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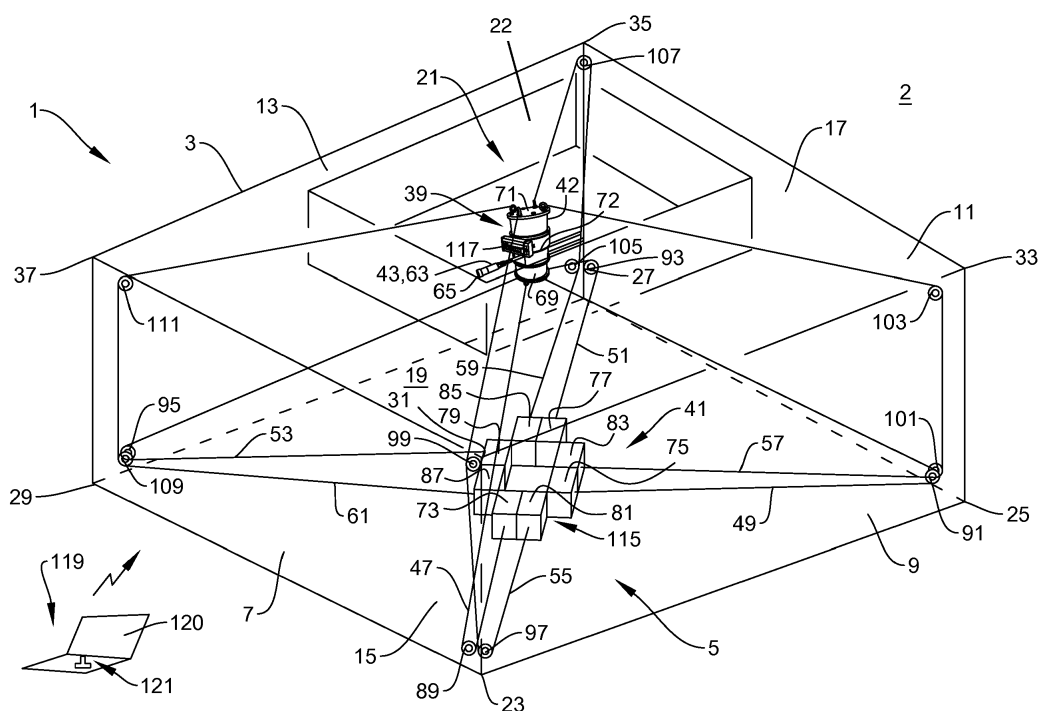
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(54) **A CLEANING SYSTEM FOR CLEANING A CHAMBER**

(57) Disclosed is a cleaning system (5) for cleaning a chamber (1), such as a freight hold, the cleaning system (5) comprising a cleaning device (39) having a body (42) and arranged on that body (42) having a cleaning nozzle (43) for emitting a cleaning fluid, and comprising a rope arrangement (41) attached to the body (42) for controlling the position of the cleaning device (39) inside the chamber (1) to be cleaned. The rope arrangement (41) comprises

at least a first rope (47) and a first winch (73), wherein the first winch (73) is configured to be fixed to the chamber (1) or in a defined position relative to the chamber (1), and wherein the first rope (47) is attached to the body (42) and is wound up on the first winch (73), so that by rotating the first winch (73) to wind up or off the first rope (47) the position of the cleaning device (39) inside the chamber (1) can be controlled.



**FIG. 1**

## Description

**[0001]** The present invention relates to a cleaning system for cleaning a chamber, such as a freight hold, preferably a freight hold of a ship. Preferably, the chamber has a chamber structure including walls, a floor and a ceiling together at least partially surrounding an interior space, as well as an opening at the top. Further aspects of the invention relate to a chamber to be cleaned comprising such a cleaning system, and to a ship comprising such a cleaning system or such a chamber.

**[0002]** Freight holds of ships are often used to store bulk freight, such as coal, grain, steel, aluminum, bauxite or any other bulk freight cargo. After unloading such bulk freight the walls, floor and ceiling of the freight hold need to be cleaned before other bulk freight is loaded in the freight hold. In view of the large dimensions of a ship freight hold this cleaning can be a laborious and time-consuming process.

**[0003]** Accordingly, the object of the present invention is to provide a cleaning system for simple and quick cleaning of the freight hold.

**[0004]** This object is achieved by a cleaning system comprising a cleaning device and a rope arrangement. The cleaning device has a preferably cylindrical body and arranged on that body has at least one cleaning nozzle for emitting, preferably spraying or blowing, a cleaning fluid. The body might include for example a container for cleaning fluid, a compressor for pressurizing the cleaning fluid, a motor or actuator for moving the cleaning nozzle, a camera, a proximity sensor, etc. The cleaning fluid might be a cleaning liquid, such as water or a liquid cleaning agent, or might be compressed air. Also, combinations of these cleaning fluid examples are possible, such as for example water or compressed air combined with a cleaning agent. Further, there might be more than one cleaning nozzle provided, for example for emitting different kinds of cleaning fluid, such as one nozzle emitting water and one nozzle emitting the cleaning agent. It is also possible that there are multiple cleaning nozzles arranged in different directions.

**[0005]** The rope arrangement is attached to the body for controlling the position of the cleaning device inside the chamber to be cleaned. The rope arrangement comprises at least a first rope and a first winch. The first winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The first rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the first winch, so that by rotating the first winch to wind up or off the first rope the position of the cleaning device inside the chamber can be controlled, specifically with respect to a first, e.g. vertical degree of freedom, using the weight of the cleaning device as a counterforce. The first rope should have sufficient strength to precisely

position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc.

**[0006]** In such a way, a very simple cleaning system is provided for cleaning e.g. a large-scale freight hold of a ship and that can be easily extended to cover further degrees of freedom by addition further ropes and winches.

