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Decontamination methods

Abstract

A decontamination method for decontaminating an object of the present disclosure has steps including initiating spray in a first direction through one or more nozzles of a spray arm rotationally coupled to a control box, where the control box is in a first position and rotationally coupled to a leg of a gantry that is movably coupled to a track and rotating the control box to a second position based on profile data of the object.

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Parent Case Text

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and is a divisional of U.S. patent application Ser. No. 14/877,511 entitled Decontamination Systems and Methods and filed on Oct. 7, 2015, which is incorporated herein by reference in its entirety.

Claims

What is claimed is:

1. A decontamination method for decontaminating an object, comprising: initiating spray in a first direction through one or more nozzles of a spray arm rotationally coupled to a control box in a first position and

rotationally coupled to a leg of a gantry that is moveably coupled to a track; rotating the control box to a second position based on profile data of the object; monitoring a concentration of fluid in a main pipe; modifying a speed of a pump based upon the concentration of the fluid in the main pipe; and receiving a user input indicating a desired concentration of the fluid in the main pipe.

2. The decontamination method of claim 1, further comprising rotating the spray arm so that the one or more nozzles are spraying in a second direction based on the profile data.

3. The decontamination method of claim 1, further comprising collecting, via a laser scanner, data indicative of a profile of the object when the gantry is moving relative to the track.

4. The decontamination method of claim 3, further comprising transmitting, by the laser scanner, the profile data to a central computing device.

5. The decontamination method of claim 4, further comprising: receiving the profile data by the central computing device; and storing the profile data in resident memory by the central computing device.

6. The decontamination method of claim 1, further comprising generating a spray plan corresponding to the object based upon the profile data received.

7. The decontamination method of claim 1, further comprising: receiving, by an operator device, a user input; transmitting data indicative of the user input to a central computing device; receiving the data indicative of the user input; and activating decontamination of the object based upon the user input.

8. The decontamination method of claim 1, further comprising: receiving data indicative of the desired concentration from an operator device; and modifying, by a central computing device, a speed of the pump based upon the data indicative of the desired concentration.

Description

BACKGROUND

In use, vehicles often can get contaminated with hazardous substances. For example, when in use vehicles may come in contact with chemical, biological, and radiological substances that are dangerous to humans, animals, or the environment. It is often necessary to employ decontamination procedures to neutralize or remove contaminants from the contaminated vehicles.

As an example, vehicle decontamination is often used during the quarantine of farms infected with foreign animal diseases. The effective and rapid decontamination of vehicles and equipment prevents the spread of contaminants into unaffected areas, thus reducing the overall human, economic and logistic cost.

SUMMARY

A decontamination system for decontaminating an object of the present disclosure has a gantry movably coupled to a track, and the gantry is situated adjacent the object. The gantry has at least one control box rotationally coupled to a first leg and at least one spray arm comprising a nozzle for spraying fluid that is rotationally coupled to the control box. Additionally, the decontamination system has logic configured for initiating spraying through the one or more nozzles in a first direction when the control box is in a first position, the logic further configured to rotate the control box to a second position based on profile data of the object.

A decontamination method for decontaminating an object of the present disclosure comprises the steps of: (1) initiating spray in a first direction through one or more nozzles of a spray arm rotationally coupled to a control box, the control box in a first position and rotationally coupled to a leg of a gantry that is movably coupled to a track; and (2) rotating the control box to a second position based on profile data of the object.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale relative to each other, emphasis instead being placed upon clearly illustrating the principles of the disclosure. Furthermore, like reference numerals designate corresponding parts throughout the several views.

FIG. 1 is a perspective view of an exemplary decontamination system in accordance with an embodiment of the present disclosure.

FIG. 2 is a perspective view of the decontamination system of FIG. 1 with the shelter removed.

FIG. 3 is a block diagram of the decontamination system of FIG. 1.

FIG. 4 is a block diagram of an exemplary computing device of the decontamination system of FIG. 3.

FIG. 5 is a block diagram of an exemplary operator device of the decontamination system of FIG. 3.

