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(54) **A tool and a system for cleaning the interior of containers and a method thereof**

(57) The present invention relates to a tool for cleaning the interior of containers comprising an arm assembly including an inner arm section (1) having a first and a second end, and an outer arm section (2) rotatably connected to the second end of the inner arm section, a fluid nozzle (3) mounted on the outer arm section, and a drive unit including an actuator (4) for rotating the outer arm section with respect to the inner arm section, wherein the actuator is disposed at the first end of the inner arm section. The arm assembly comprises a wrist portion (6) for rotatably connecting the outer arm section to the inner arm section, and the wrist portion comprises a rotatable wheel (8a) operatively connected to the outer arm section, and the drive unit comprises a transmission device (9) extending between the actuator (4) and the wheel (8a). The wrist portion comprises a shaft (10) operatively connected to the wheel and a fork element (12) fixedly connected to the second end of the inner arm section and having two legs (12a-b) rotatably connected to the shaft and disposed on opposite sides of the wheel, and the outer arm section comprises two bars (14a-b) fixedly connected to said shaft and disposed on opposite sides of the wheel, and the width of the wrist portion is less than 0.13 m.

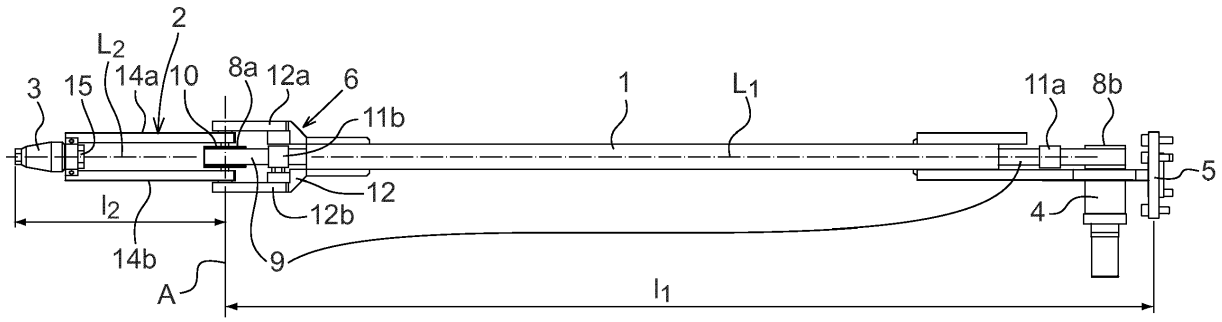

Fig. 2

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Description

Field of the invention

[0001] The present invention relates to a tool for cleaning the interior and the exterior of containers comprising an arm assembly including an inner arm section having a first and a second end, and an outer arm section rotatably connected to the second end of the inner arm section, a drive unit including an actuator for rotating the outer arm section with respect to the inner arm section, and a fluid nozzle mounted on the outer arm section. The present invention also relates to a system and a method for cleaning the interior of containers.

Prior art

[0002] Integrated Intermediate Bulk Container (IBC) is a type of containers often used for transportation of chemicals and liquids. The container is provided with a small opening in the top of the container to allow entrance of the liquid into the container and a valve at the bottom of the container to allow withdrawal of the liquid from the container. The top opening is only about 140 mm and the valve opening is only about 50 mm. The IBC-containers are made of a HDPE plastic inner container enclosed in a steel cage, placed on a pallet. The container has a rectangular cross-section, which means that the container is asymmetric. The containers can be reused several times. After each usage, the IBC-containers must be thoroughly cleaned. Due to the small openings of the container and its asymmetric shape it is difficult to provide automatic cleaning of the container. Further, to achieve an efficient cleaning of the containers it is necessary for the high-pressure wash nozzle to come close to the inner and outer walls of the container and the valve, preferably closer than 0.1 m. Today, cleaning of the IBC containers is carried out manually. This is time-consuming, laboriously and possibly hazardous and it is a desire to automatize the cleaning.