**[0007]** According to a preferred embodiment, the rope arrangement comprises a second rope and a second winch. The second winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first winch or using at least one deflection roller, to provide that the second rope extends to the cleaning device under a different angle than the first rope extends to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The second rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the second winch, so that by rotating the first and/or second winches to wind up or off the first and/or second ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to a second degree of freedom, using the weight of the cleaning device as a counterforce. The second rope similar as the first rope should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc. In such a way, the cleaning system is extended to cover a further degree of freedom.

**[0008]** In particular, it is preferred that the rope arrangement comprises a third rope and a third winch. The third winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second winches or using at least one deflection roller, to provide that the third rope extends to the cleaning device under a different angle than the first and/or second ropes extend to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The third rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the third winch, so that by rotating the first and/or second and/or third winches to wind up or off the first and/or second and/or third ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to a third degree of freedom, using the weight of the cleaning device as a counterforce. The third rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc. In such a way, the cleaning system is extended to cover a further degree of freedom.

**[0009]** In particular, it is preferred that the rope arrangement comprises a fourth rope and a fourth winch. The fourth winch is configured to be fixed to the chamber,

preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second and/or third winches or using at least one deflection roller, to provide that the fourth rope extends to the cleaning device under a different angle than the first and/or second and/or third rope extend to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The fourth rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the fourth winch, so that by rotating the first and/or second and/or third and/or fourth winches to wind up or off the first and/or second and/or third and/or fourth ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to three independent degrees of freedom and without needing to use the weight of the cleaning device as a counterforce. The fourth rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc. In such a way, the cleaning system is extended to be able to cover three independent degrees of freedom, i. e. to move into every direction, without needing the assistance of the weight of the cleaning device. This enables a very quick and precise positioning.

**[0010]** In particular, it is preferred that the rope arrangement comprises a fifth rope and a fifth winch. The fifth winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second and/or third and/or fourth winches or using at least one deflection roller, to provide that the fifth rope extends to the cleaning device under a different angle than the first and/or second and/or third and/or fourth rope extend to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The fifth rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the fifth winch, so that by rotating the first and/or second and/or third and/or fourth and/or fifth winches to wind up or off the first and/or second and/or third and/or fourth and/or fifth ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to three independent degrees of freedom and without needing to use the weight of the cleaning device as a counterforce. The fifth rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc.

**[0011]** It is further preferred that the rope arrangement comprises a sixth rope and a sixth winch. The sixth winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second and/or third and/or fourth and/or fifth winches or using at least

one deflection roller, to provide that the sixth rope extends to the cleaning device under a different angle than the first and/or second and/or third and/or fourth and/or fifth rope extend to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The sixth rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the sixth winch, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth winches to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to three independent degrees of freedom and without needing to use the weight of the cleaning device as a counterforce. The sixth rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc.

**[0012]** It is further preferred that the rope arrangement comprises a seventh rope and a seventh winch. The seventh winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second and/or third and/or fourth and/or fifth and/or sixth winches or using at least one deflection roller, to provide that the seventh rope extends to the cleaning device under a different angle than the first and/or second and/or third and/or fourth and/or fifth and/or sixth rope extend to the cleaning device. The defined position might be a fixed position but might also be a movable position on a defined path of movement. The seventh rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the seventh winch, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh winches to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to three independent degrees of freedom and without needing to use the weight of the cleaning device as a counterforce. The seventh rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc.

**[0013]** It is further preferred that the rope arrangement comprises an eighth rope and an eighth winch. The eighth winch is configured to be fixed to the chamber, preferably to the chamber structure, such as wall or floor, or to be fixed in a defined position relative to and near the chamber, either spaced apart from the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh winches or using at least one deflection roller, to provide that the eighth rope extends to the cleaning device under a different angle than the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh rope extend to the cleaning device. The defined

position might be a fixed position but might also be a movable position on a defined path of movement. The eighth rope preferably at its one end is attached to the body and preferably at its opposite end is wound up on the eighth winch, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth winches to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth ropes the position of the cleaning device inside the chamber can be controlled, specifically with respect to three independent degrees of freedom and without needing to use the weight of the cleaning device as a counterforce. The eighth rope similar as the other ropes should have sufficient strength to precisely position the cleaning device, and might be e.g. a nylon rope, a metal wire, etc.

**[0014]** In such a way, by the eight ropes and eight winches, the cleaning system is particularly suitable for cleaning a cubic chamber having eight corners - four corners at the lower end of the wall and four corners at the upper end of the walls - such as a freight hold of a ship, as from each of the eight corners a rope can extend to the cleaning device. Thereby a very precise position of the cleaning device into each of the eight corners is enabled.

**[0015]** According to a preferred embodiment, the rope arrangement comprises at least a first deflection roller for deflecting the first rope in a position between the first winch and the cleaning device. The first deflection roller is configured to be mounted to the chamber, preferably to the chamber structure, such as wall or floor, or in a defined, i.e. fixed or movable position relative to and near the chamber. Preferably, the rope arrangement comprises at least one deflection roller for each rope. By the deflection rollers the associated ropes can be deflected in a desired direction in which the cleaning device is intended to be moved, while the respective winch can be placed at a remote position, e.g. together with the other winches at the floor of the chamber.

**[0016]** According to a further preferred embodiment, the cleaning nozzle includes a pipe projecting away from the body and having a nozzle opening at its end remote from the body for emitting the cleaning fluid. The pipe is preferably rigid but might also be flexible, and projects away from the body preferably in a horizontal direction. However, the pipe might also project away from the body in an inclined direction, i.e. with an angle to the horizontal direction, when referring to a normal operating position of the body. By such a cleaning nozzle the cleaning fluid can be applied to the chamber walls from a certain distance and with a good precision.

