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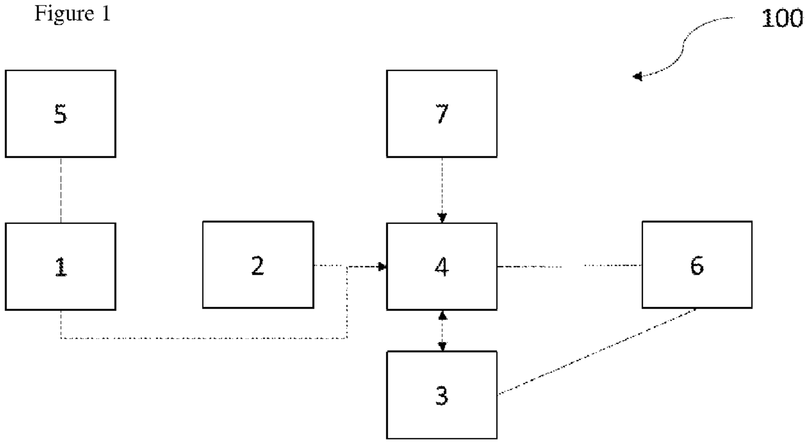
(54) **Title:** A METHOD FOR CONTROLLING MOTION OF A VEHICLE AND A SYSTEM THEREOF

Figure 1



(57) **Abstract:** The present disclosure discloses a method (300) and a system (100) for controlling motion of a vehicle (200). The system (100) comprises at least one pressure sensor (1), at least one position sensor (2), an actuation unit (3) and a control unit (4). The control unit (4) receives and compares brake force at the first brake unit (5) from the at least one pressure sensor (1) with a threshold brake force to determine decrease in brake force of the first brake unit (5). The control unit (4) receives accelerator pedal position of the vehicle (200), from the at least one position sensor (2) and selectively actuates the actuation unit (3) based on the accelerator pedal position to energize the second brake unit (6) coupled to a shaft (202). Such a system (100) may automatically restrict rotation of the shaft (202) to decelerate the vehicle (200) during emergencies.

WO 2024/180413 A1

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"A METHOD FOR CONTROLLING MOTION OF A VEHICLE AND A SYSTEM THEREOF"

TECHNICAL FIELD

Present disclosure, in general, relates to the field of automobiles. Particularly, but not exclusively, the present disclosure relates to a brake unit for controlling motion of a vehicle. Further, embodiments of the present disclosure relate to a method and a system for controlling the motion of the vehicle.

BACKGROUND OF THE DISCLOSURE

Most vehicles in operation are powered by internal combustion (IC) engines. The internal combustion engine is connectable to wheels of the vehicle and is responsible for displacement of the vehicle. Rotational energy from the internal combustion engine is stored in a flywheel of the engine and is transferred to the wheels to move the vehicle. Speed of the vehicle is regulated by controlling/absorbing the rotational energy of the wheels. Vehicles are equipped with brakes which are actuated to decelerate and stop the vehicle based on requirement. When brakes are applied, the rotational energy of the wheels is absorbed by the brakes and is dissipated as heat thereby reducing speed of the vehicle.

There exist various brake units in vehicles such as a service brake unit, an auxiliary brake unit, a parking brake unit and the like. A service brake unit aids in decelerating the vehicle during most of the operation of the vehicle. An auxiliary brake unit often assists the service brake unit to decelerate the vehicle at a faster rate and to reduce the wear of the service brake unit. A parking brake unit is often employed when the vehicle is stationary and to avoid unnecessary roll-backs or movements and is also employed in emergency to bring the vehicle to rest in case of brake failures.

Failure of brake units in the vehicle may cause accidents and may be fatal to passengers, civilians and the driver of the vehicle. Hence, some brake units such as air brake units are connected individually with two brake circuits each connected to a pair of front wheels and a pair of rear wheels of the vehicle to avoid accidents even when failure in one of the brake circuits occurs. However, braking with a single brake circuit at high speeds may cause failure of brakes. Further, use of emergency brakes at high speeds may cause the vehicle to roll-over due to wheel lock and uncontrolled fish-tailing of the vehicle. Conventionally, supplementary brake unit such as a retarder brake unit is often employed in vehicles to assist the service brake units in decelerating the vehicles. However, such supplementary brake units may not bring the vehicle to complete halt during failure of service brakes.

The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the conventional mechanisms.

SUMMARY OF THE DISCLOSURE

One or more shortcomings of the prior art are overcome by a method and a system as claimed and additional advantages are provided through the method and the system as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

In one non-limiting embodiment of the present disclosure a method for controlling motion of a vehicle is disclosed. The method includes the steps of receiving by a control unit at least one first signal on a brake force received at a first brake unit from at least one pressure sensor communicatively coupled to the control unit. The control unit compares the brake force of the first brake unit with a threshold brake force. Then, the control unit receives at least one second signal on an accelerator pedal position of the vehicle, from at least one position sensor. The control unit, then determines decrease in brake force of the first brake unit based on the comparison of the brake force with the threshold brake force. The control unit actuates an actuation unit selectively based on the accelerator pedal position to energize a second brake unit coupled to a shaft associated with at least two wheels of the vehicle. The second brake unit generates a magnetic field upon energizing by the actuation unit to restrict rotation of the shaft.

In an embodiment, the second brake unit is an electromagnetic retarder brake unit.

In an embodiment, the first brake unit is connectable to wheels of the vehicle.

In an embodiment, the control unit actuates a supercapacitor or a battery connected to the actuation unit and electrically connected to the second brake unit to energize and regulate the brake force.

In an embodiment, the control unit actuates the actuation unit when the brake force is less than the threshold brake force.

In an embodiment, the control unit receives at least one temperature signal corresponding to temperature of the second brake unit from at least one temperature sensor and compares the temperature of the second brake unit with at least one threshold temperature. The control unit actuates the actuation unit selectively based on the comparison of the temperature of the second brake unit with the at least one threshold temperature to energize the second brake unit.

