



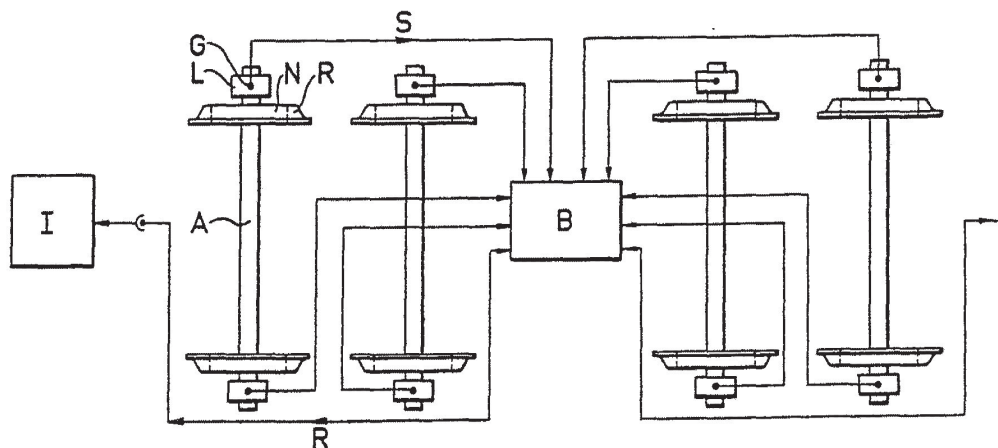
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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE81/00241 (22) International Filing Date: 28 August 1981 (28.08.81) (31) Priority Application Number: 8006052-8 (32) Priority Date: 29 August 1980 (29.08.80) (33) Priority Country: SE (71) Applicant; and (72) Inventor: SINHA, Brajnandan [SE/SE]; 17 Tunnländsvägen, S-175 46 Järfälla (SE). (74) Agents: AB STOCKHOLMS PATENTBYRÅ, ZACCO & BRUHN et al.; Box 3129, S-103 62 Stockholm (SE).		(81) Designated States: DE, DE (European patent), FR (European patent), GB, GB (European patent), JP. Published <i>With international search report</i> <i>With amended claims</i>

(54) Title: ELECTRONIC CONTROL SYSTEM FOR WHEEL AXLES OF RAIL-MOUNTED VEHICLES, ESPECIALLY RAILROAD CARS



(57) Abstract

Electronic control system for wheel axles on rail-mounted vehicles, especially railroad car sets. According to the invention, an accelerometer (G) is attached on the bearing box (L) for each axle end in all cars. Each accelerometer senses on the running vehicle the vibrations of the bearing box and emits a corresponding electric signal (S) to a signal processing unit (B) common to all accelerometers on the same vehicle. Each such unit is capable on the basis of the different frequencies caused by wheel and bearing faults to distinguish individual fault signals and their origin in the car. Information on the type of fault and on the axle (A), on which the fault is located, is passed to a fault indicating unit (I) on the locomotive. By means of an addressing arrangement via the signal processing units connected in series on the different cars, also the car is indicated, on which the fault is located.

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EX1029

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Electronic control system for wheel axles of rail-mounted vehicles, especially railroad cars

This invention relates to an electronic control system for the wheel axles of rail-mounted vehicles, especially railroad cars.

5 Neglected maintenance, as sporadic spot checks of the condition of the wheel axles, can have disastrous consequences for passengers as well as for rolling stock, caused by the tipping, derailing etc. of cars.

The present invention has the object of preventing such incidents.

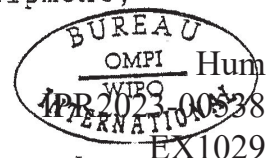
10 This object is achieved in that a transducer is attached to or adjacent each bearing box to continuously sense the vibrations of the bearing box and emits an electric signal corresponding to the vibrations to a signal processing unit common to all transducers on the
15 same vehicle. Said unit is capable to distinguish individual fault signals and their origin on the basis of different frequencies caused by wheel and bearing faults, and to pass information on the kind of fault as well as on the axle, on which the fault is located, to an indicating
20 unit.