**[0017]** According to a further preferred embodiment, the cleaning nozzle is movably mounted to the body, so that the cleaning fluid can be emitted in various directions. Preferably, the cleaning nozzle is movable circumferentially around the body, so that the cleaning fluid can be emitted within an angle of 360°. Preferably, the body comprises at least one fixed part attached to the rope or ropes,

and a movable part holding the cleaning nozzle and rotatable relative to the fixed part at least about an axis of rotation. It is further preferred that the body has a cylindrical shape extending along a vertical axis between a lower fixed part attached to some of the ropes and an upper fixed part attached to others of the ropes, wherein the movable part holds the cleaning nozzle, is sandwiched between the upper and lower fixed parts and is rotatable relative to the upper and lower fixed parts about the axis of rotation that coincides with the vertical axis of extension of the cylindrical body. In such a way, the body can be held in a stable vertical position and the cleaning nozzle can rotate within a horizontal plane with an angular coverage of 360°. Preferably, the movable part comprises a lower movable part and an upper movable part that are controllable and rotatable about the axis of rotation independently from one another. The lower movable part includes the cleaning nozzle and the upper movable part includes a camera.

**[0018]** According to another preferred embodiment, the cleaning system further comprises a control unit controlling the rotation of the respective winches to control the position of the cleaning device depending on geometric data of the respective chamber to be cleaned. The geometric data of the chamber might be predefined and stored in a related memory. Additionally or alternatively, the geometric data might also be detected and provided by a related sensor or sensors at the cleaning device. Such sensors might e.g. be provided at the outside of the body. The control unit might be arranged in or on the body but might also be arranged at a position outside the body and might communicate with the body preferably wireless or via a communication wire. In such a way, fully automatic cleaning of the chamber is possible.

**[0019]** According to an alternative embodiment, the cleaning device comprises at least one camera configured for recording a real-time image relating to the operating range of the cleaning nozzle. Preferably, the camera is attached to the movable part of the body, in particular to the upper movable part. The cleaning system further comprises a manual control device including a screen configured for displaying the real-time image to an operator, and a manual input device, such as a stick, configured to receive manual input commands by the operator and to control rotation of the respective winches to control the position of the cleaning device, depending on the input commands. Also, the angular position of the cleaning nozzle and/or the camera is preferably controllable by the manual control device and the associated operator. In such a way, cleaning of the chamber by an operator is possible.

**[0020]** A further aspect of the present invention relates to a chamber to be cleaned, such as a freight hold, preferably a freight hold of a ship. The chamber comprises a chamber structure and a cleaning system according to any of the embodiments described above. The chamber structure has an essentially cubic shape including four side walls and a floor surrounding an interior space with

a top opening. The chamber structure might also have a ceiling partially closing the interior space to the top and including the top opening. Preferably, the top opening can be closed by a hatch cover that forms part of the ceiling and that is also to be cleaned. Between the floor and each two adjacent side walls a respective first, second, third and fourth lower corner is formed, and between the top opening or, if applicable, the ceiling and each two adjacent side walls a respective first, second, third and fourth upper corner is formed. The winches or associated deflection rollers are arranged, i.e. preferably mounted to the chamber structure, in such a way that from each lower and upper corner one of the ropes is guided to the cleaning device, such that by suitable adjusting of the ropes the cleaning device can reach the entire interior space, i.e. every position in the interior space, to be able to clean the entire inner surface of the chamber structure. The features and effects mentioned above in connection with the cleaning system apply vis-à-vis also to the chamber.

**[0021]** According to a preferred embodiment, the first winch is mounted to the floor of the chamber structure, wherein a first deflection roller is mounted preferably to the side walls or floor near the first lower corner, and wherein the first rope is guided from the first winch via the first deflection roller to the cleaning device. Likewise, the second winch is mounted to the floor of the chamber structure, wherein a second deflection roller is mounted preferably to the side walls or floor near the second lower corner, and wherein the second rope is guided from the second winch via the second deflection roller to the cleaning device. Likewise, the third winch is mounted to the floor of the chamber structure, wherein a third deflection roller is mounted preferably to the side walls or floor near the third lower corner, and wherein the third rope is guided from the third winch via the third deflection roller to the cleaning device. Likewise, the fourth winch is mounted to the floor of the chamber structure, wherein a fourth deflection roller is mounted preferably to the side walls or floor near the fourth lower corner, and wherein the fourth rope is guided from the fourth winch via the fourth deflection roller to the cleaning device. Likewise, the fifth winch is mounted to the floor of the chamber structure, wherein a fifth deflection roller is mounted preferably to the side walls or floor near the first lower corner and a sixth deflection roller is mounted preferably to the side walls near the first upper corner, and wherein the fifth rope is guided from the fifth winch via the fifth and sixth deflection rollers to the cleaning device. Likewise, the sixth winch is mounted to the floor of the chamber structure, wherein a seventh deflection roller is mounted preferably to the side walls or floor near the second lower corner and an eighth deflection roller is mounted preferably to the side walls near the second upper corner, and wherein the sixth rope is guided from the sixth winch via the seventh and eighth deflection rollers to the cleaning device. Likewise, the seventh winch is mounted to the floor of the chamber structure, wherein a ninth deflection

roller is mounted preferably to the side walls or floor near the third lower corner and a tenth deflection roller is mounted preferably to the side walls near the third upper corner, and wherein the seventh rope is guided from the seventh winch via the ninth and tenth deflection rollers to the cleaning device. Likewise, the eighth winch is mounted to the floor of the chamber structure, wherein an eleventh deflection roller is mounted preferably to the side walls or floor near the fourth lower corner and a twelfth deflection roller is mounted preferably to the side walls near the fourth upper corner, and wherein the eighth rope is guided from the eighth winch via the eleventh and twelfth deflection rollers to the cleaning device. In such a way, the cleaning device can be moved in every position inside a cubic-shaped chamber while the winches can be arranged together in a common position.