In an embodiment, the control unit determines a change in position of accelerator pedal and compares the change in position of the accelerator pedal with a threshold position. The control unit actuates the actuation unit selectively based on the comparison of the change in position of the accelerator pedal with the threshold position to energize the second brake unit.

In an embodiment, the control unit receives brake force of at least two brake circuits of the first brake unit and determines a difference in brake force of the at least two brake circuits of the first brake unit. The control unit actuates the actuation unit selectively based on the difference in brake force of the at least two brake circuits of the first brake unit to energize the second brake unit.

In another non-limiting embodiment, a system for controlling motion of a vehicle is disclosed. The system comprises at least one pressure sensor, at least one position sensor, an actuation unit and a control unit. The at least one pressure sensor is configured to sense brake force of a first brake unit and transmit at least one first signal. The at least one position sensor is configured to sense position of an accelerator pedal of the vehicle and transmit at least one second signal on an accelerator pedal position. The actuation unit is connected to a second brake unit and coupled to a shaft associated with at least two wheels of the vehicle. The actuation unit is configured to energize the second brake unit. The control unit is communicatively coupled to the at least one pressure sensor, the at least one position sensor and the actuation unit.

In an embodiment, the control unit is configured to receive the at least one first signal on the brake force received at the first brake unit from the at least one pressure sensor. The control unit then compares the brake force of the first brake unit with a threshold brake force. The control unit receives the at least one second signal on the accelerator pedal position of the vehicle, from the at least one position sensor. The control unit then determines decrease in brake force of the first brake unit based on the comparison of the brake force with the threshold brake force. Lastly, the control unit actuates the actuation unit selectively based on the accelerator pedal position to energize the second brake unit coupled to the shaft, wherein the second brake unit generates a magnetic field upon energizing by the actuation unit to restrict rotation of the shaft.

In an embodiment, the wherein the first brake unit is connectable to wheels of the vehicle.

In an embodiment, the control unit receives at least one temperature signal corresponding to temperature of the second brake unit from at least one temperature sensor and compares the temperature of the second brake unit with at least one threshold temperature. The control unit actuates the actuation unit selectively based on the comparison of the temperature of the second brake unit with the at least one threshold temperature to energize the second brake unit.

In an embodiment, the control unit determines a change in position of accelerator pedal and compares the change in position of the accelerator pedal with a threshold position. The control unit actuates the actuation unit selectively based on the comparison of the change in position of the accelerator pedal with the threshold position to energize the second brake unit.

In an embodiment, the control unit receives brake force of at least two brake circuits of the first brake unit and determines a difference in brake force of the at least two brake circuits of the first brake unit. The control unit actuates the actuation unit selectively based on the difference in brake force of the at least two brake circuits of the first brake unit to energize the second brake unit.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The novel features and characteristic of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying figures. One or more embodiments are now described, by way of example only, with reference to the accompanying figures wherein like reference numerals represent like elements and in which:

Figure 1 is an exemplary block diagram of a system for controlling motion of a vehicle in accordance with an embodiment of the present disclosure.

Figure 2 is an isometric view of a vehicle with the proposed system, in accordance to an exemplary embodiments of the present disclosure.

Figure 3 is a flow diagram depicting a method for controlling motion of a vehicle in accordance with an embodiment of the present disclosure.

The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the system and method illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION

While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the figures and will be described below. It should be understood, however that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternative falling within the scope of the disclosure.

The terms “comprises”, “comprising”, or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system, method that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such system, or assembly, or device. In other words, one or more elements in a system proceeded by “comprises… a” does not, without more constraints, preclude the existence of other elements or additional elements in the system or method.

Embodiments of the present disclosure discloses a method for controlling motion of a vehicle. The method includes the steps of receiving by a control unit at least one first signal on a brake force received at a first brake unit from at least one pressure sensor communicatively coupled to the control unit. The control unit compares the brake force of the first brake unit with a threshold brake force. Then, the control unit receives at least one second signal on an accelerator pedal position of the vehicle, from at least one position sensor. The control unit, then determines decrease in brake force of the first brake unit based on the comparison of the brake force with the threshold brake force. The control unit actuates an actuation unit selectively based on the accelerator pedal position to energize a second brake unit coupled to a shaft associated with at least two wheels of the vehicle. The second brake unit generates a magnetic field upon energizing by the actuation unit to restrict rotation of the shaft. Such a method may automatically restrict rotation of the shaft to decelerate the vehicle during emergencies.

The disclosure is described in the following paragraphs with reference to Figures 1 to 3. In the figures, the same element or elements which have same functions are indicated by the same reference signs. It is to be noted that, the vehicle is not illustrated in the figures for the purpose of simplicity. One skilled in the art would appreciate that the system and the method as disclosed in the present disclosure may be used in any vehicle including but not liming to heavy and light commercial vehicles, load carrying vehicles, passenger vehicles, and the like. The system and the method of the present disclosure may also be implemented in vehicles having an auxiliary brake such as a retarder brake without deviating from the principles of the present disclosure.

Referring to Figures 1 and 2, which disclose a system (100) for controlling motion of a vehicle (200) is depicted. The system (100) may be implemented in the braking mechanism of the vehicle (200). The system (100) may comprise at least one pressure sensor (1), at least one position sensor (2), an actuation unit (3) and a control unit (4). The at least one pressure sensor (1) disposed proximal to the first brake unit (5) may be fluidly connected to the first brake unit (5). The at least one pressure sensor (1) may be configured to sense brake force of a first brake unit (5) of the vehicle (200) and transmit at least one first signal. In an embodiment, the first brake unit (5) is connectable to wheels (203) of the vehicle (200) and the first brake unit (5) may include a pneumatic brake unit, or a hydraulic brake unit, where the first brake unit (5) may include at least a first brake circuit and a second brake circuit. The first brake circuit may be connectable to front wheels (203a) of the vehicle (200) and the second brake circuit may be connectable to the rear wheels (203b) of the vehicle (200).

