCEPTED AND AMENDMENTS ALLOWED 24:1.90

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

CONVENTION APPLICATION FOR A STANDARD PATENT OR A PATENT OF ADDITION

We, MITSUBISHI DENKI KABUSHIKI KAISHA, of No. 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan hereby apply for the grant of a standard patent for an invention entitled:

"TRAIN MONITORING SYSTEM HAVING SIMULATED MALFUNCTIONS"

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION

Number of Basic Application:-
215110/85

Name of Convention Country in which Basic Application was filed:-
Japan

Date of Basic application:-
30 September, 1985

PATENT OFFICE
A.C.T. SUB-OFFICE
086947
Collector of Public Moneys

Our address for service is:-

C/- Spruson & Ferguson
Patent Attorneys
Level 33 St Martins Tower
31 Market Street
Sydney New South Wales Australia

DATED this THIRTIETH day of SEPTEMBER 1986

MITSUBISHI DENKI KABUSHIKI KAISHA

By:

Registered Patent Attorney.

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA

LODGED AT SUB-OFFICE
30 SEP 1986
Sydney

SBR:eah 64U

Spruson & Ferguson

AUSTRALIA
CONVENTION
STANDARD
& PETTY PATENT
DECLARATION
SFP4

COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

Title of Invention

"TRAIN MONITORING SYSTEM HAVING SIMULATED MALFUNCTIONS"

Full name(s) and address(es) of Declarant(s)

I/~~We~~ Hisao OKA

~~of~~ c/o Mitsubishi Denki Kabushiki Kaisha, No. 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan

do solemnly and sincerely declare as follows:—

Full name(s) of Applicant(s)

~~1. I am/We are the applicant(s) for the patent~~

(or, in the case of an application by a body corporate)

1. I am/~~We are~~ authorised by MITSUBISHI DENKI KABUSHIKI KAISHA the applicant(~~s~~) for the patent to make this declaration on its/~~their~~ behalf.

2. The basic application(~~s~~) as defined by Section 141 of the Act was/~~were~~ made

Basic Country(ies)

in Japan

Priority Date(s)

on September 30, 1985

Basic Applicant(s)

by MITSUBISHI DENKI KABUSHIKI KAISHA

~~3. I am/We are the actual inventor(s) of the invention referred to in the basic application(s)~~

Full name(s) and address(es) of inventor(s)

(or where a person other than the inventor is the applicant)

3. Yasutaka NOZAKI, Hidetoshi HOMMA and Kenji MORIHARA

~~of~~ all c/o Mitsubishi Denki Kabushiki Kaisha Itami Works, No. 1-1, Tsukaguchihonmachi 8-chome, Amagasaki-shi, Hyogo, Japan

~~(respectively)~~

is/are the actual inventor(s) of the invention and the facts upon which the applicant(~~s~~) is/~~are~~ entitled to make the application are as follows:

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s)

Applicant is the Assignee of the invention from the Inventors.

4. The basic application(~~s~~) referred to in paragraph 2 of this Declaration was/~~were~~ the first application(~~s~~) made in a Convention country in respect of the invention(~~s~~) the subject of the application.

Declared at Tokyo, Japan this 25th day of July, 19 86

MITSUBISHI DENKI KABUSHIKI KAISHA

Hisao Oka

Signature of Declarant(s)

Hisao OKA, Managing Director

SFP4 To: The Commissioner of Patents 11/81

(12) PATENT ABRIDGMENT (11) Document No. AU-B-63297/86
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 595242

(54) Title
FAULT SIMULATION IN TRAINS

International Patent Classification(s)
(51)[4] B60L 003/00

(21) Application No. : 63297/86 (22) Application Date : 30.09.86

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60-215110	30.09.85	JP JAPAN

(43) Publication Date : 02.04.87

(44) Publication Date of Accepted Application : 29.03.90

(71) Applicant(s)
MITSUBISHI DENKI KABUSHIKI KAISHA

(72) Inventor(s)
YASUTAKA NOZAKI; HIDETOSHI HOMMA; KENJI MORIHARA

(74) Attorney or Agent
SPRUSON & FERGUSON

(57) Claim

1. A monitoring system, comprising:

terminal stations installed respectively on a plurality of cars formable into a train, each said terminal station collecting operational data indicating the occurrence of malfunctions of devices mounted on said car on which said each terminal station is mounted;

a central station installed on a particular one of said cars for controlling the operations of said terminal stations and for collecting data from said terminal stations and for storing said collected data; and

a display unit installed on at least a selected one of said cars, said display unit being controlled by said central station to display predetermined data in response to said collected data;

wherein each of said terminal stations includes a simulation section for simulating said malfunctions by supplying an electrical signal to said central station in the same state as if an actual malfunction had occurred, and

said central station includes a setting section for controlling the start and the operation of a selected one of said ~~false trouble generating~~ simulation sections.

FORM 10 SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

595242

63297/86.

Class Int. Class

Complete Specification Lodged:

Accepted:

Published:

Priority:

Related Art:

Name of Applicant: MITSUBISHI DENKI KABUSHIKI KAISHA

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Actual Inventor(s): YASUTAKA NOZAKI, HIDETOSHI HOMMA
and KENJI MORIHARA

Address for Service: Spruson & Ferguson, Patent Attorneys,
Level 33 St Martins Tower,
31 Market Street, Sydney,
New South Wales, 2000, Australia

Complete Specification for the invention entitled:

"TRAIN MONITORING SYSTEM HAVING SIMULATED MALFUNCTIONS"

The following statement is a full description of this invention, including the best method of performing it known to us
SBR:eah 64U

ABSTRACT OF THE DISCLOSURE

A train monitoring system in which each car of the train has a monitoring device for detecting malfunctions on that car and transmitting the type of malfunction to a central station. Each of the monitoring devices also includes a simulation section for producing a signal similar to that for a malfunction. The simulation section is triggered by the control station and the resultant signal is treated just like a malfunction.

TRAIN MONITORING SYSTEM HAVING SIMULATED MALFUNCTIONS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a train monitoring system. In particular, it relates to a system in which detects when trouble or abnormal operations occur in a variety of devices installed on a plurality of railway vehicles composing a train. The system then provides assisting data as to the operations to be taken after the occurrence of the trouble, such as the nature and the location of the trouble and the proper response. The system of the invention has the capability of simulating such troubles.

