

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(21) Application number: **86905931.1**

(51) Int. Cl.³: **B 61 L 1/18**

(22) Date of filing: **03.10.86**

Data of the international application taken as a basis:

(86) International application number:
PCT/JP86/00508

(87) International publication number:
WO88/02326 (07.04.88 88/08)

(43) Date of publication of application:
02.11.88 Bulletin 88/44

(84) Designated Contracting States:
DE GB

(71) Applicant: **THE NIPPON SIGNAL CO. LTD.**
3-1, Marunouchi 3-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: **FUTSUHARA, Koichi**
13-8, Kamikizaki 1-chome
Urawa-shi Saitama 338(JP)

(72) Inventor: **SUZUKI, Takakazu**
13-8, Kamikizaki 1-chome
Urawa-shi Saitama 338(JP)

(72) Inventor: **HARUTA, Masanori**
13-8, Kamikizaki 1-chome
Urawa-shi Saitama 338(JP)

(72) Inventor: **TAKAHASHI, Kazuo**
13-8, Kamikizaki 1-chome
Urawa-shi Saitama 338(JP)

(74) Representative: **Ablett, Graham Keith et al,**
F.J. Cleveland & Company 40-43 Chancery Lane
London WC2A 1JQ(GB)

(54) **DEVICE FOR DETECTING VEHICLE ON TRACK.**

(57) A device for detecting the presence of a vehicle on a track, which includes a first fail-safe AND circuit that converts a local signal applied to a specific section of the track and a track signal into phase decision signals that vibrate with a reference voltage level as a center, and that generate an output depending upon the logical product of the two phase decision signals when the two phase signals are in phase, and a second fail-safe AND circuit that generates a vehicle signal depending upon the logical product of the output of said first AND circuit and an output of a fail-safe level decision circuit that generates the output provided that the voltage level of the track signal is greater than a predetermined value, when the above two outputs are simultaneously generated.

DESCRIPTION

APPARATUS FOR DETECTING VEHICLE ON TRACK

Technical Field

The present invention relates to a vehicle detecting apparatus for detecting whether or not a vehicle is present on a railroad or on rails in a marshaling yard.

Background Technique

As the vehicle detecting apparatus in a railway signal system, there is known a railway relay in which rails are used as parts of a circuit, a short circuit is formed between two rails through wheels and a wheel shaft when a train is present on a track and the change of the voltage by the formation of the short circuit is read to actuate the relay and detect the presence or absence of the vehicle. More specifically, a predetermined length of the track is divided into sections, and rails of the specific section are utilized as parts of an electric circuit. If a short circuit is formed between the rails by a train present on the track, the presence of the vehicle in this section is detected by an electromagnetic track relay. Various safety devices of the railway signal system are controlled by this detection signal. As one of the railway relay of this type, there is known an alternating current railway relay which is actuated by an alternating current flowing in rails.

For example, an alternating railway relay disclosed in a pamphlet published by LM ERICSSON Signalling Systems Department, Stockholm, Sweden is driven and controlled by utilizing a semiconductor switch. Generally, this alternating railway relay comprises an electric circuit including a first transformer for the input of an alternating current local signal applied as a reference signal to rails of the specific section, a second transformer for the input of a track signal, which is connected to rails on which a

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train runs, a third transformer for putting out a train detection judgement signal, a plurality of thyristors, a plurality of diodes and an output relay to be actuated based on the detection signal of the third transformer.

Generally, the phase of the track signal for the specific closed section is made different by π from that for the adjacent precedent section. When the phase of the track signal of the specific section becomes in agreement with the phase of the local signal and the voltage level of the track signal is maintained at a level above a predetermined value because of formation of no short circuit between the rails, that is, only when these two conditions are satisfied, an alternating current output is generated on the secondary side of the third transformer, and a signal of the absence of a train is put out to excite the railway relay.

On the other hand, if a short circuit is formed between the rails through a train, the voltage level is reduced below the predetermined value, and therefore, no output is generated on the secondary side of the third transformer and the railway relay is placed in the non-excited state, whereby the presence of a vehicle in the specific section is indicated.

In the case where an electric short circuit is formed between the specific section and the adjacent section, the voltage level is reduced to zero by the formation of this short circuit since there is the phase difference π between both the sections, and the presence of a vehicle is similarly informed.

In this conventional apparatus, the phase of the track signal is made different in respective track sections, and the presence of a vehicle is informed based on the result of the judgement of the voltage level and phase of the track signal.

In the conventional apparatus, however, since the phase judgement and the level judgement are performed by one thyristor, the noise resistance is extremely poor.

Namely, in order to judge the phases of the local signal and track signal precisely, it is most advantageous to detect

the zero level at which the polarity of the signal is changed. In the judgement of the receipt level, a noise is greatly perceived at the judgement of the zero level and the noise resistance is poorest at this point. In order to prevent this defect, it is expedient that the threshold level for receipt of signals is elevated to broaden the noise-insensitive region. On the other hand, the judgement of the phase is precise when the alternating current signals, that is, the track signal and local signals, are close to the zero points, because the judgement is hardly influenced by changes of amplitudes of the signals. In the conventional apparatus, however, since both the judgement of the phase and the judgement of the receipt level are performed based on the gate voltage of one thyristor, it is impossible to simultaneously satisfy the above-mentioned contradictory requirements, that is, increase of the threshold level at the level judgement and reduction to the zero point at the phase judgement, and therefore, it is impossible to perform the phase judgement precisely and a high precision cannot be expected in the judgement of the presence or absence of a vehicle in the specific track section.

Furthermore, in the conventional apparatus, the output relay is operated by the on-off operation of the local signal by the thyristor through the first and third transformers, and the conventional apparatus cannot be integrated as a detection apparatus having so-called intelligent functions necessary for a train detection sensor, such as the function of a precise level judgement and the filter function. Moreover, in the case where a trouble such as formation of a short circuit or disconnection is simultaneously caused in a plurality of thyristors, the level judgement of the track signal becomes impossible and even if a train is present and the track signal is at the low level, the circuit is constructed and an output is generated in the third transformer, with the result that no fail-safe effect is attained. This is a defect which is essentially caused because the voltage exciting the output relay depends on the frequency of the input signal, that is, the third transformer

directly treats the frequency of the input signal.