FIG. 6 is a perspective view of an exemplary track and gantry system such as is depicted in FIG. 2 with the vehicle removed.

FIG. 7 is a top view of exemplary control boxes and exemplary spray arms of the track and gantry system such as is depicted in FIG. 6.

FIG. 8 is a perspective view of a control box and a spray arm such as is depicted in FIG. 7.

FIG. 9 is an exemplary control box such as is depicted in FIG. 8.

FIG. 10 is an exemplary fluid delivery system of the decontamination system such as is depicted in FIG. 3.

FIG. 11 is a block diagram of an exemplary fluid delivery system controller of the fluid delivery system depicted in FIG. 10.

FIG. 12 is an exemplary "HOME" graphical user interface (GUI) of the decontamination system such as is depicted in FIG. 3.

FIG. 13 is an exemplary "CONTROL" GUI of the decontamination system such as is depicted in FIG. 3.

FIG. 14 is a flowchart depicting exemplary architecture and functionality of the decontamination system such as is depicted in FIG. 3.

DETAILED DESCRIPTION

The present disclosure describes systems and methods for decontaminating vehicles. A decontamination system in accordance with an embodiment of the present disclosure comprises a shelter that houses a track and gantry system. A vehicle that has been subjected to chemical, biological, or radiological substances is driven into the shelter between a pair of tracks and beneath a gantry that is movably coupled to the tracks. Two control boxes are rotationally coupled to either side of the gantry. Additionally, two spray arms are rotationally coupled to each control box.

Upon detection of a vehicle in the shelter, the gantry passes over the length of the tracks so that a laser scanner can detect and measure the full profile of the vehicle and its location within the tracks. The laser scanner transmits the collected data indicative of the vehicle profile to a central computing device. Upon receipt, the central computing device develops a spray plan that consists of a series of orchestrated instructions to be given in a time controlled sequence to the gantry and spray arms. Taken together, the instruction result in movements that cover every surface of the vehicle. In this regard, the central computing device transmits instructions to the control boxes and the spray arms that raise, lower, and direct nozzles on the spray arms toward the vehicle as the gantry passes over the vehicle.

A fluid delivery system supplies decontaminants and water to the gantry, which is sprayed on the affected vehicle as described above. The fluid delivery system comprises one or more tanks that hold decontaminants and/or water. During operation, a user of the decontaminant system selects one or more of the decontaminants and a concentration of the selected decontaminants to be delivered to the gantry via a handheld device. The handheld device communicates with the central computing device, which controls pumps in fluid communication with the tanks. Thus, the concentration of a selected decontaminant may be user-controlled.

FIG. 1 is a decontamination system 100 in accordance with an embodiment of the present disclosure. The decontamination system 100 comprises a shelter 105 and one or more tanks 102-104 that contain decontaminants and/or water.

Within the shelter 105 is a track and gantry system 200. Note that FIG. 1 depicts the track and gantry system 200 in a position wherein a gantry 300 is positioned closest to an opening 106 of the shelter 105. Further, spray arms 402 and 403 that are coupled to the gantry 300 via control boxes 400 and 401 are positioned in front of a vehicle 101 perpendicular to tracks 301 and 302.

The vehicle 101 enters one side of the shelter 105 and is positioned between the tracks 301 and 302 and beneath the gantry 300. Note that FIG. 1 shows the vehicle 101 in a position at the end of the track and gantry system 200 closest to the opening 106 of the shelter 105. This position of the vehicle 101 is hereinafter referred to as the "ready position."

Once the vehicle 101 is in the ready position, a driver (not shown) of the vehicle 101 exits the vehicle 101 and the shelter 105. When the driver has exited the shelter 105, decontamination of the vehicle 101 begins. The decontamination process is described further herein.

When decontamination is complete, the driver may then reenter the vehicle 101. The spray arms 402 and 403 are moved, and the driver can drive the vehicle 101 from the shelter 105 via the opening 106.