[0003] GB2446739 discloses a remotely operated cleaning device for storage tanks or vessels. The apparatus comprises an arm assembly including a plurality of arm sections rotatably arranged relative each other and a nozzle mounted on the arm assembly. The apparatus further comprises a plurality of actuators disposed between the arm sections for actuating the motions of the arm sections. The device described in this document is specialized in washing the inside of so-called "Mud Tanks", which usually are permanently installed on board ships or on oil platforms. The mud tanks are very large, usually about 4-6 meters high, and the device is installed inside the tank. This cleaning device is far too large to be used for internal cleaning of IBC-containers and is completely unable to clean the valve and the exterior of IBC-containers. Furthermore, the device requires a stationary transport unit for each container to be cleaned, such as an overhead track that through wires controls the movements of the device. The transport unit must also be installed inside the container, which is impossible to do in an IBC container of HDPE plastic.

[0004] US3895756 discloses a method and an apparatus for cleaning vessels. The apparatus includes a high pressure nozzle to be inserted into the vessel for automatically cleaning the interior of the vessel. The apparatus includes two actuators to rotate the nozzle about two orthogonal axes. The nozzle can be rotated 144° relative a vertical axis in a longitudinal direction of the vessel, and the nozzle can be rotated 64° relative a transvers direction of the vessel. The actuators are disposed at the joints of the nozzle. This apparatus is suitable for cleaning cylindrical vessels having a large opening. However, this apparatus is bulky and cannot enter the small opening of an IBC container. Further, the limited angle of rotation of the nozzle makes it difficult to clean the upper corners of a rectangular container and it is impossible to wash the valve and interior of IBC-containers using this apparatus.

[0005] EP2008728 discloses container cleaning system including a robot and a tool to be connected to a robot. The tool is provided with a rotating bush for cleaning the container. A problem with this tool is that it is difficult to reach everywhere in an IBC container having a small opening.

[0006] US3472451 discloses a washing assembly, which comprises in combination an oscillating-rotating nozzle mechanism permanently mounted within a tank. A disadvantages with this washing assembly is that it is rather complicated and accordingly expensive to manufacture. Further, the washing assembly can easily break, for example, if it is bent due to high water pressure. Thus, this washing assembly is not robust. Another disadvantage with the washing assembly is that the width of washing assembly is too large to allow it to enter the small opening an IBC container.

Object and summary of the invention

[0007] It is an object of the present invention to at least partly overcome the above mentioned problems, and to provide an attractive solution to the problem of cleaning the interior of IBC containers.

[0008] According to a first aspect of the invention, this object is achieved by a tool as defined in claim 1.

[0009] The tool according to the invention comprises an arm assembly including an inner arm section having a first and a second end, and an outer arm section rotatably connected to the second end of the inner arm section, a fluid nozzle mounted on the outer arm section, and a drive unit including an actuator for rotating the outer arm section with respect to the inner arm section, wherein the actuator is disposed at the first end of the inner arm section, the arm assembly comprises a wrist portion for rotatably connecting the outer arm section to the inner arm section, and the wrist portion comprises a rotatable wheel operatively connected to the outer arm section,

and the drive unit comprises a transmission device extending between the actuator and the wheel. The invention is characterized in that the wrist portion comprises a shaft operatively connected to the wheel and a fork element fixedly connected to the second end of the inner arm section and having two legs rotatably connected to the shaft and disposed on opposite sides of the wheel, and the outer arm section comprises two bars fixedly connected to said shaft and disposed on opposite sides of the wheel, and the width of the wrist portion is less than 0.13 m.

[0010] The invention makes it possible to reduce the width of the wrist portion/joint between the inner and outer arm sections compare to the prior art cleaning tools. The width of the wrist portion is less than 0.13 m. By that it is possible for the wrist portion to enter through the top opening of an IBC container.