The measuring values used in the control system are the vibrations occurring in the bearing boxes and arising from the contact of the wheel with the rail, from the play between wheel rim and hub disc, from defects in the
25 bearings and/or from non-circular rim.

One embodiment of the invention is described in the following, with reference to the accompanying drawings, in which

Fig. 1 is a schematic view of an axle arrangement at a driving vehicle (locomotive)
30 equipped with the system according to the invention,

Figs. 2 and 3 are flow diagrams for the signal processing unit and, respectively, indicating unit comprised in the equipment,
35



and

Figs. 5 and 6 are examples of block diagrams for fault determination and, respectively, fault indication without and, respectively, with microcomputer.

5 In Fig. 1 four equal wheel pairs are shown, each comprising an axle A, which at each end carries a hub disc N and a rim R attached thereabout for rolling on the rail. The bearing box for each axle end is designated by L. At the embodiment shown, a transducer G in the form of an
10 accelerometer (indicated merely as a dot), preferably of piezoelectric type, is rigidly attached directly on each bearing box.

The vibrations occurring on the wheel, axle and thereby on the bearing box of the vehicle when running are
15 converted by the transducer G into an electric signal S with a frequency corresponding to the vibrations.

The eight signals S (one for each wheel) are passed to an electronic signal processing unit B common to all transducers on the vehicle, in which unit the signals are
20 classified individually with respect to frequency. When in any of the frequencies a change beyond the established normal values arises and endures, the unit B determines the fault class by means of an empirically established program. Information thereon and on the location (wheel in question)
25 of the fault is passed in the form of a report signal R to an indicating unit I, which informs the driver on the situation.

When the driving vehicle propels one or several cars coupled thereto, as indicated to the right in Fig. 1, the
30 driver also needs information on the car on which the fault is located. The coupled cars are equipped in the same way as the driving vehicle, except for the indicating unit, and all signal processing units in the car set are connected in series. Upon initiation by the indicating unit,
35 an addressing signal is emitted through the entire car set, and in each processing unit the address is dated-up by one

step. The ingoing address is stored in each signal processing unit and used as address for faulty axle.

Fig. 2 is a schematic block and flow diagram for the signal processing unit B, which at the embodiment shown is of digital type. From the transducers G (only two are shown) the analogue signals S pass via amplifiers F to an analogue-digital converter A/D. The digital signals from A/D are fed to a calculating unit K, and the resulting information therefrom is sent, as described above, to the indicating unit I, which also acts as address decoding unit and initiating unit for the infeed and outfeed of series data.

According to the diagram in Fig. 3, an output signal passes from a fault indicating and address unit to a display unit D for information of the driver, and a control unit C controls the function of the indicating unit.

The invention, according to the aforesaid, is based on the observation that vibrations of bearing boxes change their nature when faults arise, i.e. the natural wheel frequency transferred to the bearing box is at faults in wheels or bearings shifted away from its nominal value corresponding to faultless condition. It was, thus, observed that wheel rim faults (play) cause a distinctive increase in frequency, and a bearing fault, tending to lock the wheel yields a more distinctive increase.

Figs. 4 and 5 show examples of block diagrams for the detection of wheel rim play and wheel locking.

In Fig. 4 showing the arrangement for each wheel of the car, the output signal of the transducer G attached to the bearing box of the wheel passes via a combined band pass filter-amplifier BP + F, which filters off undue harmonics, to the parallel connected band pass filters BP1 and BP2, which are tuned for wheel rim faults and, respectively, wheel locking. From there, the signals having different frequencies pass to the respective level indicators NI1 and NI2, which are intended to permit passage of the signal first when it exceeds a

certain amplitude or level N1 and, respectively, N2. A possibility for N2 of tapping reference level via an amplifier F connected to the output of the filter-amplifier BP + F and a filter circuit is indicated by dashed lines.

- 5 The same applies in analogue manner to level N1. A signal permitted to pass then passes in each of said cases via a voltage divider to the base of a transistor T1 and, respectively, T2, the output signal of which at the terminal U1 and, respectively, U2 indicating rim fault and,
10 respectively, locking is fed to a central computer or local computer for processing and indication.'

