

(12) **UK Patent Application** (19) **GB** (11) **2533470** (13) **A**

(43) Date of A Publication

22.06.2016

(21) Application No: **1519827.8**

(22) Date of Filing: **10.11.2015**

(71) Applicant(s):
Daimler AG
(Incorporated in the Federal Republic of Germany)
Mercedesstrasse 137, 70327 Stuttgart, Germany

(72) Inventor(s):
Sreenath Reghunath
Srikanth Venkatesh

(74) Agent and/or Address for Service:
Hofstetter Schurack & Partner
Balanstr. 57, D-81541 München, Germany

(51) INT CL:
B60C 23/18 (2006.01) **B60B 39/02** (2006.01)

(56) Documents Cited:
GB 2315251 A **CN 205059099 U**
CN 203543582 U **CN 203438788 U**
CN 202764621 U **CN 201685663 U**
CN 201217369 Y **CN 105291722 A**
JP 080067118 A **US 6266842 B1**
US 3738575 A1
KR 20090045820 A

(58) Field of Search:
 INT CL **B60B, B60C**
 Other: **ONLINE: WPI, EPODOC**

(54) Title of the Invention: **Vehicle with a reservoir for storing a fluid to be applied to a tire and method for operating a vehicle**

Abstract Title: **A vehicle with a reservoir for storing a fluid to be applied to a tire**

(57) The invention relates to a vehicle (10) with a reservoir (12) for storing a fluid to be applied to at least one tire (18) of the vehicle (10). A conduit (20) leads from the reservoir (12) to at least one outlet (14) located at the at least one tire (18). The vehicle (10) comprises means for determining a temperature of the at least one tire (18) and a control unit (44) configured to effect an application of the fluid to the at least one tire (18), if the temperature is above a predetermined threshold value. The invention further relates to a method for operating such a vehicle (10). The reservoir is configured to receive water falling onto a windshield (24) and/or a rear window (26) of the vehicle (10), which may be rainwater, water from a car wash or melting ice or snow. A heat exchanger (34) to which a coolant from an engine of the vehicle can be supplied is arranged within the conduit (20) leading from the reservoir (12) to the at least one outlet (14) with a valve element (42) for closing or opening a bypass for circumventing the heat exchanger (34).

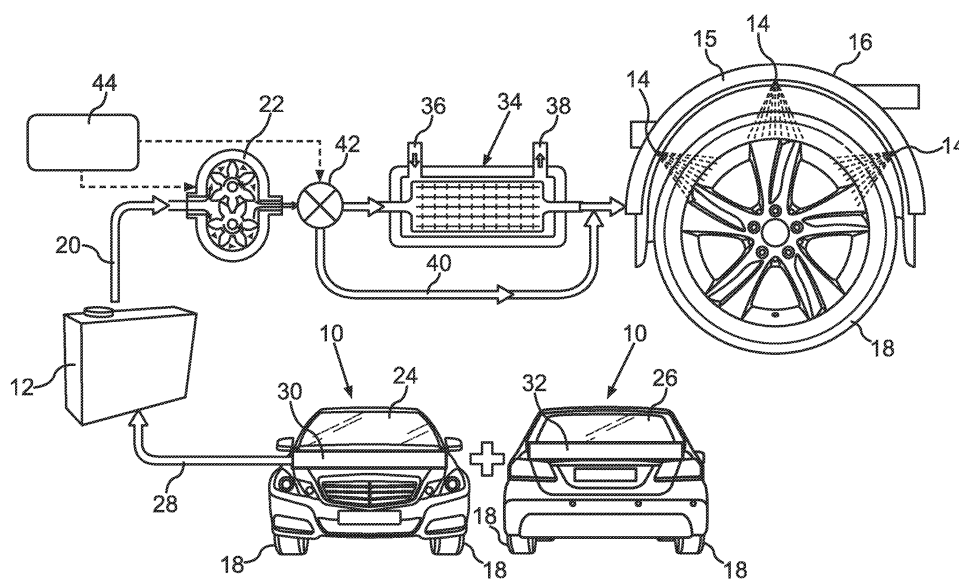


Fig.