In an embodiment, the at least one pressure sensor (1) may be configured to sense a brake force of the first brake unit (5) and transmit at least one first signal. The brake force sensed by the at least one pressure sensor (1) may include pressure in the first brake circuit and pressure in the second brake circuit. The at least one pressure sensor (1) may include at least two pressure sensors such as a first pressure sensor (1a) and a second pressure sensor (1b). The first pressure sensor (1a) may be positioned at the first brake circuit of the first brake unit (5) to sense the brake force in the first brake unit (5) and a second pressure sensor (1b) positioned at the second brake circuit of the first brake unit (5) to sense brake force of the second brake circuit of the first brake unit (5). The at least one position sensor (2) may be configured to sense position of an accelerator pedal (205) of the vehicle (200) and transmit at least one second signal on an accelerator pedal position. In an embodiment, the at least one position sensor (2) may be integrated to the accelerator pedal (205) or may be removably attached to the accelerator pedal (205) of the vehicle (200). The actuation unit (3) may be coupled to a second brake unit (6) which may be connected to a shaft (202) associated with at least two wheels (203) of the vehicle (200) as can be seen in Figure 2 and the actuation unit (3) may be configured to energize the second brake unit (6).

In an embodiment, the second brake unit (6) may include a retarder brake unit (6) coupled to a transmission of the vehicle (200). In the illustrative embodiment, the second brake unit (6) is depicted as an electromagnetic retarder brake unit (6) connected to a chassis (201) of the vehicle (200) as best seen in Figure 2. The second brake unit (6) may include a rotor, electromagnetic coils and a stator, where the stator may be connected to a portion of the vehicle body, the electromagnetic coils may be fixedly positioned within stator. The electromagnetic coils may be configured to generate a magnetic field upon being actuated by the actuation unit (3). The rotor may be rotatably positioned within the stator and coupled to a propeller shaft (202) of the vehicle (200). The propeller shaft (202) may be restricted from rotation by restricting rotation of the rotor by the magnetic field generated from the electromagnetic coils.

Referring again to Figure 1, the control unit (4) may be communicatively coupled to the at least one pressure sensor (1), the at least one position sensor (2) and the actuation unit (3). The control unit (4) may be configured to receive the at least one first signal on the brake force received at the first brake unit (5) from the at least one pressure sensor (1). In an embodiment, the control unit (4) may receive a signal corresponding to a brake force from the first brake circuit and a signal corresponding to a brake force from the second brake circuit. The control unit (4) may compare the brake force of the first brake circuit and brake force of the second brake circuit with a threshold brake force. In an embodiment, the control unit (4) may also compare the brake force of the first brake circuit and the brake force of the second brake circuit with a first threshold brake force and a second threshold brake force respectively to determine decrease in brake force in individual brake circuits. Further, the control unit (4) may determine a decrease in brake force of the first brake unit (5) when the brake force of at least one of the first brake circuit and the second brake circuit may be less than the threshold brake force. Further, the control unit (4) may determine a difference between the brake force in the first brake circuit and the brake force in the second brake circuit by comparing the brake force at the first brake circuit with the brake force at the second brake circuit.

In an embodiment, the actuation unit (3) may include a supercapacitor (3a), a battery (3b), an alternator (3c) and a junction box (3d). The supercapacitor (3a) may be configured to supply power to the second brake unit (6) in conjunction with power being supplied from the battery (3b), to eliminate need for large batteries and thereby reducing weight of the actuation unit (3) and the same shall not be considered a limitation. In an embodiment, the supercapacitor (3a) may be replaced by another battery to supply power to the second brake unit (6). The junction box (3d) may be communicatively coupled to the control unit (4) and may vary supply of power to the second brake unit (6).

Referring again to Figure 1, the control unit (4) may receive the at least one second signal on the accelerator pedal position of the vehicle (200), from the at least one position sensor (2). In an embodiment, the accelerator pedal position may include an engaged position and a disengaged position. In an embodiment, the control unit (4) may receive a plurality of signals corresponding to the accelerator pedal position from the at least one position sensor (2) and may be configured to determine a rate of change of the accelerator pedal position. The rate of change of the accelerator pedal position may be change of the accelerator pedal (205) from the engage position to the disengaged position. For example, the control unit (4) may determine the rate of change of movement of the accelerator pedal position as fast, medium and slow based on change of the accelerator pedal position. For example, when a driver of the vehicle (200) removes a foot from the accelerator pedal (205) slowly, the control unit (4) may consider the rate of change in accelerator pedal position as slow. When the driver of the vehicle (200) removes the foot from the accelerator pedal (205) faster than that of rate of change in slow considered by the control unit (4) but not suddenly, the control unit (4) may consider the rate of change in accelerator pedal position as medium. Further, the control unit (4) may consider the rate of change in accelerator pedal position as fast, when a driver of the vehicle (200) removes a foot from the accelerator pedal (205) suddenly. The control unit (4) may actuate the actuation unit (3) selectively based on the accelerator pedal position to energize the second brake unit (6) coupled to the shaft (202). In an embodiment, the second brake unit (6) may be electrically connected to the actuation unit (3). The second brake unit (6) may generate a magnetic field upon energizing by the actuation unit (3) to restrict rotation of the shaft (202). In an embodiment, the control unit (4) may actuate the actuation unit (3) upon determining decrease in brake force in at least one of the first brake circuit and the second brake circuit of the first brake unit (5) and upon receiving the at least one second signal indicative of a disengaged position of the accelerator pedal (205).