It is a primary object of the present invention to eliminate the foregoing disadvantages of the conventional apparatus by performing the judgement of the phases of the local and track signals and the judgement of the level of the track signal separately by semiconductor signal processing means and putting out a signal of the absence of a vehicle only when the following two requirements are simultaneously satisfied, that is, when by a phase judging signal vibrating with the reference level being as the center, both the phase signals are judged as being of the same phase and the voltage level of the track signal is higher than a predetermined value.

Another object of the present invention is to provide a vehicle detecting apparatus having a fail-safe effect.

Disclosure of the Invention

According to the present invention, the foregoing objects are attained by an apparatus for detecting a vehicle on a track, which comprises, as shown in Fig. 1, a track circuit in which a local signal which is an alternating current voltage signal of a specific frequency is put in a pair of rails in a specific closed section and a track signal differing in the voltage according to the presence or absence of a vehicle on the rails are put out, first phase judgement signal generating means for putting out a phase judgement signal vibrating with a reference voltage level being as the center based on said local signal, second phase judgement signal generating means for putting out a phase judgement signal vibrating with the reference voltage level being as the center based on the track signal, level judgement signal generating means for putting out a level judgement signal vibrating with the reference voltage level being as the center based on the track signal, a first logical product circuit which receives the phase judgement signal put out from the first phase judgement signal generating means and the phase judgement signal put out from the second phase

judgement signal generating means and puts out a signal based on the logical product of both the phase signals when both the phase signals are of the same phase but does not generate any signal at the time of a trouble, a level judging circuit which puts out a signal when the voltage level of the level judgement signal put out from the level judgment signal generating means is higher than a predetermined value but does not put out any signal at the time of a trouble, and a second logical product circuit which puts out a signal of the absence of a vehicle when both the first logical product circuit and the level judging circuit simultaneously put out signals but does not put out any signal at the time of a trouble.

Incidentally, the first and second logical product circuits may be constructed by a single logical product computing oscillating circuit.

According to the present invention, by the above-mentioned structure, the judgement of the phases can be performed at a low level to reduce the influences of variations of the amplitude and the level judgement can be performed at a high level to improve the noise resistance.

Moreover, according to the present invention, the local input signal can be subjected to integration processing.

Brief Description of the Drawings

Fig. 1 is a block diagram illustrating the schematic structure of the present invention.

Fig. 2 is a diagram illustrating a known alternating current track circuit.

Fig. 3 is a block diagram illustrating an embodiment of the circuit of the apparatus for detecting a vehicle on a track according to the present invention.

Fig. 4 is a circuit diagram illustrating a voltage multiplying half-wave rectifier circuit used as the rectifier in the above-mentioned embodiment.

Fig. 5 is a circuit diagram illustrating a differential

circuit used in the above-mentioned embodiment.

Fig. 6 is a circuit diagram illustrating a logical product circuit used in the above-mentioned embodiment.

Fig. 7 is a time chart illustrating the operation state in the above-mentioned embodiment.

Best Mode for Carrying Out the Invention

The present invention will now be described in detail with reference to the accompanying drawings.

Referring to Fig. 2, a vehicle 1 runs on two rails 2 and 3 in the direction indicated by the arrow. The rails 2 and 3 are divided into a plurality of sections such as a specific section 4 and a section 5 rear with respect to the direction of advance of the vehicle. For example, a transmission signal which is an alternating current reference voltage V_l (this signal is simultaneously fed to the reception side and acts as a local signal S_l) is applied to the rails of each of the block sections 4 and 5. The rails 2 and 3 are utilized as parts of the circuit and the voltage V_t between the rails 2 and 3 is put out as a track signal S_t for reception. This circuit is known as the alternating current track circuit.

The transmission signal of the track, that is, the local signal S_l , is a sine wave alternating current signal shown in Fig. 7-A and is put in a rectifying smoothening circuit 21 and a wave form rectifying circuit 22 through a transformer 11. The rectifying smoothening circuit 21 is a known circuit for rectifying and smoothening an alternating current signal and forming a direct current output power source V_s . The wave form rectifying circuit 22 acts as the first phase judgement signal generating means and is a known circuit, for example, a Schmitt circuit for rectifying a sine wave local signal to a rectangular wave as shown in Fig. 7-C. By these circuits, a rectangular wave phase judgement signal vibrating with the reference voltage level being as the center is obtained.

The track signal S_t is put in a level judging signal 23

and a wave form rectifying circuit 24 through a second transformer 12. The level judging circuit 23 is a circuit for detecting whether or not a voltage obtained by transforming the track signal S_t by the transformer 12 acting as the level judgement signal generating means, that is, a level judging signal, is higher than a predetermined value. for example, this circuit comprises a level detecting circuit such as a Schmitt circuit and a known voltage doubling half-wave rectifying circuit for rectifying the output of this detecting circuit, which includes, for example, capacitors C1 and C2 and diodes D1 and D2, as shown in Fig. 4. A relatively high threshold level is set in the Schmitt circuit. The voltage doubling half-wave rectifying circuit rectifies and smoothens the alternating current voltage put out from the Schmitt circuit by the diode D2 and the capacitor C2 through the coupling capacitor C1 and the clamp diode D1 and a rectified output is obtained from an output terminal D. The voltage doubling half-wave rectifying circuit has such a fail-safe structure that at the time of a trouble such as disconnection, no rectified output is obtained (a known four-terminal capacitor which generates no output at the time of disconnection of a terminal is shown as the capacitor C2). The direct current voltage V_s of the rectifying smoothening circuit 21 is put in the rectifying circuit. The diode D1 is constructed so that a computing oscillator of the subsequent stage is oscillated by the output of the rectifying circuit by clamping the input signal from the capacitor C1 to this input power source V_s .

The wave form rectifying circuit 24 has a threshold level sufficiently lower than the track signal S_t put in the circuit 24. Accordingly, a wave-rectified output which changes substantially at the zero point of the track signal S_t can be produced.

A differential circuit 25 comprises, for example, a capacitor C3 and a resistor R1, as shown in Fig. 5, and has such a known structure that the reference voltage level is set at the above-mentioned level V_s . Thus, the phase of the track signal is generated substantially at the zero point

(reference voltage level). Of the output of the differential circuit 25, that is, the phase signal of the track signal, only a positive signal is put into an input terminal C of a three-input logical product circuit 26 through a diode D4. A structure capable of performing a desired operation may be formed even by omitting the diode D4.

