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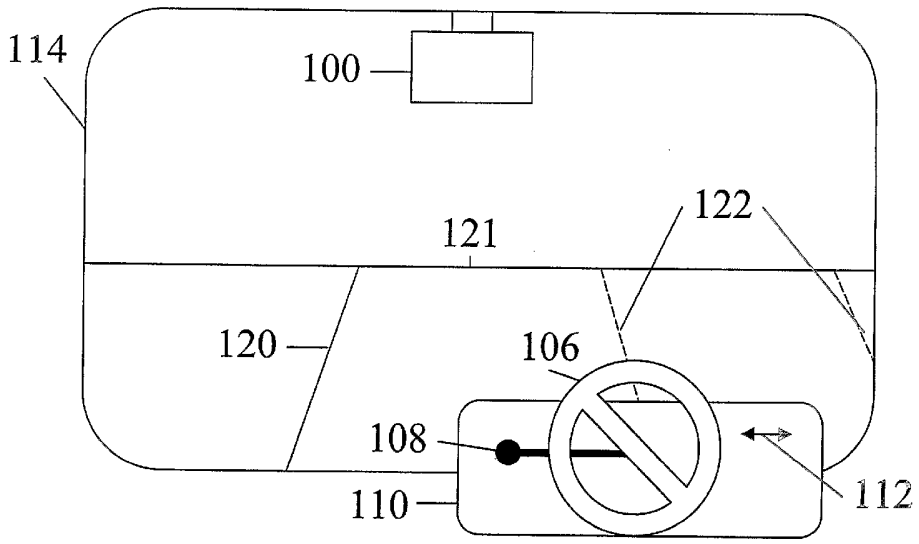
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SIGNAL APPARATUS FOR VEHICLE



(57) **Abstract:** A signal apparatus for a vehicle (1) having at least one input at which signals are received from components associated with the vehicle (1). The received signals comprise an indication demand signal initiated by a driver of the vehicle (1) and a lane detection signal produced by a lane detection apparatus (102) indicative of the position of the vehicle (1) relative to a lane (120, 122) of a highway (121). A processing means (104) is arranged to produce an indication signal that is dependent upon both the indication demand signal and the lane detection signal.

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SIGNAL APPARATUS FOR A VEHICLE

This invention relates to improvements in signal apparatus for a vehicle, especially but not exclusively for signalling the intent of a driver during a lane change manoeuvre on a highway.

A lane change on a highway having multiple lanes such as a motorway or dual carriageway requires the use of an indicator by the driver during the lane change. The indicator, usually a lamp that can produce a flashing amber light visible at the side of the vehicle in which the driver wants to turn, warns other drivers that the vehicle is changing lane. After a lane change manoeuvre is complete the driver must cancel the indicator, as a self-cancelling mechanism will not operate during such a manoeuvre in many situations. Often drivers forget to cancel the indicator, which can prove annoying to other drivers.

Some attempts have been made to overcome this problem using a timer to cancel the indicator after a predetermined time or number of flashes of the indicator. This does not provide a satisfactory solution, as the driver may not have completed the manoeuvre in the predetermined time.

According to a first aspect, the invention provides a signal apparatus for a vehicle having at least one input at which signals are received from components associated with the vehicle, the received signals comprising an indication demand signal initiated by a driver of the vehicle and a lane detection signal produced by a lane detection apparatus indicative of the position of the vehicle relative to a lane of a highway, and a processing means which is arranged to produce an indication signal that is dependent upon both the indication demand signal and the lane detection signal.

The processor may be arranged to produce the indication signal following receipt of an indication demand signal and cancel the indication signal when the lane detection signal indicates that the vehicle is at an appropriate position relative to the lanes of the highway. The vehicle may be considered to be at an appropriate position relative to the lanes by determining the heading angle of the vehicle relative to the lane. Most preferably, it is considered appropriate to cancel when the vehicle is going straight ahead in the lane, i.e. by checking that the vehicle is at a heading angle of approximately zero degrees relative to the heading of the lane.

Checking the heading angle allows a vehicle to cross multiple lanes without the indicator auto-cancelling the cancellation only occurring at the end of the manoeuvre when the vehicle is travelling straight along its lane.