FIG. 1 further depicts a trailer 190. The trailer 190 comprises various components of the system, including the central computing device (not shown) and the fluid delivery system (not shown), both of which are described further herein. Note that in one embodiment of the present disclosure, all components of the decontamination system 100 may be broken down, stored, and/or transported in the trailer 190.

Further note that the present disclosure describes decontamination of a vehicle. However, other objects may be decontaminated by the decontamination system in other embodiments. For example, the decontamination system may be used to decontaminate farm equipment.

FIG. 2 is a track and gantry system 200 in accordance with an embodiment of the present disclosure that comprises the parallel tracks 301, 302 and the U-shaped gantry 300. For clarity of discussion, the track and gantry system 200 is shown in FIG. 2 with the shelter 105 removed. Further, the vehicle 101 is positioned between the parallel tracks 301 and 302 and beneath the U-shaped gantry 300.

The inverted U-shaped gantry 300 comprises two vertical legs 303 and 305. Coupling together the top ends of the two vertical legs 303 and 305 is a horizontal bridge 304. Further, opposing ends of each leg 303 and 304 are movably coupled to respective tracks 301 and 302. During scanning, decontamination and/or rinsing, the U-shaped gantry 300 moves bi-directionally along the tracks 301 and 302, as indicated by reference arrows 221 and 220.

Coupled to the U-shaped gantry 300 is a laser scanner 364. As will be described in more detail herein, prior to decontamination, the gantry 300 moves along tracks 301 and 302 from the front of the vehicle 101 to the back of the vehicle 101. In one embodiment, proximity sensors (not shown) are used to detect the front and backend of the vehicle 101. As the gantry 300 moves, the laser scanner 364 collects data indicative of a profile of the vehicle 101. In one embodiment, the laser scanner 364 collects data indicative of x, y, and z coordinates of the profile of the vehicle.

Note that FIG. 2 depicts a position of the gantry 300 that is approximately midway down the length of the vehicle 101, and this position occurs as the vehicle is being scanned, decontaminated, or rinsed. The initial position of the track and gantry system 200 prior to beginning decontamination is described hereinabove with reference to FIG. 1.

FIG. 3 is a block diagram depicting the decontamination system 100 in accordance with an embodiment of the present disclosure. The decontamination system 100 comprises the track and gantry system 200, an operator device 500, a fluid delivery system 507, and a central computing device 504 (collectively referred to herein as system components).

The central computing device 504 is any type of computing device that can interface with the other system components either via cables or wirelessly. The central computing device 504 controls the system 100 at direction from an operator 502 via the operator device 500.

The central computing device 504 may be, but is not limited to, a server or a personal computer (PC). The central computing device 504 is communicatively coupled to the operator device 500 via a communication link 504, to the track and gantry system 200 via communication link 504 and to the fluid delivery system via communication link 505

In one embodiment, some or all communication links 503, 506, and 505 are effectuated with a wireless local area network (WLAN). In the embodiment, the central computing device 504 communicates bi-directionally with the operator device 500, the track and gantry system 200, and the fluid delivery system 507 via the WLAN.

In another embodiment, some or all communication links 503, 506, and 505 are established via direct cabling. For example, the link 506 between the central computing device 504 and the track and gantry system 200 and the link 505 between the central computing device 504 and the fluid delivery system 507 may be an Ethernet cable.

Note that communication between the system components, including the central computing device 504, the operator device 500, the track and gantry system 200, and the fluid delivery system 507, is described as being effectuated via a WLAN or Ethernet. However, other types of hardware and software may be used to establish the communication links between the system components in other embodiments. The present disclosure is not intended to limit the type of hardware and/or software that communicatively couples the system components.

The operator device 500 is any type of computing device that may be used by an operator 502 to control the system 100 via the central computing device 504, including, but not limited to, a tablet, e.g., an iPad.TM., a personal digital assistant (PDA), a cell phone, or a laptop computer. In operation, the operator 502 inputs data indicative of instructions for controlling the system 100. The data indicative of the instructions is sent to the central computing device 504, which controls the system 100 accordingly.