[0011] Due to the fork element, the tool becomes solid and does not easily break. Further advantages achieved with the invention is that the tool contains few parts, is robust, easy to repair, and has high reliability in operation.

[0012] An actuator is large and bulky. The actuator is disposed at a distance from the joint between the inner and outer arm sections and at the first end of the inner arm section. By that it is possible to insert the outer and inner arm sections into the container through the small opening, without having to insert the actuator. Thus, the actuator driving the joint between the inner and outer arm sections can be located outside the container while the outer arm section and at least a part of the inner arm section are inside the container during the cleaning. An advantage with the present invention is that it enables the arm assembly to be made thin enough for penetrating through a small opening of the container.

[0013] The tool according to the invention is suitable for cleaning the interior and exterior, and an interior valve of containers having small openings.

[0014] The rotatable wheel can be fixedly connected to the outer arm section or connected through a gear.

[0015] According to an embodiment of the invention, the tool comprises a mounting member for mounting the tool to an industrial robot, and the mounting member is disposed at the first end of the inner arm section. The robot makes it possible to automatically move the inner arm section relative to the openings of the container in several degrees of freedom. The robot can rotate the tool and move the tool linearly relative the container, while the robot is on the outside of the container. Thus, the tool can be moved in several degrees of freedom while the tool is inside the container, and all actuators are on the outside of the container.

[0016] According to an embodiment of the invention, the transmission device comprises a transmission belt extending between the actuator and the rotatable wheel. A transmission belt is more flexible and less complicated than a gear rack.

[0017] According to an embodiment of the invention, the inner arm section is hollow and the transmission device is extending inside the inner arm section. This embodiment reduces the width of the inner arm section and also protects the transmission device from wear and contamination when the inner arm section is moved relative the small opening of the container.

[0018] According to an embodiment of the invention, the wrist portion comprises a shaft fixedly connected to the outer arm section and operatively connected to the wheel, and the inner arm section is rotatably connected to the shaft. The shaft can be fixedly connected to the wheel or connected through a gear. This embodiment provides a thin wrist portion between the inner and outer arm sections.

[0019] According to an embodiment of the invention, the inner and outer arm sections are elongated, and the longitudinal axes of the inner and outer arm sections are coplanar. This embodiment reduces the width of the arm assembly and thereby facilitates for the arm assembly to enter through the opening of the container.

[0020] According to an embodiment of the invention, the inner arm section is elongated, and the outer arm section is rotatably connected to the inner arm section about a rotational axis orthogonal to the longitudinal axis of the inner arm section.

[0021] Suitably, the outer arm section is rotatably connected to the inner arm section so that the nozzle can be rotated at least 180° and preferably at least 240° relative the inner arm section. This embodiment enables the nozzle to be rotated at least 180° relative the inner arm section and accordingly to reach the corners of the container and to come close to the inner walls of a rectangular container.

[0022] According to an embodiment of the invention, the rotational axis and the longitudinal axis of the inner arm section are skew lines. The rotational axis of the outer arm section is displaced relative the longitudinal axis of the inner arm section, which increases the angle the nozzle can be rotated relative the inner arm section. This embodiment further increases the possibility for the nozzle to come close to the inner walls and corners of a rectangular container. A further advantage with this embodiment is that it facilitates the mounting of a tube for supplying fluid to the nozzle.

[0023] According to an embodiment of the invention, the rotational axis of the outer arm section is displaced relative the longitudinal axis of the inner arm section, and the displacement of the rotational axis and the longitudinal axis of the inner arm section is between 15 and 45 mm, preferably 20 and 40 mm, and most preferably between 25 and 35 mm.

[0024] According to an embodiment of the invention, the tool comprises a pipe extending through the hollow inner arm section for supplying fluid to the nozzle. Thus, the pipe is protected by the inner arm section and is not exposed to wear and damaged when the pipe is entering the small opening in the IBC container.