The processing means may cancel the indication signal by cancelling the indication demand signal, i.e. returning it to it original state prior to the driver initiated demand. Alternatively, a cancel signal may be produced which is combined with the indication demand signal to produce the indication signal. The combination may be by way of a logical operation, perhaps by passing both through an AND gate.

The processing means may be adapted to produce an indication demand signal after a driver initiated demand which continues even after a driver has indicated that the indication signal should be cancelled. This would prevent a driver cancelling a signal before a lane change has been completed.

The processing means may learn over time whether or not the indication should be cancelled after the driver has demanded that it is cancelled. For

example, where a driver persistently cancels the indication before a lane change is completed, the processing means may learn this driver behaviour. On all subsequent operations of the indicator a time delay may be applied which is equal to the average time delay between a driver cancelling the demand signal and the vehicle completing the manouevere as determined from the lane detection signal.

Producing an indication signal that is dependent on both the indicator demand signal and a lane change signal allows the indicator to be cancelled when a manoeuvre has been completed. In this way, the driver no longer needs to remember to cancel the indicators. It also permits an indication to be cancelled at the correct time even if the vehicle changes lanes within a bend.

The processing means may comprise an electronic circuit such as an ASIC. It may, alternatively, be distributed across a multiple of electronic circuits, possibly connected across a bus or wiring loom of a vehicle. The processing means may therefore be distributed around the vehicle.

According to a second aspect, the invention provides a signal apparatus comprising:

a turn signal indicator, which illuminates in response to an indication signal;

an indicator switch, which is operable by a user to produce an indication demand signal;

a lane detection apparatus, which produces a lane detection signal indicative of the position of a vehicle relative to the lanes of a multi-lane highway; and

a processor, which references the indication demand signal with the lane detection signal to generate an indication signal.

The indication signal produced by the processor may activate the turn signal following receipt of an indication demand signal and cancel the indicator when the vehicle is at an appropriate position relative to the lanes of the highway as indicated by the lane detection signal.

The lane detection apparatus may include a camera, which is located on the vehicle such that a portion of the highway in front of the vehicle is included within its field of view. An example of such an apparatus is known from our earlier International Patent Application number PCT/GB02/02324, published under publication number WO02/092375.

The indicator switch may comprise a stalk, which is located close to the steering wheel of a vehicle for operation by a driver as is known in the prior art. It may produce an indication demand signal which changes state when the driver moves the stalk. The stalk may include a latch, which holds the output of the switch in either a rest state or a demand state when operated by the driver.

The processor may be arranged to cancel the indication signal regardless of whether the indicator is in the rest or the demand positions.

The indication signal may in a simple arrangement comprise a flag, which is raised by the processor when an indication is needed and lowered when it is not needed.

According to a third aspect the invention provides a method of operating an indicator of a vehicle during a lane change manoeuvre comprising initiating the indicator when an indication demand signal is received from an indicator switch and cancelling the indicator when a signal from a lane detection apparatus indicates that the vehicle has reached an appropriate position relative to the lanes of the highway.

The method may also cancel the indicator when a cancel signal is received without waiting for the lane signalling apparatus to indicate that the appropriate position has been reached. Such a signal may be received if a driver of the vehicle operates the indicator switch to cancel the indicator.

There will now be described, by way of example only, one embodiment of the present invention with reference to the accompanying drawings of which:

Figure 1 shows a side view of a vehicle fitted with a signal apparatus according to the present invention;

Figure 2 shows a view from the interior of the vehicle of Figure 1, forwards through the front window showing the road ahead; and

Figure 3 shows a flowchart depicting the method carried out in the signal apparatus of Figures 1 and 2.

The vehicle 1 shown in the accompanying drawings is fitted with a set of indicators, of which only the front left indicator 116 is shown. These are mounted in the usual fashion at each corner of the vehicle and are arranged to be illuminated in sets, with each set comprising the indicators on the left or right hand side of the vehicle 1.