The fluid delivery system 507 comprises components for delivering decontaminants (not shown) and water (not shown) to the gantry 300. In turn, the gantry 300 sprays the vehicle 101 with the fluids delivered. Thus, the fluid delivery system 504 is in fluid communication with the track and gantry system 200 via piping 507. As will be described further with reference to FIG. 10, the fluid delivery system 507 comprises a plurality of conduits, pumps, flow meters, and tanks 102-104 (FIG. 1) for delivering the fluids to the gantry 300.

FIG. 4 is a block diagram of an exemplary central computing device 504 in accordance with an embodiment of the present disclosure. The exemplary computing device 504 comprises processor 600, output interface 608, input interface 607, a Wi-Fi transceiver 609, and a communication interface 610. Each of these components communicates over local interface 406, which can include one or more buses.

The central computing device 504 further comprises central computing device control logic 602. Central computing device control logic 602 can be software, hardware, or a combination thereof. In the exemplary central computing device 504 shown in FIG. 4, control logic 602 is software stored in memory 601. Memory 601 may be of any type of memory known in the art, including, but not limited to random access memory (RAM), read-only memory (ROM), flash memory, and the like.

As noted hereinabove, the central computing device control logic 602 is shown as stored in memory 601. When stored in memory 601, the central computing device control logic 602 can be stored and transported on any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions.

In the context of the present disclosure, a "computer-readable medium" can be any means that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer readable medium can be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium

Processor 600 may be a digital processor or other type of circuitry configured to run the central computing device control logic 602 by processing and executing the instructions of the central computing device control logic 602. Further, the processor 600 communicates with and drives the other elements within the central computing device 504 via the local interface 406.

The Wi-Fi transceiver 609 may be, for example, a low-powered radio device, e.g., a radio semiconductor, radio frequency antenna (RF antenna) or other type of communication device, which communicatively couples the central computing device 504 with the other system components, e.g., the operator device 500 (FIG. 3). In this embodiment, the Wi-Fi transceiver 609 is a wireless transceiver that is configured to transmit and receive messages wirelessly from the system components.

The output interface 608 is any type of device for providing information to the operator 502 (FIG. 3). In this regard, the output interface may be, for example, a backlit liquid crystal display (LCD) screen (not shown). Other types of output interfaces 608 may be, for example, an audio device that provides instructions to the operator 502 audibly, light emitting diodes (LED) that show status of the system 100, or any other type of output interface that provides sensory information to the operator. While some examples have been given, other types of output interfaces may be used in other embodiments of the present disclosure

The input interface 607 is any device that enables the operator to input data into the central computing device 504. In one embodiment, the input interface 607 is a touchscreen that allows the operator 502 to provide information to the central computing device 504 by selecting areas on the touch screen. In another embodiment, the input interface may be, for example, a keyboard or a microphone. In this regard, the operator may use the keyboard to type data into the central computing device 504. While some examples have been given, other types of input interfaces may be used in other embodiments of the present disclosure.

The communication interface 610 is any other type of communication interface that the central computing device 504 may use to communicate with the system components and/or a network (not shown). As an example, the communication interface 610 may be an Ethernet interface that enables the central computing device 504 to communicate with the system components, e.g., the fluid delivery system 507. As another example, the communication 610 may be any type of device that allows the central computing device 504 to communicate with the Internet.

The central computing device 504 further comprises profile data 603. The profile data 603 is data indicative of a profile of a vehicle 101 (FIG. 2) that is being decontaminated. As indicated hereinabove with reference to FIG. 2, the track and gantry system 200 (FIG. 2) comprises a laser scanner 364 (FIG. 2) that scans the vehicle 101. The laser scanner 364 collects data indicative of the x, y, and z coordinates of the profile of the vehicle 101 to be decontaminated. The laser scanner 364 transmits the profile data indicative of the scan to the central computing device 504. Upon receipt, the central computing device control logic 602 stores the data received as the profile data 603.