GB 2533470 A

Vehicle with a reservoir for storing a fluid to be applied to a tire and method for operating a vehicle

The invention relates to a vehicle with a reservoir for storing a fluid to be applied to at least one tire of the vehicle. The vehicle has a conduit leading from the reservoir to at least one outlet located at the least one tire. The invention further relates to a method for operating such a vehicle.

Document US 7 034 257 B2 describes a method for modifying friction between an object and ice or snow. Herein, a heating element is utilized to apply a pulse of thermal energy to an interface between the object and the ice or snow. Water forming at an interfacial layer of ice at the interface refreezes to form a bond between the object and the ice or snow.

Document JP H 1053002 A describes a vehicle with a trunk in which a tank with a thawing solution is arranged. A pump is fitted in the tank. Plastic piping is connected to the discharge side of the pump and arranged close to tires of the vehicle. A spray nozzle for spraying the thawing solution to the tire surface is fitted to a tip of the plastic piping. Ethylene glycol of 40% is used as the thawing solution.

Herein, it is a disadvantage that the thawing solution is only available in a quantity limited by the size of the tank, and expenses occur if the tank shall be refilled. Furthermore, this antislipping device is only intended for vehicles driving on frozen and icy surfaces. However, there are other weather conditions and driving scenarios which pose a potential threat to tires of a vehicle.

Furthermore, document KR 2014 0145761 A describes a system for warning of an overheating of a tire using a thermal camera. The thermal camera is provided on a side of a road and detects the temperature of the tires of vehicles passing the area, in which the

camera is arranged. If the temperature of the tire calculated from an infrared image taken by the camera is above a predetermined threshold temperature, the vehicle is requested to stop and water is sprayed to the tire by a cooler.

Such a system for preventing an overheating of tires is not very reliable. This is due to the fact that a request is displayed to stop the vehicle and only if the vehicle stops the water can be sprayed on the tire of the vehicle. Furthermore, if the tires of several vehicles shall be cooled down, vehicles at the end of the queue must wait for a long duration of time. By means of such a system it is also difficult to detect and identify a vehicle which would need to have the tires cooled down, if the vehicle passes the system very fast or if the traffic density is very high on a given day. Furthermore, if the system fails, no vehicle can have its tires cooled down.

Moreover, document JP 2010100176 A discloses equipment for eliminating dirt adhering to tires of transport vehicles. Herein, water is sprayed to the pavement of the road to remove dirt from the tires of the vehicles driving on this road. This device is utilized for transport vehicles driving on wet pavements at a construction site.

Document US 2009 211 605 A1 describes a washing mechanism attached to a vehicle which can be utilized as a car wash if the vehicle is stopped.

It is an object of the present invention to provide a vehicle and a method of the initially mentioned kind, which allows for increased driving safety.

This object is solved by a vehicle having the features of claim 1 and by a method having the features of claim 10. Advantageous configurations with convenient further developments of the invention are specified in the dependent claims.

The vehicle according to the invention has at least one reservoir for storing a fluid to be applied to at least one tire of the vehicle. At least one conduit leads from the at least one reservoir to at least one outlet located at the at least one tire. The vehicle comprises means for determining a temperature of the at least one tire. The vehicle further comprises a control unit which is configured to effect an application of the fluid to the at least one tire, if the temperature is above a predetermined threshold value. In this way an automatic method to regulate the tire surface temperature is provided. For example, during extremely hot temperature conditions, the tires can be cooled down. Thus, a negative effect of extreme temperature conditions on the performance of the tires can be

reduced. In particular, a bursting of a tire and consequently accidents caused by the bursting of tires due to hot ambient temperatures, in particular in conjunction with continuous high speed driving, can be avoided. Therefore, increased driving safety is achieved as the bursting of tires can be prevented by applying the fluid to a tire which is overheated.

