(12)Indian Patent Application

---

(21) Application Number: 202341085613

(22) Filing Date: 14/12/2023 (43) Publication Date: 20/06/2025

(71) Applicant(s): L AND T TECHNOLOGY SERVICES LIMITED

(72) Inventor(s): Kandaswamy, Ananda Krishnan

(51) International Classifications: A61M 5/315 B03C 1/28 A61M 5/32 B60S 3/04 A61M 5/20

(54) Title: A CLEANING DEVICE, SYSTEM AND METHOD FOR CLEANING A WHEEL OF A VEHICLE

(57) Abstract: Present disclosure discloses a cleaning device (100) for removing and collecting foreign particles from a wheel (205) of a vehicle (200). The cleaning device comprising a housing (102). A container (106) is pivotally coupled to the housing (102). The container is configured to collect the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel of the vehicle. A scraper (108) extends from a portion of the container to abut the tread area. At least one actuator (110) is disposed within the housing and movably connected to the container. The at least one actuator is configured to linearly displace the container with respect to the housing in a first position (FP) and a second position (SP). The at least one actuator displaces the container towards the tire in the first position to engage the scraper with the tread area to clean the tire.

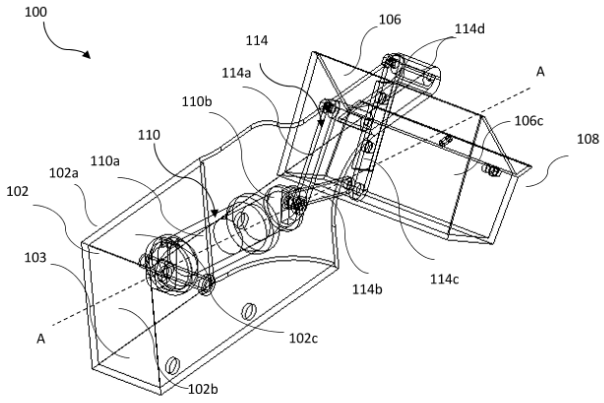

FIG. 1

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A CLEANING DEVICE, SYSTEM AND METHOD FOR CLEANING A WHEEL OF A VEHICLE

2. APPLICANT(S)

(a) NAME : **L&T TECHNOLOGY SERVICES LIMITED**
(b) NATIONALITY : **INDIAN**
(c) ADDRESS : **DLF IT SEZ Park, 2nd Floor – Block 3**
1/124, Mount Poonamallee Road,
Ramapuram, Chennai – 600 089,
INDIA.

3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification particularly describes the invention and the manner in which it is to be performed

TECHNICAL FIELD

[0001] Present disclosure relates to a field of automobiles. Particularly, but not exclusively the present disclosure relates to a cleaning and collecting device by removing foreign particles such as mud, peddles, wet soil which is deposited on a tread area of a tire fixed to a wheel of the vehicle. Further the present disclosure also discloses a system and a method for removing & collecting foreign particles from a wheel of the vehicle.

BACKGROUND

[0002] Automobiles such as heavy trucks and tippers travelling on or off road may enter or leave a particular construction site for transporting raw materials such as clinkers, cement bags etc. used for construction. Also, the trucks may usually travel on marshy surfaces and/or muddy tracks. Such construction sites may include a wet soil surface or a muddy ground surface on which the trucks need to travel. Due to this, the wheels of the trucks are susceptible to have a build-up of mud or gravel on a tread surface of a tire fixed to the respective wheels. This kind of mud and gravel deposited on the wheels from the construction site are difficult to remove as the deposited mud and gravel will be mostly -wet & difficult to maintain a place for cleaning activity. This mud and gravel will remain on the tread surface of the tire and will fall on the road when the truck enters the road from the constructions site. This may cause obstruction to the other passenger vehicles travelling on the road which is inconvenient & cause accidents. This deposition of the wet mud and gravel on the road poses severe problem to the other passenger vehicles, as the wet mud and gravel will be firmly held onto the road and cleaning of the same along an entire distance of the road is not practically feasible. Further, large amounts of this deposition of wet mud and gravel may also lead to severe accidents which is undesirable.

[0003] Conventionally, some systems have been developed to remove the dust, mud, and gravel from the wheels while the vehicle is in travelling condition. These systems typically include a brush attached to a fender portion of the vehicle that extends towards the tire of the wheel. The brush is in continuous contact with a tread portion of the tire to remove the mud deposited on the tire. Other advanced systems also include a hydraulic set-up for moving the brush and a water sprinkler unit which sprays water on the tire surface during the operation of the brush for easy removal of the mud and gravel. However, the drawback in these systems are that the mud and gravel which is removed will still fall on the road which cause inconvenience & accidents to the other passenger vehicles using the road. A common method of cleaning the wheel of the vehicle before travelling out of the construction site is

also considered, but however, this is not feasible to clean the wheel of the vehicle every time & challenging to maintain a place for cleaning activity.

[0004] The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the prior art. The information disclosed in this background of the disclosure section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY OF THE INVENTION

[0005] One or more shortcomings of existing cleaning devices for vehicle wheels have been overcome, and additional advantages are provided through the constructional aspects of a cleaning device 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.

[0006] The limitations of the prior arts are addressed by the cleaning device for removing and collecting foreign particles from a wheel of a vehicle as disclosed in the present disclosure. The cleaning device comprises a housing and a container pivotally coupled to one end of the housing. The container is configured to collect the foreign particles deposited on a tread area of a tire fixed to the wheel of the vehicle. A scraper extends from a portion of the container to abut the tread area of the tire. At least one actuator is disposed within the housing and movably connected to the container. The at least one actuator is configured to linearly displace the container with respect to the housing in a first position and a second position. The at least one actuator displaces the container towards the tire in the first position to engage the scraper with the tread area to clean the tire.

[0007] In an embodiment of the present disclosure, the housing is connectable to a chassis and proximate to the wheel of the vehicle.

[0008] In an embodiment of the present disclosure, the at least one actuator is configured to retract the container away from the tire in the second position for disposal of the foreign particles from the container.

[0009] In an embodiment of the present disclosure, the cleaning device comprises an auxiliary actuator movably coupled to a portion of the housing. The auxiliary actuator is configured to displace the housing in a traverse direction of the vehicle about an axis for disposal of the foreign particles from the container.

[0010] In an embodiment of the present disclosure, the cleaning device comprises at least one first sensor that is mounted on the scraper to detect deposition of foreign particles on the tread area of the tire. At least one second sensor is mounted within the container to determine a level and volume of the foreign particles collected within the container.

[0011] In an embodiment of the present disclosure, the at least one actuator is connected to the container through a linkage mechanism having a plurality of links disposed between the at least one actuator and the container for pivotal movement of the container with respect to the housing.

[0012] In an embodiment of the present disclosure, the at least one actuator is connected to the container through a weld or connected rod for pivotal movement of the container with respect to the housing.

[0013] Present disclosure also discloses a system for removing foreign particles from a wheel of a vehicle. The system comprises at least one cleaning device mounted on a chassis of a vehicle. The at least one cleaning device is positioned proximate to each tire fixed to a wheel of the vehicle. The at least one cleaning device comprises a housing and a container pivotally coupled to one end of the housing. The container is configured to collect the foreign particles deposited on a tread area of a tire fixed to the wheel of the vehicle. A scraper extends from a portion of the container to abut the tread area of the tire. At least one first sensor is connected to a portion of the scraper to detect presence of the foreign particles deposited on the tire of the vehicle and generate a first signal and a third signal. At least one actuator is disposed within the housing and movably connected to the container. The at least one actuator is configured to linearly displace the container with respect to the housing in a first position and a second position. A controller is communicatively coupled to the at least one first sensor and the at least one actuator. The controller is configured to receive the first signal from the at least one first sensor. The controller activates the at least one actuator to displace the container in the first position to collect the foreign particles from the tire. The controller also receives a third signal from the at least one first sensor corresponding to the

removal of the foreign particles from the tire. The controller is also configured to de-activate the at least one actuator to retract the container to a second position away from the tire.

[0014] In an embodiment of the present disclosure, the system comprises an auxiliary actuator movably coupled to the housing. The auxiliary actuator is configured to displace the container in a traverse direction of the vehicle about an axis for disposal of the foreign particles from the container.

[0015] In an embodiment of the present disclosure, the system comprises at least one second sensor arranged at a top portion of the container to determine a level of the foreign particles in the container and generate a second signal.

[0016] In an embodiment of the present disclosure, the controller is communicatively coupled to the auxiliary actuator and the at least one second sensor. The controller is further configured to receive a second signal from the at least one second sensor upon detecting the level of the foreign particles collected within the container exceeding a predefined volume. The controller is configured to activate the auxiliary actuator to displace the housing for disposal of the foreign particles from the container.