Background Art

A conventional train monitoring system is shown in Fig. 5. In Fig. 5, railway cars I, II, III ... and N form a train. More specifically, cars I and N are the end railway cars at opposite ends of the train and vehicles II, III ... N-1 are the remaining railway cars. A railway car may either provide its own motive power or be moved by one or more of the remaining cars. Railway cars can be separated from each other so that the problem exists of operating separate cars in an integrated train. The

operating conditions of devices 11, 21, 31 ... and N1 on the railway cars are to be monitored at all times. Terminal sections 12, 22, 32 ... and N2 are installed on respective railway cars. These terminal stations 12 through N2 operate to detect the abnormal operations of the respective devices 11 through N1. Furthermore, the terminal stations 12 through N2 have data transmission control sections (not shown) which, when the abnormal operations are detected, transmit the data to the central station 13 (described later) installed on the one end railway car I. The central station is connected to the terminal stations 12, 22, 32 ... and N2 through a transmission line 5 which is laid through all the railway cars, so that the data of the abnormal operations detected by the terminal stations 12 through N2 are sent to the central station 13 over the transmission line 5. Further in Fig. 5, display units 14 and N4 comprising a cathode ray tube (CRT) are installed on both of the end railway cars I and N. When an abnormal condition occurs in the train, its type and location and a method of dealing with it are display units 14 and N4 for the assistance of the train crew.

Now, the operation of the train monitoring system thus organized will be described. As shown in Fig.

6, the secondary stations in the transmission system, namely, the terminal stations 12 through N2 receive the operational data of the devices 11 through N1 to detect whether or not the devices have malfunctioned. The results of detection are transmitted as data signals 1D through ND (indicated by the broken lines in Fig. 6) to the central station 13 in response to request signals 1R through NR (indicated by the one-dot chain line in Fig. 6). The above-described single series of operations are carried out successively for the terminal stations 12 through N2 in the stated order. Therefore, the operating conditions of the railway car devices 11 through N1 can be detected from the data which have been transmitted to the central station 13. The central station 13 has a volatile memory in which the transmitted data are stored.

Now, the operation of the train monitoring system, in the case when any one of the device becomes out of order or an abnormal operation takes place in the device, will be described.

It is assumed that, in Fig. 7, the device 21 of the railway car II has gone out of order. In this case, in response to the request signal 2R from the central station 13, the terminal station 22 transmits a data signal 2D to the central station 13 to inform it of the

fact that the device 21 is out of order. The central station 13 reads the data signal 20 to determine the nature of the trouble, and transmits display signals 1I and NI (indicated by the two-dot chain lines in Fig. 7) to cause the display units 14 and N4 to display the occurrence of the trouble. That is, in response to the display instruction from the central station 13, the display units 14 and N4 display the occurrence of the trouble on the cathode ray tubes (CRT), as shown for instance in the displays of Figs. 8A and 8B.

For example, when any one of the terminal stations 12 through N2 detects that a chopper control device (not shown) which is located in one of the railway vehicle devices 11-N1 has gone out of order, the location of the trouble in the train is displayed as indicated at A-1 in Fig. 8A, and then the type of the trouble is displayed as indicated at A-2. Furthermore, an emergency response is displayed for the operator as indicated at A-3. The operator deals with the difficulty according to the type of the difficulty and the emergency response thus displayed. Thereafter, the result of the emergency response thus taken is displayed as indicated at A-4 in Fig. 8B, and then operational cautions necessary to start the device again are displayed as indicated at A-5. Thus,

all the assisting data required for the operator to perform a series of operations at the occurrence of various malfunctions on the railway cars are displayed on the display units 14 and N4.

The above-described operations will be described in more detail. All the terminal stations 12 through N2 have equivalent circuitry. That is, each terminal station 12-N2 has a structure shown for a terminal station 200 in Fig. 9. The terminal station 200 includes a data inputting section 201, a memory 202, an input data processing section, a memory 204, and a data transmission control section. Figs. 10, 11 and 12 are flow charts for, respectively, the data inputting section 201, the input data processing section 203, and the data transmission control section 205.

First, the operation of the data inputting section 201 will be described with reference to the Figs. 9 and 10. In Step 1 of Fig. 10, the data inputting section 201 receives an operational data signal T1 from a railway car device 11, 21 ... or N1 (not shown), and in Step 2 the output signal T2 of the data inputting section 201 is stored in the memory 202. These operations are repeatedly carried out.

Next, the operation of the input data processing

section 203 will be described with reference to Figs. 9 and 11. In Step 3 of Fig. 11, the operation data T3 stored in the memory 202 is read out. In Step 4, according to the operational data T3 thus read out, it is determined whether or not a trouble or an abnormal operation has taken place. Both a trouble and an abnormal operation will be referred to as a malfunction. In Step 5, when it is determined that no malfunction has taken place, then Step 3 is repeated. If, in Step 5, it is determined that a malfunction has occurred, Step 6 is performed. In Step 6, the nature or type of the malfunction is stored, as a signal T4, in the memory 204. Thereafter, Step 3 is repeated.

Next, the operation of the data transmission control section 205 will be described with reference to Figs. 9 and 12. In Step 7 of Fig. 12, the malfunction type, which is stored in the memory 204 is read out as signal T5. In Step 8, it is transmitted, as a malfunction signal T6, to the central station 13 in response to the request signal R from the central station 13. According to the signal T6, the central station 13 applies a display instruction to the display units 14 and N4.

In the case where the conventional train monitoring system is used to train the crew so that they

can effectively deal with the occurrence of troubles or abnormal operations, it is necessary to externally apply false trouble or abnormal signals to the terminal stational 12-N2. For this purpose, as shown in Fig. 13, a false trouble generating unit 6 is connected to a selected terminal unit (in the case of Fig. 13, being connected to the connecting point of the device 21 and the terminal station 22 on the railway vehicle II).

