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BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) **Title:** A VEHICLE BRAKE TESTING METHOD AND A VEHICLE BRAKE TESTING MODULE

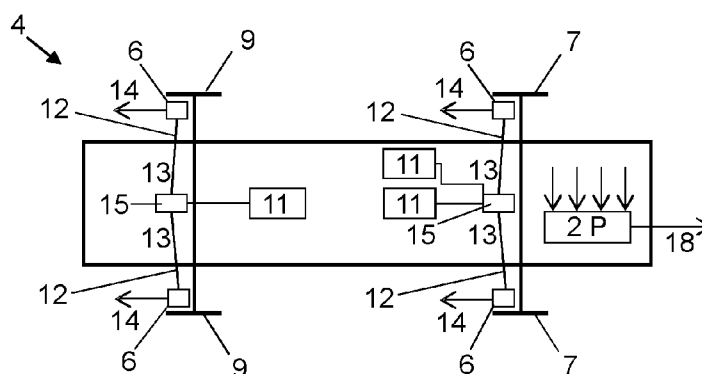


FIG. 3

(57) **Abstract:** A brake testing module (2) for a vehicle (4), configured to perform testing of brakes (6) of the vehicle according to a predetermined testing procedure, wherein the testing procedure includes the step to identify which brakes of the vehicle to be tested based upon a predetermined regulation. The testing module (2) comprises an activation member (8) adapted to receive an activation command (10) to start said testing procedure, and that during the testing procedure said brakes (6) to be tested are activated. Pressure sensors (12) are provided configured to measure at least one pressure value (14) related to a braking action of each of said activated brakes (6) during said brake activation time period; wherein said pressure sensors (12) are configured to make said pressure values (14) available at a communication network (16) of said vehicle (4). The brake testing module (2) is configured to receive said pressure values (14) from said communication network (16) and to relate said pressure values (14) to the respective activated brakes (6) of the vehicle (4), and also to compile test information (18) including said pressure values (14) and related brakes (6).



A vehicle brake testing method and a vehicle brake testing module

### Technical field

5 The present disclosure relates to a vehicle brake testing method, and to a vehicle brake testing module to perform the vehicle brake testing method.

In particular the disclosure relates to a method and a module to perform brake testing as prescribed in relevant regulations. The vehicle may be a bus, a cargo vehicle, a car, or any other vehicle having a brake system that must comply with requirements of the regulations.

10

### Background

The requirements (regulations) set up by the applicable authority often include detailed instructions defining which parameters that should be measured, and also how these parameters should be measured.

15 In addition these instructions include information where a test panel should be provided at the vehicle, e.g. to be fitted centrally on the left side of the vehicle. Among those parameters related to the brake system is the pressure of the fluid used to perform the braking action, e.g. the air or hydraulic oil that establishes a pressure within a pressure cylinder that in turn influences the brake, e.g. a disc  
20 brake.

In the following some prior art documents will be discussed that is generally related to various solutions regarding diagnostic testing of vehicles, and in particular of making diagnostic testing results available.

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DE102009048617 relates to a diagnostic system for a motor vehicle. The system is provided with a motor vehicle interface with a wireless local area network module for wireless data transmission between on-board components and off-board components. The intention with system is to avoid manual steps of  
30 connecting cables for information transfer.

WO2007024273 relates to a diagnostic tool in a vehicle information library generating method for e.g. automotive industry, and involves identifying

modifications that are made to diagnostic vehicle information, and storing modifications in library of transformations. The diagnostic vehicle information might include information regarding the vehicle's engine, transmission, electrical systems, braking system, or any other system. The diagnostic tool may

5 communicate with the vehicle in a wireless way.

US2003036832 relates to a remote diagnosis unit for vehicles. The unit includes vehicle adapter and memory for local read-out of fault indications, with computer and remote information access. The unit is connected to the vehicle via a cable or wirelessly.

10 WO-2010/019771 discloses a portable diagnostic tool system for a vehicle including diagnostic tool receiving diagnostic data from a vehicle communication interface via a wired or wireless connection.