[0017] In an embodiment of the present disclosure, the at least one first sensor and the at least one second sensor may be at least one of a proximity sensor and an ultrasonic object sensor.

[0018] Present disclosure also discloses a method for cleaning a wheel of a vehicle by the cleaning device. The method comprises the steps of initially receiving a first signal by a controller from at least one first sensor upon detecting the foreign particles deposited on a tread area of a tire fixed to the wheel of the vehicle. The at least one first sensor is mounted on a scraper connected to a container of a cleaning device. Then, the controller actuates at least one actuator to displace the container to a first position proximate to the tire for removing and collecting the foreign particles from the tire into the container. The at least one actuator is movably connected to the container. Later, the controller receives a third signal from the at least one first sensor upon removal of the foreign particles from the tire. Lastly, the controller deactivates the at least one actuator to displace the container into a second position to store the foreign particles in the container for disposal.

[0019] In an embodiment of the present disclosure, the method further comprises of receiving a second signal by the controller from at least one second sensor upon determining a predefined volume of the foreign particles collected within the container. The at least one second sensor is mounted on a scraper extending from a portion of the container. The controller actuates an auxiliary actuator to displace the housing in a traverse direction about an axis for disposal of foreign particles from the container. The controller is also configured to deactivate the auxiliary actuator to retract the housing to a home position facing the tire of the vehicle.

[0020] It is to be understood that the aspects and embodiments of the disclosure described above may be used in any combination with each other. Several of the aspects and embodiments may be combined to form a further embodiment of the disclosure.

[0021] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects and features described above, further aspects and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0022] The novel features and characteristics of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an embodiment when read in conjunction with reference to the accompanying drawings wherein like reference numerals represent like elements and in which:

FIG.1 illustrates a perspective view of a cleaning device in accordance with an embodiment of the present disclosure.

FIG. 2 illustrates the perspective view of the cleaning device with an auxiliary actuator in accordance with an embodiment of the present disclosure.

FIG. 3 illustrates the perspective view of the cleaning device with at least one first sensor and at least one second sensor attached to a scraper and a container of the cleaning device respectively, in accordance with an embodiment of the present disclosure.

FIG. 4 illustrates a schematic layout of a system for removing foreign particles from a wheel of a vehicle in accordance with an embodiment of the present disclosure.

FIG. 5a illustrates the cleaning device of Fig. 2 with the container in a first position for removing foreign particles from a wheel of a vehicle in accordance with an embodiment of the present disclosure.

FIG. 5b illustrates the container of the cleaning device in a second position in accordance with an embodiment of the present disclosure.

FIG. 6A illustrates a method for cleaning a wheel of a vehicle by a cleaning device in accordance with an embodiment of the present disclosure.

FIG. 6B illustrates a method for disposal of the foreign particles collected by the cleaning device in accordance with an embodiment of the present disclosure.

FIG. 7A illustrates a top view of the vehicle depicting the disposal of the foreign particles collected by the cleaning device in accordance with an embodiment of the present disclosure; and

FIG. 7B illustrates a rear view of the vehicle depicting the disposal of the foreign particles collected by the cleaning device 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 methods illustrated herein may be employed without departing from the objective of the disclosure described herein. It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative systems embodying the principles of the present subject matter.

DETAILED DESCRIPTION OF THE DRAWINGS

[0023] The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter which forms the subject of the claims of the disclosure. It should be appreciated by those skilled in the art that the conception and specific embodiments disclosed may be readily utilized as a basis for modifying other devices, method, and systems for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the scope of the disclosure as set forth in the appended claims. The novel features which are believed to be characteristics of the disclosure, to its device, system, and method together with further objects and advantages will be better understood from the following description when considered in

connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

[0001] In accordance with various embodiments of the present disclosure, a cleaning device for removing and collecting foreign particles from a wheel of a vehicle as disclosed in the present disclosure. The cleaning device comprises of a housing and a container pivotally coupled to one end of the housing. The container is configured to collect the foreign particles deposited on a tread area of a tire fixed to the wheel of the vehicle. A scraper extends from a portion of the container to abut the tread area of the tire. At least one actuator is disposed within the housing and movably connected to the container. The at least one actuator is configured to linearly displace the container with respect to the housing in a first position and a second position. The at least one actuator displaces the container towards the tire in the first position to engage the scraper with the tread area to clean the tire. The forthcoming paragraphs will elucidate the configuration of the cleaning device. Forthcoming embodiments elucidate a system for removing foreign particles from a wheel of a vehicle having the cleaning device and its working in detail in conjunction to FIGs 1 to 6B.

[0024] The system comprises the cleaning device mounted on a chassis of a vehicle. The cleaning device is positioned proximate to each tire fixed to a wheel of the vehicle. At least one first sensor is connected to a portion of the scraper of the cleaning device to detect presence of the foreign particles deposited on the tire of the vehicle and generate a first signal and a third signal. The system further comprises a controller that is communicatively coupled to the at least one first sensor, the at least one second sensor, and the at least one actuator. The controller is configured to receive the first signal from the at least one first sensor. The controller activates the at least one actuator to displace the container in the first position to collect the foreign particles from the tire. The controller also receives a third signal from the at least one first sensor corresponding to the removal of the foreign particles from the tire. The controller is further configured to de-activate the at least one actuator to retract the container to a second position away from the tire.

[0025] The system also comprises an auxiliary actuator movably coupled to the housing of the cleaning device to displace the housing in a traverse direction of the vehicle about an axis for disposal of the foreign particles from the container. At least one second sensor is arranged at a top portion of the container to determine a quantity or level or a volume of the foreign particles in the container and generate a second signal. The controller is communicatively coupled to the auxiliary actuator and the at least one second sensor. The controller

is further configured to receive the second signal from the at least one second sensor upon detecting the quantity i.e., full level of the foreign particles collected within the container exceeding a predefined volume. The controller is configured to activate the auxiliary actuator to displace the housing for disposal of the foreign particles from the container.

[0002] In an embodiment, the system of the configuration described above enables to displace the container of the cleaning device to collect and store the foreign particles from the tread area of the tire fixed to a wheel of the vehicle. Further, the configuration of the at least one first and second sensors being fixed to the container enables to detect the quantity of the collected foreign particles and provides confirmation on the cleaning of the tread portion of the tire respectively. This ensures that the container is appropriately filled with the foreign particles and provides a signal to an operator of the vehicle to dispose the foreign particles from the container. Advantageously, this eliminates the spillage of the foreign particles deposited on the wheel on to a road used by passenger vehicles. Further, the system of the present disclosure can be operated for a limited period of time when the cleaning of the wheel is necessary. This significantly reduces power consumption to the system when compared to conventional cleaning device that may operate throughout the movement/travelling of the vehicle. This reduces the costs associated with the maintenance of the system.

[0003] While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiments thereof have 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.

[0004] It is to be noted that a person skilled in the art would be motivated from the present disclosure and modify the aspects of the system and construction of the cleaning device connectable to the chassis of the vehicle. However, such modifications should be construed within the scope of the present disclosure. Accordingly, the drawings show only those specific details that are pertinent to understand the embodiments of the present disclosure, so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

[0005] The terms “comprise,” “comprising”, or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system and 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, method, or assembly, or device. In other words, one or more elements in a system or device proceeded by "comprises… a" does not, without more constraints, preclude the existence of other elements or additional elements in the system or device.

[0006] The following paragraphs describe the present disclosure with reference to FIG(s) 1 to 7B. In the figures, the same element or elements which have similar functions are indicated by the same reference signs. With general reference to the drawings, a cleaning device, and a system for cleaning a wheel of the vehicle in accordance with the teachings of a preferred embodiment of the present disclosure is illustrated and generally the cleaning device identified at reference numeral 100. The cleaning device (100) may be employed by a worker or a technician for installing on a chassis of the vehicle. It will be understood that the teachings of the present disclosure are not limited to a particular cleaning device (100) connected to the vehicle (400) and may be used in any moving devices or conveyors for removing the foreign particles.

[0007] The following detailed description is merely exemplary in nature and is not intended to limit application and uses. Furthermore, there is no intention to be bound by any theory presented in the preceding background or summary or the following detailed description. It is to be understood that the disclosure may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices or components illustrated in the attached drawings and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions or other physical characteristics relating to the embodiments that may be disclosed are not to be considered as limiting, unless the claims expressly state otherwise. Hereinafter, preferred embodiments of the present disclosure will be described referring to the accompanying drawings. While some specific terms of "upper", "lower", "below", "above", "right", "left", "rear" or "front" and other terms containing these specific terms and directed to a specific direction will be used, the purpose of usage of these terms or words is merely to facilitate understanding of the present invention referring to the drawings. Accordingly, it should be noted that the meanings of these terms or words should not improperly limit the technical scope of the present invention.