In order to control the indicators 116, an indicator stalk 108 is provided in the region of steering wheel 106. This is of the common design where the driver of vehicle 1 signals a demand for illumination of the indicators 116 of one set or the other by pushing the indicator stalk 108 up or down for (in the example shown in Figure 2 of the accompanying drawings where the indicator stalk 108 is mounted on the left hand side of the

steering wheel 106) left or right sets respectively. The indicator stalk 108 latches in position once pushed and can be reset by the driver overriding the force of the latch or by the latch being released. In an alternative embodiment, the demand for indication is stored electronically by raising or lowering one or more flags and in which case a latch is not needed and a simple tap-up tap-down switch may be used.

An icon 112 is provided on dashboard 110 in view of the driver, which lights to indicate illumination of the indicators 116 and hence remind the driver that they are indicating. Indicator control means 104 detects the indictor demand and flashes the relevant set of indicators in the usual manner.

The vehicle is also fitted with a video camera 100 mounted behind front window 114, which captures images of the view of the road ahead of the vehicle 1. This is coupled to a lane detection apparatus 102, which analyses the captured images to detect lane boundaries such as those at the edge 120 of the road 121 or those separating lanes 122. The lane detection apparatus 102 fits the lane markings to a curve and uses this to calculate the heading angle and offset of the vehicle 1 relative to the lane boundaries 120, 122.

Although the indicator control means 104 and lane detection apparatus 102 are depicted as separate entities, the skilled man will envisage that these could be combined into one module, or one or more of the control means 104 and lane detection apparatus 102 could be combined into modules controlling other vehicle functions.

The indicator control means 104 also acts to cancel the flashing of the indicators 116 once a lane change has been completed. It does this by releasing the latch of the indicator stalk 108, hence cancelling the driver's

demand for indication. The method that the control means 104 uses to determine whether to cancel the driver's demand is shown in Figure 3 of the accompanying drawings.

In a first step 200, the control means checks whether the driver has demanded indication by use of the indicator stalk 108. If not, then the control means need take no further action other than to ensure the icon 112 has been extinguished 208. The method then repeats back to the first step 200.

If the driver has demanded indication, the control means 104 checks 202 whether the vehicle 1 has moved to the centre of the next lane. It does this by checking the offsets from lane boundaries measured by lane detection apparatus 102. The vehicle 1 is determined to have changed lane once it is roughly (typically within percent) in equidistant from the lane boundaries of the next lane in the indicated direction. Until this happens, the method is restarted from first step 200 to check whether the driver is still demanding an indication.

Once the control means 104 has determined that the vehicle 1 is in the correct lane, it checks 204 whether the vehicle 1 is straight in the lane. It does this by checking that the vehicle 1 is at a heading angle of approximately zero (typically within a range of 5° from zero) with respect to the lane boundaries of the new lane. This check is repeated until the vehicle 1 is straight in the lane.

Once the vehicle 1 is straight, the indication may be cancelled 206. The latch is released, although in an alternative embodiment the indicator stalk 108 may be driven into the cancelled position by a solenoid or other actuator or, in the case where the demand is stored electronically, the demand flag may be cleared. The indicator icon 112 is extinguished 208

and the method returns to the first step 200 where the control means 104 waits for the driver to indicate a demand.

In a further alternative, the control means 104 records if the driver cancels the demand before the method described above would have done. If the driver consistently does this, the control means may adjust when the method cancels the demand 206 by expanding the ranges of the lane offsets and heading angles in which the vehicle 1 is determined to be straight ahead in the appropriate lane. This is subject to a maximum limit from central in the lane and within a predetermined degrees of straight-ahead.

CLAIMS

1. A signal apparatus for a vehicle (1) having at least one input at which signals are received from components associated with the vehicle (1), the received signals comprising an indication demand signal initiated by a driver of the vehicle (1) and a lane detection signal produced by a lane detection apparatus (102) indicative of the position of the vehicle (1) relative to a lane (120, 122) of a highway (121), and a processing means (104) which is arranged to produce an indication signal that is dependent upon both the indication demand signal and the lane detection signal.

2. The apparatus of claim 1 in which the processor (104) is arranged to produce the indication signal following receipt of an indication demand signal and cancel the indication signal when the lane detection signal indicates that the vehicle (1) is at an appropriate position relative to the lanes (120, 122) of the highway (121).