And finally, WO-2004/053767 relates to a data collecting and diagnosing system for a vehicle, provided with a USB control unit which collects vehicular

15 information, reads vehicle-related data from the hard drive, and stores collected vehicular information in the hard drive.

The braking system, and specifically the fluid pressure system, in connection with the brakes must be possible to monitor in order to establish the proper function.

20 Today, in various countries, e.g. in Germany, the regulation stipulates that a measurement panel is arranged at the side of the vehicle in order to be easy accessible for a service person. Figure 1 is a schematic illustration of a vehicle provided with a vehicle measurement panel 3 according to the prior art.

The illustrated vehicle 2 has brakes 6 at the front wheels 7 and the rear wheels 9.

25 The illustrated vehicle is provided with a pneumatic brake system that conventionally comprises at least one pressure tank 11 containing pressurized air. In the illustrated example three pressure tanks are provided, one for the front brakes, one for the rear brakes and one for the parking brake. The tank(s) is connected to the brakes via pipes 13 and connection points 15.

30

The measurement panel is connected to the brakes via measurement pipes 17 that are in direct contact to each of the brakes to be measured. I.e. one

measurement pipe 17 runs from each braking cylinder such that it establishes a fluid connection between the braking cylinder and the measurement panel. In the measurement panel a pressure sensor is provided to measure the pressure of the fluid within the pipe at the end of each of the pipes in the measurement panel 3 and thereby of the pressure in the respective braking cylinder. To fulfil the above regulation that the left and right front brakes and one rear wheel brake should be tested, at least three pipes are arranged running from the different braking cylinders to the measurement panel. The measurement is then performed by a service person by running through a service or testing program for the brakes and at the same time monitoring and storing the pressure values from the respective braking cylinder and thereby receive a diagnostic measure of the status of the braking system. Previously, the service person had to connect a measurement sensor directly to each of the braking cylinder, which sometimes was difficult in that the braking cylinders were hard to access.

The solution used today, i.e. a measurement panel connected to the braking cylinders, has the advantage that the testing is made easier in that it is not necessary to connect the measurement sensor to each braking cylinder. However, mounting of the measurement pipes might be cumbersome and adds on hardware and thus manufacturing costs. In addition, as the pipes are directly connected to the braking fluid they are indirectly a part of the braking system, which adds on to the complexity of the system. Also, the measurement pipes, often made from plastic, have a length of up to several meters which might influence the measurement accuracy and also the function of the braking system.

The object of the present invention is to remove, or at least mitigate, the above-mentioned drawbacks of the presently used diagnostic testing of the braking system of a vehicle and to achieve an improved measurement method and testing tool.

### Summary

The above-mentioned object is achieved by the present invention according to the independent claims.

According to a first aspect the present invention relates to a brake testing method  
5 as defined in the first independent claim.

According to a second aspect the present invention relates to a brake testing module as defined in the second independent claim.

Preferred embodiments are set forth in the dependent claims.

10 In vehicles of today the control of the braking system is normally made via the communication network of the vehicle, e.g. the CAN-bus. The present invention is based upon the inventors' insight that the parameters required and measured during testing of the braking system already are available at the communication network of a vehicle. At least the following pressure values are normally available  
15 at the CAN-bus: The pressure in the pressure tank containing the fluid, e.g. air; the pressure of the fluid in connection points, or the pressures of the fluid in the braking cylinders. These pressure values are measured by conventional pressure sensors arranged in connection to each of the listed locations.

In particular, during the braking procedure the pressure values of the respective  
20 braking cylinder, or along the pipe from the connection point, are available at the CAN-bus. Pressure sensors are provided at the braking cylinder and/or along the pipe to achieve the control of the braking procedure.

The brake testing method and the brake testing module according to the present  
25 invention have at least the following advantages in comparison to the presently used technique.

It has an improved performance compared to the presently used testing system as it is less complex.