[0025] According to an embodiment of the invention, the length of the outer arm section and the nozzle is in

the interval of 0.3 - 0.5 m, and the length of the inner arm section is in the interval of 1-1.5 m. This embodiment enables the tool to reach the walls and corners inside a standard IBC container.

[0026] According to a second aspect of the invention, the above object is achieved by a system for cleaning the interior of containers, wherein the system comprises an industrial robot movable about at least four joints and a cleaning tool according to the invention mounted to the robot.

[0027] According to a third aspect of the invention, the above object is achieved by a method for cleaning the interior of a container having an opening, as defined in claim 11.

[0028] The method comprises:

- mounting a tool according to the invention to an industrial robot positioned outside the container,
- moving the tool through the opening of the container by means of the robot so that the outer arm section and at least a part of the inner arm section is positioned inside the container, and
- rotating the inner arm section relative the opening by means of the robot and moving the outer arm section with respect to the inner arm section by means of said actuator while ejecting fluid from the nozzle on the walls the container.

[0029] This method enables automatic cleaning of containers having small openings. Naturally, the tool, system and method can also be used for cleaning the outside of the container.

[0030] The present invention also relates to the use of a tool according to the invention for cleaning the interior of IBC containers. The tool is moved by an industrial robot positioned outside the container. Due to the small openings of IBC containers, the tool according to the invention is particularly suitable for cleaning IBC containers. However, the tool according to the invention can also be used for cleaning other types of containers and vessels.

Brief description of the drawings

[0031] The invention will now be explained more closely by the description of different embodiments of the invention and with reference to the appended figures.

Fig. 1 shows a view from above of a cleaning tool according to a first embodiment of the invention.

Fig. 2 shows a side view of the tool shown in figure 1.

Fig. 3 shows a wrist portion of the first embodiment of the tool in more details.

Fig. 4 shows a view from above of a cleaning tool according to a second embodiment of the invention.

Fig. 5 shows a cross-section A-A through an inner section of the tool shown in figure 4.

Fig. 6 shows a wrist portion of the second embodiment of the tool in more details.

Figs. 7 and 8 illustrate use of a tool according to the invention for cleaning an IBC container.

Detailed description of preferred embodiments of the invention

[0032] Figures 1 - 3 show a tool for cleaning the interior of containers according to a first embodiment of the invention. Figure 1 shows a view from above of a tool, figure 2 shows a side view of the tool, and figure 3 shows a wrist portion of the tool in more details. The tool comprises an arm assembly including an elongated inner arm section 1 having a first end 1a and a second end 1b, and an elongated outer arm section 2 having a first end 2a and a second end 2b. The outer arm section 2 is rotatably connected to the second end 1b of the inner arm section. The outer arm section 2 is provided with a fluid nozzle 3 for ejecting a fluid, for example water jet, at high pressure for cleaning the containers. The fluid nozzle 3 is mounted on the second end 2b of the outer arm section. In one embodiment, the fluid nozzle 3 is a high pressure spray nozzle. The outer arm section 2 is rotatably connected to the inner arm section 1 so that the nozzle 3 can be rotated at least 180° relative the inner arm section. This rotation makes it possible for the tool to reach the corners of a container. If the tool is to be used for cleaning the interior of an IBC container, the length L2 of the outer arm section 2 and the nozzle 3 is suitably between 0.3 - 0.5 m, and the length L1 of the inner arm 1 section is suitably between 1-1.5 m.

[0033] The tool further comprises a drive unit including an actuator 4 for rotating the outer arm section 2 with respect to the inner arm section 1. The actuator 4 is disposed at the first end 1a of the inner arm section. For example, the actuator 4 includes a motor and a gear box. The actuator 4 is fixedly connected to the inner arm section 1. The tool may include a power supply 7 for supplying the motor with power.

[0034] The tool further comprises a mounting member 5 for mounting the tool to a manipulator, for example, an industrial robot. The mounting member 5 is disposed at the first end 1a of the inner arm section. In this embodiment, the mounting member 5 comprises a mounting plate for mounting to an industrial robot.