Upon receipt or prior to beginning decontamination, the central computing device control logic 602 translates the profile data 603 into a spray plan for spraying the vehicle 101 and stores data indicative of the spray plan as spray plan data 620. In translation, the central computing device control logic 602 generates a three-dimensional mode of the vehicle 101 and generates the spray plan data 620 based upon the three-dimensional model. Note as described above, the profile data 603 comprises the x, y, and z coordinates of the profile of the vehicle 101. Thus, in translation, the central computing device control logic 602 analyzes the coordinates and determines instructions to be sent to the track and gantry system 200 for moving the components of the track and gantry system 200 so that the surfaces of the vehicle are sprayed with decontaminants and rinse. As a mere example, the coordinates may define a height of the vehicle 101 as ten (10) feet. Thus, the central computing device control logic 602 would translate this data into an instruction that moves the spray arms 402 and 403 from ground level and up the front of the vehicle 101 ten (10) feet. This process is described further herein.

FIG. 5 is a block diagram of an exemplary operator device 500 in accordance with an embodiment of the present disclosure. The exemplary operator device 500 generally comprises processor 700, output interface 708, input interface 707, a wireless transceiver 709, and a communication interface 710. Each of these components communicates over local interface 706, which can include one or more buses.

The operator device 500 further comprises operator device control logic 702. Operator device control logic 702 can be software, hardware, or a combination thereof. In the exemplary operator device 500 shown in FIG. 5, operator device control logic 702 is software stored in memory 701. Memory 701 may be of any type of memory known in the art, including, but not limited to random access memory (RAM), read-only memory (ROM), flash memory, and the like.

As noted hereinabove, operator device control logic 702 is shown as stored in memory 701. When stored in memory 701, operator device control logic 702 can be stored and transported on any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions.

In the context of the present disclosure, a "computer-readable medium" can be any means that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer readable medium can be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium

Processor 700 may be a digital processor or other type of circuitry configured to run the operator device control logic 702 by processing and executing the instructions of the operator device control logic 702. Further, the processor 700 communicates with and drives the other elements within the operator device 500 via the local interface 706.

The wireless transceiver 709 may be, for example, a low-powered radio device, e.g., a radio semiconductor, radio frequency antenna (RF antenna) or other type of communication device, which communicatively couples the operator device 500 with the other system components. In this embodiment, the wireless transceiver 709 is a wireless transceiver that is configured to wirelessly transmit data to and wirelessly receive messages from the system components.

The output interface 708 is any type of device for providing information to the operator 502 (FIG. 3). In this regard, the output interface may be, for example, a touchscreen display device. Other types of output interfaces 708 may be, for example, an audio device that provides instructions to the operator audibly, light emitting diodes (LED) that show status of the system 100, or any other type of output interface that provides sensory information to the operator. While some examples have been given, other types of output interfaces may be used in other embodiments of the present disclosure

The input interface 707 is any device that enables the operator to input data into the operator device 500. In one embodiment, the input interface 607 is a touchscreen that allows the user to provide information to the operator device 500 by selecting areas on the touch screen. In another embodiment, the input interface 707 may be, for example, a keyboard or a microphone. In this regard, the operator may use the keyboard to type data into the operator device 500. While some examples have been given, other types of input interfaces may be used in other embodiments of the present disclosure.

In addition, the operator device 500 comprises a battery 711. The battery 711 supplies power to the operator device 500.

During operation, the operator 502 (FIG. 3) uses the operator device 500 to indirectly control the decontamination system 100 via communication with the central computing device 504. As will be described further herein, the operator 502 may enter data indicative of parameters of the decontamination process and transmit the data to the central computing device 504. Upon receipt, the central computing device control logic 602 (FIG. 4) translates the data received into instructions for operating the system 100.

As an example, when the driver (not shown) of the vehicle 101 (FIG. 2) exits the shelter 105, then decontamination can begin. In such an example, after the operator 502 ensures that the driver is clear of the shelter 105, the operator 502 enters input into the operator device 500 to begin the decontamination process. The operator device 500 transmits data indicative of the input to the central computing device 504. In response, the central computing device control logic 602 (FIG. 3) begins the process of decontamination, i.e., activating the fluid delivery system 507 (FIG. 3) and the track and gantry system 200 (FIG. 3).