Further, the control unit (4) may actuate the actuation unit (3) upon determining the rate of change of the accelerator pedal position as fast, based on the plurality of signals from the at least one position sensor (2). The junction box (3d) of the actuation unit (3) may supply power to the second brake unit (6) from the supercapacitor (3a) of the actuation unit (3), where the second brake unit (6) generates a magnetic field upon energizing by the actuation unit (3) to restrict the rotation of the shaft (202). Thus, the system (100) may prevent accidents of the vehicle (200) due to decrease in brake force in the first brake unit (5) of the vehicle (200) automatically.

In an embodiment, the control unit (4) may be communicatively coupled to at least one temperature sensor (7) positioned proximal to the second brake unit (6). The at least one temperature sensor (7) may be positioned proximal to the electromagnetic coils and may be disposed on a portion of the stator. The at least one temperature sensor (7) may sense temperature of the second brake unit (6). In an embodiment, the at least one temperature sensor (7) may sense temperature of the electromagnetic coils of the second brake unit (6), where the electromagnetic coils may be heated due to generation of the magnetic field. The at least one temperature sensor (7) may generate a temperature signal corresponding to the temperature of the electromagnetic coils of the second brake unit (6). The control unit (4) may receive the temperature signal from the at least one temperature sensor (7) and may compare the temperature of the second brake unit (6) with at least one threshold temperature. In an embodiment, the control unit (4) may actuate the actuation unit (3) upon comparison of the temperature of the second brake unit (6) with the at least one threshold temperature, when the temperature may be less than the at least one threshold temperature.

In an embodiment, when the control unit (4) does not receive inputs on decrease in brake force of the first brake unit (5) i.e., when the brake force of the first brake circuit and the brake force of the second brake circuit are greater than or equal to the threshold brake force, the actuation unit (3) may supply power to the second brake unit (6) from the battery (3b) of the actuation unit (3), where the second brake unit (6) functions as an auxiliary brake in the vehicle (200) since the electromagnetic coils of the second brake unit (6) are energized gradually unlike when the second brake unit (6) may be actuated by the supercapacitor (3a). In an embodiment, the electromagnetic coils of the second brake unit (6) may be energized 30% to 50 % slower than that of operation as the auxiliary brake in the vehicle (200)

In an embodiment, the control unit (4) may be configured to restrict acceleration of the vehicle (200) upon determining decrease in brake force of at least one of the first brake circuit and the second brake circuit of the first brake unit (5) and upon sensing the engaged position of the accelerator pedal (205) of the vehicle (200) by actuating other auxiliary brakes such as an engine (204) exhaust brake and the like. Thus, the system (100) may prevent acceleration of the vehicle (200) when decrease in brake force of the first brake unit (5) may be determined.

In an embodiment, the control unit (4) may actuate the actuation unit (3) selectively based on the accelerator pedal position to energize the second brake unit (6). In an embodiment, the control unit (4) may actuate the actuation unit (3) upon determining decrease in brake force in at least one of the first brake circuit and the second brake circuit of the first brake unit (5) and upon receiving the at least one second signal indicative of a disengaged position of the accelerator pedal (205). Further, the control unit (4) may actuate the actuation unit (3) upon determining the rate of change of the accelerator pedal position as fast, based on the plurality of signals from the at least one position sensor (2). The control unit (4) may compare the temperature of the second brake unit (6) with the at least one threshold temperature. In an embodiment, the control unit (4) may actuate the actuation unit (3) upon comparison of the temperature of the second brake unit (6) with the at least one threshold temperature, when the temperature may be less than the at least one threshold temperature. The control unit (4) may selectively actuate the actuation unit (3) to energize the second brake unit (6) upon determining at least two of decrease in brake force, difference in brake force of the first brake circuit and the second brake circuit, the accelerator pedal position, the change in accelerator pedal position, the rate of change in accelerator pedal position, temperature of the second brake unit (6). The junction box (3d) of the actuation unit (3) may supply power to the second brake unit (6) from the supercapacitor (3a) of the actuation unit (3), where the second brake unit (6) generates a magnetic field upon energizing by the actuation unit (3) to restrict the rotation of the shaft (202). Thus, the method (300) may prevent accidents of the vehicle (200) due to decrease in brake force and/or failure of the first brake unit (5) of the vehicle (200) automatically by actuating the second brake unit (6) to bring the vehicle (200) to rest.

In an embodiment, the control unit (4) may be a centralised control unit of the vehicle (200) or may be a dedicated control unit to the system associated with the centralised control unit of the vehicle (200). The control unit (4) may also be associated with other control units including, but not limited to, body control unit, engine control unit, transmission control unit, and the like. The control unit (4) may be comprised of a processing unit. The processing unit may comprise at least one data processor for executing program components for executing user- or system-generated requests. The processing unit may be a specialized processing unit such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc. The processing unit may include a microprocessor, such as AMD Athlon, Duron or Opteron, ARM's application, embedded or secure processors, IBM PowerPC, Intel's Core, Itanium, Xeon, Celeron or other line of processors, etc. The processing unit may be implemented using a mainframe, distributed processor, multi-core, parallel, grid, or other architectures. Some embodiments may utilize embedded technologies like application-specific integrated circuits (ASICs), digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), etc.

The control unit (4) may be disposed in communication with one or more memory devices (e.g., RAM, ROM etc.) via a storage interface. The storage interface may connect to memory devices including, without limitation, memory drives, removable disc drives, etc., employing connection protocols such as serial advanced technology attachment (SATA), integrated drive electronics (IDE), IEEE-1394, universal serial bus (USB), fiber channel, small computing system (100) interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, redundant array of independent discs (RAID), solid-state memory devices, solid-state drives, etc.

Referring now to Figure 3, which is an exemplary embodiment of the present disclosure illustrating a method (300) of controlling motion of a vehicle (200).

The method (300) may describe in the general context of processor executable instructions in the control unit (4). Generally, the executable instructions may include routines, programs, objects, components, data structures, procedures, modules, and functions, which perform particular functions or implement particular abstract data types.