[0035] The arm assembly further comprises a wrist portion 6 for rotatably connecting the outer arm section 2 to the inner arm section 1. The wrist portion 6 comprises a rotatable wheel 8a operatively connected to the outer arm section 2. The wheel 8a is disposed at the second end 1b of the inner arm section. The drive unit further comprises a transmission belt 9 extending between the actuator 4 and the wheel 8a. Suitably, the transmission belt 9 is a toothed transmission belt. In an alternative embodiment, the transmission device can be a rack or a gear rack. The actuator 4 moves the transmission belt 9, which rotates the wheel 8a and by that rotates the outer arm section 2, and accordingly the nozzle 3, with respect to the inner arm section 1. The actuator 4 is connected

to a second rotatable wheel 8b, and the transmission belt 9 is arranged between the first and second wheels 8a-b.

[0036] In one embodiment, the inner arm section 1 is hollow and the transmission belt 9 is extending inside the inner arm section. The transmission belt 9 extends from the actuator 4, through the hollow inner arm section 1, around the wheel 8a, and back to the actuator. The actuator 4 is arranged to drive the motions of the transmission belt. The tool may also include guiding means 11a-b for guiding the transmission belt.

[0037] The wrist portion 6 comprises a shaft 10 rotatably connected to the inner arm section 1, and fixedly connected to the outer arm section 2. The shaft 10 is operatively connected to the wheel 8a. The shaft 10 can be directly connected to the wheel. Alternatively, the wrist portion 6 includes a gear arranged between the first wheel 8a and the shaft 10, and the shaft is connected to the first wheel via the gear. The position of the shaft 10 and the first wheel 8a is misaligned with the longitudinal axis L1 of the inner arm section, i.e. the shaft 10 and the wheel 8a are displaced relative the inner arm section, as shown in figure 1. This misalignment increased the angle the nozzle 3 can be rotated relative the inner arm section 1.

[0038] The inner arm section 1 has a longitudinal axis L1 and the outer arm section 2 has a longitudinal axis L2. The longitudinal axes L1 and L2 of the inner and outer arm sections are coplanar, as shown in figure 2. The outer arm section 2 is rotatably connected to the inner arm section about a rotational axis A. The rotational axis A is orthogonal to the longitudinal axis L1 of the inner arm section 1 and to the longitudinal axis L2 of the outer arm section.

[0039] The wrist portion 6 further comprises a fork element 12 having two legs 12a-b rotatably connected to the shaft 10. The fork element 12 is fixedly connected to the second end 1b of the inner arm section 1. One end of fork element 12 is fixedly connected to the second end 1b of the inner arm section 1 and the other end of the fork element is provided with the legs 12a-b. The two legs 12a-b are arranged in parallel and disposed on opposite sides of the first wheel 8a. The shaft 10 is rotatably arranged between the legs 12a-b. The outer arm section 2 comprises two bars 14a-b arranged in parallel. The bars 14a-b extend in the longitudinal direction of the outer arm section between the nozzle 3 and the wrist portion 6. The two bars 14a-b are fixedly connected to the shaft 10. The two bars 14a-b are disposed on opposite sides of the first wheel 8a and between the legs 12a-b. Suitably, the width w of the fork element 12 is less than 0.13 m. Accordingly, the width w of the wrist portion also is less than 0.13 m. By that it is possible for the wrist portion to penetrate through the narrow opening of an IBC container.

[0040] The nozzle 3 comprises a coupling 15 for connecting a tube between the nozzle and a supply pump for supplying fluid at high pressure to the nozzle. In this embodiment, the nozzle 3 is fixedly connected to the outer arm section 2. The nozzle 3 is arranged aligned with the longitudinal axis L2 of the outer arm section so that a counter force from the water jet is going through the shaft 10. Thus, no torque is originated which cannot be absorbed by the transmission belt 9.