In other words, a mechanism is provided to cool down the tires of the vehicle in a case of a predicted overheating scenario, in particular while the vehicle is running at high speed in hot ambient temperatures.

The invention is based on the finding that a vehicle's cooling system is extremely important in order to avoid problems and breakdowns. However, conventionally the cooling focus is primarily on the engine of the vehicle. But extreme temperature conditions, in particular high ambient temperatures, can also be a threat to the performance of the tires.

Preferably, the control unit is also configured to effect an application of the fluid to the at least one tire, if the temperature is below a predetermined further threshold value. This is based on the finding that also extremely cold temperatures can affect the performance of tires. Cold temperature conditions can lead to a decrease in the tire pressure and therefore to an underinflation of the tire. By applying the fluid to the tire, the temperature of the tire can be raised, and the problems related to a very cold temperature of the tire can be avoided, or at least the negative effects of very cold temperatures can be mitigated.

In this configuration, an automatic method to regulate the tire surface temperature in the case of extremely hot and extremely cold temperature conditions is provided.

Preferably, at least one further conduit is coupled to an inlet of the reservoir. The at least one further conduit is configured to receive water falling onto a windscreen and/or a rear window of the vehicle. This embodiment allows replenishing the fluid by capturing water falling onto the vehicle body and reusing this water for cooling or heating the tires. In the same way, washing fluids applied to the vehicle in a car wash can be utilized for replenishing the at least one reservoir. Furthermore, the melting of ice and snow contributes to replenishing the reservoir.

The further conduit can for example be coupled to a water box arranged below the windscreen and below the rear window of the vehicle, respectively. Thus, the harvesting of water, in particular rain water, to refill the reservoir is particularly easily accomplished. Such a recycling of water also helps in energy conservation as water does not need to be provided by other means to the reservoir. Furthermore, utilizing the water falling onto the vehicle is a particularly economical way of refilling the reservoir.

Preferably, a heat exchanger is arranged within the conduit leading from the reservoir to the at least one outlet. To this heat exchanger a coolant from an engine of the vehicle, in particular an internal combustion engine, can be supplied. Thus, heat from the engine coolant can be utilized to heat the fluid before the fluid is applied to the tires of the vehicle. In this way, excess snow or ice deposited on the tire can be removed or warded off.

Preferably, the vehicle comprises means for detecting rainfall onto the vehicle, wherein the means are configured to transmit a corresponding signal to the control unit. In this case, rain or drizzle which can cool down the tires naturally can be detected. In such situations no cooling down of the tires by means of the fluid needs to be performed, or less fluid needs to be applied to the tires. These means can comprise a rain sensor or the detection of a windshield wiper activation. A false detection during windshield washing operations can be avoided by monitoring the duration of the wiper activation. The rain sensor can in particular comprise an ambient temperature sensor.

Finally, it has proven advantageous if the means for determining a temperature of the at least one tire are configured to take into account a signal from a tire temperature sensor and/or an ambient temperature sensor and/or a tire pressure sensor. The signals of such sensors can particularly easily be evaluated for determining the tire temperature. Alternatively or additionally, suspension parameters and/or a velocity of the vehicle can be taken into account for determining the temperature of the tire. In this way, a rule based algorithm considering a plurality of factors is created for activating the heating or cooling of the vehicle's tires by spraying the fluid onto them.

In the method according to the invention for operating a vehicle, a fluid which is stored in a reservoir is applied to at least one tire of the vehicle. The fluid is supplied to at least one outlet located at least at one tire through a conduit leading from the reservoir to the at least one outlet. Herein, a temperature of the at least one tire is determined. The fluid is

applied to the at least one tire, if the temperature is above a predetermined threshold value.

The advantages and preferred embodiments described with respect to the vehicle according to the invention correspondingly apply to the method according to the invention.