As another example, which is described further herein with reference to FIG. 10, the operator 502 may enter data indicative of concentrations of particular decontaminants for delivery to the gantry 300, which the operator device 500 transmits to the central computing device 504. During the decontamination process, the central computing device control logic 602 may control a pump speed associated with the particular decontaminant to ensure delivery of the specified concentration of the decontaminant.

FIG. 6 depicts the track and gantry system 200 with the vehicle 101 (FIG. 2) removed for clarity and completeness of discussion. Note that in the depiction of FIG. 6, the spray arms 402 and 403 are actuated such that they meet at a center point and are perpendicular to the tracks 301 and 302, respectively.

As discussed above with reference to FIG. 2, the track and gantry system 200 comprises the parallel tracks 301 and 302 and the U-shaped gantry 300. In addition, the track and gantry system 200 further comprises the control boxes 400 and 401. The control boxes 400 and 401 are rotationally coupled to the legs 303 and 305, respectively, of the gantry 300. Further, the spray arms 402 and 403 are rotationally coupled to the control boxes 400 and 401, respectively.

During operation, the control boxes 400 and 401 are adapted to move upward and downward in directions indicated by reference arrows 450 and 451, respectively. Further, the control boxes 400 and 401 are adapted to rotate in directions indicated by reference arrows 452 and 453, respectively, relative to the legs 303 and 306, respectively. Additionally, the spray arms 402 and 403 are adapted to rotate relative to the control boxes 400 and 401, which are described further with reference to FIG. 7.

FIG. 7 is top view of the control boxes 400 and 401 and their respective rotationally coupled spray arms 402 and 403. The spray arms 402 and 403 are shown meeting at a center point and perpendicular to the tracks 301 (FIG. 6) and 302 (FIG. 6) at a position indicated as Position A. In Position A, the length of each spray arm 402 and 403 is such that each reaches approximately half the distance between the tracks 301 and 302.

In Position A nozzles 454 can be oriented in a direction such that decontaminants and water from the nozzles 454 are directed toward a front of the vehicle 101 (FIG. 2). Also, as indicated with reference to FIG. 6, the control boxes 400 and 401 move upward and downward in the direction indicated by the reference arrows 450 (FIG. 6) and 451 (FIG. 6). Thus decontaminants and water can be sprayed via the nozzles 454 onto the entire front surface of the vehicle 101 when the nozzles are oriented as shown, and the control boxes 400 and 401 move upward and downward as indicated by the reference arrows 450 and 451.

In addition to the upward, downward and rotational movement of the control boxes 400 and 401, the spray arms 402 and 403 also rotate relative to the control boxes 400 and 401, respectively. In this regard, the spray arms 402 and 403 can bi-directionally rotate relative to the control boxes 400 and 401 as indicated by reference arrows 390 and 391, respectively.

Therefore, in addition to Position A, the spray arms 402 and 403 are adapted to rotate to Position B. To move to Position B, the control box 400 rotates relative to the gantry leg 303 (FIG. 6), and the spray arm 402 rotates relative to the control box 400. When the control box 400 rotates ninety degrees (90.degree.) relative to the gantry leg 303 as indicated by reference arrow 380, and the spray arm 402 rotates one hundred and eighty degrees (180.degree.) relative to the control box 400 as indicated by reference arrow 390, the spray arm 402 rests in Position B with the nozzles 454 pointing toward the side of the vehicle 101. Similarly, when the control box 401 rotates ninety degrees (90.degree.) relative to the gantry leg 305 (FIG. 6) as indicated by reference arrow 382, and the spray arm 403 rotates one hundred and eighty degrees (180.degree.) relative to the control box 401 as indicated by reference arrow 391, the spray arm 403 rests in Position B with the nozzles 454 pointing toward the other side of the vehicle 101.