The order in which the method (300) is described is not intended to be construed as a limitation, and any number of the described method (300) blocks may be combined in any order to implement the method (300). Additionally, individual blocks may be deleted from the methods without departing from the scope of the subject matter described herein. Furthermore, the method (300) can be implemented in any suitable hardware, software, firmware, or combination thereof.

At block 301, the control unit (4) receives at least one first signal on a brake force received at a first brake unit (5) from at least one pressure sensor (1) communicatively coupled to the control unit (4). In an embodiment, the first brake unit (5) is connectable to wheels (203) of the vehicle (200) and the first brake unit (5) may include a pneumatic brake unit, and a hydraulic brake unit, where the first brake unit (5) may include at least a first brake circuit and a second brake circuit.

In an embodiment, the brake force sensed by the at least one pressure sensor (1) may include pressure in the first brake circuit and pressure in the second brake circuit. The at least one pressure sensor (1) may include a first pressure sensor (1a) positioned at the first brake circuit of the first brake unit (5) and a second pressure sensor (1b) positioned at the second brake circuit of the first brake unit (5) to sense brake force of the first brake circuit and the second brake circuit.

In an embodiment, the control unit (4) may be communicatively coupled to at least one temperature sensor (7) positioned proximal to the second brake unit (6). The at least one temperature sensor (7) may be positioned proximal to the electromagnetic coils and may be disposed on a portion of the stator. The at least one temperature sensor (7) may sense temperature of the second brake unit (6). In an embodiment, the at least one temperature sensor (7) may sense temperature of the electromagnetic coils of the second brake unit (6), where the electromagnetic coils may be heated due to generation of the magnetic field. The at least one temperature sensor (7) may generate a temperature signal corresponding to the temperature of the electromagnetic coils of the second brake unit (6). The control unit (4) may receive the temperature signal from the at least one temperature sensor (7).

At block 302, the control unit (4) compares the brake force of the first brake unit (5) with a threshold brake force. The control unit (4) may compare the brake force of the first brake circuit and brake force of the second brake circuit with the threshold brake force. In an embodiment, the control unit (4) may also compare the brake force of the first brake circuit and the brake force of the second brake circuit with a first threshold brake force and a second threshold brake force respectively. In an embodiment, the control unit (4) may compare the pressure in the first brake circuit with the pressure in the second brake circuit to determine a difference in the pressure between the first brake circuit and the second brake circuit.

At block 303, the control unit (4) receives at least one second signal on an accelerator pedal position of the vehicle (200), from at least one position sensor (2). In an embodiment, the accelerator pedal position may include an engaged position and a disengaged position. In an embodiment, the control unit (4) may receive a plurality of signals at regular intervals corresponding to the accelerator pedal position from the at least one position sensor (2) and may be configured to determine a rate of change of the accelerator pedal position. The rate of change of the accelerator pedal position may be change of the accelerator pedal from the engage position to the disengaged position. For example, the control unit (4) may determine the rate of change of the accelerator pedal position as fast, medium and slow based on change of the accelerator pedal position.

At block 304, the control unit (4), may determine decrease in brake force of the first brake unit (5) based on the comparison of the brake force with the threshold brake force. In an embodiment, the control unit (4) may determine decrease in brake force of at least one of the first brake circuit and the second brake circuit of the first brake unit (5). The control unit (4) determines decrease in brake force of the first brake circuit when the brake force of the first brake circuit may be less than the threshold brake force. The control unit (4) may determine decrease in brake force of the second brake circuit when the brake force of the second brake circuit may be less than the threshold brake force. Further, the control unit (4) may determine a difference between the brake force in the first brake circuit and the brake force in the second brake circuit by comparing the brake force at the first brake circuit with the brake force at the second brake circuit.

Lastly at block 305, the control unit (4) actuates an actuation unit (3) selectively based on the accelerator pedal position to energize a second brake unit (6) coupled to a shaft (202) associated with at least two wheels (203) of the vehicle (200). In an embodiment, the second brake unit (6) may be electrically connected to the actuation unit (3). The second brake unit (6) may generate a magnetic field upon energizing by the actuation unit (3) to restrict rotation of the shaft (202). In an embodiment, the control unit (4) may actuate the actuation unit (3) upon determining decrease in brake force in at least one of the first brake circuit and the second brake circuit of the first brake unit (5) and upon receiving the at least one second signal indicative of a disengaged position of the accelerator pedal (205). Further, the control unit (4) may actuate the actuation unit (3) upon determining the rate of change of the accelerator pedal position as fast, based on the plurality of signals from the at least one position sensor (2). The control unit (4) may compare the temperature of the second brake unit (6) with the at least one threshold temperature.

In an embodiment, the control unit (4) may actuate the actuation unit (3) upon comparison of the temperature of the second brake unit (6) with the at least one threshold temperature, when the temperature may be less than the at least one threshold temperature. In an embodiment, the at least one threshold temperature may include a first threshold temperature and a second threshold temperature. The control unit (4) may compare temperature of the second brake unit (6) with the second threshold temperature and may restrict supply of power from the actuation unit (3) to the second brake unit (6) to avoid overheating of the electromagnetic coils of the second brake unit (6). The control unit (4) may restrict supply of power from the actuation unit (3) when the temperature of the electromagnetic coils of the second brake unit (6) may be greater than the second threshold temperature. In the illustrative embodiment, the second threshold temperature may be greater than the first threshold temperature. The control unit (4) may selectively actuate the actuation unit (3) to energize the second brake unit (6) upon determining at least two of decrease in brake force, difference in brake force of the first brake circuit and the second brake circuit, the accelerator pedal position, the change in accelerator pedal position, the rate of change in accelerator pedal position, temperature of the second brake unit (6). The junction box (3d) of the actuation unit (3) may supply power to the second brake unit (6) from the supercapacitor (3a) of the actuation unit (3), where the second brake unit (6) generates a magnetic field upon energizing by the actuation unit (3) to restrict the rotation of the shaft (202). Thus, the method (300) may prevent accidents due to decrease in brake force in the first brake unit (5) of the vehicle (200) automatically by actuating the second brake unit (6) to bring the vehicle (200) to rest.

