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(54) **DEVICE FOR SELECTED DEPLOYMENT OF A TIRE DEFLATOR**

(57) A device (100) for stopping an approaching target vehicle by deflating the vehicle's tires. The device (100) has a scissor-like extendable and retractable construction with upward facing spikes. After deployment, the deflator (200) may be retracted automatically and/or by the push of a button. The deflator (200) can be stored in the enclosure (130) to which it is attached. The deflator (200) is extended by pushing a central hinge (202) of the scissor construction forward, almost completely out of the enclosure (130). The propulsion means is actuated by a compressed gas capsule, preferably carbon dioxide, and an air cylinder (120) with a linear movable piston (121) connected to the deflator (200). The gas capsule releases gas under pressure to the air cylinder (120) and moves the piston (121) in a first direction, thereby extending the deflator (200). By leading compressed gas of the gas capsule to the opposite side of the cylinder (120), the piston (121) moves in the opposite direction and the deflator (200) is retracted.

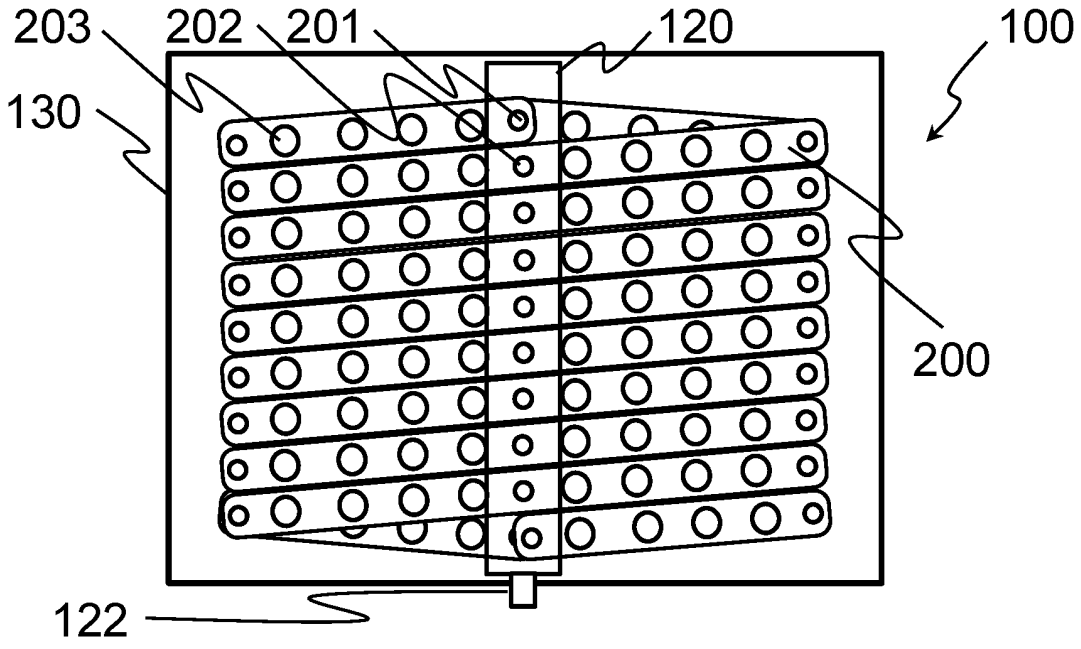

Fig. 2

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Description

TECHNICAL FIELD

[0001] The invention relates to devices for stopping vehicles by deflating tires thereof, and more particularly to devices for storing and automatically deploying tire deflators.

BACKGROUND

[0002] Currently, devices are available to deflate the tires of a motor vehicle by placing a device with upward facing metal spikes in the path of the vehicle. There are multiple applications and situations in which such a device may be used. Law enforcement officers and security guards may use the device as a deterrent or to actually stop or slow down target vehicles.

[0003] Hereafter publications are discussed which disclose such devices.

[0004] U.S. Patent application No. 13/405,252 by Ethan Spencer et al. is summarized as tire deflation device capable of being remotely operated to extend and retract a spike assembly into the path of a vehicle to deflate one or more of its tires. An embodiment includes a self-contained supply of pressurized air that is in communication with an actuator that operatively extends and retracts the spike assembly based on a signal received from a wireless remote control. By pulling opposite extending ends of a scissor-like construction by an actuator in a perpendicular direction relatively to the extension direction of the assembly, the assembly is extended. The actuator is powered by a fluid.

[0005] U.S. Patent No. 5,253,950 by Donald Kilgrow is summarized as vehicle tire deflator that is foldable and can be deployed by pushing it or pulling it to an extended attitude across at least one full traffic lane.

[0006] Other devices using spikes or the like are disclosed in U.S. Pat. Nos. 5,330,285 and 5,820,293.

[0007] U.S. Patent No. 6,527,475 by David F. Lowrie is summarized as a system for the selective deployment of a tire deflation device. The system incorporates the use of a mounted housing combined with a compressed gas propulsion source for ejecting a collapsed tire deflation device that is attached to the housing with a tether line. The device is tethered so as to limit the distance it will travel from the housing.

[0008] These and similar devices are either deployed by hand or they are stored in a housing (enclosure) after deployment by hand.

[0009] It is an object of the invention to provide a solution for automatically deploy and retract a tire deflator. It is a further object to provide a device which is mobile, relatively light weighted and compact. It is yet a further object to provide a device which is easy to handle and safe and reliable to use.

[0010] The object is realized by the present invention and its embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The figures show views of embodiments in accordance with the present invention.

Figure **1** shows a schematic overview of the activation mechanism of the device.

Figure **2** shows an embodiment of the device with a retracted deflator.

Figure **3** shows an embodiment of the cylinder of the pneumatic actuator in a retracted state of the deflator.

Figure **4** shows an embodiment of the cylinder of the pneumatic actuator in an at least partially extended state of the deflator.