As was described above, where the conventional train monitoring system is used to train the crew so that they can effectively deal with the occurrence of troubles or abnormal operations, it is necessary to connect the false trouble generating unit 6 to at least one of the terminal units 12-N2. Furthermore, when it is required to connect the unit 6 to each of the terminals units 12-N2, then the unit 6 must be moved along the train. Therefore, if the train is long, the training will become rather difficult.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to eliminate the above-described difficulty accompanying a conventional train monitoring system during training exercises.

More specifically, an object of the invention is

to provide a train monitoring system which makes it unnecessary to externally connect the false trouble generating device to the terminal stations.

A further object of this invention is to make it possible to train the crew so that they can effectively deal with the occurrence of troubles or abnormal conditions in a variety of devices installed on the railway cars.

Accordingly, in one broad form there is provided a monitoring system, comprising:

terminal stations installed respectively on a plurality of cars formable into a train, each said terminal station collecting operational data indicating the occurrence of malfunctions of devices mounted on said car on which said each terminal station is mounted;

a central station installed on a particular one of said cars for controlling the operations of said terminal stations and for collecting data from said terminal stations and for storing said collected data; and

a display unit installed on at least a selected one of said cars, said display unit being controlled by said central station to display predetermined data in response to said collected data;

wherein each of said terminal stations includes a simulation section for simulating said malfunctions by supplying an electrical signal to said central station in the same state as if an actual malfunction had occurred, and

said central station includes a setting section for controlling the start and the operation of a selected one of said ~~false trouble generating~~ simulation sections.

~~transmission control section.~~

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the arrangement of a terminal station in the example of a train monitoring system according to this invention;

Fig. 2 is a flow chart for a description of a data inputting section in the terminal section;

Fig. 3 is an explanatory diagram showing the entire arrangement of the example of the train monitoring system according to the invention;

Fig. 4 is a block diagram showing the arrangement of a terminal station in another example of the train monitoring system according to the invention;

Fig. 5 is an explanatory diagram showing the entire arrangement of a conventional train monitoring system;

Figs. 6 and 7 are explanatory diagrams for a description of the operation of the train monitoring system shown in Fig. 5;

Fig. 8 is also an explanatory diagram showing one example of an instruction displayed on a display unit;

Fig. 9 is a block diagram showing the arrangement of a terminal station in the train monitoring system shown in Fig. 5;

Fig. 10 is a flow chart for a description of the operation of a data inputting section in Fig. 9;

Fig. 11 is a flow chart for a description of the operation of an input data processing section in Fig. 9;

Fig. 12 is a flow chart for a description of the operation of a data transmission control section in Fig. 9.

Fig. 13 is a block diagram for a description of the occurrence of a false trouble in the trains monitoring system shown in Fig. 5.

In these figures, like parts are designated by like reference numerals or characters.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first example of a train monitoring system according to this invention will be described. Fig. 1 shows the arrangement of a terminal station 200a located in each of the cars according to the invention. The terminal station 200a is different from the conventional terminal station 200 of Fig. 9 in that there is included in the data inputting section 201a a false trouble generating section 206 for producing false trouble signals representative of the occurrence of various troubles or abnormal operations (malfunctions). The false trouble signal is stored in the memory 202 irrespective of the

operational data signal T1 which is applied to the data inputting section 201a from the railway car device. A signal T7 applied to the false trouble generating section 206 by the central station 13 is the start instruction signal. The start instruction signal T7 also specifies the type of trouble or abnormal operation. The other circuit elements are the same as those of the conventional terminal unit.

Fig. 2 is a flow chart for a description of the operation of the data inputting section 201a shown in Fig. 1. The operation of the terminal station 200a will be described. In this connection, the operation of the data inputting section 201a will be described with reference to Figs. 1 and 2.

In Step 1 of Fig. 2, the data inputting section 201a reads the operational data signal T1 of the device (not shown). In Step 2, the output signal T20 of the data inputting section 201a is stored in the memory 202. These operations are repeatedly carried out. However, if in Step 9 the central station supplies the start instruction signal T7 to the false trouble generating section 206, according to the start instruction signal T7 the output signal T20 is stored in the memory 202 by being ORed with the false trouble signal provided by the false trouble

generating section 206. The operations of the input data processing section 203 and the data transmission control section 205 are the same as those of the conventional ones which have been described with reference to Figs. 9, 11 and 12. Accordingly, as long as the start instruction signal T7 is applied to the false trouble generating section 206 in the data inputting section 201a by the central station 13, the false trouble signal representing the specified malfunction is stored in the memory 203 irrespective of the operational data signal T1 from the railway vehicle device. The false trouble signal thus stored is processed by the input data processing section 203 and is then transmitted to the central station by the data transmission control section 205 in the normal way.

Fig. 3 shows the entire arrangement of the train monitoring system according to the invention. The system is different from the conventional one of Fig. 5 in that the arrangement of each of terminal stations 12a, 22a, 32a ... and N2a on the railway cars I through N is a terminal station 200a, as described with reference to Figs. 1 and 2, rather than terminal station 200 of Fig. 9. Also a central station 13a has a setting section 130 for supplying the start instruction signal T7 to the false trouble generating section 206 of the terminal stations

12a-N2a. The start instruction signal T7 is applied to the terminal station 22a on the second railway car II in Fig. 3 by way of example. The setting section 130 is made up of digital switches. In other words, the setting section 130 is so designed as to be able to select a desired one of the railway cars and a desired one of the malfunctions by operating the digital switches. Therefore, first the central station 130 sets the car number of the railway vehicle whose device should suffer from a simulated malfunction for training the crew. Then the instructor at the central station 130 sets the false trouble number corresponding to the false trouble signal provided by the false trouble generating section of the terminal station 206. The instructor thereafter applies the start instruction signal T7 to the false trouble generating section 206 of the specified railway car so that the specified false trouble signal is produced. As a result, the false trouble generating section 206 of the specified railway car carries out the operations which have been described with reference to Fig. 2. The terminal station 200a transmits the malfunction signal T6 to the central station 13a so that it is displayed on both the display units 14 and N4 for the use of the trainees.

In the above-described embodiment, the false

trouble generating section 206 is included in the data inputting section 201a as shown in Fig. 1. However, the false trouble generating section 206 may be provided separately from the data inputting section in a terminal station 200b as shown in Fig. 4. In this case, an OR-gate 207 receives the operation data signal T2 from the data inputting section 201 and the false trouble signal T21 from the false trouble generating section 206. The OR-gate 207 supplies an output signal T22 to the memory 202 provided between the data inputting section 201 and the memory 202. The operational data signal T2 and the false trouble signal T21 are stored in the memory 202 independently or each other.