3. The apparatus of claim 2 in which the vehicle is considered to be in the appropriate position when the vehicle is heading straight along a lane.

4. The apparatus of claim 1, 2 or claim 3 in which the processing means (104) is arranged to cancel the indication signal by cancelling the indication demand signal, i.e. returning it to it original state prior to the driver initiated demand.

5. The apparatus of claim 1, 2 or 3 in which the processing means (104) is arranged to produce a cancel signal which is combined with the indication demand signal to produce the indication signal.

6. The apparatus of any preceding claim in which the processing means (104) is adapted to produce an indication demand signal after a driver initiated demand which continues even after a driver has indicated that the indication signal should be cancelled.

7. The apparatus of claim 6 in which the processing means (104) learns over time whether or not the indication should be cancelled after the driver has demanded that it is cancelled.

8. A signal apparatus comprising:
a turn signal indicator (116), which illuminates in response to an indication signal;
an indicator switch (108), which is operable by a user to produce an indication demand signal;
a lane detection apparatus (102), which produces a lane detection signal indicative of the position of a vehicle (1) relative to the lanes (120, 122) of a multi-lane highway (121); and
a processor (104), which references the indication demand signal with the lane detection signal to generate an indication signal.

9. The apparatus of claim 8 in which the indication signal produced by the processor (104) activates the turn signal following receipt of an indication demand signal and cancels the indicator when the vehicle (1) is at an appropriate position relative to the lanes (120, 122) of the highway (121) as indicated by the lane detection signal.

10. The apparatus of claim 9 in which the vehicle is at an appropriate position when the heads angle is substantially the same as the heading of the lane.

11. The apparatus of claim 8, 9 or claim 10 in which the lane detection apparatus (102) includes a camera (100), which is located on the vehicle (1) such that a portion of the highway (121) in front of the vehicle (1) is included within its field of view.

12. A method of operating an indicator (116) of a vehicle (1) during a lane change manoeuvre comprising initiating the indicator (116) when an indication demand signal is received from an indicator switch (108) and cancelling the indicator when a signal from a lane detection apparatus (102) indicates that the vehicle (1) has reached an appropriate position relative to the lanes (120, 122) of the highway (121).

13. The method of claim 12 which further comprises cancelling the indicator (116) when a cancel signal is received without waiting for the lane signalling apparatus (102) to indicate that the appropriate position has been reached.

14. A signal apparatus for a vehicle (1) substantially as described herein with reference to and as illustrated in the accompanying drawings.

15. A method of operating an indicator (116) of a vehicle (1) during a lane change manoeuvre substantially as described herein with reference to and as illustrated in the accompanying drawings.