In an embodiment, the second brake unit (6) may be defined with a cooling module configured to cool the second brake unit (6). In an embodiment, the cooling module may include an air cooling module and a cooling fan and the like proximal to the second brake unit (6). In an embodiment, the control unit (4) may control the cooling module to cool the second brake unit (6) upon comparison of the temperature of the second brake unit (6) with the threshold temperature and when the temperature may be greater than the threshold temperature to operate the second brake unit (6), when the control unit (4) may determine at least two of decrease in brake force, difference in brake force of the first brake circuit and the second brake circuit, the accelerator pedal position, the change in accelerator pedal position, the rate of change in accelerator pedal position.

In an embodiment, the system (100) may actuate the second brake unit (6) by the supercapacitor (3b) to decelerate and bring the vehicle (200) to rest quickly.

EQUIVALENTS

With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system (100) having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system (100) having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

Referral Numeral:

Component	**Number**
At least one pressure sensor	1

First pressure sensor	1a
Second pressure sensor	1b
At least one position sensor	2
Actuation unit	3
Supercapacitor	3a
Battery	3b
Alternator	3c
Junction box	3d
Control unit	4
First brake unit	5
Second brake unit	6
Temperature sensor	7
System	100
Vehicle	200
Chassis	201
Shaft	202
Wheels	203

Front wheels	203a
Rear wheels	203b
Engine	204
Method	300
Accelerator pedal	205

We claim:

1. A method (300) for controlling motion of a vehicle (200), comprising:

   receiving, by a control unit (4), at least one first signal on a brake force received at a first brake unit (5) from at least one pressure sensor (1) communicatively coupled to the control unit (4);

   comparing, by the control unit (4), the brake force of the first brake unit (5) with a threshold brake force;

   receiving, by the control unit (4), at least one second signal on an accelerator pedal position of the vehicle (200), from at least one position sensor (2);

   determining, by the control unit (4), decrease in brake force of the first brake unit (5) based on the comparison of the brake force with the threshold brake force; and

   actuating, by the control unit (4), an actuation unit (3) selectively based on the accelerator pedal position to energize a second brake unit (6) coupled to a shaft (202) associated with at least two wheels (203) of the vehicle (200), wherein the second brake unit (6) generates a magnetic field upon energizing by the actuation unit (3) to restrict rotation of the shaft (202).

2. The method (300) as claimed in claim 1, wherein the second brake unit (6) is an electromagnetic retarder brake unit.

3. The method (300) as claimed in claim 1, wherein the first brake unit (5) is connectable to wheels (203) of the vehicle (200).

4. The method (300) as claimed in claim 1, comprising, actuating, by the control unit (4), a supercapacitor (3a) or a battery (3b) is connected to the actuation unit (3) and electrically connected to the second brake unit (6) to energize and regulate the brake force.

5. The method (300) as claimed in claim 1, comprising, actuating, by the control unit (4), the actuation unit (3) when the brake force is less than the threshold brake force.

6. The method (300) as claimed in claim 1, comprising:

   receiving, by the control unit (4), at least one temperature signal corresponding to temperature of the second brake unit (6) from at least one temperature sensor (7);

comparing, by the control unit (4), the temperature of the second brake unit (6) with at least one threshold temperature; and

actuating, by the control unit (4), the actuation unit (3) selectively based on the comparison of the temperature of the second brake unit (6) with the at least one threshold temperature to energize the second brake unit (6).

7. The method (300) as claimed in claim 1, comprising:

determining, by the control unit (4), a change in position of accelerator pedal (205);

comparing, by the control unit (4), the change in position of the accelerator pedal (205) with a threshold position; and

actuating, by the control unit (4), the actuation unit (3) selectively based on the comparison of the change in position of the accelerator pedal (205) with the threshold position to energize the second brake unit (6).

8. The method (300) as claimed in claim 1, comprising:

receiving, by the control unit (4), brake force of at least two brake circuits of the first brake unit (5);

determining, by the control unit (4), difference in brake force of the at least two brake circuits of the first brake unit (5); and

actuating, by the control unit (4), the actuation unit (3) selectively based on the difference in brake force of the at least two brake circuits of the first brake unit (5) to energize the second brake unit (6).

9. A system (100) for controlling motion of a vehicle (200), the system (100) comprising:

at least one pressure sensor (1) configured to sense brake force of a first brake unit (5) and transmit at least one first signal;

at least one position sensor (2) configured to sense position of an accelerator pedal (205) of the vehicle (200) and transmit at least one second signal on an accelerator pedal position;

an actuation unit (3) connected to a second brake unit (6) and coupled to a shaft (202) associated with at least two wheels (203) of the vehicle (200), the actuation unit (3) being configured to energize the second brake unit (6); and a control unit (4) communicatively coupled to the at least one pressure sensor (1), the at least one position sensor (2), and the actuation unit (3), wherein the control unit (4) is configured to:

receive the at least one first signal on the brake force received at the first brake unit (5) from the at least one pressure sensor (1);

compare the brake force of the first brake unit (5) with a threshold brake force;

receive the at least one second signal on the accelerator pedal position of the vehicle (200), from the at least one position sensor (2);

determine decrease in brake force of the first brake unit (5) based on the comparison of the brake force with the threshold brake force; and

actuate the actuation unit (3) selectively based on the accelerator pedal position to energize the second brake unit (6) coupled to the shaft (202), wherein the second brake unit (6) generates a magnetic field upon energizing by the actuation unit (3) to restrict rotation of the shaft (202).

10. The system (100) as claimed in claim 9, wherein the first brake unit (5) is connectable to wheels (203) of the vehicle (200).