**[0022]** According to a preferred embodiment, the first to eighth winches are arranged together in a central position at the floor of the chamber structure, where the winches can be fixed to the floor e.g. by magnets, preferably switchable magnets. Preferably, the winches are fixed on a base frame that can be dismantled for transporting from chamber to chamber. In such a way, the winches can be stored and transported together as a common unit and can be easily actuated e.g. by a common actuator assembly. Further, the switchable magnets allow a very quick and simple fixing of the winches at the chamber floor, resulting in a minimum set-up time.

**[0023]** A further aspect of the present invention relates to a ship comprising the cleaning system according to any of the embodiments described above, or comprising a chamber, in particular a freight hold, according to any of the embodiments described above. The features and effects mentioned above in connection with the cleaning system and with the chamber apply vis-à-vis also to the ship.

**[0024]** Hereinafter, a preferred embodiment of the present invention is described in more detail by means of a drawing. The drawing shows in

Fig. 1 a schematic perspective view of a chamber in the form of a freight hold of a ship including a cleaning system according to the invention installed therein, and

Fig. 2 an isolated view of the cleaning device of the cleaning system shown in Fig. 1.

**[0025]** In Fig. 1 a chamber 1 according to an embodiment of the present invention is shown. In the shown embodiment, the chamber is a freight hold of a ship 2.

**[0026]** The chamber 1 comprises a chamber structure 3 and a cleaning system 5 for cleaning the chamber 1. The chamber structure 3 has an essentially cubic shape including four side walls 7, 9, 11, 13, a floor 15 and a ceiling 17 surrounding an interior space 19 with a top opening 21 in the ceiling 17. The top opening 21 is closed by a hatch cover 22 that forms part of the ceiling 17.

Between the floor 15 and each two adjacent side walls 7, 9, 11, 13 a respective first, second, third and fourth lower corner 23, 25, 27, 29 is formed, and between the ceiling 17 and each two adjacent side walls 7, 9, 11, 13 a respective first, second, third and fourth upper corner 31, 33, 35, 37 is formed.

**[0027]** The cleaning system 5 comprises a cleaning device 39 and a rope arrangement 41. The cleaning device 39 has a cylindrical body 42 and arranged on that body 42 has a cleaning nozzle 43 for emitting a cleaning fluid. The rope arrangement 41 comprises several ropes 47, 49, 51, 53, 55, 57, 59, 61 attached to the body 42 for controlling the position of the cleaning device 39 inside the chamber 1 to be cleaned.

**[0028]** As illustrated in further detail in Fig. 2, the cleaning nozzle 43 includes a rigid pipe 63 projecting away from the body 42 in a horizontal direction and having a nozzle opening 65 at its end remote from the body 42 for emitting the cleaning fluid. Further, the cleaning nozzle 43 is movably mounted to the body 42, so that the cleaning fluid can be emitted in various directions. Specifically, the cleaning nozzle 43 is movable circumferentially around the body 42, so that the cleaning fluid can be emitted within an angle of 360°. The body 42 has a cylindrical shape extending along a vertical axis 67 between a lower fixed part 69 attached to some of the ropes 47, 49, 51, 53, an upper fixed part 71 attached to others of the ropes 55, 57, 59, 61, and a movable part 72 sandwiched between the upper and lower fixed parts 69, 71 and rotatable relative to the upper and lower fixed parts 69, 71 about the vertical axis 67 of the body 42. In the present embodiment, the movable part 72 comprises a lower movable part 72a and an upper movable part 72b that are movable independently from one another. The lower movable part 72a includes the cleaning nozzle 43 and the upper movable part 72b includes a camera 117.

**[0029]** The rope arrangement 41, as shown in Fig. 1, comprises first, second, third, fourth, fifth, sixth, seventh and eighth ropes 47, 49, 51, 53, 55, 57, 59, 61 and first, second, third, fourth, fifth, sixth, seventh and eighth winches 73, 75, 77, 79, 81, 83, 85, 87. The first winch 73 is mounted to the floor 15 of the chamber structure 3. The first rope 47 at its one end is attached to the lower fixed part 69 of the body 42 and at its opposite end is wound up on the first winch 73, so that by rotating the first winch 73 to wind up or off the first rope 47 the position of the cleaning device 39 inside the chamber 1 can be controlled. The first rope 47 is formed as a steel wire. Further, a first deflection roller 89 is mounted to the side walls 7, 9, 11, 13 near the first lower corner 23, and the first rope 47 is guided from the first winch 73 via the first deflection roller 89 to the cleaning device 39.

**[0030]** The second winch 75 is mounted to the floor 15 of the chamber structure 3. The second rope 49 at its one end is attached to the lower fixed part 69 of the body 42 and at its opposite end is wound up on the second winch 75, so that by rotating the first and/or second winches 73, 75 to wind up or off the first and/or second ropes

47, 49 the position of the cleaning device 39 inside the chamber 1 can be controlled. The second rope 49 is formed as a steel wire. Further, a second deflection roller 91 is mounted to the side walls 7, 9, 11, 13 near the second lower corner 25, and the second rope 49 is guided from the second winch 75 via the second deflection roller 91 to the cleaning device 39.

**[0031]** The third winch 77 is mounted to the floor 15 of the chamber structure 3. The third rope 51 at its one end is attached to the lower fixed part 69 of the body 42 and at its opposite end is wound up on the third winch 77, so that by rotating the first and/or second and/or third winches 73, 75, 77 to wind up or off the first and/or second and/or third ropes 47, 49, 51 the position of the cleaning device 39 inside the chamber 1 can be controlled. The third rope 51 is formed as a steel wire. Further, a third deflection roller 93 is mounted to the side walls 7, 9, 11, 13 near the third lower corner 27, and the third rope 51 is guided from the third winch 77 via the third deflection roller 93 to the cleaning device 39.