The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of figure and/or shown in the figure alone are usable not only in the respectively specified combination, but also in other combinations or alone, without departing from the scope of the invention. Thus, implementations are also to be considered as encompassed and disclosed by the invention, which are not explicitly shown in the figure or explained, but arise from and can be generated by separated feature combinations from the explained implementations. Therefore also embodiments and feature combinations shall be considered as disclosed, which do not have all the features of an originally drafted independent claim.

Further advantages, features and details of the invention are apparent from the claims, the following description of preferred embodiments as well as based on the drawing.

The figure schematically shows a vehicle with means for cooling or heating vehicle tires by spraying a fluid onto the tires depending on a temperature of the tires.

In the figure a vehicle 10 is shown, which has a reservoir 12 for storing a fluid such as water. The water is provided to outlets which are in particular formed as nozzles 14 arranged at a wheel arch 16 of at least one tire 18 of the vehicle 10. The nozzles 14 can in particular be fitted on a tube 15 extending around the tire 18 at the wheel arch 16. Preferably, all the tires 18 of the vehicle 10 are equipped with such nozzles 14 for spraying the water on a surface of the tires 18.

At least one conduit 20 leads from the reservoir 12 to the nozzles 14 arranged or located at the tires 18. A pump 22 or pressure pump is provided for spraying the water onto the tires 18 through the nozzles 14 at a reasonable pressure. The reservoir 12 or central tank for storing the fluid can in particular be utilized to store normal water as the fluid to be sprayed onto the tires 18.

Preferably, a mechanism is provided for collecting water falling onto a windscreen 24 and/or a rear window 26 of the vehicle 10. For example, a further conduit 28, which is

coupled to an inlet of the reservoir 12, can be attached to a water box 30 arranged below the windscreen 24 and/or to a water box 32 arranged below the rear window 26. Thus, rain water or washing liquid falling onto the vehicle 10 or melted snow or ice can be utilized to replenish the reservoir 12.

The further conduit 28, which is connected to at least one of the water boxes 30, 32, is an example of a mechanism to replenish the reservoir 12 for the cooling fluid. If the fluid is water, this can in particular be done by capturing water falling onto the vehicle body using collectors and reusing the water for cooling or heating the tires 18.

In particular, a heat exchanger 34 can be provided in the conduit 20 upstream of the nozzles 14. In the embodiment shown in the figure, the heat exchanger has an inlet 36 for coolant coming from an engine (not shown) of the vehicle. Through an outlet 38 of the heat exchanger 34 the engine coolant can be returned to the engine after having heated the fluid passing through the heat exchanger 34. In other words, the heat exchanger 34 allows transferring heat from a radiator of the vehicle to the fluid to be utilized to cool down or heat the tires 18.

However, the heat exchanger 34 is only utilized in cold ambient conditions. Therefore, the conduit 20 preferably comprises a bypass 40 through which the fluid flows in hot ambient temperature conditions. A bypass valve 42 is arranged upstream of the heat exchanger 34. A control unit 44 or controller operates the pump 22 and the bypass valve 42. In hot ambient conditions the bypass 40 is utilized, and cold fluid is sprayed onto the tires 18 to cool down the tires 18.

In cold ambient temperature conditions the bypass valve 42 is switched to a position by the control unit 44 in which the fluid, in particular the water, flows through the heat exchanger 34. Therefore, snow or ice can be removed from the tires 18 or an accumulation of snow and ice on the tires 18 can be prevented.

Alternatively at least one valve (not shown) can be utilized at the inlet 36 and/or at the outlet 38 of the heat exchanger 34 to prevent coolant from entering the heat exchanger 34. In such a configuration no bypass 40 needs to be utilized to prevent the fluid to be heated in hot ambient temperature conditions.

The control unit 44 can estimate the temperature of the road the vehicle 10 drives on from the ambient temperature which can be provided in particular by an ambient temperature

sensor (not shown). The tire temperature can also be measured directly by means of a tire temperature sensor (not shown), if such a sensor is present.