The logical product circuit 26 has three input terminals a, b and c, and this circuit receives the output of the wave form rectifying circuit 22 at the input terminal a and the output of the level detecting circuit 23 at the input terminal b. The logical product circuit 26 is a logical product computing oscillating circuit shown in Fig. 6, which comprises a first logical product circuit for detecting (phase judgement) that the phase judgement signal of the local signal S_L by the wave form rectifying circuit 22 and the phase judgement signal of the track signal S_t by the differential circuit 25 are of the same phase, a second logical product circuit which generates an output signal when a signal of the detection of the same phase in the first logical product circuit and a signal of the detection of the level judgement signal of the track signal S_t higher than the predetermined value by the level detecting circuit are received. The logical product computing oscillating circuit generates an oscillating output when all of the inputs at the input terminals a, b and c are higher than the power source voltage V_s and has a fail-safe structure in which when a constituent element of the circuit gets out of order, oscillation is impossible and therefore, no output is generated at the time of a trouble. In order to construct the computing oscillator so that it is actuated by a negative power source, it is sufficient if the type of the transistor is changed to NPN from PNP and the direction of the diode is reversed.

The specific structure of the logical product computing oscillating circuit 26 will now be described with reference to Fig. 6. Transistors Tr1 and Tr2 are connected to each other through an attenuation resistor R6, and the collector of the transistor Tr2 is connected to the base of a

transistor Tr3 through a level shifting Zener diode ZD1 and the connecting point between a Zener diode ZD2 connected to the collector of the transistor Tr3 and a resistor R4 is connected to the base of the transistor Tr1 through a resistor R5. R2 and R3 represent collector resistors, R7 represents a resistor on the leak current side, that is, a resistor for flowing of a leak current of the base of the transistor Tr3, Vs represents an input power source, and C represents an output terminal. In the logical product computing oscillator having this structure, when Zener voltages VZ1 and VZ2 of the Zener diodes ZD1 and ZD2 and a voltage Ve higher than the power source voltage Vs are put in the input terminals a, b and c respectively, that is, when voltages exceeding the range of the power source voltage are put in the input terminals a, b and c, the transistors Tr1 through Tr3 are turned on and off in sequence and an oscillating output oscillating between the input voltage level given to the input terminal and the level substantially equal to zero is obtained at the output terminal C. On the other hand, if the input voltage applied to any one of the input terminals a, b and c is lower than the power source voltage, the operation of the transistors Tr1 through Tr3 is not reversed and the oscillation is stopped. Also when a trouble such as disconnection is caused in the circuit, the oscillation is stopped and no oscillating output is generated at the output terminal C. In this case, it is preferred that the Zener voltages VZD1 and VZD2 of the Zener diodes ZD1 and VZD2 of the Zener diodes ZD1 and ZD2 be selected to satisfy the condition of $VZD2 < V_s < VZD1$. Incidentally, as is obvious to experts in the art, a computing oscillator of a high output can be constructed by connecting a known amplifier to the input terminal.

Incidentally, the level judging circuit 23 and the rectifying circuit 27 described hereinafter may comprise, for example, the voltage doubling half-wave rectifying circuit, and this voltage doubling half-wave rectifying circuit and the the logical product computing oscillator shown in Fig. 6 may be a known fail-safe logical product circuit in which no

output is produced unless input signals are applied to all of the input terminals a, b and c, disclosed in, for example, Japanese Utility Model Application Laid-Open Specification No. 4764/82 or Japanese Patent Publication No. 38211/76.

The rectified output of the rectifying circuit 27 for rectifying the output of the logical product computing oscillating circuit 26 is fed back to the input terminal c, in which the output of the differential circuit 25 is put, through the diode D3. An alternating current amplifying circuit 28 amplifies the oscillating output of the logical product computing oscillating circuit 26, and the amplified output is rectified by a rectifying smoothening circuit 29 to drive a trade relay 30, as in the conventional apparatus.

The above-mentioned transformer 12, wave form rectifying circuit 24, differential circuit 25, rectifying circuit 27 and diodes D3 and D4 constitute the second phase judgement signal generating means, and the wave rectifying circuit 24 and differential circuit 25 constitute the means for detecting the zero point of the track signal.

The operation will now be described with reference to the time chart of Fig. 7.

The alternating current local signal shown in Fig. 7-A is put in the rectifying smoothening circuit 21 and wave form rectifying circuit 22 through the first transformer 11. At the rectifying smoothening circuit 21, there is generated the direct current output V_s to be used as the power for driving the level detecting circuit 23, wave form rectifying circuits 22 and 24, amplifying circuit 28, logical product computing oscillating circuit 26 and track relay 30. Furthermore, at the wave form rectifying circuit 22, a rectangular wave shown in Fig. 7-C is generated as the phase judging signal. This phase judging signal oscillates with the reference voltage level (corresponding to the zero point of the track signal) being as the center.

When the vehicle 1 is not present in the specific section 1, the track signal St put in the second transformer 12 from the rails 2 and 3 has a shape of a sine wave as shown in Fig. 7-B. The track signal St is put in the level judging

circuit 23 and wave form rectifying circuit 24, and a rectified direct current output VL1 for detecting a level higher than a predetermined value, as shown in Fig. 7-D, is produced from the former circuit. Furthermore, a rectangular wave as shown in Fig. 7-E is put out from the latter circuit and a differential pulse as shown in Fig. 7-F is put out from the differential circuit 25. Incidentally, each of the outputs of the wave form rectifying circuits 22 and 24, level judging circuit 23 and differential circuit 25 is put out in the state where the direct current output Vs of the rectifying smoothening circuit 21 is over-lapped.

Accordingly, each of positive pulses of the wave rectifying circuit 22, level judging circuit 23 and differential circuit 25 to be put into the input terminals a, b and c of the logical product computing oscillating circuit 26, respectively, has an input level higher than the power source voltage Vs at which initiation of the oscillation is possible. And, if positive pulses are put in the logical product computing oscillating circuit 26 from the wave form rectifying circuit 22 and differential circuit 25, the phase judgement condition (the local signal and the track signal are of the same phase) is established (first logical product), and the logical product (second logical product) of this established condition and the already established level judgement condition (the voltage level of the track signal is higher than a predetermined value) is established and oscillation is initiated in the logical product computing oscillating circuit 26.