**[0032]** The fourth winch 79 is mounted to the floor 15 of the chamber structure 3. The fourth rope 53 at its one end is attached to the lower fixed part 69 of the body 42 and at its opposite end is wound up on the fourth winch 79, so that by rotating the first and/or second and/or third and/or fourth winches 73, 75, 77, 79 to wind up or off the first and/or second and/or third and/or fourth ropes 47, 49, 51, 53 the position of the cleaning device 39 inside the chamber 1 can be controlled. The fourth rope 53 is formed as a steel wire. Further, a fourth deflection roller 95 is mounted to the side walls 7, 9, 11, 13 near the fourth lower corner 29, and the fourth rope 53 is guided from the fourth winch 79 via the fourth deflection roller 95 to the cleaning device 39.

**[0033]** The fifth winch 81 is mounted to the floor 15 of the chamber structure 3. The fifth rope 55 at its one end is attached to the upper fixed part 71 of the body 42 and at its opposite end is wound up on the fifth winch 81, so that by rotating the first and/or second and/or third and/or fourth and/or fifth winches 73, 75, 77, 79, 81 to wind up or off the first and/or second and/or third and/or fourth and/or fifth ropes 47, 49, 51, 53, 55 the position of the cleaning device 39 inside the chamber 1 can be controlled. The fifth rope 55 is formed as a steel wire. Further, a fifth deflection roller 97 is mounted to the side walls 7, 9, 11, 13 near the first lower corner 23 and a sixth deflection roller 99 is mounted to the side walls 7, 9, 11, 13 near the first upper corner 31. The fifth rope 55 is guided from the fifth winch 81 via the fifth and sixth deflection rollers 97, 99 to the cleaning device 39.

**[0034]** The sixth winch 83 is mounted to the floor 15 of the chamber structure 3. The sixth rope 57 at its one end is attached to the upper fixed part 71 of the body 42 and at its opposite end is wound up on the sixth winch 83, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth winches 73, 75, 77, 79, 81, 83 to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth ropes 47, 49, 51,

53, 55, 57 the position of the cleaning device 39 inside the chamber 1 can be controlled. The sixth rope 57 is formed as a steel wire. Further, a seventh deflection roller 101 is mounted to the side walls 7, 9, 11, 13 near the second lower corner 25 and an eighth deflection roller 103 is mounted to the side walls 7, 9, 11, 13 near the second upper corner 33. The sixth rope 57 is guided from the sixth winch 83 via the seventh and eighth deflection rollers 101, 103 to the cleaning device 39.

**[0035]** The seventh winch 85 is mounted to the floor 15 of the chamber structure 3. The seventh rope 59 at its one end is attached to the upper fixed part 71 of the body 42 and at its opposite end is wound up on the seventh winch 85, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh winches 73, 75, 77, 79, 81, 83, 85 to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh ropes 47, 49, 51, 53, 55, 57, 59 the position of the cleaning device 39 inside the chamber 1 can be controlled. The seventh rope 59 is formed as a steel wire. Further, a ninth deflection roller 105 is mounted to the side walls 7, 9, 11, 13 near the third lower corner 27 and a tenth deflection roller 107 is mounted to the side walls 7, 9, 11, 13 near the third upper corner 35. The seventh rope 59 is guided from the seventh winch 85 via the ninth and tenth deflection rollers 105, 107 to the cleaning device 39.

**[0036]** The eighth winch 87 is mounted to the floor 15 of the chamber structure 3. The eighth rope 61 at its one end is attached to the upper fixed part 71 of the body 42 and at its opposite end is wound up on the eighth winch 87, so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth winches 73, 75, 77, 79, 81, 83, 85, 87 to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth ropes 47, 49, 51, 53, 55, 57, 59, 61 the position of the cleaning device 39 inside the chamber 1 can be controlled. The eighth rope 61 is formed as a steel wire. Further, an eleventh deflection roller 109 is mounted to the side walls 7, 9, 11, 13 near the fourth lower corner 29 and a twelfth deflection roller 111 is mounted to the side walls 7, 9, 11, 13 near the fourth upper corner 37. The eighth rope 61 is guided from the eighth winch 87 via the eleventh and twelfth deflection rollers 109, 111 to the cleaning device 39.

**[0037]** This means, the winches 73, 75, 77, 79, 81, 83, 85, 87 and associated deflection rollers 89, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111 are arranged in such a way that from each lower and upper corner 23, 25, 27, 29, 31, 33, 35, 37 one of the ropes 47, 49, 51, 53, 55, 57, 59, 61 is guided to the cleaning device 39, such that by suitable adjusting of the ropes 47, 49, 51, 53, 55, 57, 59, 61 the cleaning device 39 can reach every position in the interior space 19 to be able to clean the entire inner surface of the chamber structure 3.

**[0038]** The first to eighth winches 73, 75, 77, 79, 81, 83, 85, 87 are arranged together in a central position at

the floor 15 of the chamber structure 3, where the winches 73, 75, 77, 79, 81, 83, 85, 87 are fixed to the floor 15 by switchable magnets 115.

**[0039]** Further, the camera 117 arranged at the upper movable part 72b of the body 42 (see Fig. 2) is configured for recording a real-time image relating to the operating range of the cleaning nozzle 43. The cleaning system 5 further comprises a manual control device 119 arranged remote from the cleaning device 39 and including a screen 120 configured for displaying the real-time image to an operator, and a manual input device 121 configured to receive manual input commands from the operator and to control rotation of the respective winches 73, 75, 77, 79, 81, 83, 85, 87 to control the position of the cleaning device 39, depending on the input commands.