[0008] Also, it is to be understood that the phraseology and terminology used herein is for description and should not be regarded as limiting. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are

used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings. It is to be understood that this disclosure is not limited to the specific devices, assemblies, methods, applications, conditions, or parameters described and/or shown herein and that the terminology used herein is to describe particular embodiments by way of example and is not intended to be limiting of the claimed invention. Hereinafter in the following description, various embodiments will be described. For purposes of explanation, specific configurations and details are outlined to provide a thorough understanding of the embodiments. However, it will also be apparent to one skilled in the art that the embodiments may be practiced without the specific details. Furthermore, well-known features may be omitted or simplified in order not to obscure the embodiment being described.

[0009] Referring to FIGs 1 to 5 in conjunction, which illustrates a cleaning device (100) for removing and collecting foreign particles from a wheel of a vehicle (200) and the system (300) for cleaning the wheel of the vehicle along with various components associated with the system (300). Hereinafter, features of the cleaning device (100) along with its working may be elucidated.

[0010] Referring to FIG. 1, the cleaning device (100) among other components may comprise a housing (102) defined with a base (103) and a plurality of walls extending from the base (103) to form an enclosure defined with an opening (104) to access an internal area of the housing (102). The plurality of walls include at least two sidewalls (102a) extending from the base (103), a rear wall (102b) and a top wall (102c) connecting each of the at least two sidewalls (102a). The top wall (102c) extends in a lengthwise direction of the housing (102) to a predefined distance. The housing (102) is connectable to a chassis (204) of the vehicle (200) and disposed along an axis (A-A) defined in a longitudinal direction of the vehicle (200). The housing (102) is positioned proximate to a wheel of the vehicle (200). A container (106) is pivotally coupled to one end of the housing (102) about the top wall (102c). The container (106) is connected to a portion of the top wall (102c) through at least one link (or) a support member. The container (106) is defined with a bottom wall (106a) and at least four walls (106a, 106b, 106c, 106d) extend from the bottom wall (106a) and the at least four walls (106a, 106b, 106c, 106d) are interconnected to each other to form a storage area (107). In an embodiment, the at least four walls (106a, 106b, 106c, 106d) may be structured in any one of a square, a rectangle or in a polygonal shape depending on the requirement. The container (106) is configured to collect the foreign particles deposited on

a tread area (205b) of a tire (205a) fixed to the wheel (205) of the vehicle (200) within the storage area (107). A fixing plate (105) is connected to a back wall (106c) of the container (106) for connecting the container (106) to the housing (102). A scraper (108) extends from a portion of the container (106), preferably from a front wall (106b) of the at least four walls (106a, 106b, 106c, 106d) to abut a tread area (205b) of a tire (205a). The scraper (108) is a metallic structure defined in a shape of a rectangle extending in a widthwise direction of the housing (102). The scraper (108) is configured to contact the tire (205a) about the tread area (205b) and remove the foreign particles from the tire (205a). The scraper (108) redirects the foreign particles into the storage area (107) of the container (106). In an embodiment, the scraper (108) may extend about a portion of the width of the container (106). Further, at least one actuator (110) disposed within the housing (102) along the lengthwise direction. The at least one actuator (110) is movably connected to the container (106) through a linkage mechanism (114). The at least one actuator (110) is configured to linearly displace the container (106) with respect to the housing (102) in a first position (FP) and in a second position (SP). The at least one actuator (110) comprises a hollow cylinder (110a) firmly fastened within the housing (102) through a suitable fastening mechanism (not shown in Figs.). A piston (110b) is slidably disposed within the hollow cylinder (110a) and is configured to extend and retract about the hollow cylinder (110a) upon actuation of the at least one actuator (110). The linkage mechanism (114) is disposed between the piston (110b) and the container (106). The linkage mechanism (114) comprises a plurality of links (114a, 114b, 114c, 114d) namely, a first link (114a), a second link (114b) and a third link (114c). The first link (114a) is connected to the piston (110b) at one end. The third link (114c) is pivotally connected to the container (106) about the fixing plate (105). The second link (114b) is disposed between the first link (114a) and the third link (114c). The second link (114b) is connected at one end of the first link (114a) and the third link (114c) through suitable fasteners (not shown in Figs.) such as but not limited to nut and bolt, screws, studs etc. Further, the first link (114a) and the third link (114c) are connected to a portion of the top wall (102c) of the housing (102) through a connecting link (114d) at an other end of the first link (114a) and the third link (114c) respectively. The first link (114a) and the third link (114c) is pivotable about the respective connecting links (114d). The second link (114b) is pivotable about the first link (114a) and the third link (114c) simultaneously at the other end such that the container (106) is pivotable with respect to the housing (102). In an embodiment, the connecting links (114d) may be at least one of a stud, a bolt, or a screw. Upon activating the at least one actuator (110), the piston (110b) displaces the second link (114b) such that the

container (106) is pivoted towards the tire (205a) in the first position (FP) to engage the scraper (108) with the tread area (205b) to clean the tire (205a). Similarly, when the at least one actuator (110) is deactivated, the piston (110b) retracts the second link (114b) to displace the container (106) back to the first position (FP) and away from the tire (205a). The foreign particles removed from the tread area (205b) of the tire (205a) by the cleaning device (100) is collected in the container (106) in the second position (SP) for disposal of the foreign particles. In an embodiment, the at least one actuator (110) is connected to the container (106) through a connected rod that may be joined between the at least one actuator (110) and the housing through welding process, for pivotal movement of the container (106) with respect to the housing (102). However, this may not be construed as a limitation and, any other suitable mechanism may be connected to the container (106) to unable pivoting movement of the container (106).

[0011] Referring to Fig. 2 the cleaning device (100) further comprises an auxiliary actuator (112) movably coupled to a portion of the housing (102). The auxiliary actuator (112) is coupled to the housing (102) through the plurality of linear bearings (113). The auxiliary actuator (112) is disposed in an axis (B-B) defined in a traverse direction of the vehicle (200). The auxiliary actuator (112) comprises a hollow block (112a) and a rod (112b) slidably disposed within the hollow block (112a). The plurality of linear bearings (113) are displaceable along with the rod (112b) of the auxiliary actuator (112). The auxiliary actuator (112) is configured to displace the housing (102) the auxiliary actuator (112) is configured to displace the housing (102) in a traverse direction of the vehicle (200) about the axis (B-B) for disposal of the foreign particles from the container (106). The auxiliary actuator (112) is actuated to displace the housing (102) away from the wheel (205) in the traverse direction of the vehicle (200) along the axis (B-B). Further, the at least one actuator (110) is activated to displace the housing (102) along the axis (A-A) defined in the longitudinal direction of the vehicle (200). In other words, the at least one actuator (110) is activated until the container (106) is pivoted at an angle which allows the disposal of the foreign particles collected in the container (106) due to gravity. However, this cannot be construed as a limitation and the container (106) may be unloaded manually. In an embodiment, the at least one actuator (110) and the auxiliary actuator (112) may be at least one linear actuator operated by a hydraulic or a pneumatic means.

[0012] Referring to Fig. 3, the cleaning device (100) comprises at least one first sensor (118) and at least one second sensor (120). The at least one first sensor (118) is mounted on the scraper (108) to detect deposition of foreign particles on the tread area (205b) of the tire

(205a). The at least one first sensor (118) generates a first signal upon detecting the deposition of foreign particles on the tire (205a). The at least one first sensor (118) also detects the tread area (205b) of the tire (205a) and generates a third signal accordingly. In other words, the first signal is generated when the at least one first sensor (118) interferes with the foreign particles deposited on the tread area (205b) of the tire (205a). In contrast, the third signal is generated when the at least one first sensor (118) directly interferes with the tread area (205b) of the tire (205a). The at least one second sensor (120) is mounted within the container (106) to determine a quantity (or) level of the foreign particles collected within the container (106). In an embodiment, the at least one second sensor (120) is mounted to an internal surface of any of the at least four walls (106a, 106b, 106c, 106d) of the container (106). The at least one second sensor (120) generates a second signal when the quantity of the foreign particles collected in the container (106) exceeds a predefined volume. The predefined volume of the foreign particles corresponds to an exact volume of the foreign particles that the container (106) can hold and is proportional to the volume of the container (106). When the at least one second sensor (120) interferes with the foreign particles collected within the container (106), a second signal is generated. In an embodiment, the second signal is generated when the at least one second sensor (120) interferes with the foreign particles collected within the container (106). In an embodiment, the at least one first sensor (118) and the at least one second sensor (120) may be at least one of a proximity sensor and an ultrasonic object sensor. In an embodiment, the at least one first sensor (118) and the at least one second sensor (120) are mounted through a suitable fastening mechanism such as but not limited to screws, bolt and nuts, rivets etc. In an embodiment, the first signal generated by the at least one first sensor (118) may be a high frequency (or) a high signal. In other words, upon detection of the tread area (205b) of the tire (205a), the at least one first sensor (118) transmits a high signal and upon detection of foreign particles on the tread area (205b) of the tire (205a), a low frequency signal (or) a low signal is transmitted to the controller (124). In an embodiment, the at least one second sensor (120) may transmit the high signal upon detection of a wall surface of the container (106) when the level (or) volume of foreign particles are less than the predefined volume. The at least one second sensor (120) transmits the signal upon detection of the foreign particles within the container (106) when the level (or) volume of the foreign particles within the container (106) are equal to the predefined volume. In an embodiment, the high signal and the low signal may correspond to a voltage output level of the at least one first and second sensors (118, 120).