As was described above, according to the invention, the false trouble generating section simulates malfunctions of the railway car devices. These false trouble generating sections installed in the terminals stations on the separate cars in such a manner that they are started by the instruction from the central station. Therefore, in the case where the train monitoring system is used to train the crew so that they can effectively deal with the occurrence of malfunctions, it is unnecessary to use the external false trouble generating unit. Furthermore, the occurrence of false troubles can

be readily instructed from one position on the train. Therefore, the crew can be trained by using the actual railway cars. In addition, the trouble or abnormal operation detecting function can be also tested simultaneously.

Of course, the invention can be applied to vehicles other than train cars which are separate units that can be joined into an integrated operating unit.

The claims defining the invention are as follows:

1. A monitoring system, comprising:

terminal stations installed respectively on a plurality of cars formable into a train, each said terminal station collecting operational data indicating the occurrence of malfunctions of devices mounted on said car on which said each terminal station is mounted;

a central station installed on a particular one of said cars for controlling the operations of said terminal stations and for collecting data from said terminal stations and for storing said collected data; and

a display unit installed on at least a selected one of said cars, said display unit being controlled by said central station to display predetermined data in response to said collected data;

wherein each of said terminal stations includes a simulation section for simulating said malfunctions by supplying an electrical signal to said central station in the same state as if an actual malfunction had occurred, and

said central station includes a setting section for controlling the start and the operation of a selected one of said ~~false trouble generating~~ simulation sections.

2. A monitoring system as recited in Claim 1, wherein each said terminal station includes an OR-circuit receiving both said operational data and an output of said simulation section.

3. A monitoring system as recited in Claim 1, or Claim 2 wherein said cars are railway cars.

4. A monitoring system as claimed in any preceding claim further comprising memory means for storing fault data indicative of actual trouble conditions, and wherein said simulation section simulates said malfunctions by storing data in said memory means the same as said data indicative of actual fault conditions.

5. The monitoring system of any previous claim further including means for simulating the operation of one or more of said devices mounted on said car.

6. The system of any previous claim wherein said central station is located in a particular one of said cars which is manned by a crew member;

said central station being operable by said crew member.

7. The system of any previous claim wherein a cable-based communication system is utilised for communication purposes between said central station, said display unit and said terminal stations.

8. The monitoring system of any previous claim wherein each said terminal station includes switching means for selectively receiving an input signal representing an operation condition from the respective devices to be monitored and an input signal from its respective said simultation section.

9. A monitoring system as hereinbefore particularly described with reference to what is shown in Figures 1 and 2.

DATED this THIRTEENTH day of DECEMBER 1989

Mitsubishi Denki Kabushiki Kaisha

Patent Attorneys for the Applicant

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HRF/0145z

FIG. 1

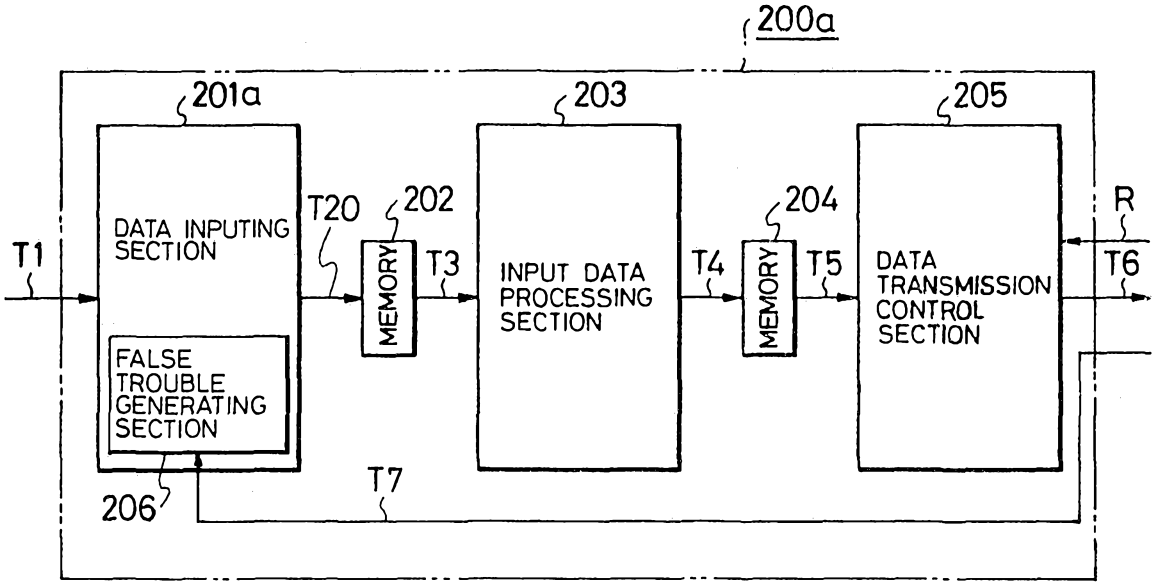
200a
201a
203
205
DATA INPUTING SECTION
FALSE TROUBLE GENERATING SECTION
206
T1
T20
202
MEMORY
T3
INPUT DATA PROCESSING SECTION
T4
204
MEMORY
T5
DATA TRANSMISSION CONTROL SECTION
R
T6
T7