## Claims

1. A cleaning system (5) for cleaning a chamber (1), such as a freight hold, the cleaning system (5) comprising

a cleaning device (39) having a body (42) and arranged on that body (42) having a cleaning nozzle (43) for emitting a cleaning fluid, and a rope arrangement (41) attached to the body (42) for controlling the position of the cleaning device (39) inside the chamber (1) to be cleaned, wherein the rope arrangement (41) comprises at least a first rope (47) and a first winch (73), wherein the first winch (73) is configured to be fixed to the chamber (1) or in a defined position relative to the chamber (1), and wherein the first rope (47) is attached to the body (42) and is wound up on the first winch (73), so that by rotating the first winch (73) to wind up or off the first rope (47) the position of the cleaning device (39) inside the chamber (1) can be controlled.

2. The cleaning system according to claim 1, wherein the rope arrangement (41) comprises a second rope (49) and a second winch (75),

wherein the second winch (75) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the second rope (49) is attached to the body (42) and is wound up on the second winch (75), so that by rotating the first and/or second winches (73, 75) to wind up or off the first and/or second ropes (47, 49) the position of the cleaning device (39) inside the chamber (1) can be controlled.

3. The cleaning system according to claim 2, wherein the rope arrangement (41) comprises a third rope

(51) and a third winch (77),

wherein the third winch (77) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the third rope (51) is attached to the body (42) and is wound up on the third winch (77), so that by rotating the first and/or second and/or third winches (73, 75, 77) to wind up or off the first and/or second and/or third ropes (47, 49, 51) the position of the cleaning device (39) inside the chamber (1) can be controlled.

4. The cleaning system according to claim 3, wherein the rope arrangement (41) comprises a fourth rope (53) and a fourth winch (79),

wherein the fourth winch (79) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the fourth rope (53) is attached to the body (42) and is wound up on the fourth winch (79), so that by rotating the first and/or second and/or third and/or fourth winches (73, 75, 77, 79) to wind up or off the first and/or second and/or third and/or fourth ropes (47, 49, 51, 53) the position of the cleaning device (39) inside the chamber (1) can be controlled.

5. The cleaning system according to claim 4, wherein the rope arrangement (41) comprises a fifth rope (55) and a fifth winch (81),

wherein the fifth winch (81) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the fifth rope (55) is attached to the body (42) and is wound up on the fifth winch (81), so that by rotating the first and/or second and/or third and/or fourth and/or fifth winches (73, 75, 77, 79, 81) to wind up or off the first and/or second and/or third and/or fourth and/or fifth ropes (47, 49, 51, 53, 55) the position of the cleaning device (39) inside the chamber (1) can be controlled,

wherein the rope arrangement (41) comprises a sixth rope (57) and a sixth winch (83), wherein the sixth winch (83) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the sixth rope (57) is attached to the body (42) and is wound up on the sixth winch (83), so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth winches (73, 75, 77, 79, 81, 83) to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth ropes (47, 49, 51, 53, 55, 57) the position of the cleaning device

(39) inside the chamber (1) can be controlled, wherein the rope arrangement comprises a seventh rope (59) and a seventh winch (85), wherein the seventh winch (85) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the seventh rope (59) is attached to the body (42) and is wound up on the seventh winch (85), so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh winches (73, 75, 77, 79, 81, 83, 85) to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh ropes (47, 49, 51, 53, 55, 57, 59) the position of the cleaning device (39) inside the chamber (1) can be controlled, wherein the rope arrangement comprises an eighth rope (61) and an eighth winch (87), wherein the eighth winch (87) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1), and wherein the eighth rope (61) is attached to the body (42) and is wound up on the eighth winch (87), so that by rotating the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth winches (73, 75, 77, 79, 81, 83, 85, 87) to wind up or off the first and/or second and/or third and/or fourth and/or fifth and/or sixth and/or seventh and/or eighth ropes (47, 49, 51, 53, 55, 57, 59, 61) the position of the cleaning device (39) inside the chamber (1) can be controlled.

6. The cleaning system according to any of claims 1 to 5, wherein the rope arrangement (41) comprises at least a first deflection roller (89) for deflecting the first rope (47) in a position between the first winch (75) and the cleaning device (39), wherein the first deflection roller (89) is configured to be mounted to the chamber (1) or in a defined position relative to the chamber (1).

7. The cleaning system according to any of claims 1 to 6, wherein the cleaning nozzle (43) includes a pipe (63) projecting away from the body (42) and having a nozzle opening (65) at its end remote from the body (42) for emitting the cleaning fluid.

8. The cleaning system according to any of claims 1 to 7, wherein the cleaning nozzle (43) is movably mounted to the body (42), so that the cleaning fluid can be emitted in various directions.

9. The cleaning system according to claim 8, wherein the cleaning nozzle (43) is movable circumferentially around the body (42), so that the cleaning fluid can be emitted within an angle of 360°.