Note that in Position B, the nozzles 454 are oriented in a direction such that decontaminants and water from the nozzles 454 are directed toward the side surfaces of the vehicle 101. Also, the control boxes 400 and 401 move upward and downward in the directions indicated by the reference arrows 450 and 451. Thus, decontaminants and water can be sprayed via the nozzles 454 onto the entire side surfaces of the vehicle 101.

In addition to Positions A and B, the spray arms 402 and 403 may also rotate to Position C. When the control box 400 rotates ninety degrees (90.degree.) relative to the gantry leg 303 as indicated by reference arrow 381, the spray arm 402 rests in Position C with the nozzles 454 pointing toward the side surface of the vehicle 101. Note that because of the initial orientation of the spray nozzles 454, no additional rotation of the spray arm 402 is necessary to effectuate Position C. Similarly, when the control box 401 rotates ninety degrees (90.degree.) relative to the gantry leg 305 as indicated by reference arrow 382, the spray arm 403 rests in Position C with the nozzles 454 pointing toward the side surface of the vehicle 101. Note that because of the initial orientation of the spray nozzles 454, no additional rotation of the spray arm 403 is necessary to effectuate Position C.

Further note that in Position C, the nozzles 454 are oriented in a direction such that decontaminants and water from the nozzles 454 are directed toward the side surfaces of the vehicle 101. Also, the control boxes 400 and 401 move in the direction indicated by the reference arrows 450 and 451. Thus decontaminants and water can be sprayed via the nozzles 454 onto the entire side surfaces of the vehicle 101.

In regard to the back end of the vehicle 101, the spray arms 402 and 403 are positioned, similar to Position A, i.e., perpendicular to the tracks 301 and 302. However, the spray arms 402 and 403 are rotated such that the nozzles 454 are pointing in the direction toward the back of the vehicle 101. When the nozzles 454 are oriented toward the back end of the vehicle, and the control boxes 400 and 401 are moved along legs 303 and 305 in the direction indicated by reference arrows 450 and 451, the entire back surface of the vehicle is sprayed with decontaminants and/or water.

Additionally, the spray arms 402 and 403 may be positioned and moved in order to decontaminate an underside of the vehicle 101. To decontaminate the underside of the vehicle 101, the control boxes 400 and 401 are moved to the bottom of the legs 301 and 302 in the direction indicated by reference arrow 451.

From Position A, the spray arms 402 and 403 are rotated ninety degrees (90.degree.) such that the nozzles 454 point upward toward the underside of the vehicle 101. The gantry 300 then moves toward the front of the vehicle 101, as indicated by reference arrow 221 (FIG. 2) spraying the underside of the vehicle.

As indicated hereinabove, prior to spraying the vehicle 101, the central computing device computing logic 602 (FIG. 3) generates spray plan data 620 that comprises instructions for moving the control boxes 400 and 401 and the spray arms 402 and 403. In the spray plan data 620 are instructions that move the control boxes 400 and 401 such that the obstacles along the underside of the vehicle 101 are avoided when the underside is being sprayed. In this regard, when obstacles, e.g., tires, are in the path of the spray arms 402 and 403, the central computing device control logic 602 transmits instructions that rotate the control boxes 400 and 401 thereby allowing the spray arms 402 and 403 avoid the obstacles. The central computing device control logic 602 then transmits instruction that move the spray arms 402 and 403 back to their positions perpendicular to the tracks 301 and 302 to continue spraying the underside of the vehicle 101.

With further reference to FIG. 6, the spray arms 402 and 403 may be positioned both via rotation of the control boxes 400 and 401 relative to the gantry legs 303 and 305 and rotation of the spray arms 402 and 403 relative to the control boxes 400 and 401. Thus, the front, back, side, and under surfaces of the vehicle 101 may be sprayed with decontaminants and water as needed.

An exemplary spray procedure is now described with reference to FIGS. 6 and 7. To begin the spray procedure, the gantry 300 is located at one end of the vehicle 101 (FIG. 2). The spray arms are positioned perpendicular to the tracks 301 and 302 at ground level. When in this