Figure **5** shows an embodiment of the device with an at least partially extended deflator.

DETAILED DESCRIPTION

[0012] The invention is now described by the following aspects and embodiments, with reference to the figures. Hereinafter embodiments are listed.

[0013] In a first aspect, the invention comprises a device for deflating tires, the device configured for being activated selectively, the device comprising:

a deflator configured as an extendable and retractable scissor-like construction configured with upward facing spikes, and which, when in a retracted state, is configured for being stored in an enclosure, and when in an extended state, is configured for covering a part of a road;
an actuator configured for automatically extending the deflator;
the enclosure configured for receiving and storing the deflator in a retracted state; propulsion means configured for pushing the deflator out of the enclosure;
means for selectively actuating the propulsion means, wherein the pushing out of the deflator of the enclosure is performed by an extending scissor movement which lengthens the deflator in a direction away from the enclosure,
the propulsion means comprises a pneumatic actuator with a compressed gas capsule and a linear air cylinder having a linear movable piston with a rod connected to the deflator, whereby the gas capsule is configured to release gas under pressure to the linear air cylinder and move the piston in a first direction, said piston thereby extending the deflator,
wherein the propulsion means comprises a manifold and a first control valve which, upon opening, is configured to control the direction of the released gas

from the gas capsule in the first direction towards the back of the cylinder, said piston thereby extending the deflator, and which comprises a second control valve which, upon opening, is configured to control the direction of the released gas from the gas capsule in a second direction towards the front of the cylinder, said piston thereby retracting the deflator.

[0014] An embodiment of the invented device, wherein the cylinder is positioned above the deflator in longitudinal direction relatively to the direction of the deflator when extended, whereby the piston's rod is connected to a central hinge of the deflator and configured for pushing the hinge forward and outward of the enclosure to extend the deflator, and whereby the piston's rod is configured for pulling the hinge back into the enclosure to retract the deflator.

[0015] An embodiment of the invented device, wherein the first and second control valves are controlled by a control unit comprised in the device.

[0016] An embodiment of the invented device, wherein the device comprises a propellant cartridge assembly configured for receiving the compressed gas capsule, whereby the gas capsule comprises a replaceable compressed gas capsule with a gas outlet connected to a pressure regulator which controllably leads the gas further to conduits leading to the cylinder.

[0017] An embodiment of the invented device, wherein the gas capsule is a carbon dioxide capsule with carbon dioxide stored in a solid state, the capsule being sealed by a seal, said seal configured for being punctured by a puncture device in the propellant cartridge assembly.

[0018] An embodiment of the invented device, wherein the pressure of the release of the carbon dioxide from the capsule is regulated by a pressure reducing valve.

[0019] An embodiment of the invented device, wherein the pressure is adjustable from 0 bar to a maximum allowable system pressure by a controllable pressure reducing valve.

[0020] An embodiment of the invented device, wherein the pressure is adjustable from 5 to 10 bar by a controllable pressure reducing valve.

[0021] An embodiment of the invented device, wherein the pressure is stepless adjustable.

[0022] An embodiment of the invented device, wherein the pressure reducing valve is controlled by the control unit.

[0023] An embodiment of the invented device, wherein the control unit comprises a receiver configured for being controlled remotely by a remote control

[0024] An embodiment of the invented device, wherein the control unit comprises a Global Positioning System, GPS module configured for determining the geographic location of the device.

[0025] An embodiment of the invented device, wherein the control unit comprises modules of the group comprising:

a counter for counting the number of expansions of the deflator;
a counter for counting the times that gas is released from the gas capsule;
a counter for keeping track of successful and/or unsuccessful deflations of tires as detected by sensors in the deflator;
a timer for counting the duration of the deflator in extended state
a timer for counting the time of the device being in operation from the last time of maintenance and/or replacement of the gas capsule.
a memory for storing the counted data
a software module for running software configured for processing the data.
an image recognition module configured for recognizing the approach of a target vehicle.

[0026] An embodiment of the invented device, wherein the device comprises a wireless communication module configured for wirelessly communicating with an external system configured for wireless communication.

[0027] An embodiment of the invented device, wherein the wireless communication module comprises a short-range wireless communication module, such as a Bluetooth module. An embodiment of the invented device, wherein the software is configured for constructing a status of the device as processed from the data, whereby the status and/or the data are communicated to the external system by the wireless communication module, when a status change is detected which fulfills a predetermined condition.

[0028] An embodiment of the invented device, wherein the software module of the control unit comprises a mobile communication module for communicating over a cellular telecommunication network with a central server, whereby the software module is configured for being updated with new software over the air via the cellular telecommunication network.

[0029] An embodiment of the invented device, wherein the control unit is configured for communicating the status via the mobile communication module to the central server, said status comprising any one of the group comprising:

an operation status, such as duration of operation or number of actuations;
a failure status, such as a failure code or a failure description and severity or urgency level;
a maintenance status, such as maintenance required within a certain calculated period. An embodiment of the invented device, wherein the external system is configured for simultaneously communicating with multiple devices which are configured according to the invention, whereby the multiple devices each comprises a wireless communication module and are configured for receiving a command for activation of the device.

[0030] An embodiment of the invented device, wherein the device is configured for being armed pending an activation command.

[0031] Summarizing, the invention comprises a device for stopping an approaching target vehicle by deflating the vehicle's tires. The device has a scissor-like extendable and retractable construction with upward facing spikes. The deflator is extended to cover a part of a road. After deployment, the deflator may be retracted automatically and/or by the push of a button. The deflator can be stored in the enclosure to which it is attached. The deflator is extended by pushing a central hinge of the scissor construction forward, almost completely out of the enclosure. The propulsion means is actuated by a compressed gas capsule, preferably carbon dioxide, and an air cylinder with a linear movable piston connected to the deflator. The gas capsule releases gas under pressure to the air cylinder and moves the piston in a first direction, thereby extending the deflator. By leading compressed gas of the gas capsule to the opposite side of the cylinder, the piston moves in the opposite direction and the deflator is retracted.