It is a lighter system in that no measurement pipes to the test panel are required.

30 It comprises fewer parts which result in lower cost and easier installation.

It offers a better and easier testing environment for the testing person.

Brief description of the drawings

Figure 1 is a schematic illustration of a vehicle provided with a vehicle measurement panel according to the prior art.

Figure 2 is a flow diagram illustrating the method according to the present invention.

Figure 3 is a schematic illustration of a vehicle provided with a vehicle brake testing module according to the present invention.

Figure 4 is a schematic block diagram illustrating a vehicle brake testing module according to the present invention.

Detailed description

The invention will now be described in detail with references to the appended figures. Throughout the figures like or similar items have the same reference signs. The method and the module is in particular advantageous in pneumatic brake systems, but may also be applied in hydraulic brake system. The invention will be described by referring to a pneumatic brake system.

First, with references to figure 2 a flow diagram of the brake testing method according to the present invention is illustrated.

A vehicle brake testing method is provided that comprises the following steps:

A - Activating a testing procedure in a brake testing module, wherein the testing procedure includes identifying which brakes of the vehicle to be tested based upon a predetermined regulation. The regulation may e.g. require that the left and right front brakes, and the left rear brake, are tested. The test module is preferably implemented as a software module that e.g. is a part of a general control program of the vehicle.

B - Activating said brakes to be tested during a brake activation time period. The person that performs the test will now activate the brakes, e.g. by pressing down the braking pedal(s) a predetermined amount, or pressing a button, etc. During

the test different brakes may be activated, e.g. the service brake and the parking braking. The brake activation time period is the time period during which the testing module is ready to receive measurement values. The length of the time period may be set in accordance to which brakes to be tested, and may be in the  
5 interval from 1 seconds up to some minutes.

C- Measuring at least one pressure value related to a braking action of each of the brakes being activated during the brake activation time period. The pressure value is preferably the pressure within a brake cylinder arranged close to the  
10 brake or in a pipe connected to the brake cylinder. During braking action the air pressure within the brake cylinder is increased and e.g. a piston is moved that in turn urge brake members e.g. a brake blocks to perform the braking action.

D - Making the pressure values available at a communication network of the  
15 vehicle. The communication network is preferably the CAN-bus of the vehicle. CAN bus (for controller area network) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN bus is a message-based protocol, designed specifically for automotive applications but is now also used in many other  
20 applications.

D – Receiving, in the brake testing module, the pressure values from the communication network. The brake testing module is connected to the communication network such that it is configured to receive the air pressure  
25 values, e.g. by gaining access to a storage location where the pressure values are stored.

E - Relating, in the test module, the air pressure values to the respective activated brakes of the vehicle.

F - Compiling test information including the pressure values and related brakes. The regulation requires that the test information, i.e. the brake testing result, comprises at least the pressure values and which brake each value relate to.

5 Preferably, the method further comprises transferring the test information to a presentation module. The presentation module may be a hand-held module provided with a display e.g. a touchscreen for interaction with the module. The presentation module may also be an application program for a smartphone. The method comprises presenting the test information at said presentation module in a  
10 predefined presentation format, e.g. in compliance with the requirements set up by the authorities. The presented information may include measurement values for each brake, time and date for the measurement, identification of the vehicle, and the name, or identification number, of the testing person.

15 It may also be possible to transfer the test information wirelessly from the test module to an external device, e.g. a monitoring computer of a test center. In addition, it may be possible to make the test information available at the communication network of the vehicle, and then e.g. presented at the vehicle information display.

20

With references to the schematic figures 3 and 4 the brake testing module 2 for the vehicle 4 will now be described in detail. The brake testing module 2 is configured to perform testing of brakes 6 of the vehicle according to a predetermined testing procedure which procedure has been described above.

25 The testing procedure includes the step to identify which brakes of the vehicle to be tested based upon a predetermined regulation.