[0013] Referring to Fig. 4, a schematic layout of a system (300) for removing foreign particles from the wheel (205) of the vehicle (200) is disclosed. The system (300) comprises of the cleaning device (100) mounted on a chassis (204) of a vehicle (200). The at least one cleaning device (100) is positioned proximate to each tire (205a) fixed to a wheel (205) of the vehicle (200). A controller (124) is communicatively coupled to the at least one first sensor (118), the at least one second sensor (120), the at least one actuator (110), and the auxiliary actuator (112) of the cleaning device (100). The controller (124) is configured to receive the first signal from the at least one first sensor (118). The controller (124) activates the at least one actuator (110) to displace the container (106) in the first position (FP) to collect the foreign particles from the tire (205a) upon receipt of the first signal (as shown in Fig. 5a). In this first position, the scraper (108) defined on the container (106) abuts the tread area (205b) of the tire (205a) fixed to the wheel (205) of the vehicle (200). As the vehicle (200) travels, the foreign particles deposited on the tire (205a) is removed by the scraper (108) and is collected within the storage area (107) of the container (106). The controller (124) is also configured to receive a third signal from the at least one first sensor (118) corresponding to the removal of the foreign particles from the tire (205a). The third signal is generated when the foreign particles are completely removed from the tread area (205b) of the tire (205a) and the at least one first sensor (118) detects only the tread area (205b). Upon receiving the third signal, the controller (124) deactivates the at least one actuator (110) to retract the container (106) to a second position (SP) away from the tire (205a) (as shown in Fig. 5b).

[0014] In an embodiment, the controller (124) comprises a processor (not shown in FIGS.) and a memory unit (not shown in FIGS.) is communicatively coupled to the processor. The processor may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. The memory unit stores processor-executable instructions, which, on execution, causes the processor to receive one or more command signals from the at least one first sensor (118) and the at least one second sensor (120) of the system (300). In an embodiment, the controller (124), upon receiving the signals activates the at least one actuator (110) and the auxiliary actuator (112) to position the cleaning device (100) at a required position for cleaning the wheel (205) and/or for disposing the foreign particles. In an embodiment, a user interface unit (125) having a display may be connected to the controller (124) to display graphical information related to the positioning of the cleaning device (100). In an embodiment, the

user interface unit (125) may receive inputs from a user to manually operate the at least one actuator (110) and the auxiliary actuator (112) if and when required. In an embodiment, the user interface unit (125) may be positioned in a cabin of the vehicle (200).

[0015] Now referring to Figs. 6A and 6B, a method (400) of operation of the system (300) for cleaning the wheel (205) of the vehicle (200) is now explained. The system (300) includes a cleaning device (100) that is mounted to the chassis (204) of the vehicle (200) proximate to each wheel (205) of the vehicle (200). The method (400) includes the steps of initially receiving, by a controller (124), a first signal from at least one first sensor (118) upon detecting the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel (205) of the vehicle (200) at step 401. At step 402, the controller (124) actuates the at least one actuator (110) to displace the container (106) to the first position (FP) proximate to the tire (205a). The scraper (108) abuts with the tread area (205b) of the tire for removing and collecting the foreign particles from the tire (205a) into the container (106). Later, at step 403, the controller (124) receives a third signal from the at least one first sensor (118) after the removal of the foreign particles from the tread area (205b) of the tire (205a). Lastly at step 404, the controller (124) deactivates the at least one actuator (110) to displace the container (106) into the second position (SP). The container (106) in the second position (SP) stores the foreign particles for disposal. The disposal of the foreign particles is done by actuating the auxiliary actuator by the controller (124).

[0016] The method (400) of disposal of the foreign particles from the container (106) is explained with reference to Fig. 6b. Initially, at step 405, the controller (124) receives a second signal from at least one second sensor (120) upon determining a predefined volume of the foreign particles collected within the container (106). Later at step 406, the controller (124) actuates an auxiliary actuator (112) to displace the housing (102) in a traverse direction of the cleaning device (100) about the axis (B-B) for disposal of foreign particles from the container (106). Followed by deactivating the auxiliary actuator (112) by the controller (124) to retract the housing (102) to the second position (SP) in which the housing of the cleaning device (100) faces the wheel (205) of the vehicle (200).

[0017] In an embodiment, the foreign particles may be at least one of a mud, gravel, pebbles, wet soil etc., that may deposit on a tread area (205b) of the tire (205a).

[0018] In an embodiment, the controller (124) may be an electronic control unit of the vehicle (200) that is powered by a vehicle battery.

[0019] The system (300) of the present disclosure may be easily installed in a different types of vehicle such as passenger or commercial vehicles.

[0020] The cleaning device (100) of the present disclosure comprises few components and is automatically operated upon detection of the foreign particles on a tread area (205b) of the tire (205a) fixed to the wheel (205) of the vehicle (200) by the at least one second sensor (120).

[0021] The cleaning device (100) of the present disclosure enables collecting the foreign particles after removing from the tire (205a). Advantageously, this prevents the deposition of the foreign particles on the road which may otherwise cause inconvenience to other vehicles travelling on the road.

[0022] It is to be understood that a person of ordinary skill in the art may develop a cleaning device, system, and a method of similar configuration without deviating from the scope of the present disclosure. Such modifications and variations may be made without departing from the scope of the present disclosure. Therefore, it is intended that the present disclosure covers such modifications and variations provided they come within the ambit of the appended claims and their equivalents.

WE CLAIM:

1. A cleaning device (100) for removing and collecting foreign particles from a wheel (205) of a vehicle (200), the cleaning device (100) comprising:

   a housing (102);

   a container (106) pivotally coupled to one end of the housing (102), wherein the container (106) is configured to collect the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel (205) of the vehicle (200);

   a scraper (108) extending from a portion of the container (106) to abut the tread area (205b) of the tire (205a);

   at least one actuator (110) disposed within the housing (102) and movably connected to the container (106), wherein the at least one actuator (110) is configured to linearly displace the container (106) with respect to the housing (102) in a first position (FP) and a second position (SP); and

   wherein, the at least one actuator (110) displaces the container (106) towards the tire (205a) in the first position (FP) to engage the scraper (108) with the tread area (205b) to clean the tire (205a).

2. The cleaning device (100) as claimed in claim 1, wherein the housing (102) is connectable to a chassis (204) and proximate to the wheel (205) of the vehicle (200).

3. The cleaning device (100) as claimed in claim 1, wherein the at least one actuator (110) is configured to retract the container (106) away from the tire (205a) in the second position (SP) for disposal of the foreign particles from the container (106).

4. The cleaning device (100) as claimed in claim 1, comprises an auxiliary actuator (112) movably coupled to a portion of the housing (102), wherein the auxiliary actuator (112) is configured to displace the housing (102) in a traverse direction of the vehicle (200) about an axis (B-B) for disposal of the foreign particles from the container (106).

5. The cleaning device (100) as claimed in claim 1, comprises at least one first sensor (118) mounted on the scraper (108) to detect deposition of the foreign particles on the tread area (205b) of the tire (205a); and

   at least one second sensor (120) mounted within the container (106) to determine a level and volume of the foreign particles collected within the container (106).

6. The cleaning device (100) as claimed in claim 1, wherein the at least one actuator (110) is connected to the container (106) through a linkage mechanism (114) having a plurality of links (114a, 114b, 114c, 114d) disposed between the at least one actuator (110) and the container (106) for pivotal movement of the container (106) with respect to the housing (102).

7. The cleaning device (100) as claimed in claim 1, wherein the at least one actuator (110) is connected to the container (106) through a connecting rod by welding (115) for pivotal movement of the container (106) with respect to the housing (102).