[0032] The propulsion means comprises a first control valve which, upon opening, is configured to control the direction of the released gas from the gas capsule in the first direction towards the back of the cylinder, said piston thereby extending the deflator, and which comprises a second control valve which, upon opening, is configured to control the direction of the released gas from the gas capsule in a second direction towards the front of the cylinder, said piston thereby retracting the deflator.

[0033] The cylinder is powered by a compressed gas capsule, whereby the gas is released in a controlled manner towards a piston in the cylinder which is connected to the scissor-like deflator. By using a compressed gas capsule, a rapid deployment (i.e. extension of the scissor-like deflator) is possible. The fast expansion is often desired to prevent that an approaching vehicle has sufficient time to break and deviate from its path and miss the deflator, or to turn around and get away. Rapid deployment also enables precise timing of the deployment of the device. An operator (typically, a law enforcer) who is anticipating e.g. a stolen car or a car with a suspected lawbreaker (a so-called "target vehicle") involved in a close pursuit by a police car, waits for the right moment to activate the mechanism which deploys the deflator. The device may be hidden away at the side of the road, and when the target vehicle has approached sufficiently close to not being able to avoid the device, the device may be rapidly activated, and the deflator deployed. The stolen car will then pass over the extended deflator, and the upright facing spikes o the device will subsequently deflate one or more of the vehicle's tires.

[0034] Gas capsules are sealed and contained in a propellant cartridge assembly until armed by the operator. This extends standby time to the limits of the power supply and or charging source i.e. Police vehicle. Preferably, easily available and standard dimensioned capsules with solid pressurized carbon dioxide may be used in the invented device. When opening the capsule by a control valve, the solid carbon dioxide in the capsule changes into a gaseous state (in a sublimation process) at a near explosive speed and force. To harness the power of the released gas, a pressure release valve may be incorporated in a conduit leading the gas from the capsule to the cylinder. Alternatively, capsules with other kinds of gases may be used, such as nitrous oxide. Using gas capsules is preferable, because the invented device is preferably designed for being portable and mobile. This makes it possible to deploy the device virtually anywhere, where there is a chance that a target vehicle passes. Gas capsules are light weighted, and the device is designed such that the capsules are easily replaceable.

[0035] The use of gas capsules has a downside, in that the gas capsules deliver a high pressure to the mechanism as long as there is sufficient compressed gas in the capsule. Unavoidably, the gas capsules will run empty at a point in time. For maintaining a minimum pressure, sufficient gas is needed. The invention proposes to incorporate a manometer (also known as pressure gauge) which is configured for measuring expansion pressure of the released gas. When the pressure falls below a predetermined threshold, this is visible for the operator. Alternatively, or additionally, a signaling or indicating module may be configured which, upon a pressure drop below the threshold, may provide a warning or indication which is visible, audible or which is wirelessly communicated to an external device or central server. When the pressure is too low, indicating that the gas capsule is (near) empty, an operator may exchange the empty gas capsule for a new full one. Typically a small gas capsule will provide for 4-6 actions (i.e. releases of gas). Alternatively, or additionally a counter may be configured which counts the number of activations. Reaching a certain number of activations will then lead to a warning or signaling similar to the warning/signaling system as described above.

[0036] The time it takes to fully extract the deflator is more or less constant. The time in which the gas capsule is opened for release of the gas is set as to be sufficient for fully extending the deflator.

[0037] A further improvement provided by the invented device, in comparison with existing solutions, comprises that the deflator is also retracted automatically. Preferably for the retraction, the same gas capsule is used to power the cylinder. For the retraction action, the expanding gas is led to the opposite side of the cylinder to cause the piston in the cylinder to move in opposite direction relative to the expansion action.

[0038] Pneumatic actuator movement is in the same direction as the deflator assembly movement resulting in less force being required completing extraction or retraction cycles.

[0039] The configuration of the conduits for the gas and the valves is such that an extension action of the deflator may be reversed into a retraction action.

[0040] One particular embodiment of the invention comprises a so-called shutter function. This is explained as follows. There are situations wherein a single device is possibly less effective. One such situation is a wide road width exceeds the length of the deflator when fully extended. When, for example, the deflator is extended to a length of 3 meter, and provided that usually the device will be positioned at the side of a road, and assuming that the road is 6 meters wide, the deflator will only cover half of the road. An approaching targeted vehicle will have the possibility to dodge the device covering the right side of the road and evade to the left side of the road. Currently, this is solved by positioning two devices, each at an opposite side of the road and each directed to the middle of the road. This, however, requires that operation of both devices is done synchronous, at least, when there is a need for a surprise- or precisely timed activation of the device.

[0041] Current devices are operated manually, thereby relying on good communication between the operators of both devices. The present invention proposes to incorporate a (preferably wireless) communication module which makes it possible to let a first device communicate with one or more other devices. When e.g. two devices are set in "shutter mode", the activation of the first device will automatically activate the second device. For this purpose software running on the first device will activate a control unit in the first device which activates the first device and at the same time the software may generate a signal which is sent by a transceiver in the first device to a transceiver of the second device. This signal is then received by the transceiver of the second device and processed by software running on the second device which activates a control unit configured for activating the second device. The delay between both activations will be minimized in this way and a solid impenetrable barrier is created for the target vehicle.

[0042] By pairing multiple devices and set them in shutter mode, the multiple devices may be activated all at once in the way described above. A typical situation, where this may be useful comprise a (total) closing off of an area, such as a stretch of road, a parking lot, or a residential area.