11. The system (100) as claimed in claim 9, wherein the control unit (4) is configured to:

receive at least one temperature signal corresponding to temperature of the second brake unit (6) from at least one temperature sensor (7);

compare the temperature of the second brake unit (6) with at least one threshold temperature; and

actuate the actuation unit (3) selectively based on the comparison of the temperature of the second brake unit (6) with the at least one threshold temperature to energize the second brake unit (6).

12. The system (100) as claimed in claim 9, wherein the control unit (4) is configured to:

determining, by the control unit (4), a change in position of an accelerator pedal (205);

comparing, by the control unit (4), the change in position of the accelerator pedal (205) with a threshold position; and actuating, by the control unit (4), the actuation unit (3) selectively based on the comparison of change in position of the accelerator pedal (205) with the threshold position to energize the second brake unit (6).

13. The system (100) as claimed in claim 9, wherein the control unit (4) is configured to:

receiving, by the control unit (4), brake force of at least two brake circuits of the first brake unit (5);

determining, by the control unit (4), difference in brake force of the at least two brake circuits of the first brake unit (5); and

actuating, by the control unit (4), the actuation unit (3) selectively based on the difference in brake force of the at least two brake circuits of the first brake unit (5) to energize the second brake unit (6).

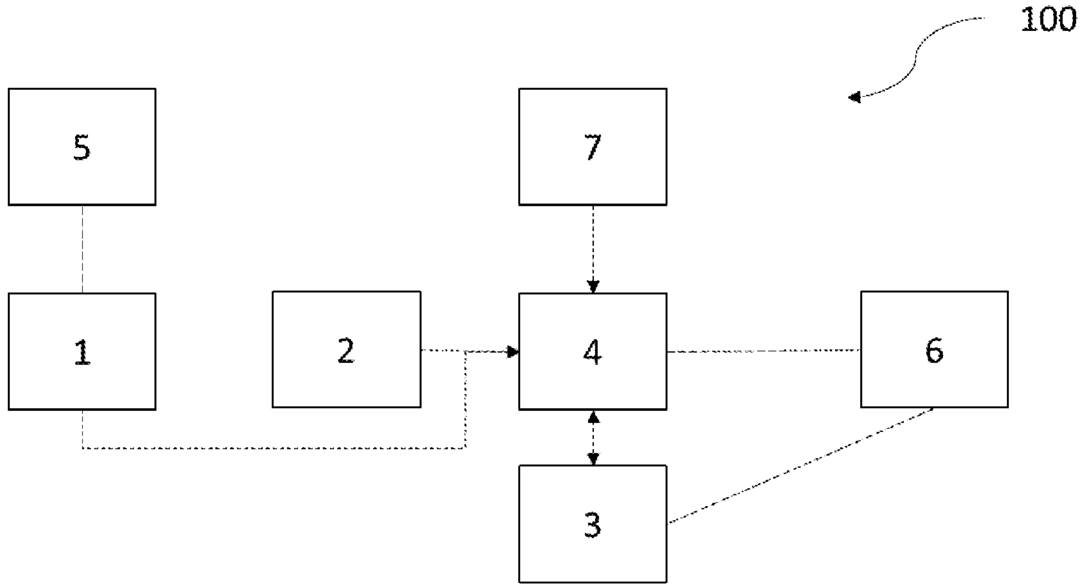

Figure 1

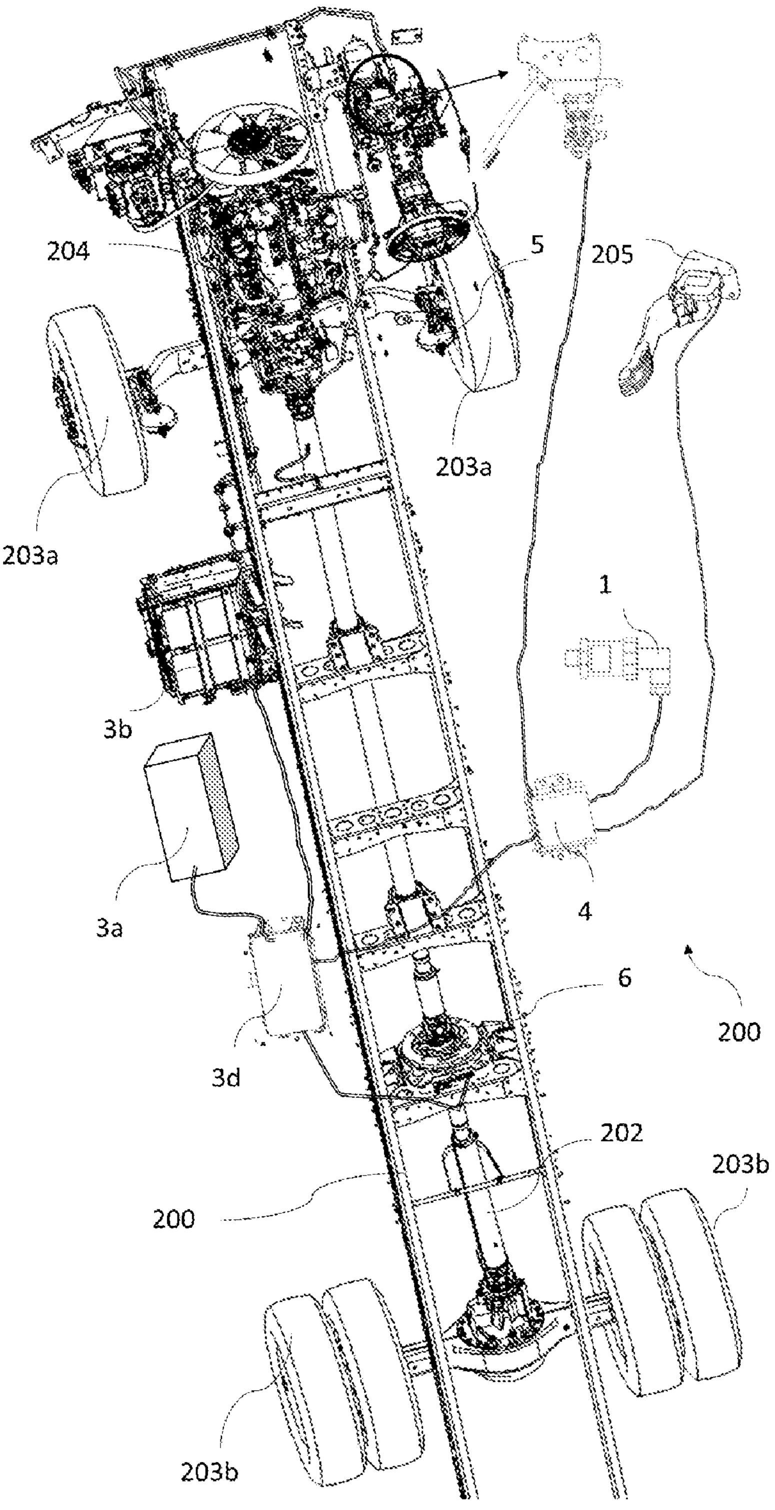

Figure 2

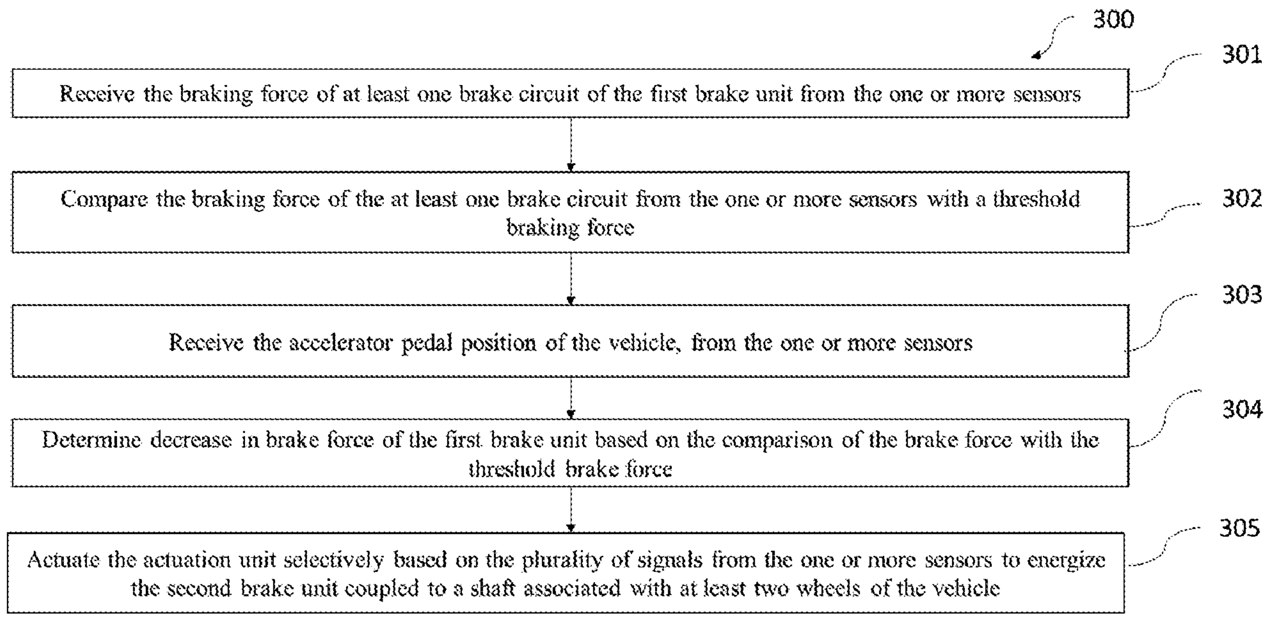
300
Receive the braking force of at least one brake circuit of the first brake unit from the one or more sensors
301
Compare the braking force of the at least one brake circuit from the one or more sensors with a threshold braking force