8. A system (300) for removing foreign particles from a wheel (205) of a vehicle (200), the system (300) comprising:

at least one cleaning device (100) mounted on a chassis (204) of a vehicle (200), wherein the at least one cleaning device (100) is positioned proximate to each tire (205a) fixed to a wheel (205) of the vehicle (200), the at least one cleaning device (100) comprises:

a housing (102)

a container (106) pivotally coupled to one end of the housing (102), wherein the container (106) is configured to collect the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel (205) of the vehicle (200);

a scraper (108) extending from a portion of the container (106) to abut the tread area (205b) of the tire (205a);

at least one first sensor (118) connected to a portion of the scraper (108), wherein the at least one first sensor (118) is configured to detect presence of the foreign particles deposited on the tire (205a) of the vehicle (200) and generate a first signal and a third signal;

at least one actuator (110) disposed within the housing (102) and movably connected to the container (106), wherein the at least one actuator (110) is configured to linearly displace the container (106) with respect to the housing (102) in a first position (FP) and a second position (SP);

a controller (124) communicatively coupled to the at least one first sensor (118), and the at least one actuator (110), wherein the controller (124) is configured to:

receive the first signal from the at least one first sensor (118);

activate the at least one actuator (110) to displace the container (106) in the first position (FP) to collect the foreign particles from the tire (205a);

receive a third signal from the at least one first sensor (118) corresponding to the removal of the foreign particles from the tire (205a); and

de-activate the at least one actuator (110) to retract the container (106) to a second position (SP) away from the tire (205a).

9. The system (300) as claimed in claim 8, comprises an auxiliary actuator (112) movably coupled to the housing (102), wherein the auxiliary actuator (112) is configured to displace the housing (102) in a traverse direction of the vehicle (200) about an axis (B-B) for disposal of the foreign particles from the container (106).

10. The system (300) as claimed in claim 8, comprises at least one second sensor (120) arranged at a top portion of the container (106), wherein the at least one second sensor (120) is configured to determine a level of the foreign particles collected in the container (106) and generate a second signal.

11. The system (300) as claimed in claim 10, wherein the controller (124) is communicatively coupled to the auxiliary actuator (112) and the at least one second sensor (120), the controller (124) is further configured to:

receive a second signal from the at least one second sensor (120) upon detecting the level of the foreign particles collected within the container (106) exceeding a predefined volume; and

activate the auxiliary actuator (112) to displace the housing (102) for disposal of the foreign particles from the container (106).

12. The system (300) as claimed in claim 10, wherein the at least one first sensor (118) and the at least one second sensor (120) may be at least one of a proximity sensor and an ultrasonic object sensor.

13. A method (400) for cleaning a wheel (205) of a vehicle (200) by a cleaning device (100), the method (400) comprising:

receiving, by a controller (124), a first signal from at least one first sensor (118) upon detecting the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel (205) of the vehicle (200), wherein the at least one first sensor (118) is mounted on a scraper (108) connected to a container (106) of a cleaning device (100);

actuating, by the controller (124), at least one actuator (110) to displace the container (106) to a first position (FP) proximate to the tire (205a) for removing and collecting the foreign particles from the tire (205a) into the container (106), the at least one actuator (110) is movably connected to the container (106);

receiving, by the controller (124), a third signal from the at least one first sensor (118) upon removal of the foreign particles from the tire (205a); and

deactivating, by the controller (124), the at least one actuator (110) to displace the container (106) into a second position (SP) to store the foreign particles for disposal.

14. The method (400) as claimed in claim 13, further comprises of:

receiving, by the controller (124), a second signal from at least one second sensor (120) upon determining a predefined volume of the foreign particles collected within the container (106), wherein the at least one second sensor (120) is mounted on a scraper (108) extending from a portion of the container (106);

actuating, by the controller (124), an auxiliary actuator (112) to displace the housing (102) in a traverse direction about an axis (B-B) for disposal of foreign particles from the container (106); and

deactivating, by the controller (124), the auxiliary actuator (112) to retract the housing (102) to a home position facing the tire (205a) of the vehicle (200).

Dated this 14th day of December 2023

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, Chennai, TN, 600089.

ABSTRACT

A CLEANING DEVICE, SYSTEM AND METHOD FOR CLEANING A WHEEL OF A VEHICLE

Present disclosure discloses a cleaning device (100) for removing and collecting foreign particles from a wheel (205) of a vehicle (200). The cleaning device comprising a housing (102). A container (106) is pivotally coupled to the housing (102). The container is configured to collect the foreign particles deposited on a tread area (205b) of a tire (205a) fixed to the wheel of the vehicle. A scraper (108) extends from a portion of the container to abut the tread area. At least one actuator (110) is disposed within the housing and movably connected to the container. The at least one actuator is configured to linearly displace the container with respect to the housing in a first position (FP) and a second position (SP). The at least one actuator displaces the container towards the tire in the first position to engage the scraper with the tread area to clean the tire.