[0041] The outer arm section 2, and accordingly the nozzle 3, can be rotated an angle v1 in one direction and an angle v2 in the opposite direction with respect to the position of the nozzle when the longitudinal axes L1 and L2 of the inner and outer arm sections are aligned, as shown in figure 1. The wrist portion 6 is designed to enable the outer arm section to be rotated at least 120°, preferably at least 140°, and most preferably at least 150° in each direction relative the inner arm section 1. A larger angle enables the nozzle to come closer to the inner walls and corners of the container.

[0042] In this embodiment, the rotational axis A and the longitudinal axis L1 of the inner arm section are skew lines, as shown in figure 1. Thus, the rotational axis A is displaced relative the longitudinal axis L1 of the inner arm section, which increases the angle the outer arm section 2, and accordingly the nozzle 3, can be rotated relative the inner arm section. Thus, in this embodiment the angle v2 is larger than v1. In this embodiment, the maximum angle v1 the nozzle can be rotated in a first direction, i.e. away from the displacement, is about 155°, and the maximum angle v2 the nozzle can be rotated in the opposite direction, i.e. in the direction of the displacement, is about 175°. Thus, the nozzle can be rotated at about 330° relative the inner arm section. Preferably, the wrist portion 6 is designed to enable the outer arm section to be rotated an angle v2 of at least 150°, preferably at least 160°, and most preferably at least 170° in one direction relative the inner arm section 1. An advantage achieved by this embodiment of the tool is that it is possible to reach everywhere in the container and accordingly to clean all interior surfaces of the container. The displacement of the rotational axis A and the longitudinal axis L1 of the inner arm section is suitably between 15 and 45 mm, preferably 20 and 40 mm, and most preferably between 25 and 35 mm. In this embodiment the displacement of the rotational axis A and the longitudinal axis L1 of the inner arm section is about 30 mm.

[0043] Figures 4 - 6 shows a tool according to a second embodiment of the invention. Figure 4 is a view from above of the tool, figure 5 is a cross-sectional view A-A through the inner arm section 1, and figure 6 is a side view of the wrist portion. Components corresponding to those in figures 1-3 have been given the same reference numerals, and will not be described in more detail here. As can be seen in figure 4, the tool comprises a pipe 17 extending through the hollow inner arm section 1 together with the transmission belt 9. An outlet 18 of the pipe 17 is protruding at the second end 1b of the inner arm section. A flexible tube 19 is connected between the nozzle 3 and the outlet 18 of the pipe. The tube 19 and the pipe 17 are arranged for supplying fluid to the nozzle.

[0044] Figures 7 and 8 shows an example of a system

for cleaning the interior of IBC containers. The system comprises an industrial robot 25 movable about at least four joints and a cleaning tool according to an embodiment of the invention mounted to the robot. The system includes a fluid supply 34 for supplying the tool with a cleaning fluid. The tool is moved by means of the industrial robot. The industrial robot 25 comprises a robot controller 26 including hardware and software for running one or more control programs for controlling the motions of the joints of the tool and the robot. Thus, the motions of the tool are controlled by one or more control programs run on the robot controller 26. The tool is attached to the robot by means of the mounting plate 5.

[0045] In the following, a method for cleaning the interior of an IBC container using a tool according to the invention will be explained with reference to figures 7 and 8.

[0046] An IBC (Intermediate Bulk Container) container 30 is a type of containers often used for transportation of liquid. The container is provided with a small opening 32 to allow entrance of the liquid into the container. The opening 32 is only about 140 mm.

[0047] The method comprises mounting a tool according to the invention to an industrial robot 25 positioned outside the container 30. The tool is connected to a fluid supply 36, for example, via the robot. The tool is moved through the opening 32 of the container by means of the robot so that the nozzle 3, the outer arm section 2 and at least a part of the inner arm section 1 is positioned inside the container, and the actuator is positioned outside the container, as shown in figure 7. Fluid is supplied to the nozzle 3, and the inner arm section 1 is rotated relative the opening 32 by means of the robot 25, and the outer arm section 2 is moved with respect to the inner arm section 1 by means of the actuator 4 while ejecting fluid from the nozzle on the walls of the container, as shown in figure 8.