In Fig. 5, which refers to an arrangement common to all wheels of a car and utilizing a micro-computer, the output signal from each transducer G (only one shown) passes via a
15 band pass filter BP to an analogue-digital converter A/D, which via a data bus DB and an address bus AB communicates with a micro-computer μ D. The analogue signal from the converter A/D passes via an amplifier F with automatic amplification control to the two band pass filters BP1 and
20 BP2, which as in the foregoing case are tuned for wheel rim faults and, respectively, wheel locking. The output signals of the filters are fed to an analogue gate AG. The output signal therefrom passes by control from the address bus AB to the converter A/D, which transduces the information to the micro-computer μ D via the data bus DB. On
25 the basis of this information the computer sends output signals to existing indicators for wheel faults and, respectively, bearing faults.

The invention is not restricted to the embodiment
30 described above, but various modifications can be imagined within the scope of the invention. Accelerometers, for example, of a type other than piezoelectric can be used. Alternatively, the use of acusto-electric converters (microphones) for the electric representation of the
35 vibrations can be imagined, which always are accompanied by sound phenomena.



WHAT I CLAIM IS:

1. An electronic control system for wheel axles on rail-mounted vehicles, especially railroad cars, characterized in that on or adjacent each bearing box (L) a transducer (G) continuously sensing the vibrations of the box at running vehicle is attached and emits an electric signal (S) corresponding to the vibrations to an electronic signal processing unit (B) common to all transducers on the same vehicle, which unit is capable to distinguish individual fault signals and their origin on the basis of the different frequencies caused by wheel and bearing faults and to pass information (R) on the type of fault and on the axle (A), on which the fault is located, to an indicating unit (I).
2. A control system as defined in claim 1 on a vehicle propelling a plurality of cars coupled thereto, for example a car set, characterized in that the indicating unit (I) is located in the driver's cab on the driving vehicle, and all cars have a signal processing unit (B) of their own, all of which are connected in series so that, upon initiation by the indicating unit, an address signal is transferred through the entire car set, and in each processing unit the address is dated-up by one step, and stored for use at fault indication as address for faulty axle.
3. A control system as defined in claim 1 or 2, characterized in that the transducers (G) are accelerometers, preferably of piezoelectric type.
4. A control system as defined in claim 1 or 2, characterized in that the transducers (G) are acusto-electric converters.
5. A control system as defined in any one of the preceding claims, characterized in that the signal processing unit (B) is of digital type.



AMENDED CLAIMS

(received by the International Bureau on 21 January 1981 (21.01.81))

1. (amended)

An electronic control system for wheel axles on rail-mounted vehicles, especially railroad cars, a transducer (G) being mounted on or adjacent to each bearing box (L) for emitting, during the travel of the vehicle, an electric signal (S) corresponding to the behaviour of the axle (A) to an electronic signal processing unit (B) common to all transducers on the same vehicle, characterized in that the transducer (G) is adapted to emit continuously a signal corresponding to the vibrations of the wheel axle, said signal being a measure of the natural frequency of the wheel (N,R) transmitted to the axle (A) and the bearing box (L), and that the processing unit (B) is adapted to detect natural frequencies distinctly deviating from the nominal natural frequency corresponding to faultless conditions, said deviating frequencies, which are different for faults in a wheel or in a bearing box, being, in form of respective fault signals, transmitted to an indicating unit (I) together with a signal indicating the locality of the origin of the particular frequency whereby the indicating unit delivers information of the type of fault as well as the axle (A) where the fault has developed.

2. (cancelled)

nded) 3. A control system as defined in claim 1, wherein the transducers (G) are accelerometers, preferably of piezoelectric type.

nded) 4. A control system as defined in claim 1, wherein the transducers (G) are acusto-electric converters.

nded) 5. A control system as defined in any one of the preceding claims, wherein the signal processing unit (B) is of digital type.