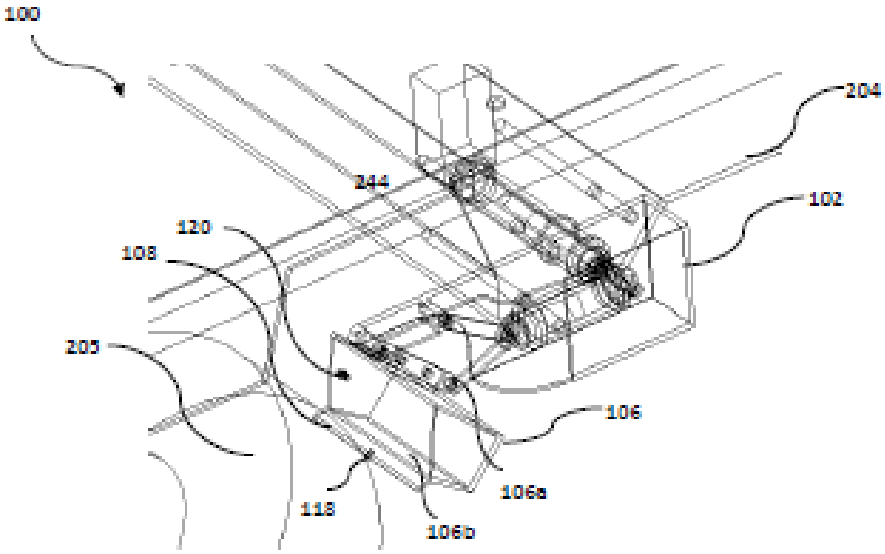

FIG. 3

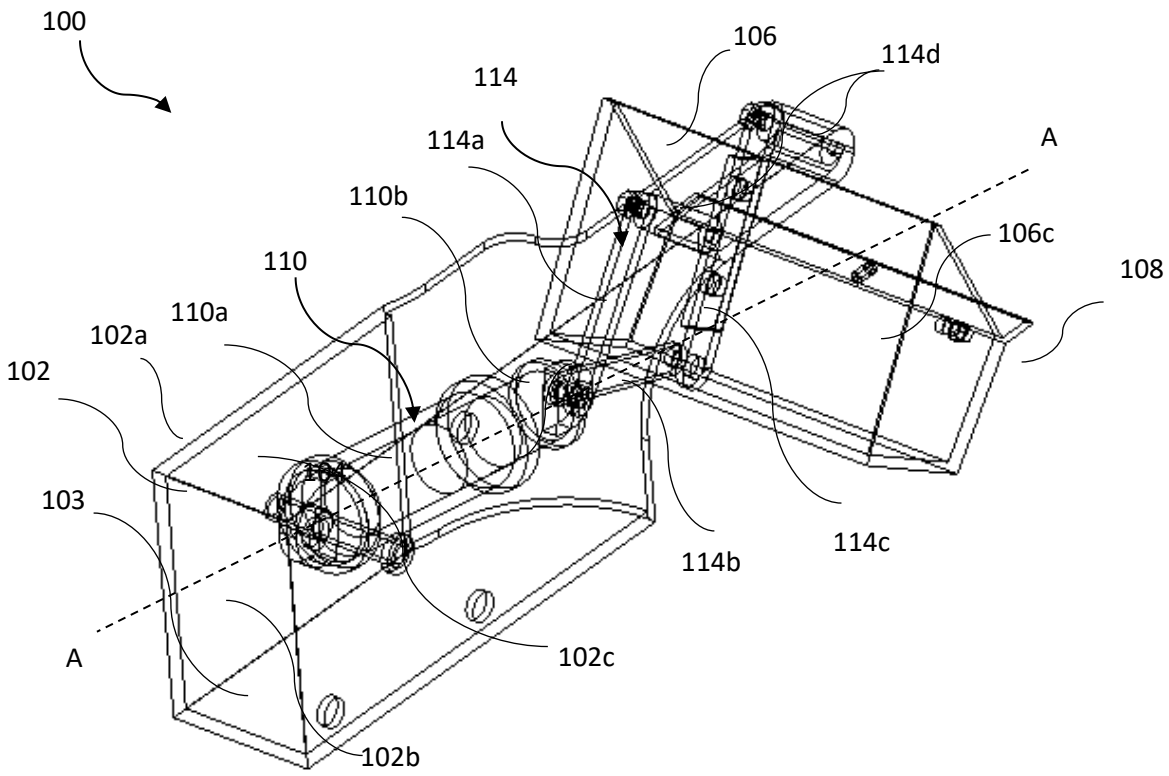

FIG. 1

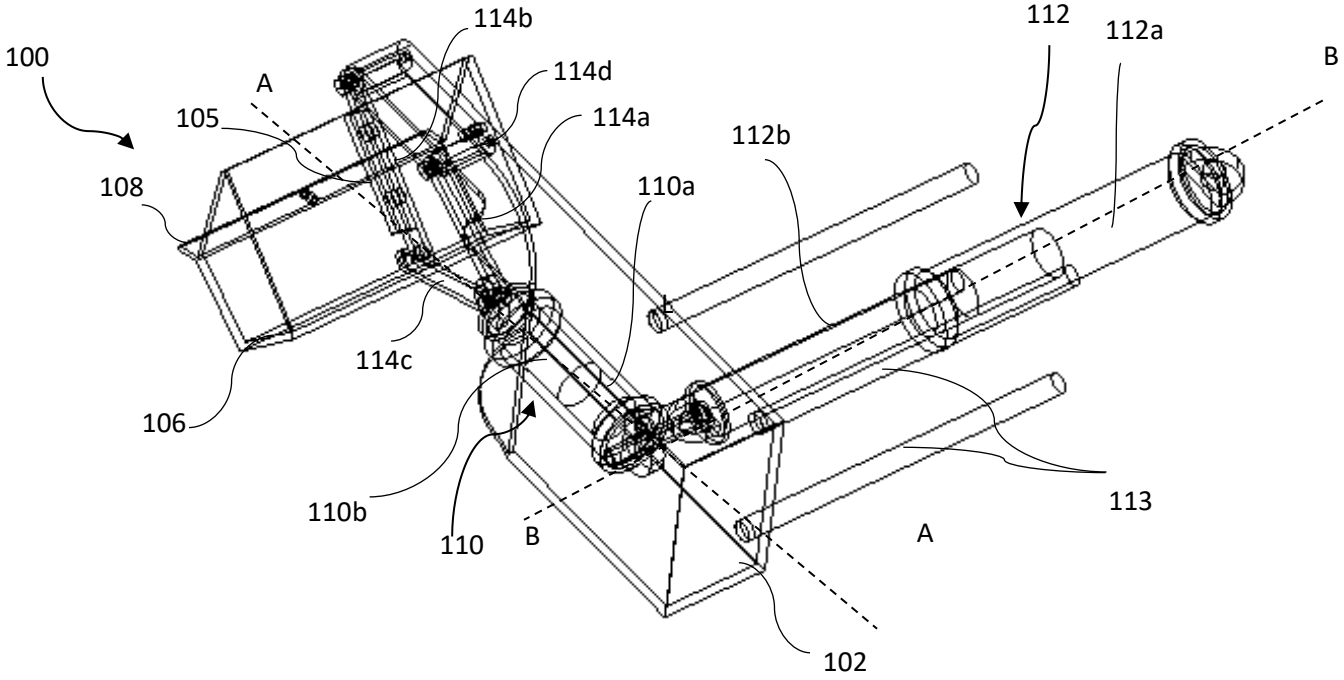

FIG. 2

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.

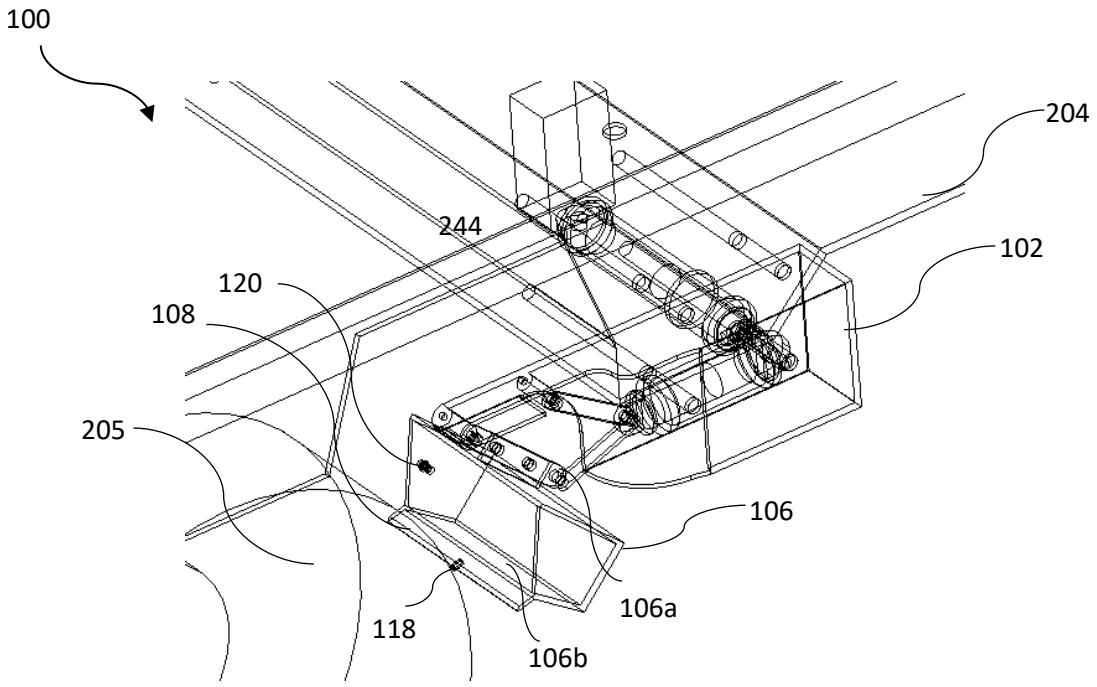

FIG. 3

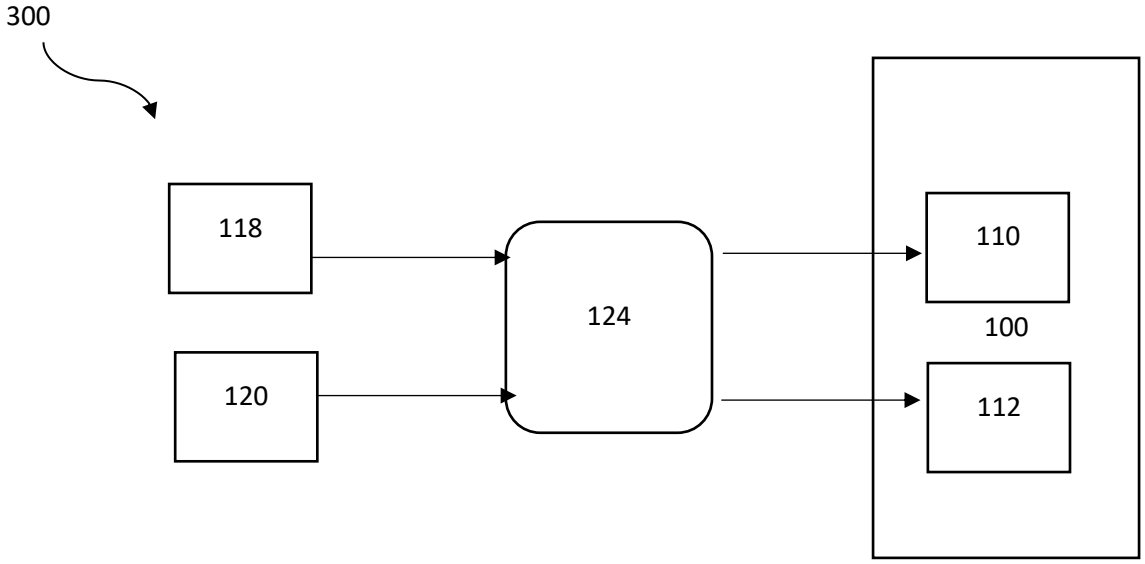

FIG. 4

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.