FIG. 2

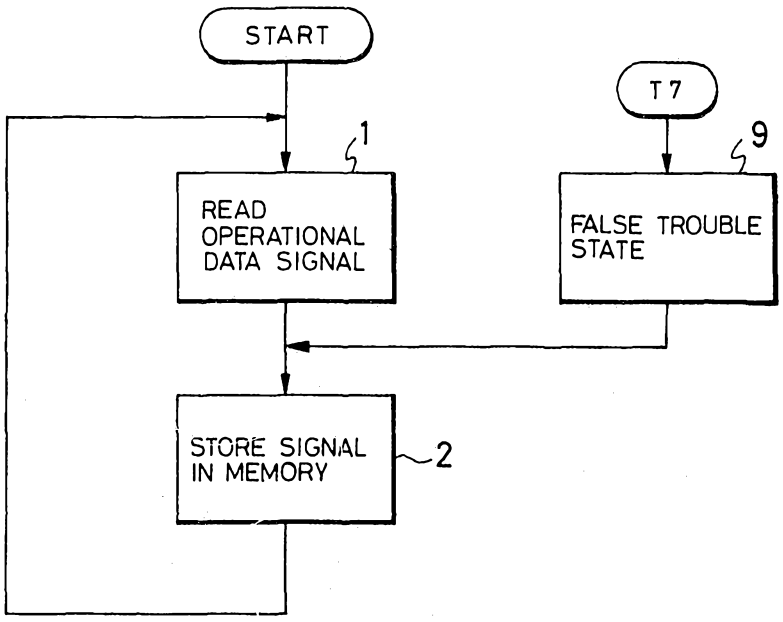
START
1
READ OPERATIONAL DATA SIGNAL
STORE SIGNAL IN MEMORY
2
T7
9
FALSE TROUBLE STATE

FIG. 3

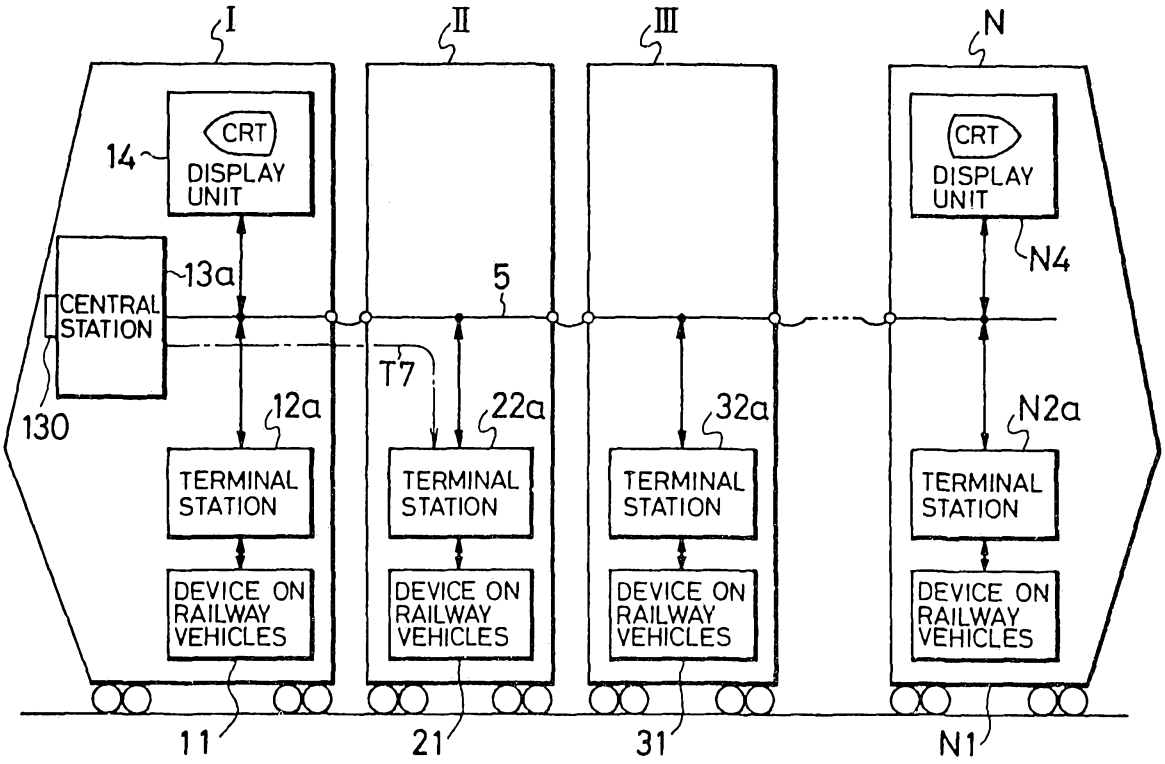
I
II
III
N
14
CRT
DISPLAY UNIT
13a
CENTRAL STATION
130
5
T7
12a
22a
32a
N2a
N4
TERMINAL STATION
DEVICE ON RAILWAY VEHICLES
11
21
31
N1

FIG. 4

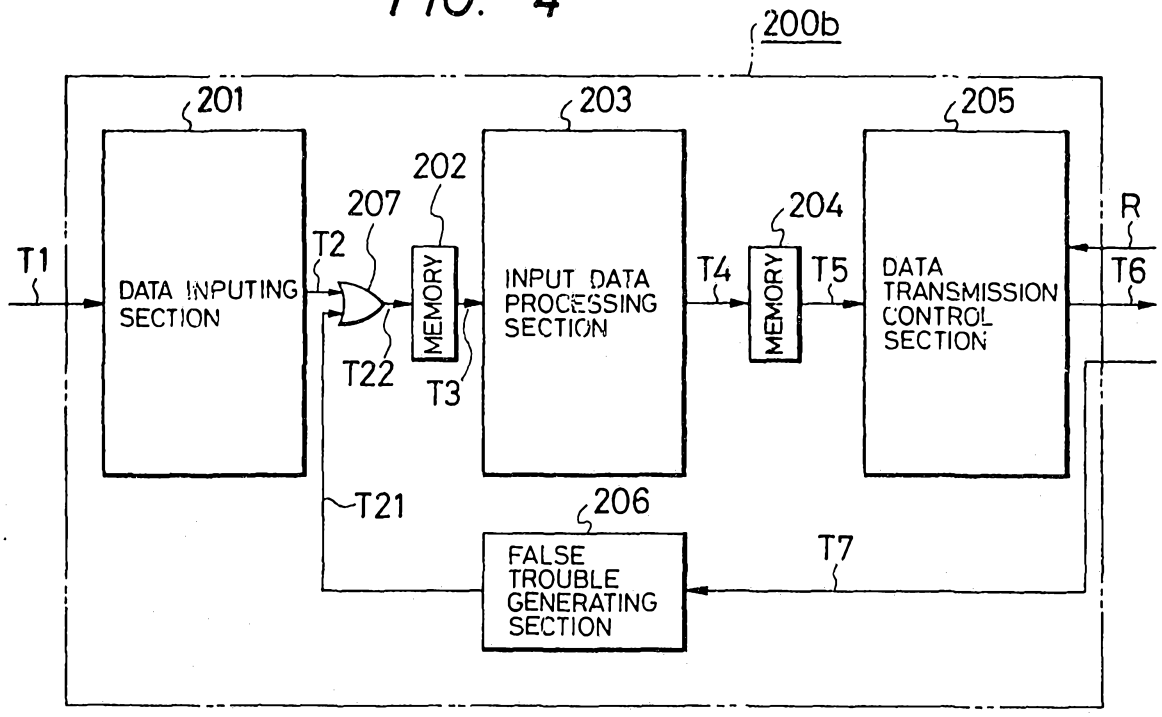
200b
201
203
205
202
207
204
R
T1
T2
T4
T5
T6
DATA INPUTING SECTION
MEMORY
INPUT DATA PROCESSING SECTION
MEMORY
DATA TRANSMISSION CONTROL SECTION
T22
T3
T21
206
T7
FALSE TROUBLE GENERATING SECTION