The oscillating output of the computing oscillating circuit 26 is put in the alternating current amplifying circuit 28 and is simultaneously rectified by the rectifying circuit 27 and fed back to the input terminal c through the diode D3 to self-retain the output of the computing oscillator 26 until the phase signal on the local signal side (Fig. 7-C) falls, whereby amplification of the pulse width is effected (see Fig. 7-G). Incidentally, the diode D3 prevents extinction of the differential pulse at the capacitor C2 of the rectifying circuit 27.

The pulse width-amplified output, shown in Fig. 7-G, of the computing oscillating circuit 26 is amplified by the alternating amplifying circuit 28, rectified by the rectifying smoothening circuit 29 and supplied to the relay 30 to retain the relay 30 in the excited state. Namely, the absence of a train in the track circuit is informed.

If a train intrudes into the track circuit, a short circuit is formed between the rails 2 and 3 by the train and the voltage level V_t of the track signal St put in the second transformer 12 is reduced. At this point, the output of the level judging circuit 23 is reduced to VL_2 shown in Fig. 7-D and the condition of the logical product of the computing oscillating circuit 26 is not established. Accordingly, the oscillation is impossible and generation of the output is stopped, and therefore, the relay 30 falls in the non-excited state and the presence of the train in the track circuit 4 is detected.

Incidentally, in this phase judgement, if there is a phase deviation between the local signal and the track signal, it happens that the oscillation condition of the computing oscillating circuit 26 is satisfied even when both the signals are not of the same phase, and an erroneous judgement is made.

In order to prevent this disadvantage, in the present embodiment, the track signal St put out from the wave rectifying circuit 24 is differentiated and the positive differential pulse is put in the computing oscillating circuit 26, whereby the oscillating output is self-retained and maintained.

In the conventional apparatus, when the level at which the thyristor is turned on, that is, the voltage level of the track signal for judging formation of a short circuit between the rails, is determined, the phase to be judged is simultaneously determined. In this case, since the voltage level of the track signal is greatly varied by changes of the rail-laying environment, for example, rain or snow, the judged value of the phase is changed with this change of the voltage level. This change becomes great as the set value

for the judgement of the level is large. In order to prevent an erroneous operation by a noise generated by a train current or the like, it is preferred that the above-mentioned set value be large. Accordingly, the conventional apparatus is disadvantageous in that if increase of the precision of the level judgement is intended, the precision of the phase judgement is reduced and if maintenance of a high precision of the phase judgement is intended, the precision of the level judgement is reduced.

In contrast, in the present embodiment, since signals for the level judgement and the phase judgement are independently generated and both the judgements are separately performed, the set value for the level judgement can be increased, and the phase judgement can always be done at the point where the phase judging signal crosses the reference voltage, that is, at the point (zero point) where the track signal is changed to the positive value from the negative value. Accordingly, the detection precision can be elevated and the reliability can be improved. Moreover, since known fail-safe logical product computing oscillating circuit 26, level judging circuit 23, rectifying circuit 27, alternating current amplifying circuit 28 and differential circuit 25 are used, a fail-safe structure is realized in the detecting apparatus. Moreover, since the computing oscillating circuit 26 is not self-retained if the diode D3 is opened, a power sufficient to excite the relay 30 is not obtained, and since the differential pulse is absorbed in the capacitor C2 and no signal is put in the input terminal c of the computing oscillating circuit 26 if a short circuit is formed, a fail-safe effect is attained.

Incidentally, in the present embodiment, the logical product of the level judgement and the phase judgement is made by one logical product circuit, but the present invention is not limited to this structure. Namely, there may be adopted a structure in which the phase judgement is carried out by using a fail-safe logical product circuit, the relay 30 is driven by this judgement signal and the contact output of the relay driven by the output of the level judging

circuit 23 is connected in series to the contact output of the relay 30. Although the rectifying circuit is used as the level judging circuit 23, it is obvious that the output may be rectified by using a known level detector of the alternating current input type.

In the case where the input level of the track signal is stable, it is obvious that an alternating current output from the level detecting circuit of the level judging circuit 23, as indicated by a dot line in Fig. 3, can be utilized instead of the wave rectifying circuit 24. Furthermore, if the input detection level of the logical product circuit is made equal to the judgement level of the track signal, the logical product circuit can be utilized as the level judging circuit 23. In this case, it is sufficient if the level judging circuit 23 is replaced by a rectifying circuit.

Moreover, it is obvious that if the oscillating output of the logical product computing oscillating circuit 26 is not directly applied to the alternating current amplifying circuit 28 but the oscillating output is put in a voltage multiplying rectifying circuit as shown in Fig. 4 and the input terminals a, b and c shown in Fig. 6 are connected to one common computing oscillating circuit and if the alternating current output signal of this computing oscillating circuit is put in the alternating current amplifying circuit shown in Fig. 3 (that is, if a rectifying circuit and a computing oscillating circuit are interposed between the logical product computing oscillating circuit 26 and the alternating current amplifying circuit 28), the capacity of the smoothening capacitor C2 of the interposed rectifying circuit can be increased, whereby an erroneous operation by a noise of the track signal or the like can be moderated.

As is apparent from the foregoing description, according to the present invention, the local input signal is rectified to obtain a direct current power and precise and various level detections can be performed by this direct current power, and the logical computation is carried out as the logical processing of the output of such level detection and

such processing can be integrated, whereby the size of the apparatus can be reduced. Moreover, when the apparatus gets out of order, the output is inevitably reduced to zero and the relay falls to the safe side, and a fail-safe effect can be assuredly attained. Furthermore, since the phase difference between the local signal and the track signal is judged separately from the level of the track signal, the phase judgement can be made at a voltage level close to the reference level while the level judgement can be made at a voltage level higher than a predetermined value, and precise phase judgement and level judgement become possible.

Industrial Applicability

As is apparent from the foregoing description, the apparatus for detecting a vehicle on a track according to the present invention is most effectively utilized for detecting a train on a rails in a signal system of a railroad line or in an unmanned operation system in a factory, a dockyard or an assorting or marshaling yard.