[0043] A further improvement comprises that the device may be armed by other systems, devices, or persons than the operator of the device himself, or by the operator. Arming the device may be useful to prepare the device for deployment, to switch the power on and/or to be set in a mode to receive a deployment command. Arming the device may for example be (autonomously) performed by a proximity sensor. The proximity sensor may be incorporated in the enclosure of the device facing approaching traffic. The proximity sensor may also be a separate module which may be placed at a distance from the device, e.g. placed forward towards the approaching traffic. As such a kind of advanced warning system may be created which alerts the operator for an approach of a vehicle and prepare the device for activation.

[0044] Arming may also be done by a central server, or by a second device which is positioned and activated further up the road, when the target vehicle passes the second device, and the second device was (in the unlikely case) not successful in fully stopping the vehicle.

[0045] Arming may also be done when the approaching vehicle is recognized as the target vehicle. An image sensor may be collocated with the device, or placed at a distance from the device (such as configured in a police vehicle). The image sensor captures images of an approaching vehicle, whereby the images are processed and possibly identified as indicating the approach of a target vehicle. This identification will then lead to a warning of the operator and./or arming of the device. When the device is armed, this may be indicated by a light signal on the device for the operator to be alerted.

[0046] Image recognition may be based on or integrated in an Automatic Number Plate Recognition (ANPR) system, using CCTV camera's which are already installed next to or above roads where a target vehicle may move. Using the optional wireless transceiver of the invented device, a positive identification may be communicated to the device (and/or to the operator).

[0047] **FIGURE 1** shows a schematic overview of the activation mechanism of the device 100, whereby a propellant cartridge assembly 101 comprises a receiving unit configured for receiving a cartridge (i.e. a capsule) which is filled with a substance which, when released is expanded rapidly into a gaseous state. Preferably a carbon dioxide filled capsule is used as explained above. The receiving unit further comprises mechanisms for arming, reloading and depressurization. The activation mechanism further comprises that the expanded gas is led through a conduit (151) to a pressure regulator 102 configured for reducing pressure from propellant cartridge assembly 101 to a required system maximum working pressure. Pressure regulator 102 preferably includes a pressure gauge to indicate system pressurization. The Pressure gauge facilitates that an operator is able to check the system pressure. Too little pressure (indicated by a needle, or any other indicator) will warn the operator that either the capsule needs to be replaced, or there is a pressure leak somewhere in the device. Pressure regulator 102 further includes an overpressure protection device that vents pressure to atmosphere in case of overpressure conditions in propellant cartridge assembly 101.

[0048] From pressure regulator 102, the expanding gas is led by conduit 152 to an operator safety valve mechanism 103 that will vent system pressure downstream of the valve to the atmosphere in case of an operator opening the enclosure. The enclosure is equipped with e.g. a switch to activate safety valve 103. System pressure upstream of the valve is maintained with the purpose of quick return to operating conditions after retraction of the deflator and closing of the enclosure.

[0049] Valve mechanism 103 is preferably directly connected to or comprised in a valve manifold 104 which

diverts the gas through conduits 153a,b respectively, to either separate actuator activation solenoid valve 105a or 105b (i.e. control valves). Actuator activation valves 105a,b vent downstream pressure to atmosphere when not actuated.

[0050] Either through conduits 154a or 154b, actuator activation valve 105a, respectively 105b leads the expanded gas to quick exhaust valves 106a,b respectively. Preferably exhaust valves 106a,b are equipped with a throttle silencer to control extraction and retraction speed.

[0051] Selection of extending of the deflator is done by switching activation valve 105a. Selection of retracting of the deflator is done by switching activation valve 105b.

[0052] When gas arrives as selected at exhaust valve 106a, the gas is in this case led through conduit 155a to pneumatic actuator 120 which provides a linear motion to extend the deflator (i.e. the spike strip mechanism). When gas arrives as selected at exhaust valve 106b the gas is in this case led through conduit 155a to pneumatic actuator 120 which provides a linear motion to retract the deflator (i.e. the spike strip mechanism).

[0053] Pneumatic actuator 120 comprises a piston 121 with actuating rod 122 connected. Piston 121 and rod 122 are freely movable in the cylinder of pneumatic actuator 120. Actuation of the piston takes place in the right direction in the figure when gas arrives under pressure at intake 156a. The expanded gas enters chamber 123, and pushes piston to the right in the figure, causing rod 122 to move to the right in a linear motion. Rod 122 is attached to the deflator and extends the scissor-like construction. On the other hand, when the expanded gas arrives through conduit 155b at intake 156b of pneumatic actuator 120, the gas enters chamber 124 and pushes piston 121 in the opposite direction (to the left in the figure). Attached rod 122 then retracts the deflator. The linear forward- and backward directions of the piston are indicated by the arrow.

[0054] One of the innovative aspects of the present invention comprises that the device is very suitable for mobile operation and comprises several safety measures. The placement of pneumatic actuator 120, for example allows for a compact construction, whereby the deflator can be stored in an enclosure before and after expansion of the deflator. This provides for a safe handling without the risk of an operator being hurt by the sharp spikes. The automatic operation (by the push of a button, or even completely autonomous) reduces the risk of erroneous operation considerably. For example, any other sequence but extraction followed by retraction is prevented by the control logic in the software module. Working with relatively high-pressured gas requires extra measurements, such as visual indication of gas pressure in the system, valves which vent pressured gas, when the device is not in operation, and other incorporation of safety measures, such as safety valves, which are all provided for in the invented device. The mobility aspect is further provided by the use of light weight, easily replaceable gas capsules instead of including a heavy air pressurized air device. Furthermore a (preferably) carbon dioxide capsule provides relatively high pressure (much higher, when compared to a similarly sized pressured air device), without the need of an external power source to build up the pressure. The preferably incorporated (rechargeable) battery of the invented device needs therefore only be dedicated to powering the electronics and running of software, without the need to provide power for extension or retraction of the deflator.