10. The cleaning system according to any of claims 1 to 9, further comprising a control unit controlling the rotation of the respective winches (73, 75, 77, 79, 81, 83, 85, 87) depending on geometric data of the respective chamber (1) to be cleaned, wherein the geometric data of the chamber (1) are predefined and stored in a related memory and/or are detected and provided by a related sensor at the cleaning device (39). 5
11. The cleaning system according to any of claims 1 to 9, wherein the cleaning device (39) comprises a camera (117) configured for recording a real-time image relating to the operating range of the cleaning nozzle (43), wherein the cleaning system (5) further comprises a manual control device (119) including a screen (120) configured for displaying the real-time image to an operator, and a manual input device (121) configured to receive input commands by the operator and to control the rotation of the respective winches (73, 75, 77, 79, 81, 83, 85, 87) depending on the input commands. 10
12. A chamber (1) to be cleaned, such as a freight hold, comprising 15
- a cubic chamber structure (3) having four side walls (7, 9, 11, 13) and a floor (15) surrounding an interior space (19) with a top opening (21) and/or a ceiling (17), wherein between the floor (15) and each two adjacent side walls (7, 9, 11, 13) a respective first, second, third and fourth lower corner (23, 25, 27, 29) is formed, and wherein between the top opening (21) or ceiling (17) and each two adjacent side walls (7, 9, 11, 13) a respective first, second, third and fourth upper corner (31, 33, 35, 37) is formed, and a cleaning system (5) according to any of claims 1 to 11 when depending on claim 5, 20
- wherein the winches (73, 75, 77, 79, 81, 83, 85, 87) or associated deflection rollers (89, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111) are arranged in such a way that from each lower and upper corner (23, 25, 27, 29, 31, 33, 35, 37) one of the ropes (47, 49, 51, 53, 55, 57, 59, 61) is guided to the cleaning device (39), such that by suitable adjusting of the ropes (47, 49, 51, 53, 55, 57, 59, 61) the cleaning device (39) can reach the entire interior space (19). 25
13. The chamber according to claim 12, wherein the first winch (73) is mounted to the floor (15) of the chamber structure (3), wherein a first deflection roller (89) is mounted near the first lower corner (23), and wherein the first rope (47) is guided from the first winch (73) via the first deflection roller (89) to the cleaning device (39). 30
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wherein the second winch (75) is mounted to the floor (15) of the chamber structure (3), wherein a second deflection roller (91) is mounted near the second lower corner (25), and wherein the second rope (49) is guided from the second winch (75) via the second deflection roller (91) to the cleaning device (39), wherein the third winch (77) is mounted to the floor (15) of the chamber structure (3), wherein a third deflection roller (93) is mounted near the third lower corner (27), and wherein the third rope (51) is guided from the third winch (77) via the third deflection roller (93) to the cleaning device (39), wherein the fourth winch (79) is mounted to the floor (15) of the chamber structure (3), wherein a fourth deflection roller (95) is mounted near the fourth lower corner (29), and wherein the fourth rope (53) is guided from the fourth winch (79) via the fourth deflection roller (95) to the cleaning device (39), wherein the fifth winch (81) is mounted to the floor (15) of the chamber structure (3), wherein a fifth deflection roller (97) is mounted near the first lower corner (23) and a sixth deflection roller (99) is mounted near the first upper corner (31), and wherein the fifth rope (55) is guided from the fifth winch (83) via the fifth and sixth deflection rollers (97, 99) to the cleaning device (39), wherein the sixth winch (83) is mounted to the floor (15) of the chamber structure (3), wherein a seventh deflection roller (101) is mounted near the second lower corner (25) and an eighth deflection roller (103) is mounted near the second upper corner (33), and wherein the sixth rope (57) is guided from the sixth winch (83) via the seventh and eighth deflection rollers (101, 103) to the cleaning device (39), wherein the seventh winch (85) is mounted to the floor (15) of the chamber structure (3), wherein a ninth deflection roller (105) is mounted near the third lower corner (27) and a tenth deflection roller (107) is mounted near the third upper corner (35), and wherein the seventh rope (59) is guided from the seventh winch (85) via the ninth and tenth deflection rollers (105, 107) to the cleaning device (39), wherein the eighth winch (87) is mounted to the floor (15) of the chamber structure (3), wherein an eleventh deflection roller (109) is mounted near the fourth lower corner (29) and a twelfth deflection roller (111) is mounted near the fourth upper corner (37), and wherein the eighth rope (61) is guided from the eighth winch (87) via the eleventh and twelfth deflection rollers (109, 111) to the cleaning device (39).

14. The chamber according to claim 12 or 13, wherein

the winches (73, 75, 77, 79, 81, 83, 85, 87) are arranged together in a central position at the floor (15) of the chamber structure (3).

15. A ship (2) comprising the cleaning system (5) according to any of claims 1 to 11, or comprising a chamber (1) according to claim 12 to 14.

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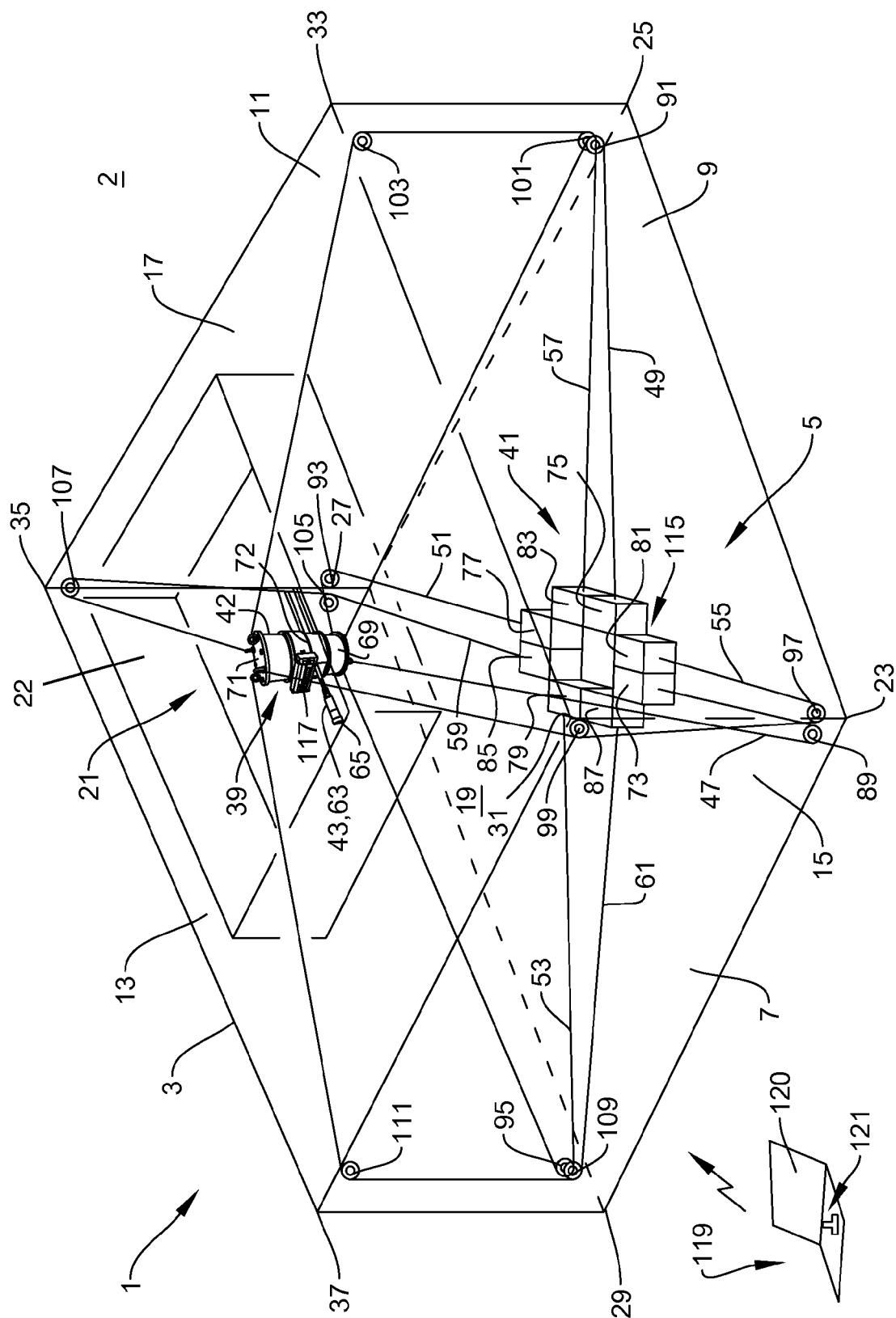