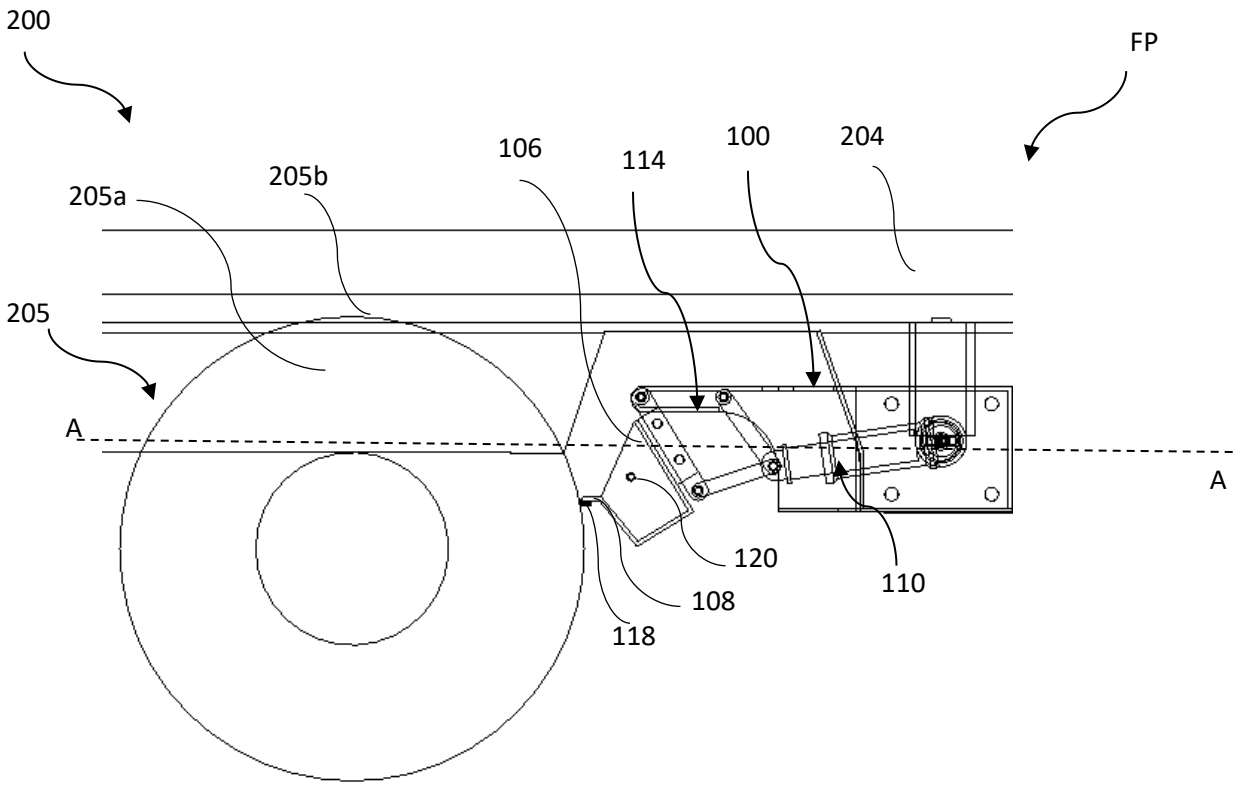

FIG. 5a

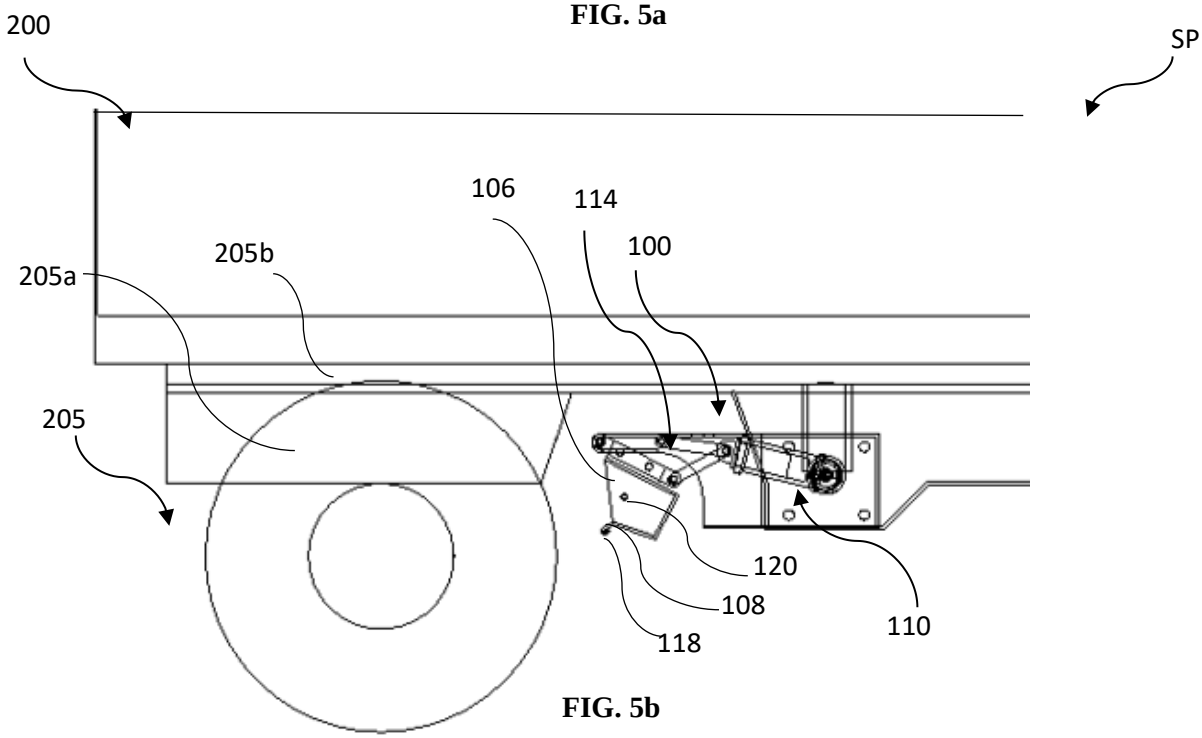

FIG. 5b

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.

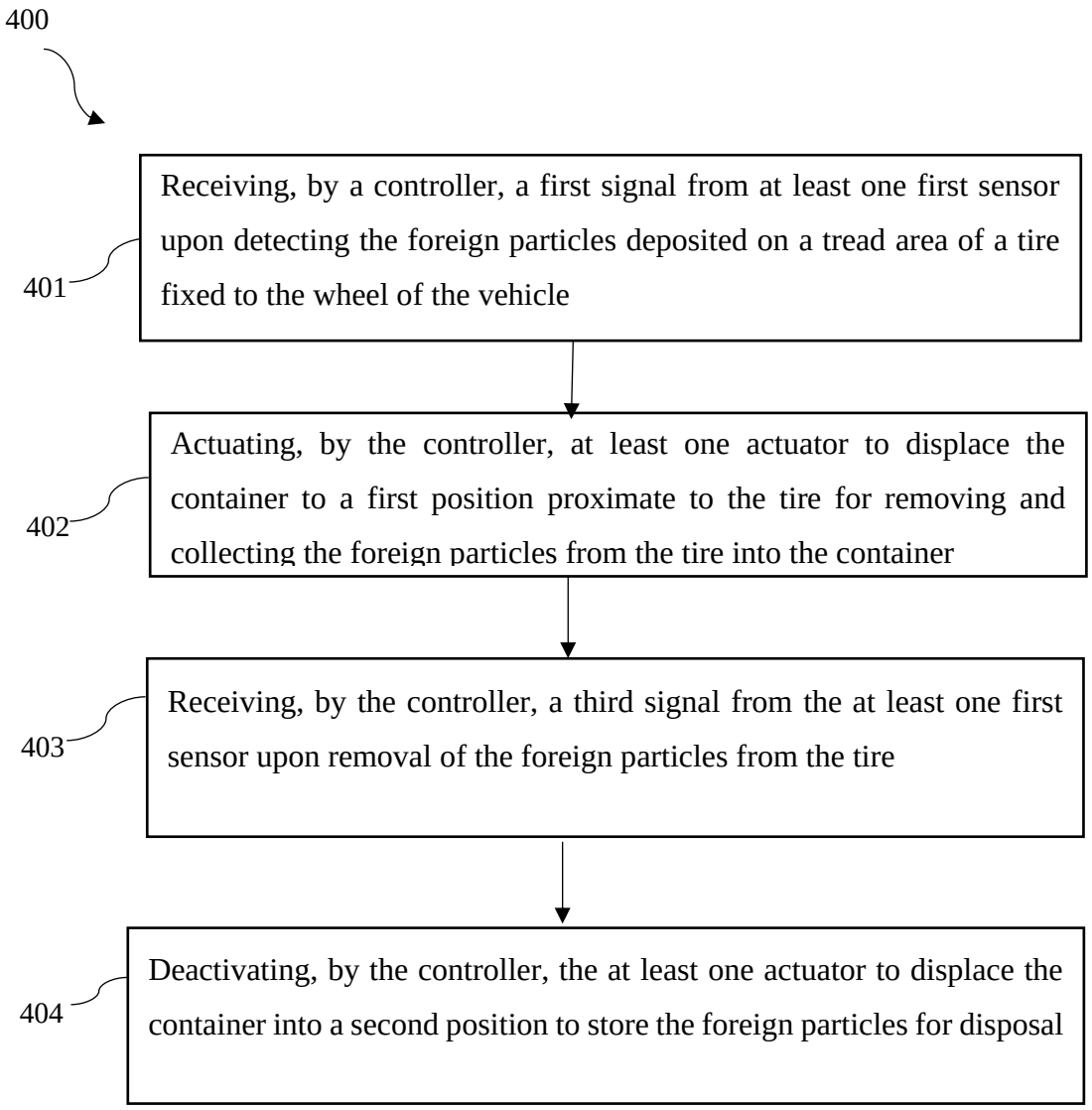

FIG. 6A

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.