[0055] A further advantage in comparison with a pressure device as actuator the overall pressure is much higher anyway than a pressurized air device as used in the prior art. This allows for a rapid activation (as well extension and retraction) of the device.

[0056] One particular aspect of the invented device comprises that the activating cylinder (i.e. pneumatic actuator 120) is positioned in longitudinal direction, i.e. the direction in which the deflator is extended and retracted. The first end of the deflator, being the end that stays in or close to the enclosure is fixed (also to the pneumatic activator for stability) , whereas the other end of the deflator is extended away from the enclosure. This movement is caused by rod 122 which is brought into motion by piston 121 as a result of entering of expanding gas in chamber 123. Rod 122 is connected to a central hinge point of the deflator, and the linear motion causes to narrowing and lengthening the deflator as is a result of the scissor-like construction, and which motion is commonly known. By connecting rod 122 to preferably the second hinge, and by configuring the pneumatic activator 120 in longitudinal direction, a linear motion may be powered with a relatively or even substantially constant power (and torque) provided by the pneumatic actuator, as the scissor-like elements are pushed outward at the central hinge point in longitudinal direction. This configuration is very advantageous in comparison with a perpendicular configuration when force is exerted in perpendicular direction, whereby extremes of the scissor-like elements are being pulled towards each other. The latter requires a high force at the start of the extension motion, and an exponentially lower force as the deflator extends. This would require a high torque at the beginning of the movement and a much lower torque at the end of the movement. Therefore a linear configuration provides much more control of the scissor motion than a device with a perpendicular configuration. **FIGURE 2** shows an embodiment of the device 100 with a retracted deflator 200. Scissor-like segments are in retracted position, thereby saving much storing space in enclosure 130.Cylinder 120 is positioned above deflator 200 to save space as well. Deflator 200 is held in position in the enclosure by hinge 201 which is rotatably connected to the enclosure. The partially extending rod 122 is connected to preferably the second central hinge 202 of deflator 200. From tip 122a, a bracket 125 (as shown in figure 3) runs backwards to second hinge 203.

[0057] **FIGURE 3** shows an embodiment of the cylinder

120 of the pneumatic actuator in a retracted state of the deflator 200. Piston 121 is in the pushed in position at the back of cylinder 120 leaving a chamber 123 at the back for the expanded gas to enter. An inlet 156a is provided for the gas. At the front of piston 122 a chamber is created for piston 122 to move. Rod 122 is connected to piston 121 and is able to move together with piston 121. At the tip 122a of rod 122 bracket 125 is connected, which runs backwards and is connected to second hinge 202.

[0058] **FIGURE 4** shows an embodiment of the cylinder 120 of the pneumatic actuator in an at least partially extended state of the deflator 200. When compressed gas enters chamber 123 through inlet 156a, the expanding gas forces piston to move (in the figure to the left). Rod 122 is then pushed out of cylinder 120 and pulls hinge 202 of deflator 200 to the left, thereby extending deflator 200 in longitudinal direction. After at least partial extension of deflator 200, deflator 200 may be retracted for storing in enclosure 130. This done by leading expanding gas through inlet 156 in chamber 124. This forces piston 121 to move (to the right in the figure). The forward and backward motion of piston 121 is indicated by the arrow.

[0059] **FIGURE 5** shows an embodiment of the device 100 with an at least partially extended deflator 200. Cylinder 120 is positioned in the enclosure 130 above deflator 200. Rod 122 is extended from cylinder 120 and hinge 202 is connected to bracket 125 which is connected to tip 122a of rod 122. The movement of the piston 120 and with it rod 122 backwards and forwards, is indicated by arrow 501. The extension and retraction motion of deflator 200 is indicated by arrow 502. By creating a relatively small motion 501, a relatively large motion 502 is created. This enables a small format for an enclosure and deflator in stored position and a large span for maximum road coverage.

[0060] The advantages of the invention are summed up as follows, without being limiting:

- A controlled movement of the deflator with a constant force.
- A compact design with low weight (typically <17 kg), so it may be carried by a single person.
- Compact dimensions which allows safe storage in a small enclosure.
- The use of commonly available and easily replaceable CO2 gas capsule with pressure build-up, and adjustable reducer.
- CO2 gas capsules are sealed until the moment of deployment, which allows for storage of the device for a long period, without losing gas pressure.
- Protected against accidental activation.
- Several safety means, such as a system pressure relief through a safety valve.
- Remote controllable by remote controller, whereby an operator may operate the device at a safe distance.
- Position determination through integrated GPS module, for keeping track of the locations where the device has been positioned and operated, and for tracking the device when it is stolen, or lost.
- Multiple units can be activated simultaneously by means of pairing with 1 remote control. This makes control of a larger area possible.
- Low power consumption, long standby time. The battery is not needed for powering the deployment of the deflator.
- Fast commissioning procedure and rapid deployment.
- The spikes interchangeable after deployment, e.g. when broken or stuck in the deflated tires.

[0061] The term "substantially" herein, such as in "substantially ..." etc., will be understood by the person skilled in the art. In embodiments the adjective substantially may be removed. Where applicable, the term "substantially" may also include embodiments with "entirely", "completely", "all", etc. Where applicable, the term "substantially" may also relate to **90%** or higher, such as **95%** or higher, especially **99%** or higher, including **100%.** The term "comprise" includes also embodiments wherein the term "comprises" means "consists of. It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The term "and/or" includes any and all combinations of one or more of the associated listed items. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The article "the" preceding an element does not exclude the presence of a plurality of such elements. In the device claim enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. A device for deflating tires, the device configured for being activated selectively, the device comprising:

   - a deflator configured as an extendable and retractable scissor-like construction configured with upward facing spikes, and which, when in a retracted state, is configured for being stored in an enclosure, and when in an extended state, is configured for covering a part of a road;
   - an actuator configured for automatically extending the deflator;