WHAT IS CLAIMED IS

1. An apparatus for detecting a vehicle on a track, which comprises a track circuit in which a local signal which is an alternating circuit voltage signal of a specific frequency is put in a pair of rails in a specific closed section and track signals differing in the voltage according to the presence or absence of a vehicle on the rails are put out, first phase judgement signal generating means for putting out a phase judgement signal vibrating with a reference voltage level being as the center based on said local signal, second phase judgement signal generating means for putting out a phase judgement signal vibrating with the reference voltage level being as the center based on the track signal, level judgement signal generating means for putting out a level judgement signal vibrating with the reference voltage level being as the center based on the track signal, a first logical product circuit which receives the phase judgement signal put out from the first phase judgement signal generating means and the phase judgement signal put out from the second phase judgement signal generating means and puts out a signal based on the logical product of both the phase signals when both the phase signals are of the same phase but does not generate any signal at the time of a trouble, a level judging circuit which puts out a signal when the voltage level of the level judgement signal put out from the level judgement signal generating means is higher than a predetermined value but does not put out any signal at the time of a trouble, and a second logical product circuit which puts out a signal of the absence of a vehicle when both the first logical product circuit and the level judging circuit simultaneously put out signals but does not put out any signal at the time of a trouble.

2. A vehicle detecting apparatus as set forth in claim 1, wherein the second phase judgement signal generating means comprises a transformer for transforming the voltage of the track signal, a first wave form rectifying circuit for rectifying the output signal of the transformer to a

rectangular wave signal vibrating with the reference voltage level being as the center, a differential circuit for differentiating the output of the first wave form rectifying circuit and putting the differentiated output into the first logical product circuit and self-retaining means for feeding back the output of the first logical product circuit to the first logical product circuit through a diode and self-retaining the output of the first logical product circuit.

3. A vehicle detecting apparatus as set forth in claim 1, wherein the second phase judgement signal generating means comprises a differential circuit for differentiating the output signal of the level judging means and self-retaining means for feeding back the output of the first logical product circuit to the first logical product circuit through a diode and self-retaining the output of the first logical product circuit.

4. A vehicle detecting apparatus as set forth in claim 1, wherein the level judging circuit comprises a threshold circuit for putting out only a voltage higher than a predetermined value of the level judging signal put out from the level judging signal generating means and a voltage doubling half-wave rectifying circuit for processing the output signal of the threshold circuit.

5. A vehicle detecting apparatus as set forth in claim 1, wherein the first logical product circuit and second logical product circuit constitute logical product computing oscillating means which has an input terminal a for receiving the output of the first phase judgement signal generating means, an input terminal b for receiving the output of the level judging means, an input terminal c for receiving the output of the second phase judgement signal generating means and a reference voltage input terminal for receiving a signal of a direct current voltage V_s , and which is constructed so that an oscillating output is generated when voltages exceeding the range of the direct current voltage V_s are simultaneously applied to the three input terminals a, b and c.

6. A vehicle detecting apparatus as set forth in claim

5, wherein the first phase judgement signal generating means comprises a second wave form rectifying circuit for rectifying the local signal to a rectangular wave signal and putting out the rectangular wave signal to the input terminal a, and the second phase judgement signal generating means comprises a first wave form rectifying circuit for rectifying a track signal to a rectangular wave signal, a differential circuit for differentiating the output of the first wave form rectifying circuit and putting the differentiated output into the input terminal c, a rectifying circuit for rectifying the oscillating output of the logical product computing oscillating circuit and self-retaining means including a diode for putting the output of the rectifying circuit only into the terminal c.

7. A vehicle detecting apparatus as set forth in claim 5, wherein the logical product computing oscillating means comprises a first transistor connected through a first collector resistor between the input terminal a and the reference voltage input terminal, the collector voltage of said first transistor being put in the base through an attenuation resistor, a second transistor connected through a second collector resistor between the input terminal b and the reference voltage input terminal, the collector voltage of the second transistor being put in the base through a first Zener diode, a leak resistor interposed between the base and the power earth and a third transistor connected through a third collector resistor and a second Zener diode between the input terminal c and the power earth, the divided voltage of the third collector resistor and second Zener diode is put in the base of the first transistor and an output terminal is connected between the second Zener diode and the collector of the third transistor.

8. A vehicle detecting apparatus as set forth in claim 7, wherein the first phase judgement signal generating means comprises a second wave form rectifying circuit for rectifying the local signal to a rectangular wave signal and putting out the rectangular wave signal into the input terminal a, and the second phase judgement signal generating

means comprises a first wave form rectifying circuit for rectifying the track signal to a rectangular wave signal, a differential circuit for differentiating the output of the first wave form rectifying circuit and putting the differentiated signal in the input terminal c, a rectifying circuit for rectifying the oscillating output of the logical product oscillating computing circuit and a diode for putting the output of the rectifying circuit only in the terminal c.

9. A vehicle detecting apparatus as set forth in claim 8, wherein the level judging means comprises a threshold circuit for putting out a voltage higher than a predetermined value of the level judging signal put out from the level judging signal generating means and a voltage multiplying half-wave rectifying circuit for processing the output signal of the threshold circuit.

10. A vehicle detecting apparatus as set forth in claim 1, wherein the first phase judgement signal generating means, second phase judgement signal generating means, level judging signal generating means, level judging means, first logical product circuit and second logical product circuit use a direct current output obtained by rectifying the local signal as a power source.