FIG. 5 PRIOR ART

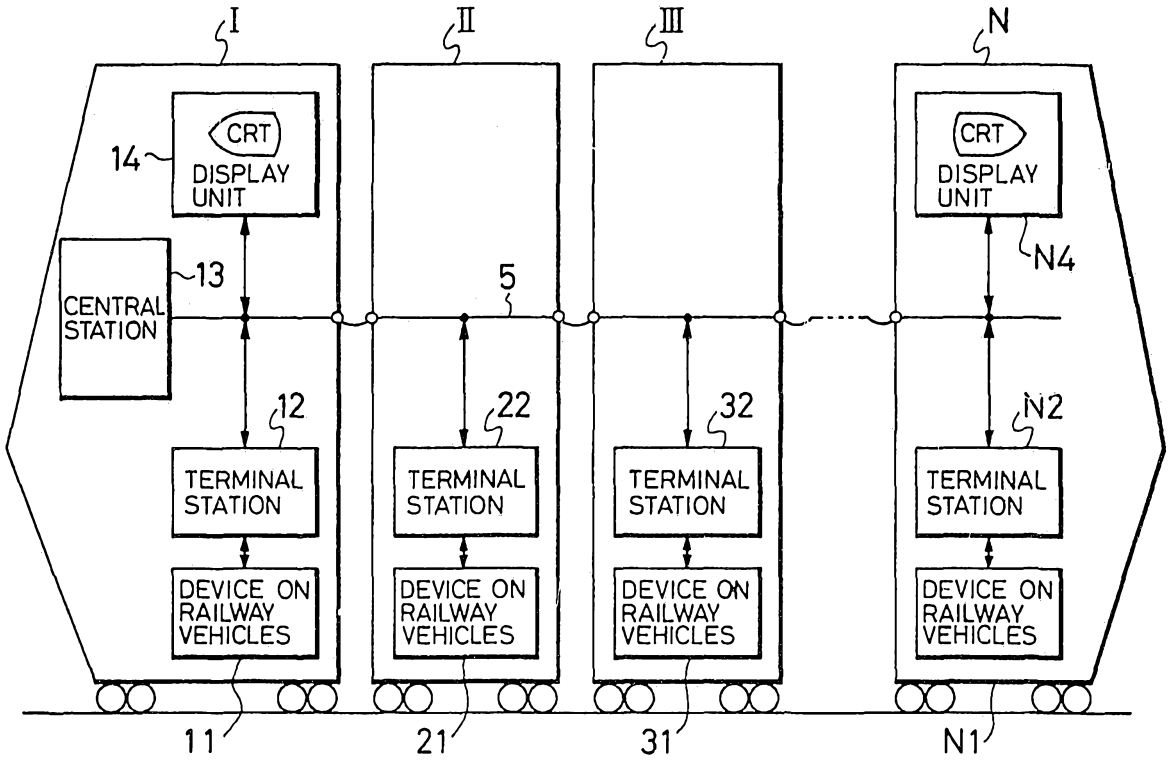

FIG. 6 PRIOR ART

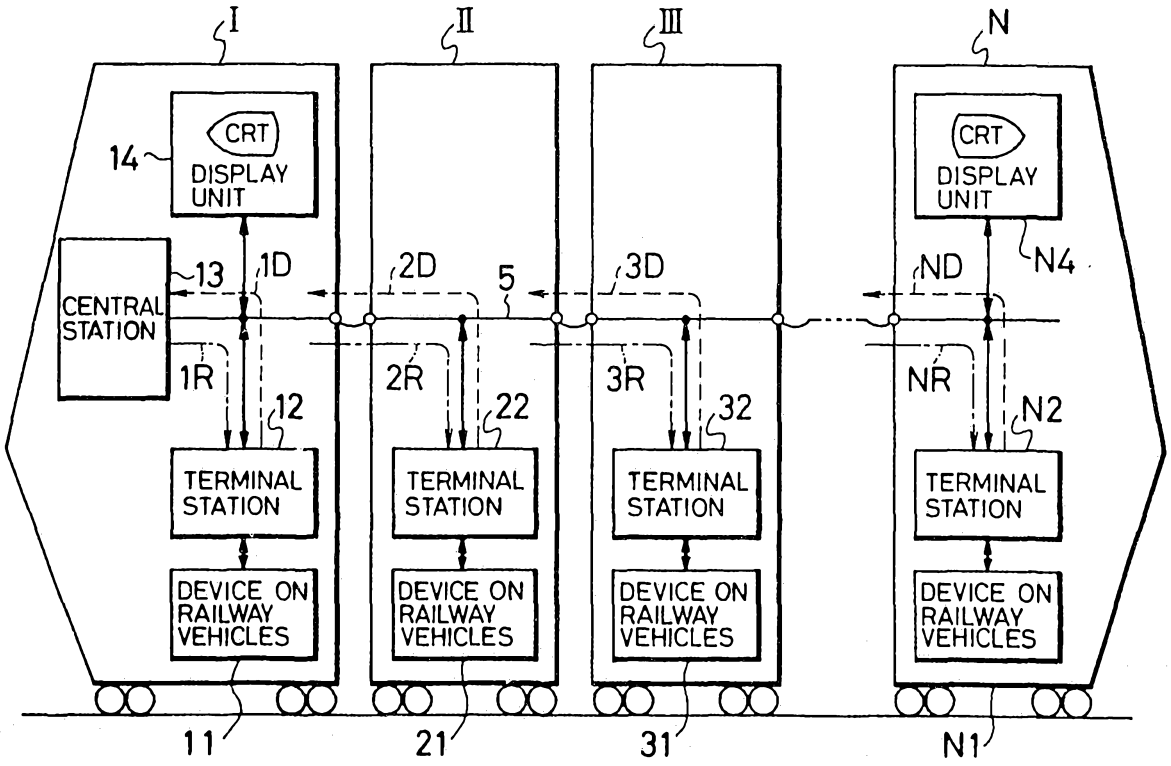

FIG. 7 PRIOR ART

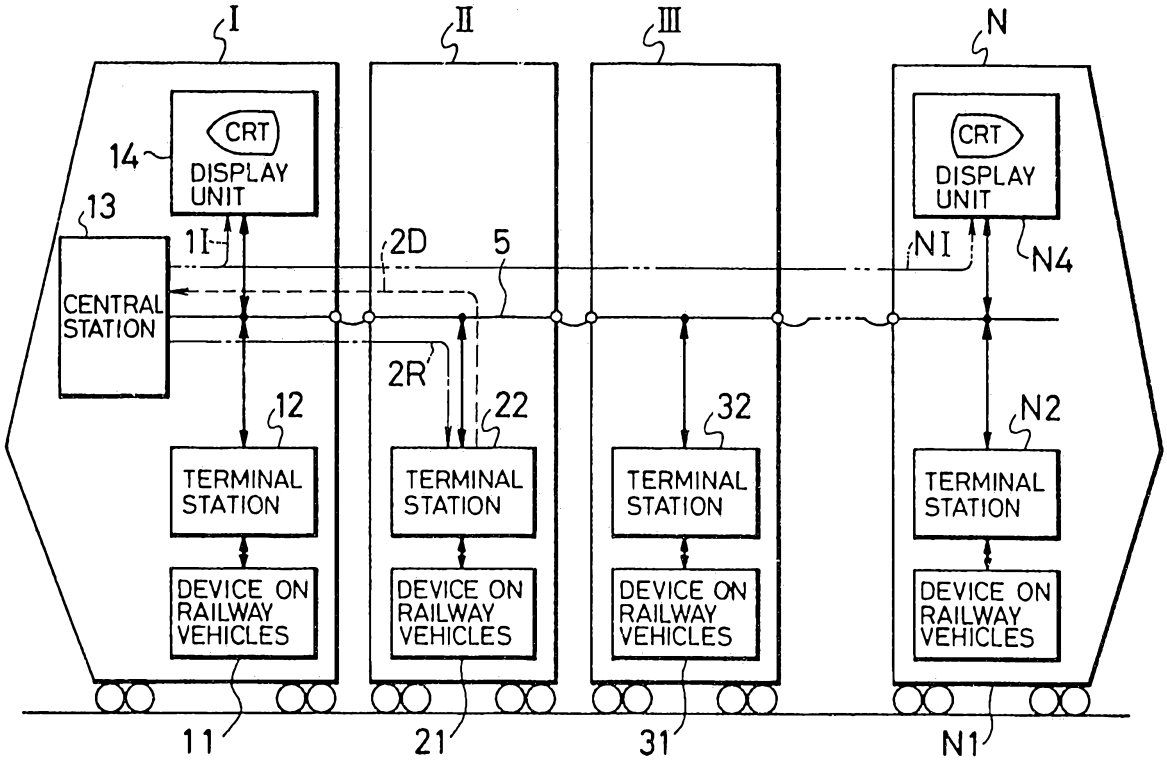