- the enclosure configured for receiving and storing the deflator in a retracted state;
- propulsion means configured for pushing the deflator out of the enclosure;
- means for selectively actuating the propulsion means, wherein the pushing out of the deflator of the enclosure is performed by an extending scissor movement which lengthens the deflator in a direction away from the enclosure,
- the propulsion means comprises a pneumatic actuator with a compressed gas capsule and a linear air cylinder having a linear movable piston with a rod connected to the deflator, whereby the gas capsule is configured to release gas under pressure to the linear air cylinder and move the piston in a first direction, said piston thereby extending the deflator,

characterized in that, the propulsion means comprises a manifold and a first control valve which, upon opening, is configured to control the direction of the released gas from the gas capsule in the first direction towards the back of the cylinder, said piston thereby extending the deflator, and which comprises a second control valve which, upon opening, is configured to control the direction of the released gas from the gas capsule in a second direction towards the front of the cylinder, said piston thereby retracting the deflator.

2. The device of claim 1, **characterized in that**, the cylinder is positioned above the deflator in longitudinal direction relatively to the direction of the deflator when extended, whereby the piston's rod is connected to a central hinge of the deflator and configured for pushing the hinge forward and outward of the enclosure to extend the deflator, and whereby the piston's rod is configured for pulling the hinge back into the enclosure to retract the deflator.

3. The device of claim 1, **characterized in that**, the first and second control valves are controlled by a control unit comprised in the device.

4. The device of claim 1, **characterized in that**, the device comprises a propellant cartridge assembly configured for receiving the compressed gas capsule, whereby the gas capsule comprises a replaceable compressed gas capsule with a gas outlet connected to a pressure regulator which controllably leads the gas further to conduits leading to the cylinder.

5. The device of claim 1, **characterized in that**, the gas capsule is a carbon dioxide capsule with carbon dioxide stored in a solid state, the capsule being sealed by a seal, said seal configured for being punctured by a puncture device in the propellant cartridge assembly.

6. The device of claim 1, **characterized in that**, the pressure of the release of the carbon dioxide from the capsule is regulated by a pressure reducing valve.

7. The device of claim 1, **characterized in that**, the pressure is adjustable from 0 bar to a maximum allowable system pressure by a controllable pressure reducing valve.

8. The device of claim 6, **characterized in that**, the pressure is adjustable from 5 to 10 bar by a controllable pressure reducing valve.

9. The device of claim 1, **characterized in that**, the pressure is stepless adjustable.

10. The device of claim 1, **characterized in that**, the pressure reducing valve is controlled by the control unit.

11. The device of claim 1, **characterized in that**, the control unit comprises a receiver configured for being controlled remotely by a remote control

12. The device of claim 1, **characterized in that**, the control unit comprises a Global Positioning System, GPS module configured for determining the geographic location of the device.

13. The device of claim 1, **characterized in that**, the control unit comprises modules of the group comprising:

- a counter for counting the number of expansions of the deflator;
- a counter for counting the times that gas is released from the gas capsule;
- a counter for keeping track of successful and/or unsuccessful deflations of tires as detected by sensors in the deflator;
- a timer for counting the duration of the deflator in extended state
- a timer for counting the time of the device being in operation from the last time of maintenance and/or replacement of the gas capsule.
- a memory for storing the counted data
- a software module for running software configured for processing the data.
- an image recognition module configured for recognizing the approach of a target vehicle.

14. The device of claim 1, **characterized in that**, the device comprises a wireless communication module configured for wirelessly communicating with an external system configured for wireless communica-

tion.

15. The device of claim 1, **characterized in that**, the wireless communication module comprises a short-range wireless communication module, such as a Bluetooth module.

16. The device of claim 1, **characterized in that**, the software is configured for constructing a status of the device as processed from the data, whereby the status and/or the data are communicated to the external system by the wireless communication module, when a status change is detected which fulfills a predetermined condition.

17. The device of claim 1, **characterized in that**, the software module of the control unit comprises a mobile communication module for communicating over a cellular telecommunication network with a central server, whereby the software module is configured for being updated with new software over the air via the cellular telecommunication network.

18. The device of claim 16, **characterized in that**, the control unit is configured for communicating the status via the mobile communication module to the central server, said status comprising any one of the group comprising:

- an operation status, such as duration of operation or number of actuations;
- a failure status, such as a failure code or a failure description and severity or urgency level;
- a maintenance status, such as maintenance required within a certain calculated period.

19. The device of claim 14, **characterized in that**, the external system is configured for simultaneously communicating with multiple devices which are configured according to the invention, whereby the multiple devices each comprises a wireless communication module and are configured for receiving a command for activation of the device.

20. The device of claim 14, **characterized in that**, the device is configured for being armed pending an activation command.