FIG. 1

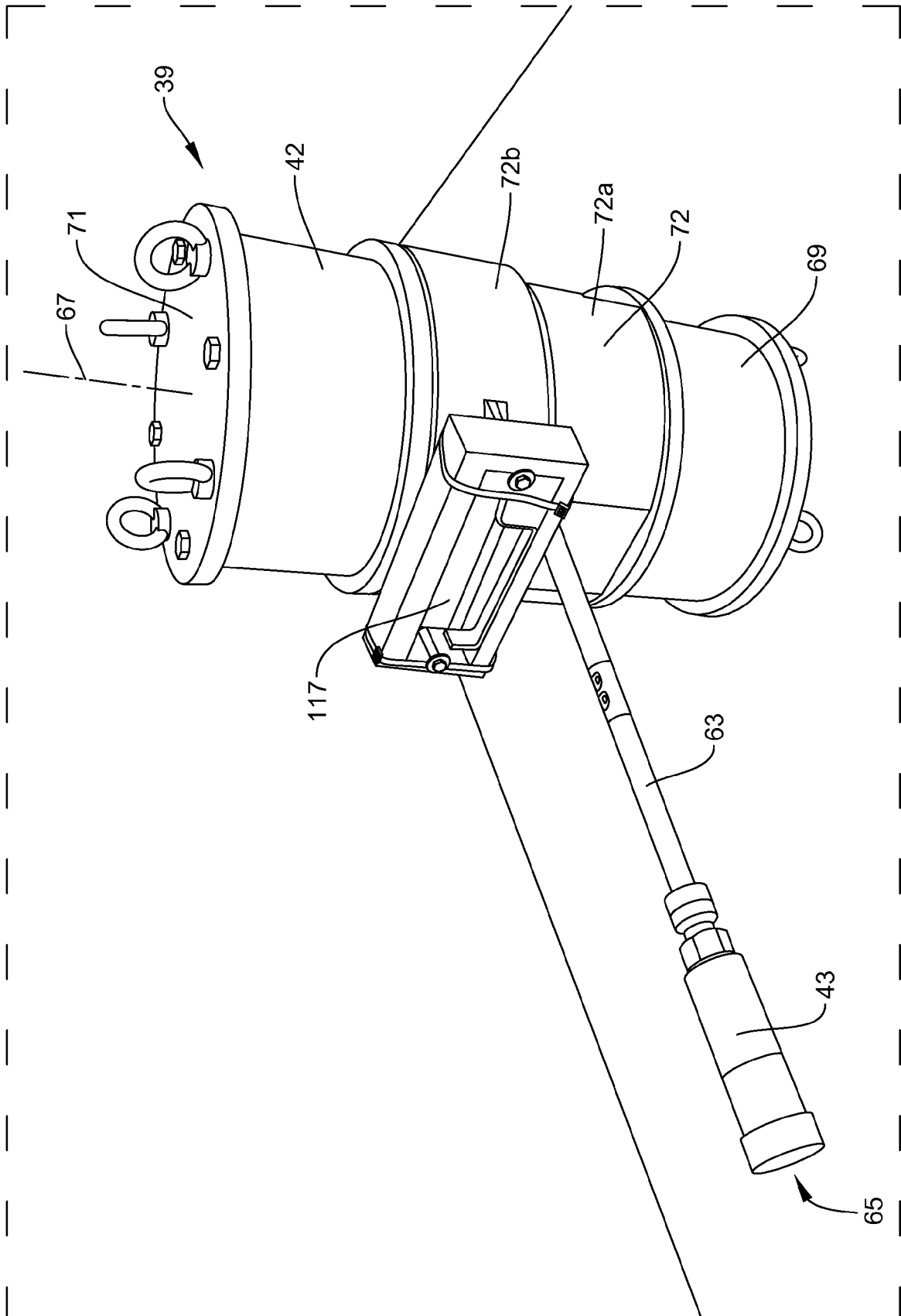


FIG. 2



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Application Number  
EP 19 16 6530

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The Hague		15 October 2019	Fernandez Ambres, A
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