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FIG.1

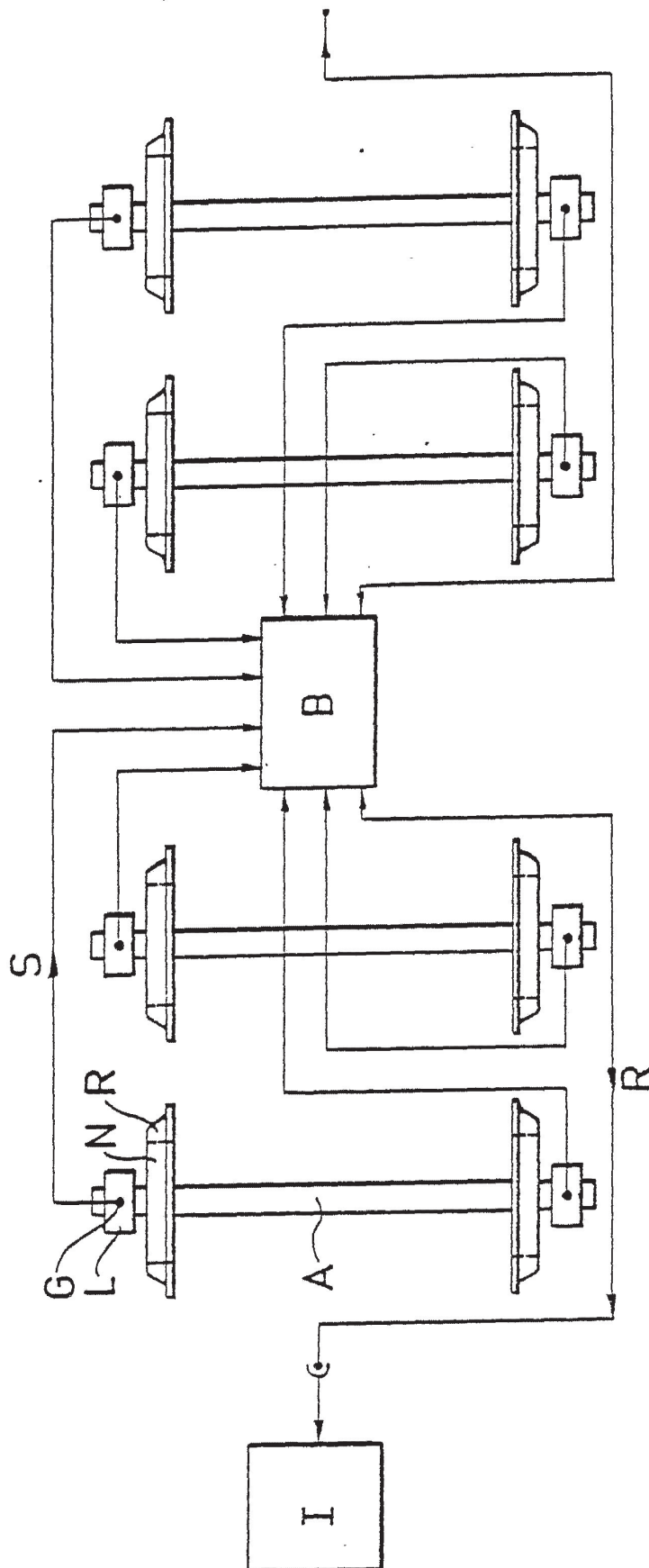