302
Receive the accelerator pedal position of the vehicle, from the one or more sensors
303
Determine decrease in brake force of the first brake unit based on the comparison of the brake force with the threshold brake force
304
Actuate the actuation unit selectively based on the plurality of signals from the one or more sensors to energize the second brake unit coupled to a shaft associated with at least two wheels of the vehicle
305

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2024/051406

A. CLASSIFICATION OF SUBJECT MATTER
B60T7/12,B60T8/172,B60T17/22,B60T13/74,B60T8/92,B60T8/32,B60L15/20 Version=2024.01
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)

B60T, B60W, B60L, H02K

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

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

PatSeer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US20210146897A1, (ROBERT BOSCH GMBH) 20 MAY 2021(20-05-2021) paragraphs [0001], [0002], [0018], [0028], [0041]; fig. 1-6	1-13
Y	WO2013000042A1, (OLOFSSON ERLAND) 03-JANUARY-2013(03-01-2013) paragraphs [0014], [0117]-[0149]; fig. 2, 11	1-13
Y	CN105774772A, (WANG DEHONG) 20-JULY-2016 (20-07-2016) (English Translation from Google Patens) summary of invention, claim 10	2, 9
Y	US20060069488A1, (CATERPILLAR INC) 30-MARCH-2006 (30-03-2006) detailed description	6, 9, 11
Y	CN108422987A, (JIANGSU UNIVERSITY) 21-AUGUST-2018 (21-08-2018) (English Translation from Google Patens) abstract, summary of the invention, fig. 1	4, 8, 9, 13

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent 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
21-05-2024	21-05-2024

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Pushpendra Chouhan Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IB2024/051406

Citation	Pub.Date	Family	Pub.Date
US 2021146897 A1	20-05-2021	CN 110869254 B	02-08-2022
		JP 2020525347 A	27-08-2020
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