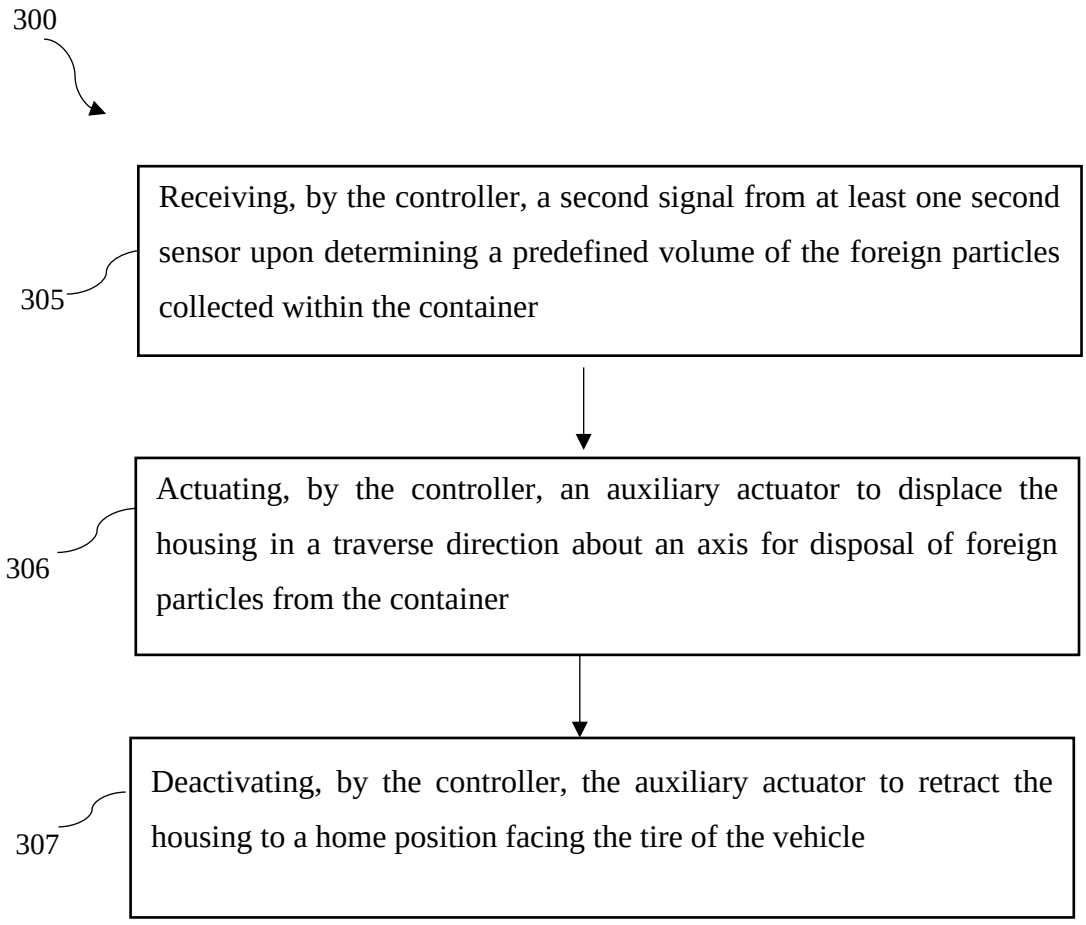

FIG. 6B

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.

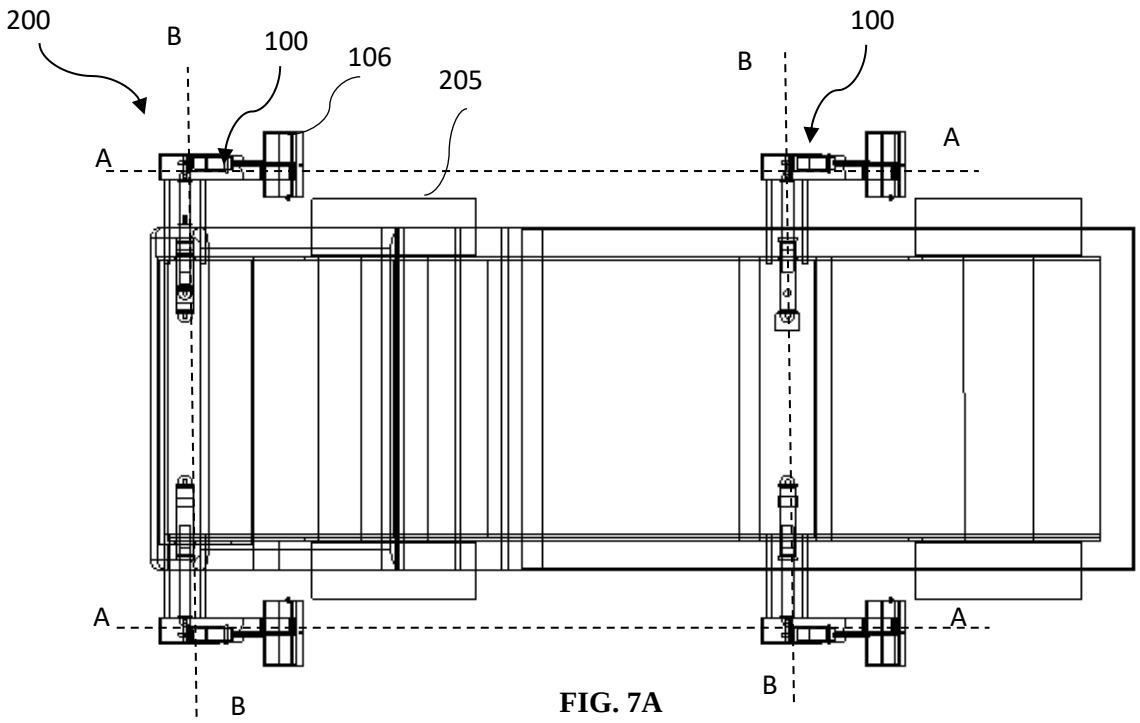

FIG. 7A

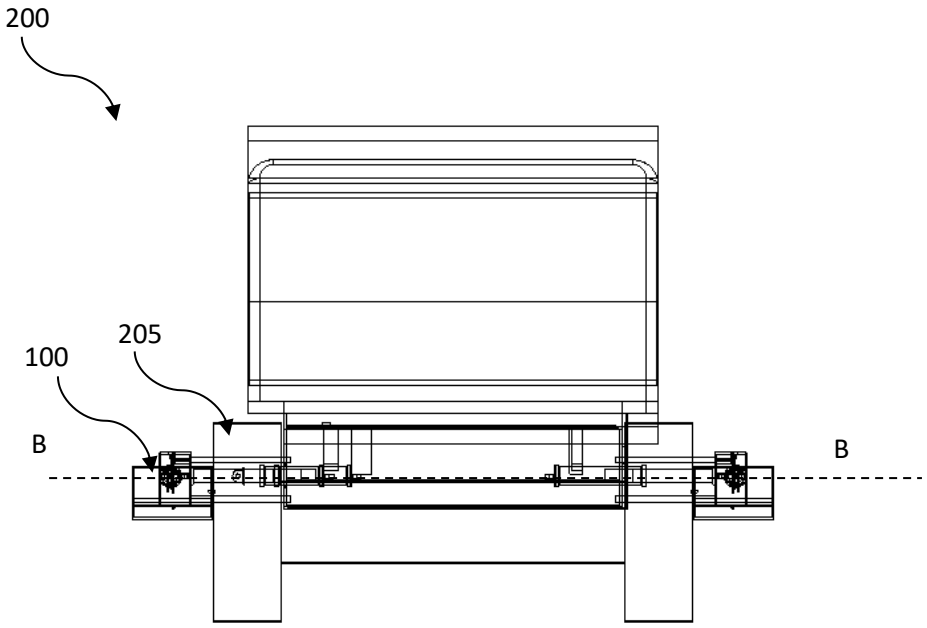

FIG. 7B

--Digitally Signed--
Bhanu Prasad (INPA No: 3253)
Head, IPR Dept.,
L&T Technology Services Limited,
DLF 3rd Block, 2nd Floor,
Manapakkam, TN, Chennai - 600089.