FIG.1

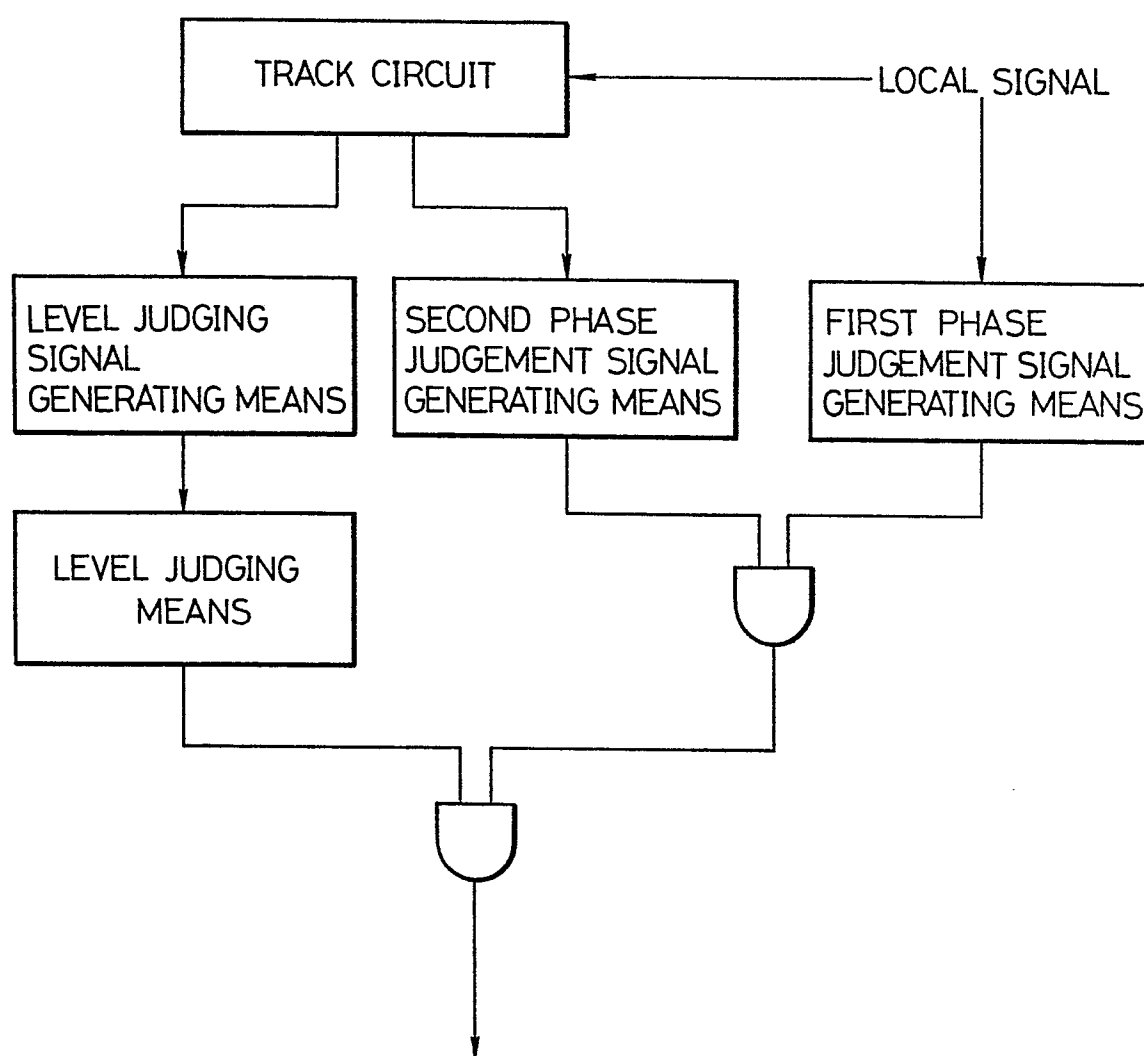


FIG 2

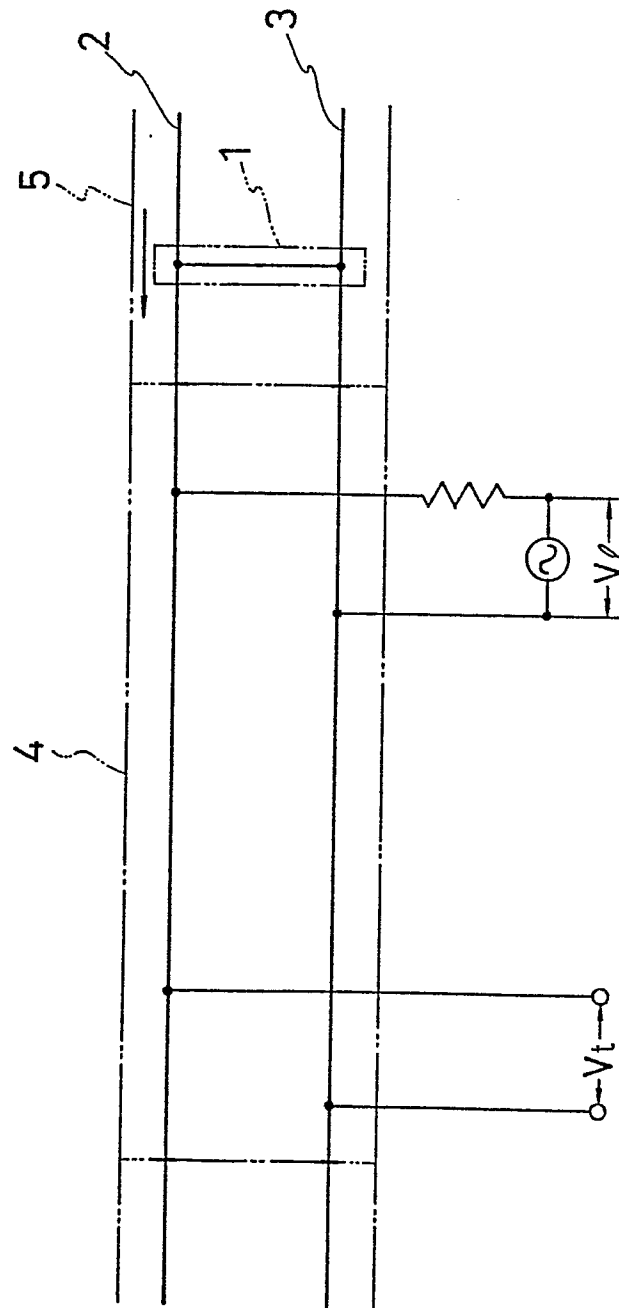


FIG. 3

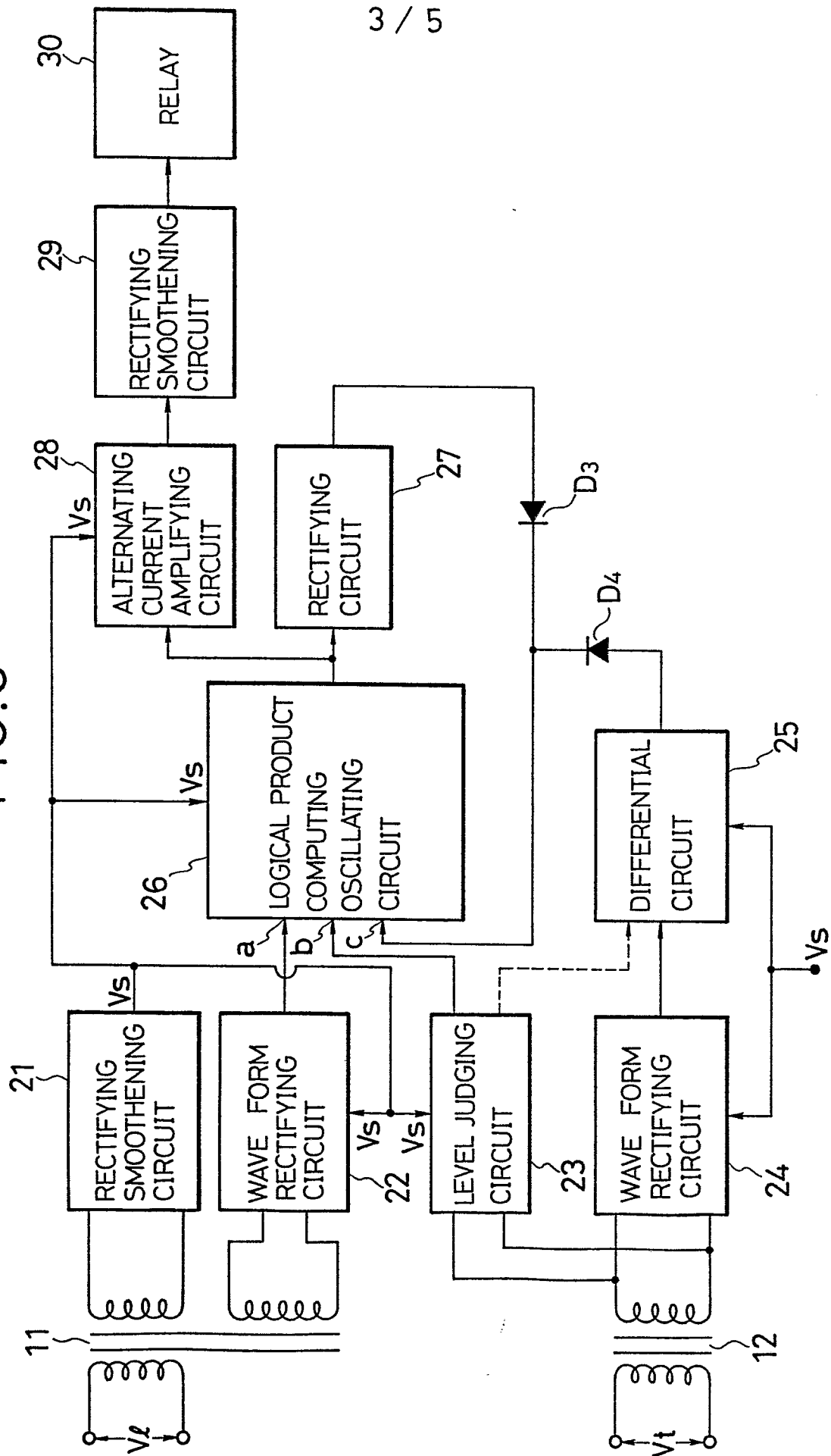


FIG 4

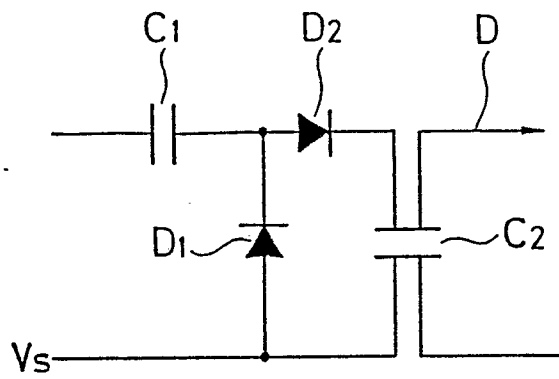


FIG 5

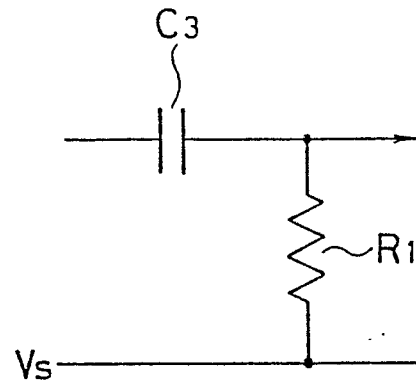


FIG 6

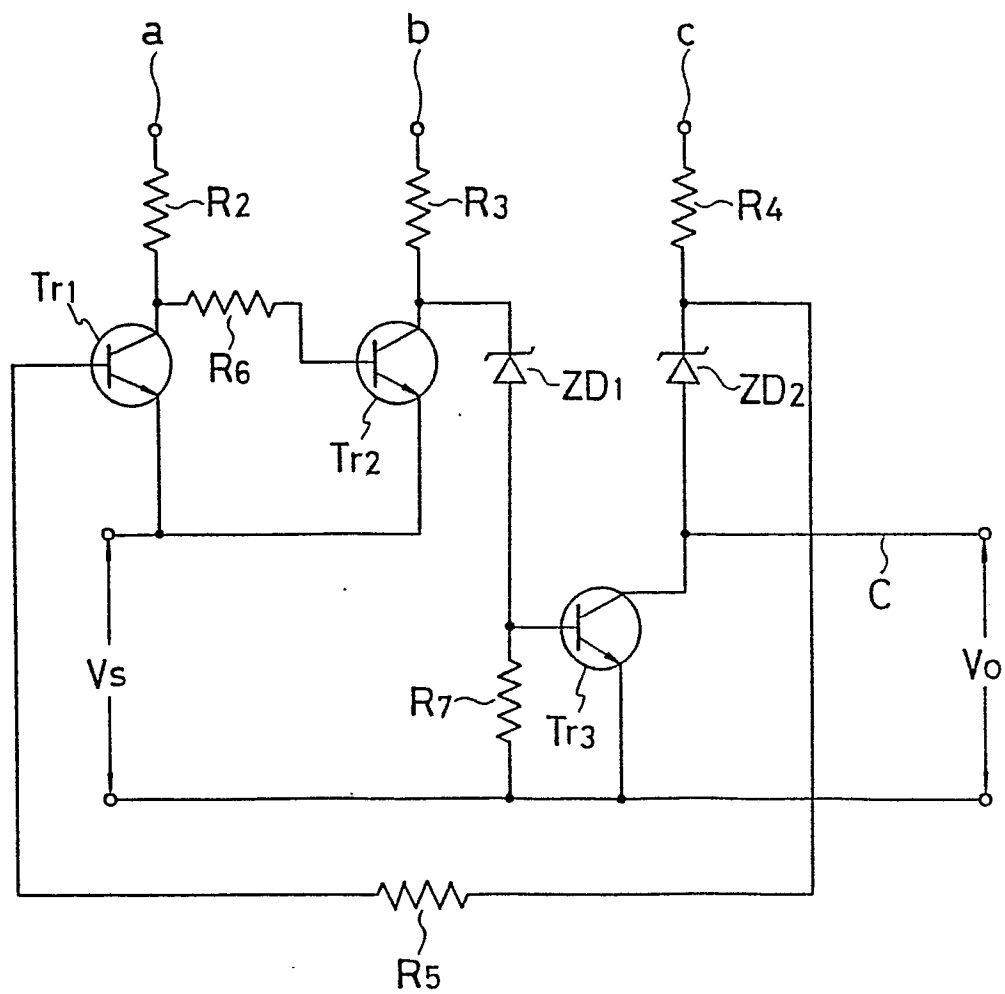
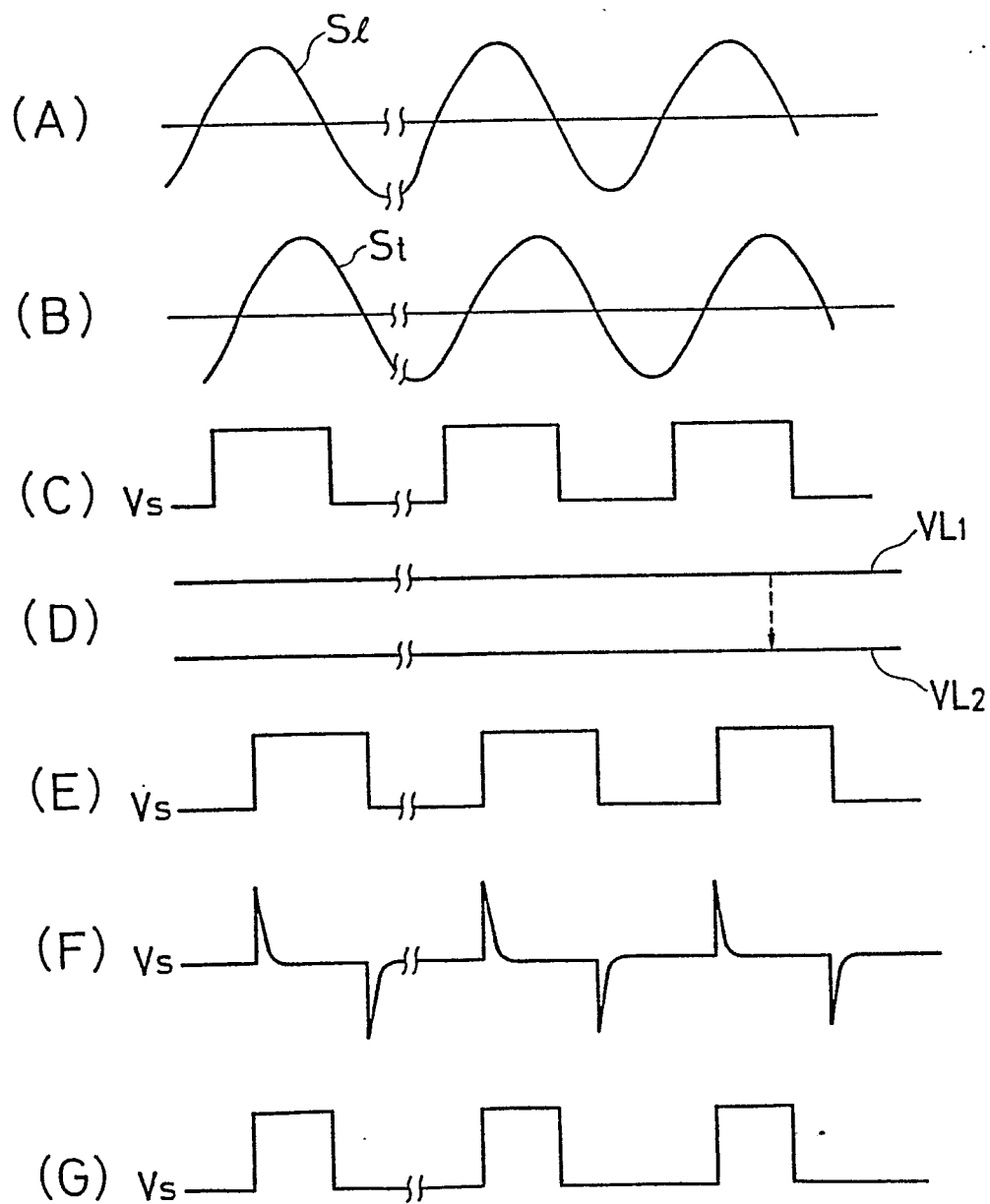


FIG 7



INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP86/00508

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl ⁴ B61L1/18		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC	B61L1/18	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
Jitsuyo Shinan Koho		1951 - 1986
Kokai Jitsuyo Shinan Koho		1971 - 1986
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁷	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	JP, B1, 43-15126 (Japanese National Railways) 26 June 1968 (26. 06. 68) Page 1, left column, lines 23 to 37 (Family: none)	1-9
¹⁵ Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "Z" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²		Date of Mailing of this International Search Report ²
December 10, 1986 (10. 12. 86)		December 22, 1986 (22. 12. 86)
International Searching Authority ¹		Signature of Authorized Officer ¹⁰
Japanese Patent Office		