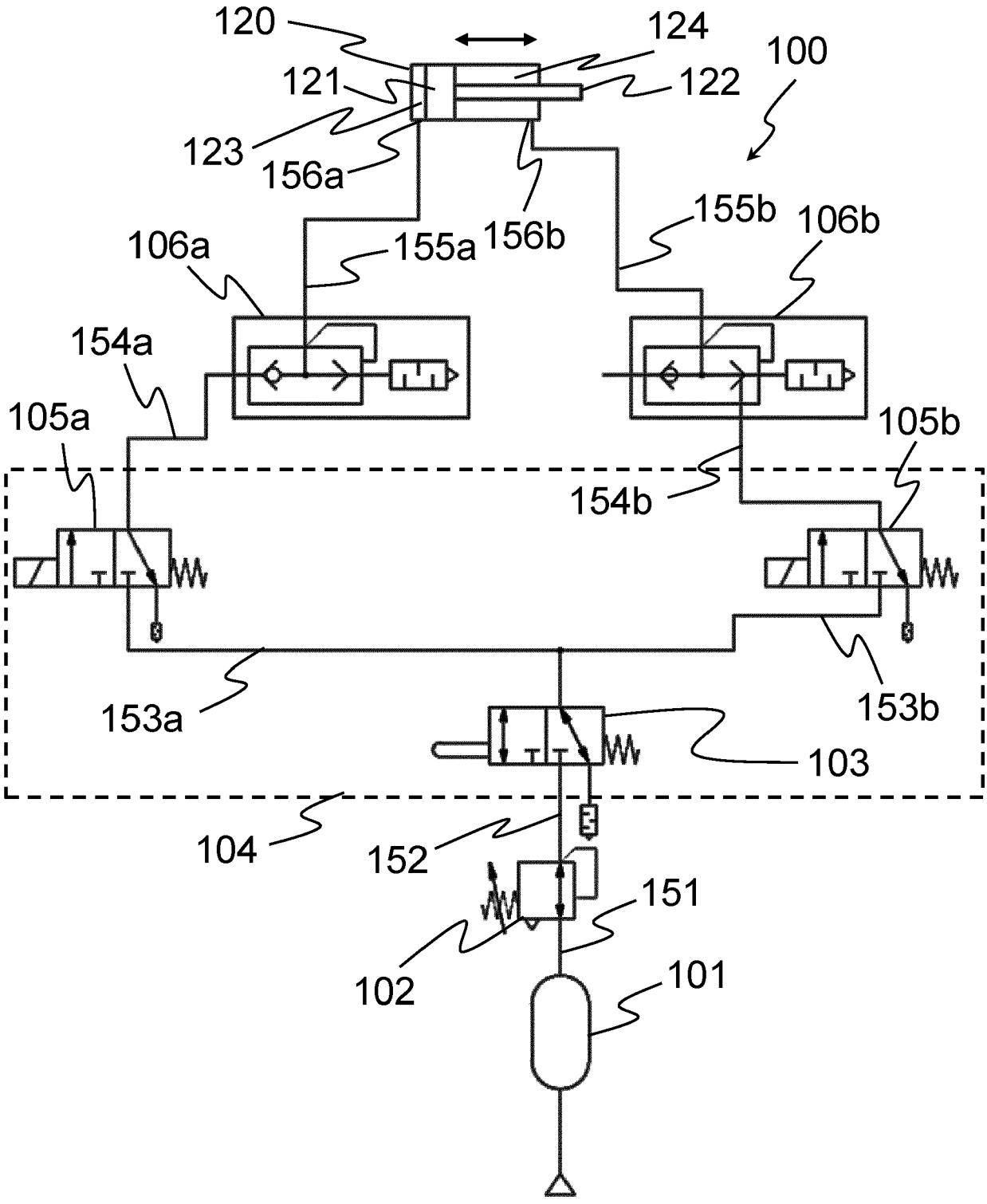
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Fig. 1