FIG. 9 PRIOR ART

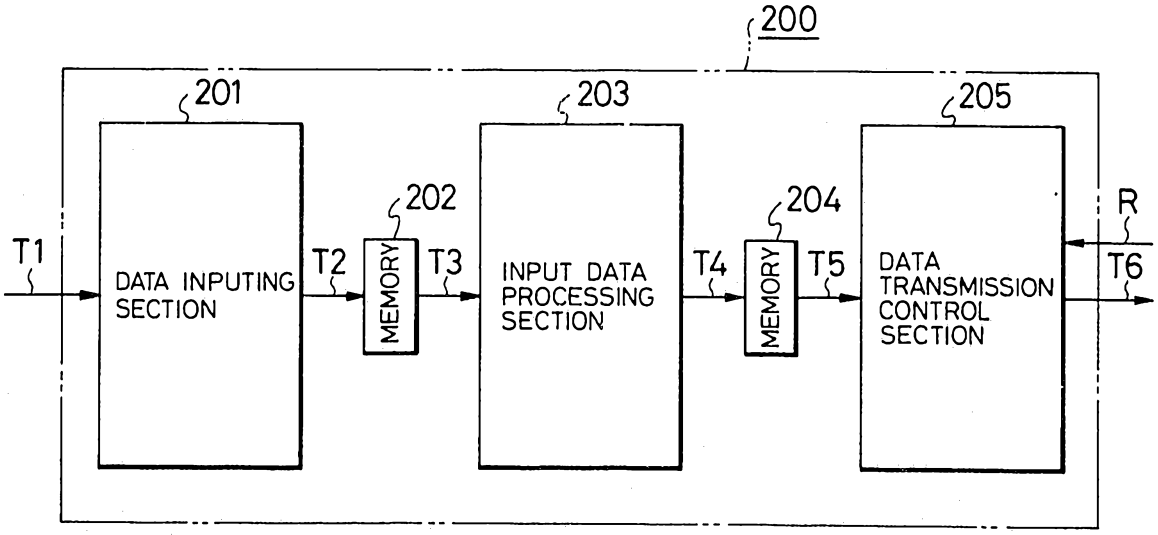

FIG. 8A
PRIOR ART

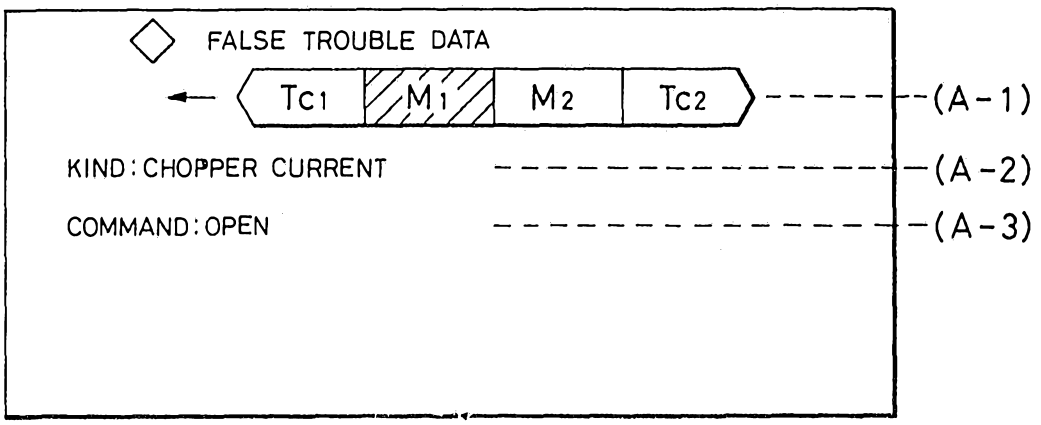

FIG. 8B
PRIOR ART

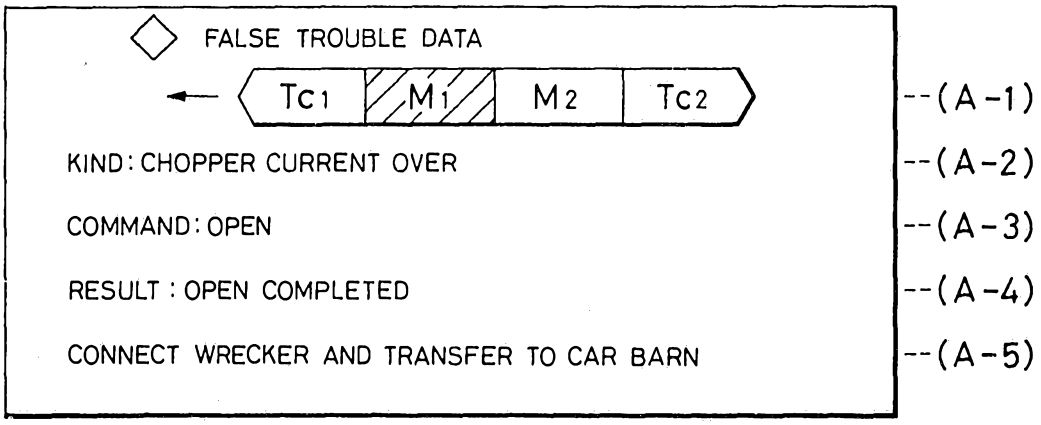

FIG. 10