The testing module 2 comprises an activation member 8 (see figure 4) adapted to receive an activation command 10 to start said testing procedure. This is preferably realized by pressing a button on a touchscreen. During the testing  
30 procedure the brakes 6 to be tested are activated during a brake activation time period as discussed above. Pressure sensors 12 are provided configured to

measure at least one pressure value 14 related to a braking action of each of the activated brakes 6 during the brake activation time period.

Each of the pressure sensors 12 is mounted such that it measures the pressure directly influencing the braking action in connection to the brake. Preferably, each  
5 of the pressure sensors 12 is configured to measure the pressure of braking fluid, e.g. air, in a braking cylinder or in a pipe connected to the brake cylinder.

The pressure sensors 12 are configured to make the pressure values 14 available at a communication network 16, e.g. the CAN-bus, of the vehicle 4.

- 10 The brake testing module 2 is configured to receive the pressure values 14 from the communication network 16 and to relate the pressure values 14 to the respective activated brakes 6 of the vehicle 4. In addition the module 2 is configured to compile test information including the pressure values 14 and related brakes 6.

15

Preferably the testing module is a software module. As an alternative it may be realized as a separate hand held module configured to communicate with the communication network 16 via a wire connection or wirelessly.

- 20 The testing module is configured to transfer the test information to a presentation module 18 that may be separate from the testing module or may be an integral part of the testing module. The presentation module 18 is configured to present the test information in a predefined presentation format, in line with what is prescribed by the regulation. The test information may also be made available at  
25 the communication network 16 of the vehicle 4 in order to be presented at a vehicle information display.

- The invention also relates to a computer program P (see figures 3 and 4) that comprises a computer program code to cause a vehicle brake testing module, or  
30 a computer connected to the vehicle brake testing module, to perform the method which has been described above. Furthermore, the invention also comprises a computer program product comprising a computer program code stored on a

computer-readable medium to perform the method as described above, when the computer program code is executed by a vehicle brake testing module or by a computer connected to the vehicle brake testing module.

- 5 The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

Claims

1. A vehicle brake measurement and testing method comprising the following steps:
  - activating a testing procedure in a brake testing module, wherein the testing
  - 5 procedure includes identifying which brakes of the vehicle to be tested based upon a predetermined regulation;
  - activating said brakes to be tested during a brake activation time period;
  - measuring at least one pressure value related to a braking action of each of said brakes being activated during said brake activation time period;
  - 10 - making said pressure values available at a communication network of said vehicle;
  - receiving in said brake testing module said pressure values from said communication network;
  - relating, in said testing module, said pressure values to the respective activated
  - 15 brakes of the vehicle, and
  - compiling test information including said pressure values and related brakes,
  - transferring said test information to a presentation module.
2. The vehicle brake measurement and testing method according to
- 20 claim 1, wherein the method comprises presenting said test information at said presentation module in a predefined presentation format.
3. The vehicle brake measurement and testing method according to any
- of claims 1-2, wherein the transferring of the test information is wireless.
- 25
4. The vehicle brake measurement and testing method according to any
- of claims 1-3, wherein the test information is made available at the communication
- network of the vehicle.
5. The vehicle brake measurement and testing method according to any
- 30 of claims 1-4, wherein said test module is a software module.

6. A brake measurement and testing module (2) for a vehicle (4), configured to perform testing of brakes (6) of the vehicle according to a predetermined testing procedure, wherein the testing procedure includes to identify which brakes of the vehicle to be tested based upon a predetermined regulation,

5 said testing module (2) comprises an activation member (8) adapted to receive an activation command (10) to start said testing procedure, and that during the testing procedure said brakes (6) to be tested are activated during a brake activation time period, and that pressure sensors (12) are provided configured to measure at least one pressure value (14) related to a braking action of each of  
10 said activated brakes (6) during said brake activation time period; wherein said pressure sensors (12) are configured to make said pressure values (14) available at a communication network (16) of said vehicle (4),

characterized in that the brake testing module (2) is configured to  
15 receive said pressure values (14) from said communication network (16) and to relate said pressure values (14) to the respective activated brakes (6) of the vehicle (4), and also to compile test information (18) including said pressure values (14) and related brakes (6), wherein the testing module is configured to transfer said test information to a presentation module (20).