FIG.2

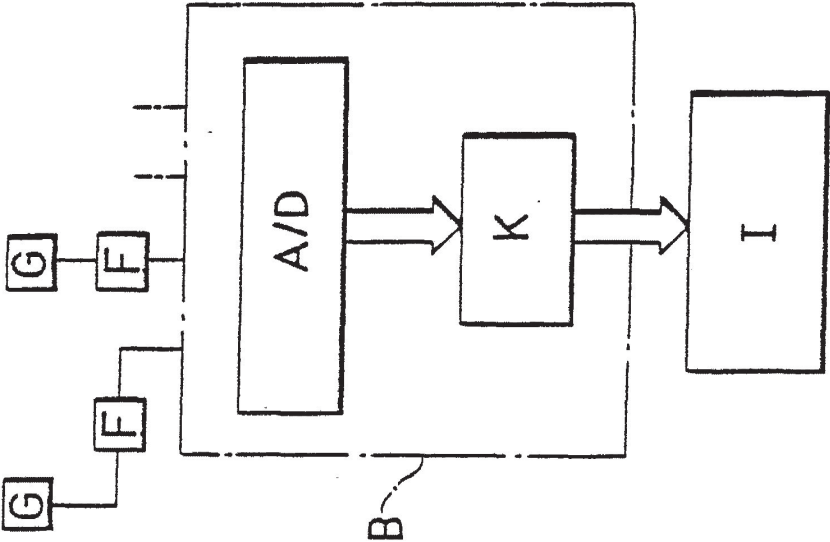


FIG.3

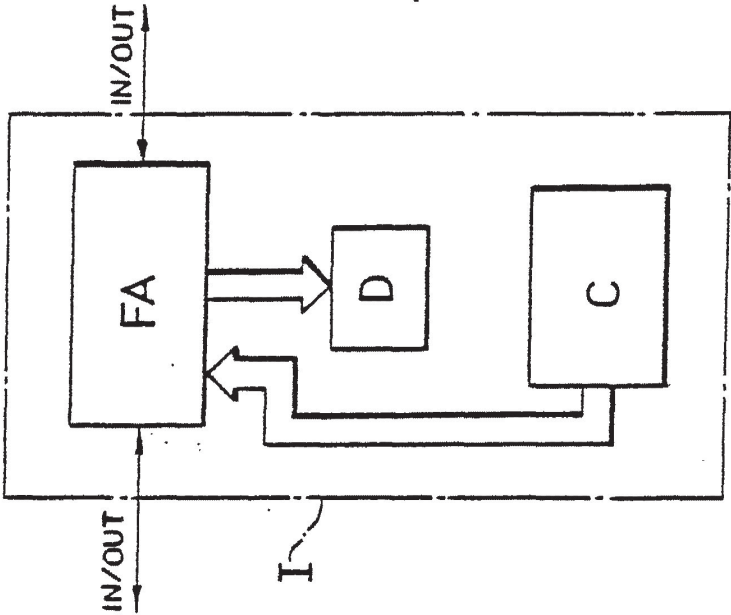