Otherwise, the temperature of the tires 18 can be estimated based on parameters like the ambient temperature, the tire pressure, suspension parameters, the vehicle speed or velocity or the like. The suspension inputs can comprise the suspension geometry, suspension travel and the like. The vehicle velocity is normally available through measurements and displayed in an instrument cluster of the vehicle 10.

If the temperature of the tires 18 is beyond a predetermined value, which can in particular be a safety threshold value, the fluid or water can be applied to the tires 18. Additionally, the average speed of the vehicle 10 can be monitored for a predetermined period of time. If the average velocity also is above a safety threshold value, then the probability of a tire burst is high. Upon the detection of such parameters, i.e. the temperature of the tires 18 above a threshold value and the average speed of the vehicle 10 above a threshold value, the bypass valve 42 is opened. Then the working fluid, in particular water from the storage tank or reservoir 12, is sprayed at reasonable pressure onto the hot tires 18. This reduces the probability of overheating and thereby a bursting of the tires 18.

Preferably, the quantity and the duration of spraying or applying the liquid or fluid to the tires 18 and also an intervals of spraying periods and of periods without applying the fluid to the tires 18 can be a function of the temperature of the tires 18 and of the average vehicle speed.

If by means of a rain sensor (not shown) of the vehicle 10 rainfall is detected, or if a signal of a windshield wiper activation is transmitted to the control unit 44, it can be determined by the control unit 44, whether the fluid should be applied to the tires 18 or if the cooling down by the detected rainfall is sufficient. Therefore, if rainfall or drizzle is detected, the application of the fluid to the tires 18 through the nozzles 14 can be stopped or reduced in quantity.

At cold ambient temperatures the bypass valve 42 can be closed and the working fluid or water passes through the heat exchanger 34. Here, the heat from the engine coolant is transferred to the working fluid. The heated up fluid is then sprayed onto the cold tires 18 in order to remove excess snow deposited on the tires 18 or to ward off snow or ice from the tires 18.

List of reference signs

| | |
|----|----------------|
| 10 | vehicle |
| 12 | reservoir |
| 14 | nozzle |
| 15 | pipe |
| 16 | wheel arch |
| 18 | tire |
| 20 | conduit |
| 22 | pump |
| 24 | windscreen |
| 26 | rear window |
| 28 | conduit |
| 30 | water box |
| 32 | water box |
| 34 | heat exchanger |
| 36 | inlet |
| 38 | outlet |
| 40 | bypass |
| 42 | valve |
| 44 | control unit |

Claims

1. Vehicle with a reservoir (12) for storing a fluid to be applied to at least one tire (18) of the vehicle (10), and with a conduit (20) leading from the reservoir (12) to at least one outlet (14) located at the at least one tire (18), characterized in that the vehicle (10) comprises means for determining a temperature of the at least one tire (18) and a control unit (44) configured to effect an application of the fluid to the at least one tire (18), if the temperature is above a predetermined threshold value.
2. Vehicle according to claim 1, characterized in that the control unit (44) is configured to effect an application of the fluid to the at least one tire (18), if the temperature is below a predetermined further threshold value.
3. Vehicle according to claim 1 or 2, characterized in that at least one further conduit (28) is coupled to an inlet of the reservoir (12), wherein the at least one further conduit (28) is configured to receive water falling onto a windscreen (24) and/or a rear window (26) of the vehicle (10).
4. Vehicle according to any one of claims 1 to 3, characterized in that a heat exchanger (34) to which a coolant from an engine of the vehicle can be supplied is arranged within the conduit (20) leading from the reservoir (12) to the at least one outlet (14).