20 7. The vehicle brake measurement and testing module (2) according to claim 6, wherein the said presentation module (20) is configured to present the test information in a predefined presentation format.

25 8. The vehicle brake measurement and testing module (2) according to any of claims 6-7, wherein the transferring of the test information is wireless.

9. The vehicle brake measurement and testing module (2) according to any of claims 6-8, wherein the test information is made available at the  
30 communication network (16) of the vehicle (4).

10. The vehicle brake measurement and testing module (2) according to

any of claims 6-9, wherein each of said pressure sensors (12) is mounted such that it measures the pressure directly influencing the braking action in connection to the brake.

5 11. The vehicle brake measurement and testing module (2) according to any of claims 6-10, wherein each of said pressure sensors (12) is configured to measure the pressure of braking fluid in a braking cylinder.

12. The vehicle brake measurement and testing module (2) according to  
10 any of claims 6-11, wherein said testing module is a software module.

13. A computer program P, wherein said computer program P comprises a computer program code to cause a vehicle brake measurement and testing module, or a computer connected to said vehicle brake testing module, to perform  
15 the method according to any of claims 1-5.

14. A computer program product comprising a computer program code stored on a computer-readable medium to perform the method according to any of the claims 1-5, when the computer program code is executed by a vehicle brake  
20 measurement and testing module or by a computer connected to the vehicle brake testing module.

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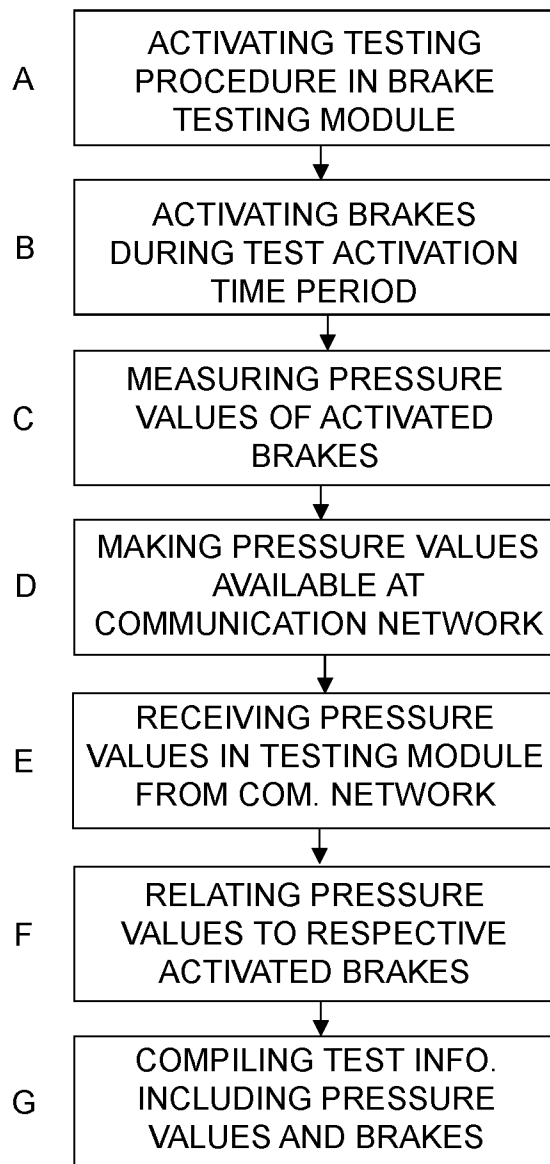
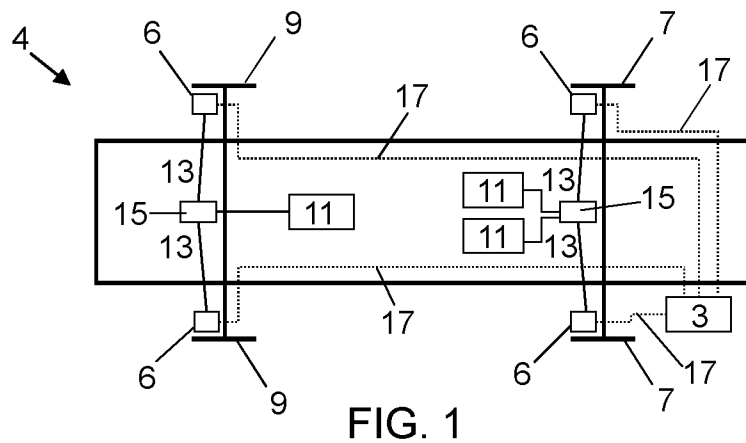