FIG. 4

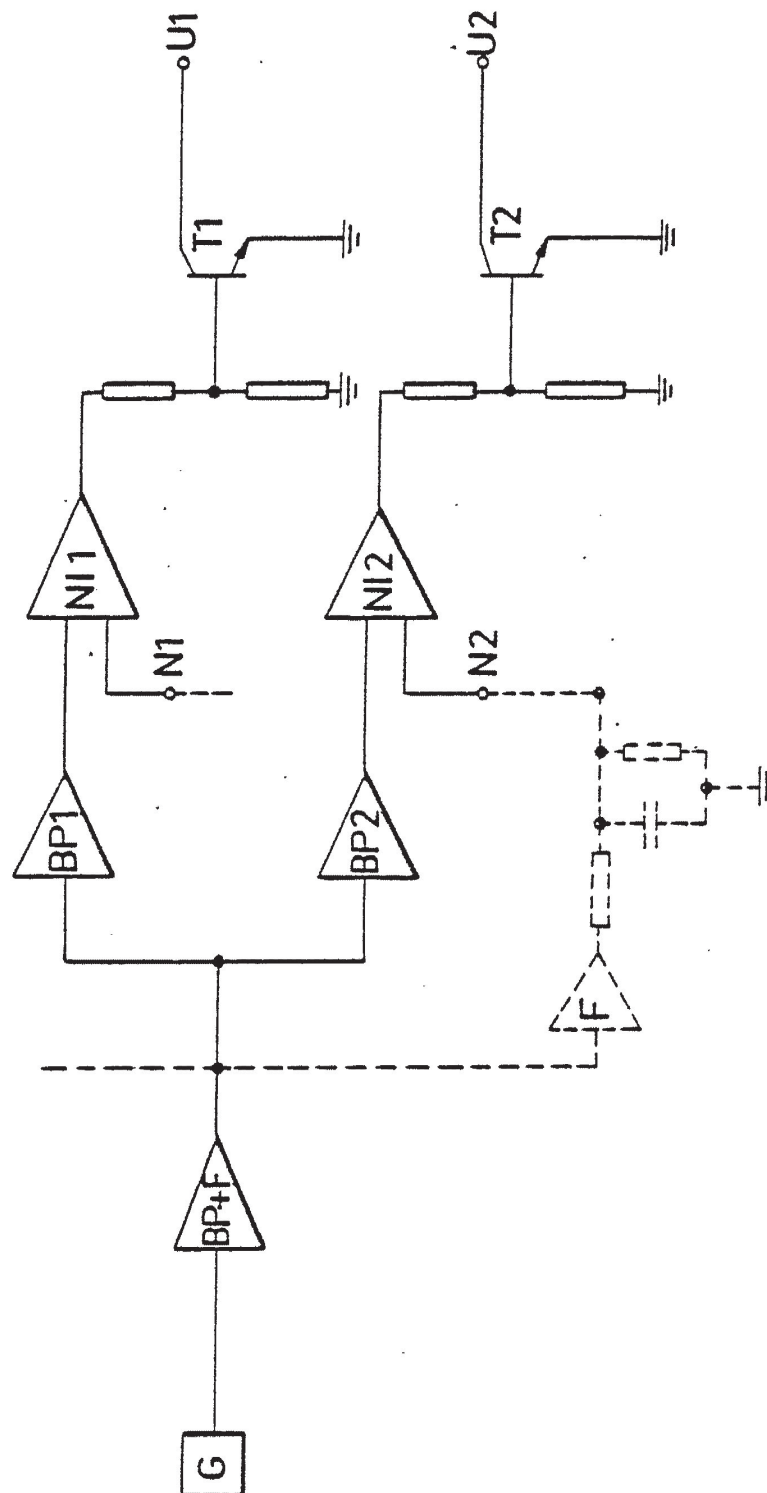
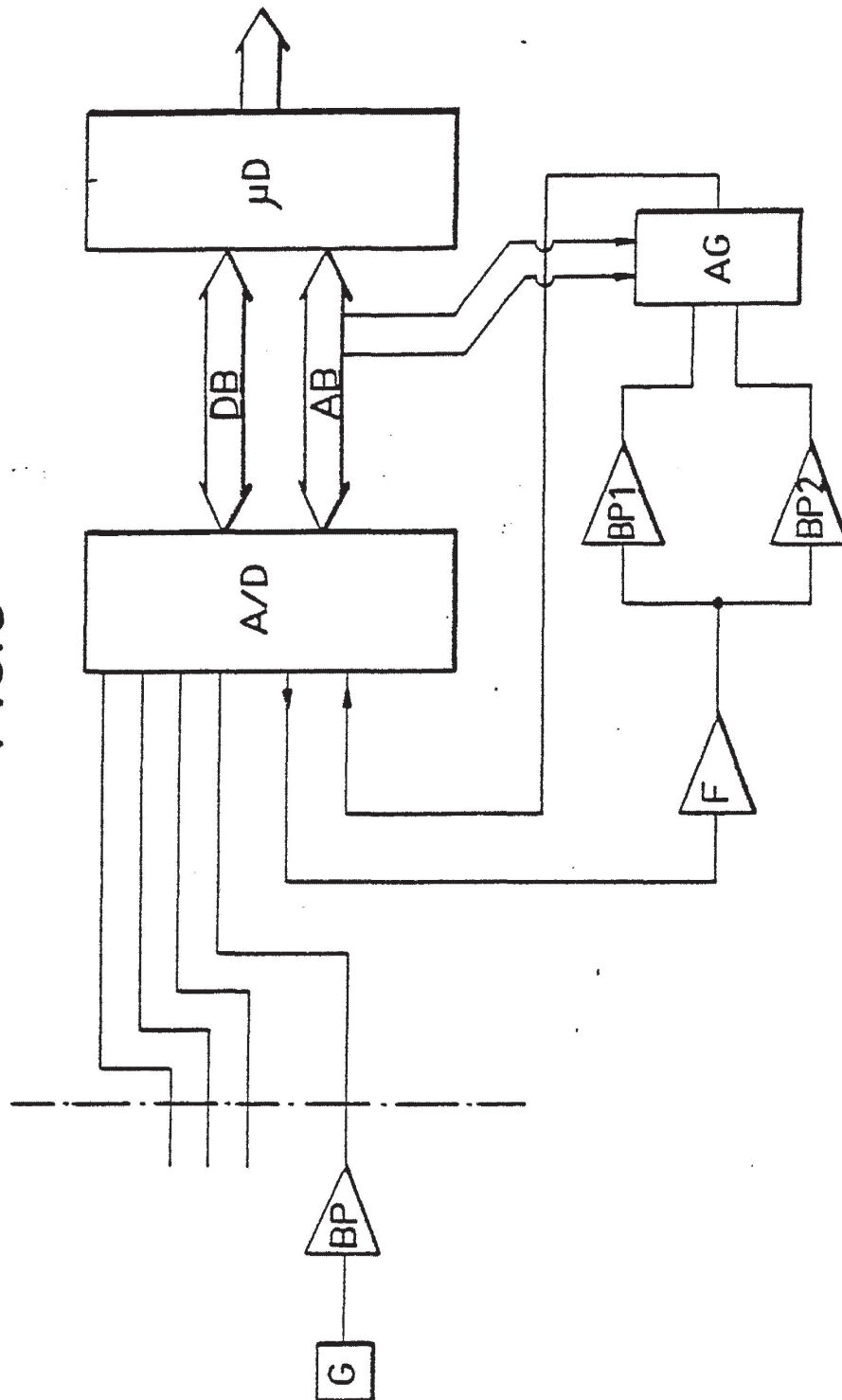