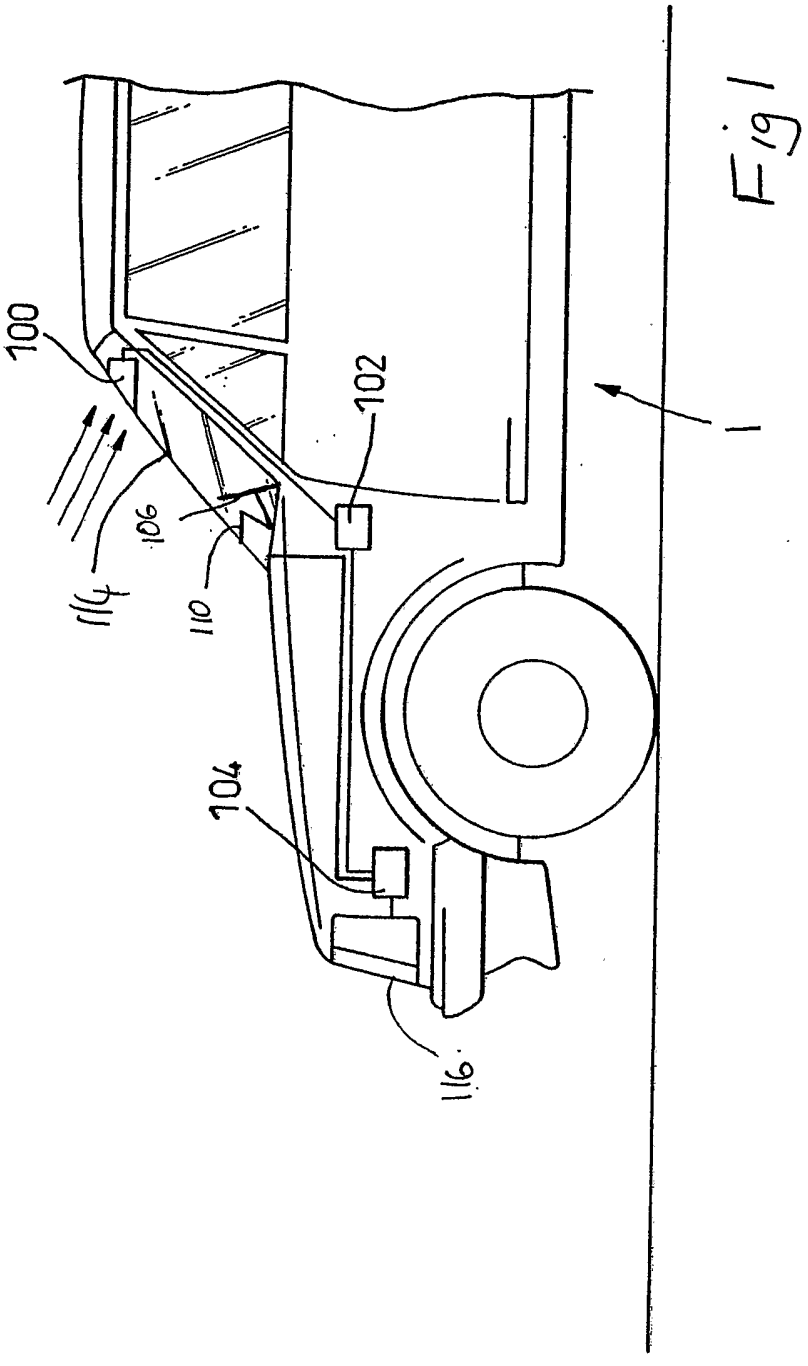

Fig 1

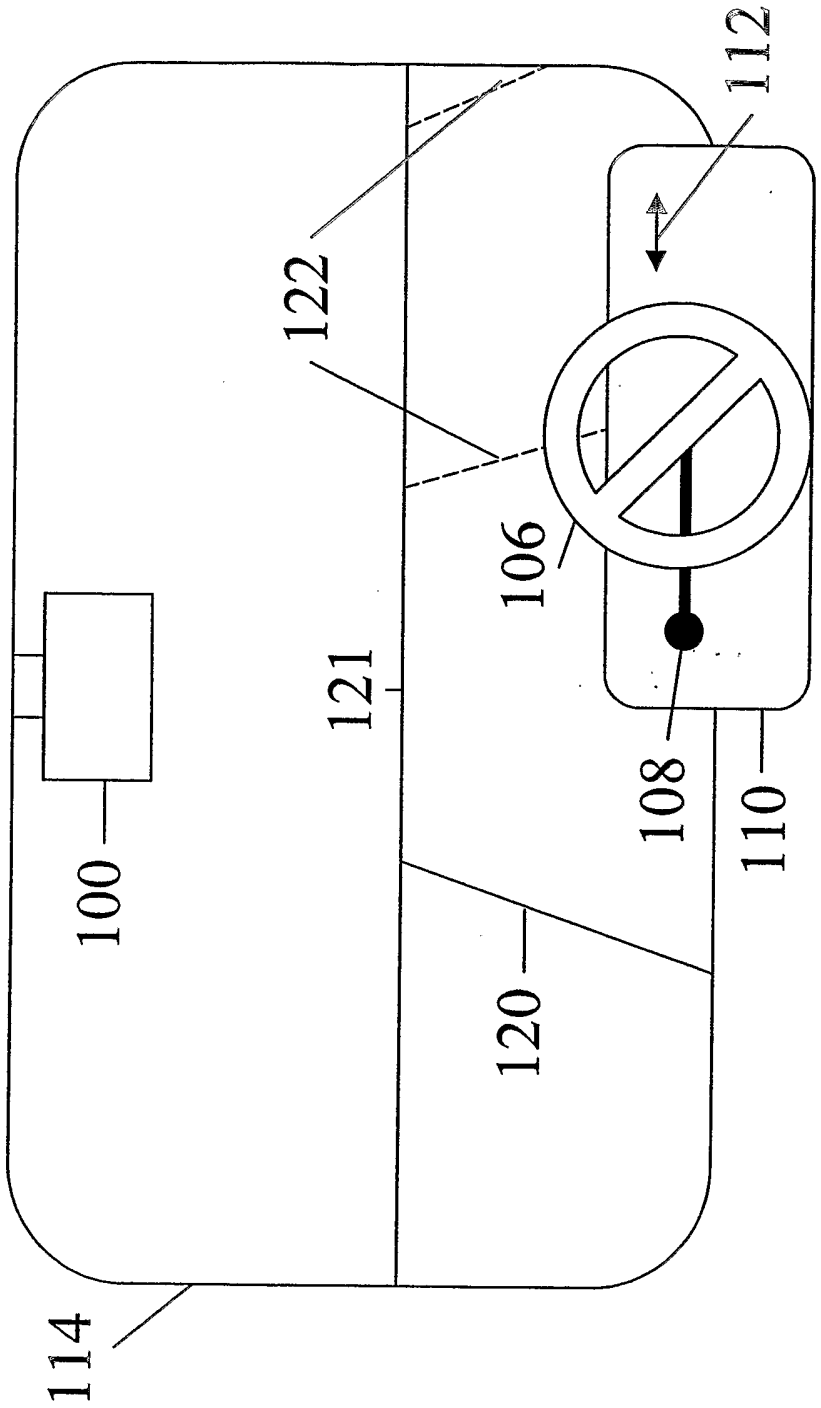

Fig 2

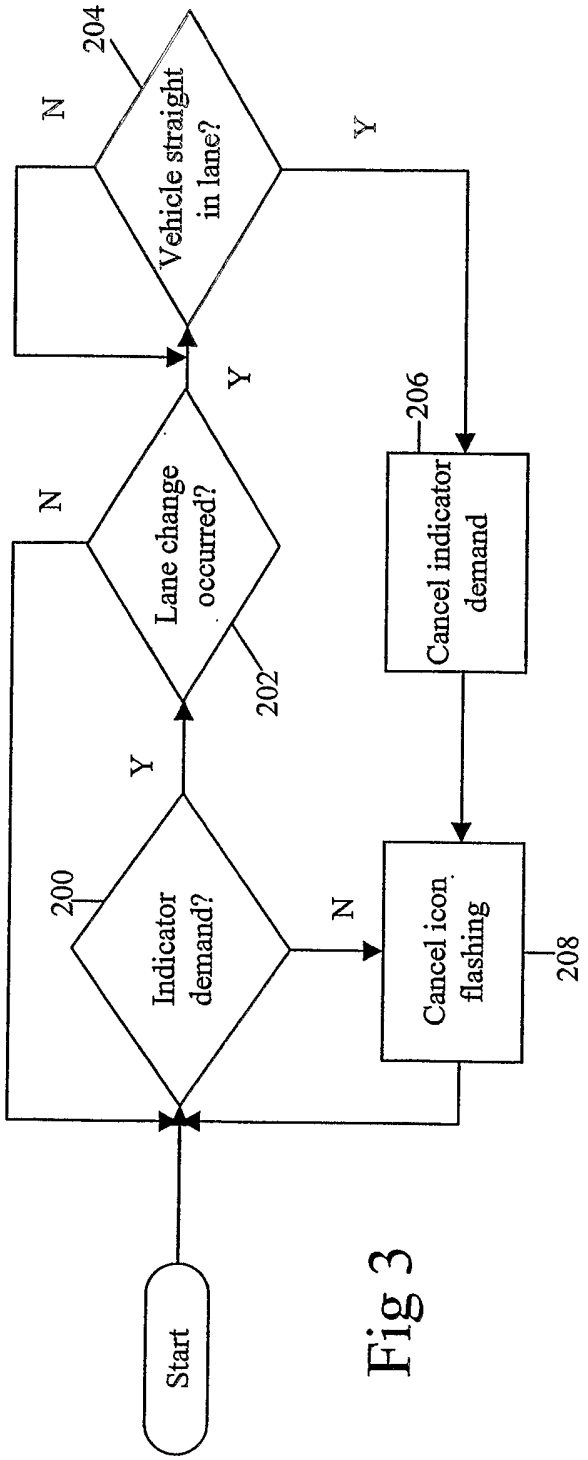
Start
Indicator demand?
200
N
Y
Lane change occurred?
202
N
Y
Vehicle straight in lane?
204
N
Y
Cancel indicator demand
206
Cancel icon flashing
208