5. Vehicle according to claim 4,
characterized in that
the conduit (20) leading from the reservoir (12) to the at least one outlet (14)
comprises a bypass (40) for circumventing the heat exchanger (34).
6. Vehicle according to claim 5,
characterized in that
a valve element (42) for closing or opening the bypass (40).
7. Vehicle according to any one of claims 1 to 6,
characterized in that
the vehicle (10) comprises means for detecting rainfall onto the vehicle (10),
wherein the means are configured to transmit a corresponding signal to the control
unit (44).
8. Vehicle according to any one of claims 1 to 7,
characterized in that
the at least one outlet is formed as at least one nozzle (14) arranged at a wheel
arch (16) of the at least one tire (18).
9. Vehicle according to any one of claims 1 to 8,
characterized in that
the means for determining a temperature of the at least one tire (18) are configured
to take into account a signal from a tire temperature sensor and/or an ambient
temperature sensor and/or a tire pressure sensor and/or suspension parameters
and/or a velocity of the vehicle (10).
10. Method for operating a vehicle (10), wherein a fluid which is stored in a reservoir
(12) is applied to at least one tire (18) of the vehicle (10), wherein the fluid is
supplied to at least one outlet (14) located at the at least one tire (18) through a
conduit (20) leading from the reservoir (12) to the at least one outlet (14),
characterized in that
a temperature of the at least one tire (18) is determined, and the fluid is applied to
the at least one tire (18), if the temperature is above a predetermined threshold
value.



Application No: GB1519827.8

Examiner: Damien Huxley

Claims searched: 1, 3 to 10

Date of search: 13 May 2016

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

| Category | Relevant to claims | Identity of document and passage or figure of particular relevance |
|----------|---------------------|--|
| X,E | X: 1, 3, 8 to10 | CN 205059099 U (QUZHOU TUYI IND DESIGN CO LTD) See the figures, WPI Abstract Accession Number 2016-14724J and the Google Patents translation found at http://www.google.com/patents/CN205059099U?cl=en |
| X,E | 1, 8 to 10 | CN 105291722 A (ZHENGWEIWEISHENG SENSING SYSTEM WUHU CO) See the figures and WPI Abstract Accession Number 2016-109195. |
| X,Y | X: 1, 8 to 10 Y: 3 | KR 20090045820 A (BYOUNG) See the figures and WPI Abstract Accession Number 2009-K04609. |
| X,Y | X; 1, 8 to 10. Y: 3 | CN 203438788 U (TANG WEIMIN) See the figures and WPI Abstract Accession Number 2014-G64849. |
| X,Y | X: 1, 8 to 10 y: 3 | CN 202764621 U (SUN WEINAN) See the figures and WPI Abstract Accession Number 2013-J43649. |
| X,Y | X: 1, 8 to 10 Y: 3 | CN 201685663 U (BAONAN WANG) See the figures and WPI Abstract Accession Number 2011-B32885. |
| X,Y | X: 1, 8 to 10 Y: 3 | CN 201217369 Y (AINIWAER MUNUER) See the figures and WPI Abstract Accession Number 2009-H41663. |
| X,Y | X: 1, 8 to 10 Y: 3 | JP 08067118 A (MORI KENICHI) See the figures and WPI Abstract Accession Number 1996-196098. |
| Y | 3 | CN 203543582 U (HAN SHIZE) See the figures and WPI Abstract Accession Number 2014-L18522. |
| Y | 3 | GB 2315251 A (ROVER GROUP LTD) See the whole document, especially the figures and line 20 of page 1 to line 4 of page 2. |



| | | |
|---|---|--|
| Y | 3 | US 6266842 B1 (MÜLLER HERMANN-FRANK) See the whole document, especially the figures and lines 51 to 67 of column 1. |
| Y | 3 | US 3738575 A1 (SOMER) See the whole document, especially the figures and lines 42 to 50 of column 1. |

Categories:

| | | | |
|---|---|---|--|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

| |
|--|
| |
|--|

Worldwide search of patent documents classified in the following areas of the IPC

| |
|------------|
| B60B; B60C |
|------------|

The following online and other databases have been used in the preparation of this search report

| |
|---------------------|
| ONLINE: WPI, EPODOC |
|---------------------|

International Classification:

| Subclass | Subgroup | Valid From |
|----------|----------|------------|
| B60C | 0023/18 | 01/01/2006 |
| B60B | 0039/02 | 01/01/2006 |