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE81/00241

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ¹ According to International Patent Classification (IPC) or to both National Classification and IPC 3 B 61 K 9/00														
II. FIELDS SEARCHED Minimum Documentation Searched ⁴ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;"> IPC 3 National Cl </td> <td style="padding: 5px;"> B 61 K 9/00,08,10,12, G 01 H 1/00,04,06,08 20h:1 .../... </td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁴ SE, NO, DK, FI classes as above			Classification System	Classification Symbols	IPC 3 National Cl	B 61 K 9/00,08,10,12, G 01 H 1/00,04,06,08 20h:1 .../...								
Classification System	Classification Symbols													
IPC 3 National Cl	B 61 K 9/00,08,10,12, G 01 H 1/00,04,06,08 20h:1 .../...													
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category ¹</th> <th style="width: 60%; border-bottom: 1px solid black;">Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="width: 30%; border-bottom: 1px solid black;">Relevant to Claim No. ¹⁸</th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">DE, A, 2 105 869 (LICENTIA PATENT-VERWALTUNGS-GmbH) 17 August 1972 (17.08.72)</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-3</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">CH, A5, 478 686 (J DULTINGER AND L SCHENKER) 14 November 1969 (14.11.69)</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">SE, B, 381 625 (MAGYAR ÁLLAMVASUTAK) 15 December 1975 (15.12.75)</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1, 3-5</td> </tr> </table>			Category ¹	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸	Y	DE, A, 2 105 869 (LICENTIA PATENT-VERWALTUNGS-GmbH) 17 August 1972 (17.08.72)	1-3	Y	CH, A5, 478 686 (J DULTINGER AND L SCHENKER) 14 November 1969 (14.11.69)	1	Y	SE, B, 381 625 (MAGYAR ÁLLAMVASUTAK) 15 December 1975 (15.12.75)	1, 3-5
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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 <table style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search ¹</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report ¹</td> </tr> <tr> <td style="text-align: center; padding: 5px;">1981-12-08</td> <td style="text-align: center; padding: 5px;">1981-12-10</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority ¹</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorized Officer ¹⁰</td> </tr> <tr> <td style="text-align: center; padding: 5px;">Swedish Patent Office</td> <td style="text-align: center; padding: 5px;"> Ingemar Josefsson </td> </tr> </table>			Date of the Actual Completion of the International Search ¹	Date of Mailing of this International Search Report ¹	1981-12-08	1981-12-10	International Searching Authority ¹	Signature of Authorized Officer ¹⁰	Swedish Patent Office	 Ingemar Josefsson				
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International Searching Authority ¹	Signature of Authorized Officer ¹⁰													
Swedish Patent Office	 Ingemar Josefsson													

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II

Fields Searched (cont)

US C1 73:67.2, 70, 70.2, 71, 71.1, 71.2,
71.3, 71.4, 146, 579, 649, 651-661;
104:1

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.