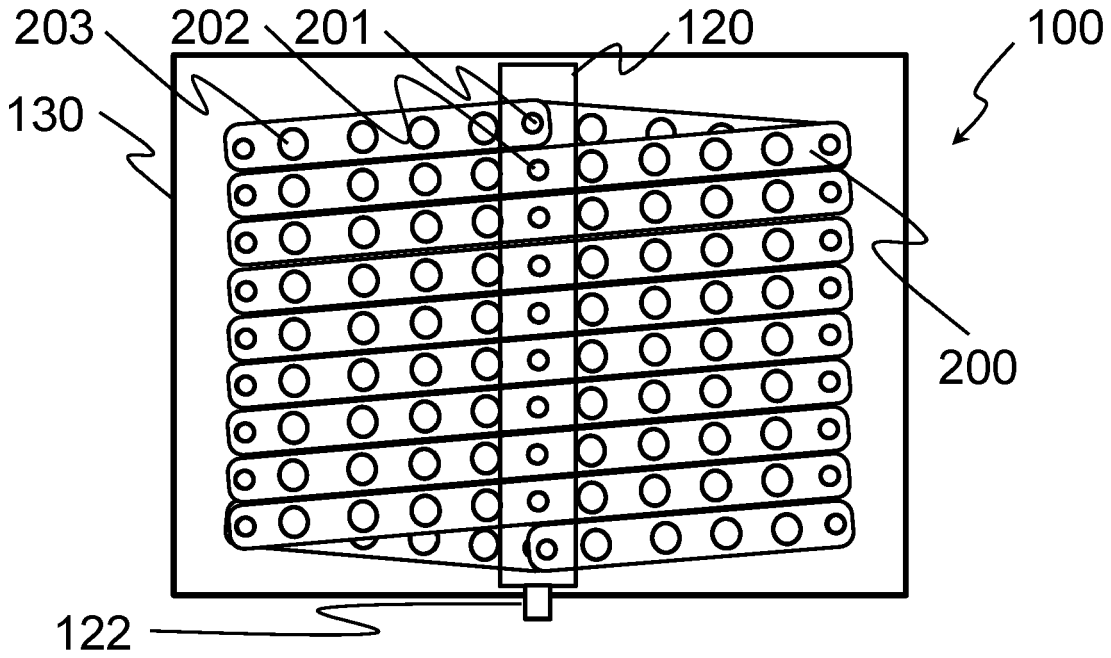

Fig. 2

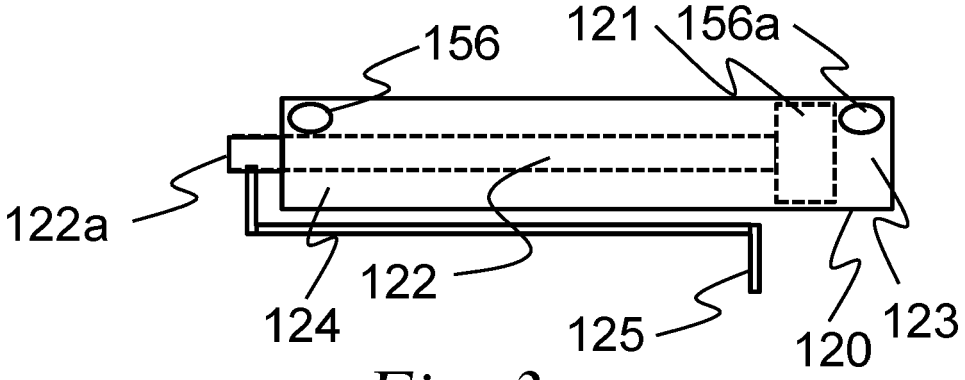

Fig. 3

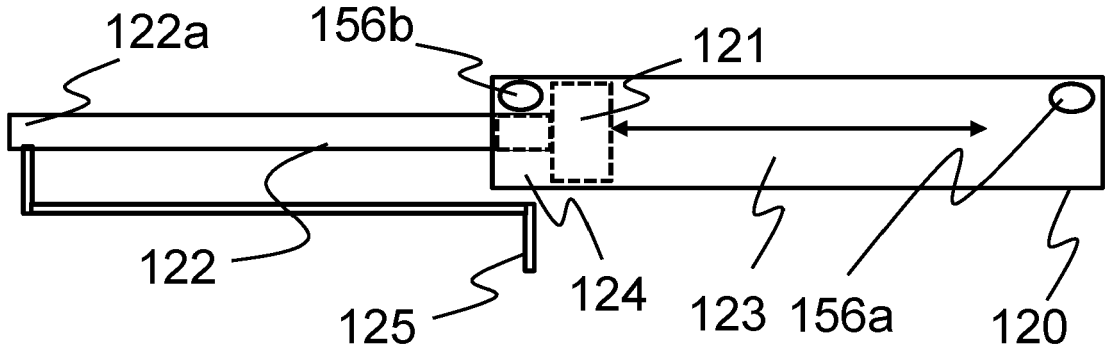

Fig. 4

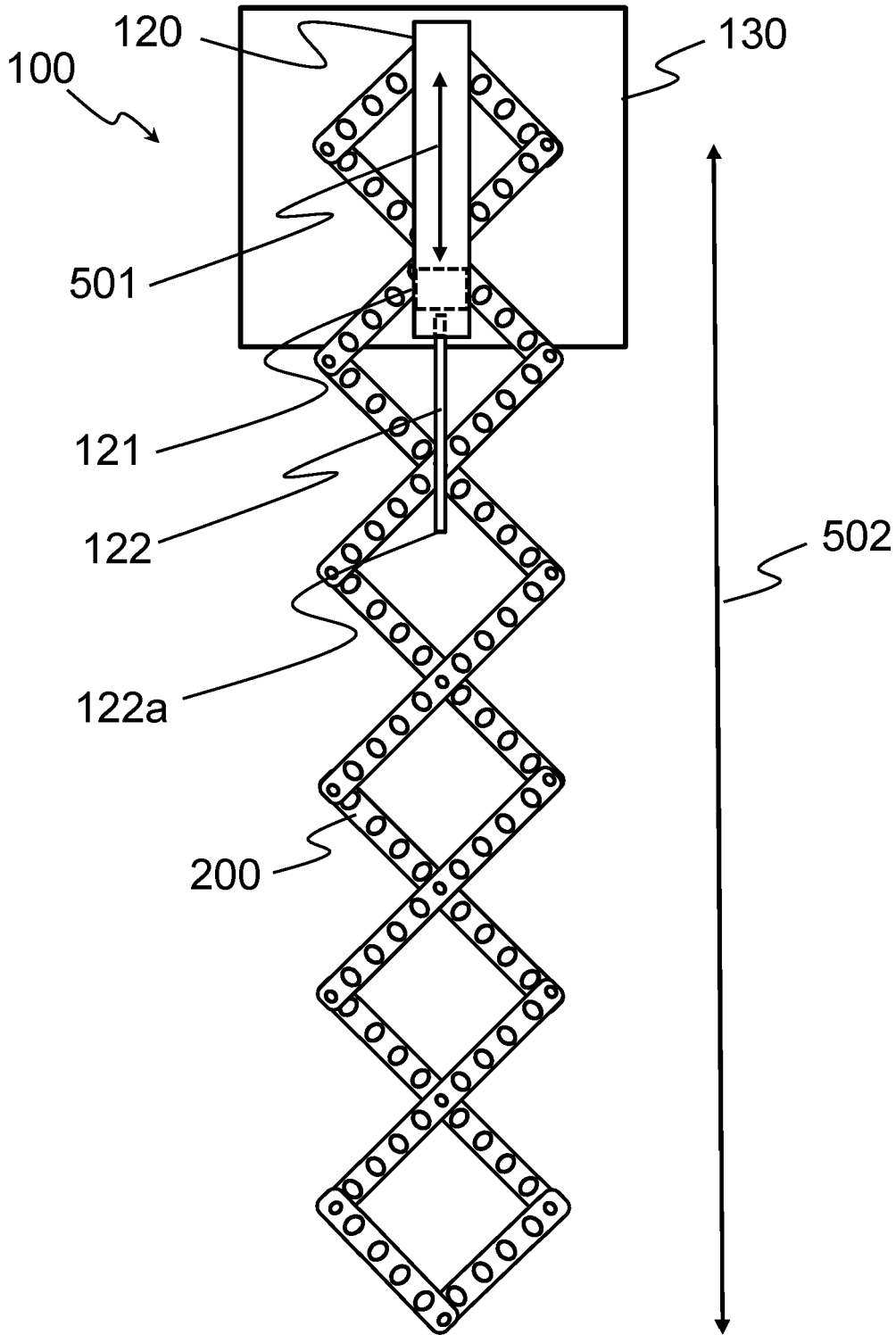

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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