Fig 3

INTERNATIONAL SEARCH REPORT

PCT/GB2004/001598

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60Q1/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60Q G05D G08G H04N B62J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 199 62 945 A (DAIMLER CHRYSLER AG) 26 April 2001 (2001-04-26)	1-5, 8-10,12, 13
Y	column 1, line 33 - column 2, line 57 column 4, line 28 - line 51	6,7,11
Y	EP 0 927 677 A (RENAULT) 7 July 1999 (1999-07-07) paragraphs '0003!, '0004!, '0010!, '0011!, '0014!, '0015!, '0021!, '0024!	6,7,11
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 06, 30 June 1997 (1997-06-30) & JP 9 039650 A (AQUEOUS RES:KK), 10 February 1997 (1997-02-10) abstract	1-5, 8-10,12, 13

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° 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 when the document is taken alone

"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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 August 2004	18/08/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Goltes, M

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

PCT/GB2004/001598

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 0145, no. 45 (M-1054), 4 December 1990 (1990-12-04) & JP 2 231241 A (MATSUSHITA ELECTRIC IND CO LTD), 13 September 1990 (1990-09-13) abstract	1,8, 11-13
A	PATENT ABSTRACTS OF JAPAN vol. 0112, no. 47 (M-615), 12 August 1987 (1987-08-12) & JP 62 055236 A (HIROAKI SAKUMOTO), 10 March 1987 (1987-03-10) abstract	1-3,8-10
A	PATENT ABSTRACTS OF JAPAN vol. 0062, no. 60 (M-180), 18 December 1982 (1982-12-18) & JP 57 155131 A (HONDA GIKEN KOGYO KK), 25 September 1982 (1982-09-25) abstract	1-3
A	US 2003/004643 A1 (SEREZAT LAURENT) 2 January 2003 (2003-01-02) paragraphs '0006!, '0023! - '0027!, '0041!	1,8,12

INTERNATIONAL SEARCH REPORT

PCT/GB2004/001598

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 14,15
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, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ 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 claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 14,15

According to Art. 6 PCT, the claims shall define the matter for which protection is sought. Moreover, according to Rule 6.3 PCT, the definition of the matter for which protection is sought shall be in terms of the technical features of the invention. In the present case, the lack of (essential) features in claims 14, 15, which only refer to the description and the drawings, is such as to render a meaningful search over the whole scope of these claims impossible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

PCT/GB2004/001598

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19962945 A	26-04-2001	DE 19962945 A1	26-04-2001
EP 0927677 A	07-07-1999	FR 2773130 A1	02-07-1999
		DE 69811842 D1	10-04-2003
		DE 69811842 T2	04-03-2004
		EP 0927677 A1	07-07-1999
		ES 2190048 T3	16-07-2003
JP 9039650 A	10-02-1997	JP 2731899 B2	25-03-1998
JP 2231241 A	13-09-1990	JP 1928519 C	12-05-1995
		JP 6053473 B	20-07-1994
JP 62055236 A	10-03-1987	NONE	
JP 57155131 A	25-09-1982	JP 1450099 C	11-07-1988
		JP 62058941 B	08-12-1987
US 2003004643 A1	02-01-2003	FR 2815311 A1	19-04-2002
		EP 1237750 A1	11-09-2002
		WO 0232719 A1	25-04-2002
		JP 2004511389 T	15-04-2004