PRIOR ART

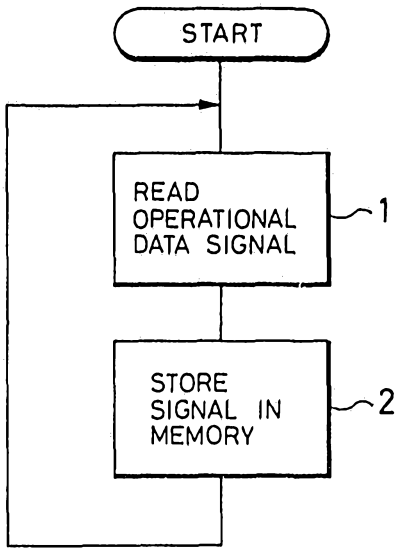

FIG. 11
PRIOR ART

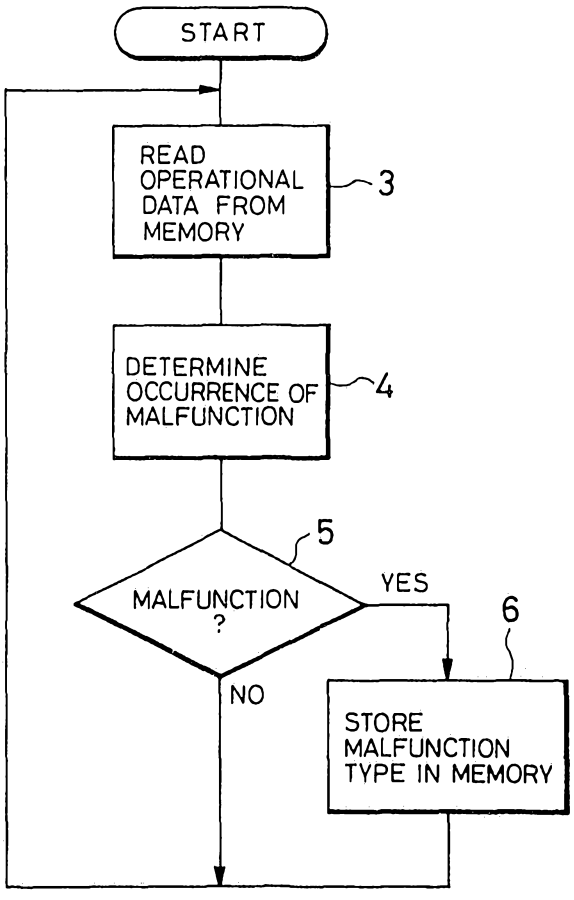

FIG. 12 PRIOR ART

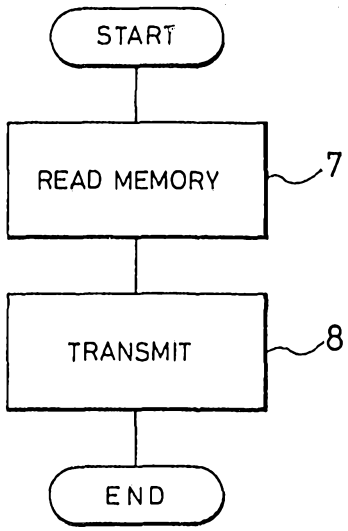

FIG. 13 PRIOR ART