FIG. 2

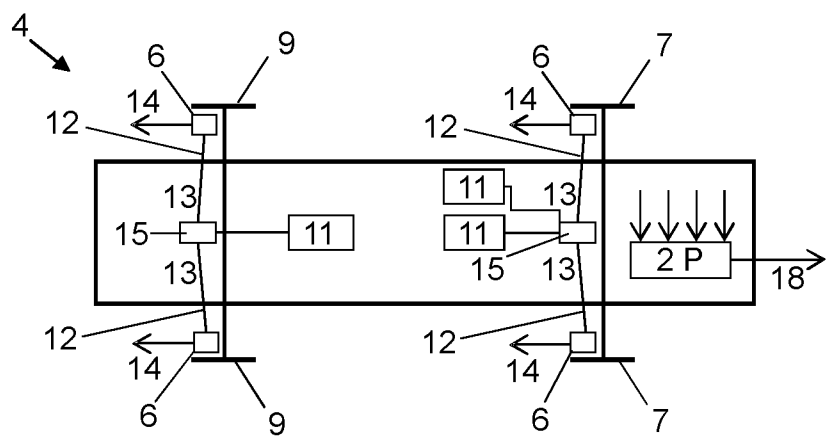


FIG. 3

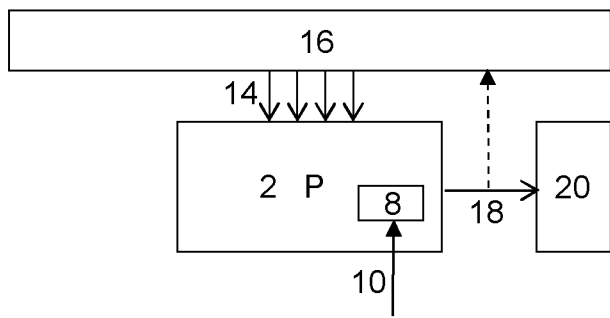


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE2016/050132

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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: B60T, G07C

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| P, X      | EP 2960126 A2 (JAGUAR LAND ROVER LTD), 30 December 2015 (2015-12-30); abstract; paragraph [0037]; figure 1; claims 1,2<br>--                  | 1-14                  |
| A         | US 20090292415 A1 (AVERBECK THORSTEN ET AL), 26 November 2009 (2009-11-26); paragraphs [0022]-[0023]; figures 1,2; claim 1<br>--              | 1-14                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "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                                              |
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| "P" document published prior to the international filing date but later than the priority date claimed                                                                  |                                                                                                                                                                                                                                                  |

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE2016/050132

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                  |                       |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------|
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| A                                                     | WO 2007024273 A1 (SNAP ON TOOLS CORP ET AL), 1 March 2007 (2007-03-01); page 7, line 3 - line 17; figure 1<br>-- | 1-14                  |
| A                                                     | DE 102009048617 A1 (DAIMLER AG), 17 June 2010 (2010-06-17); abstract; figure 1<br>--<br>-----                    | 1-14                  |

**Continuation of:** second sheet

**International Patent Classification (IPC)**

***B60T 17/22*** (2006.01)

***G07C 5/08*** (2006.01)

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

PCT/SE2016/050132

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