[0048] The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope of the following claims. For example, the rotational axis can be coplanar with the longitudinal axis of the inner arm section. In one embodiment, the nozzle can be rotatably connected to the outer arm section. Further, the tool can be provided with two or more nozzles. In one embodiment of the invention, the tool is provided with two individually controlled outer arm sections, each arm section provided with at least one nozzle, to further improve the flexibility of the tool and to make it possible to simultaneously clean a larger surface. In another embodiment, the inner arm section can be arranged telescopically.

Part list

[0049]

1. Inner arm section
1a first end
1b second end
2. Outer arm section
2a first end
2b second end
3. Fluid nozzle
4. Actuator
5. Mounting member
6. Wrist portion
7. Power supply
8a First rotatable wheel
8b Second rotatable wheel
9. Transmission belt
10. Shaft
11a-b. Guiding means
12. Fork element
12a-b Legs
14a-b Bars
15. Coupling to nozzle
17. Pipe for fluid
18. Outlet of pipe
19. Tube for fluid
25. Industrial robot
26. Robot controller
30. IBC container
32. Opening of the IBC container
34. Fluid supply
L1 Longitudinal axis inner arm section
L2 Longitudinal axis outer arm section

Claims

1. A tool for cleaning the interior of containers comprising:

- an arm assembly including an inner arm section (1) having a first (1a) and a second end (1b), and an outer arm section (2) rotatably connected to the second end of the inner arm section,
- a fluid nozzle (3) mounted on the outer arm section, and
- a drive unit including an actuator (4) for rotating the outer arm section with respect to the inner arm section, wherein the actuator is disposed at the first end of the inner arm section, the arm assembly comprises a wrist portion (6) for rotatably connecting the outer arm section (2) to the inner arm section (1), and the wrist portion comprises a rotatable wheel (8a) operatively connected to the outer arm section, and the drive unit comprises a transmission device (9) extending between the actuator (4) and the wheel (8a), **characterized in that** the wrist portion (6) comprises a shaft (10) operatively connected to the wheel (8a) and a fork element (12) fixedly connected to the second end of the inner arm section and having two legs (12a-b) rotatably connected to the shaft 10 and disposed on opposite

sides of the wheel, and the outer arm section 2 comprises two bars (14a-b) fixedly connected to said shaft and disposed on opposite sides of the wheel, and the width of the wrist portion is less than 0.13 m.

2. The tool according to claim 1, wherein the tool comprises a mounting member (5) for mounting the tool to an industrial robot, and the mounting member is disposed at the first end (1a) of the inner arm section.

3. The tool according to claim 1 or 2, wherein the transmission device is a transmission belt (9).

4. The tool according to any of the previous claims, wherein the inner arm section (1) is hollow and said transmission device (9) is extending inside the inner arm section.

5. The tool according to any of the previous claims, wherein the length of the outer arm section and the nozzle is in the interval of 0.3 - 0.5 m, and the length of the inner arm section is in the interval of 1-1.5 m.

6. The tool according to any of the previous claims, wherein the outer arm section is rotatably connected to the inner arm section so that the nozzle can be rotated at least 180° and preferably at least 240° relative the inner arm section.

7. The tool according to claim 6, wherein the tool comprises a pipe (17) extending through the hollow inner arm section (1) for supplying fluid to the nozzle.

8. The tool according to any of the previous claims, wherein the inner and outer arm sections (1, 2) are elongated and the longitudinal axes (L1, L2) of the inner and outer arm sections are coplanar.

9. The tool according to any of the previous claims, wherein the inner arm section (1) is elongated, and the outer arm section (2) is rotatably connected to the inner arm section about a rotational axis (A) orthogonal to the longitudinal axis (L1) of the inner arm section.

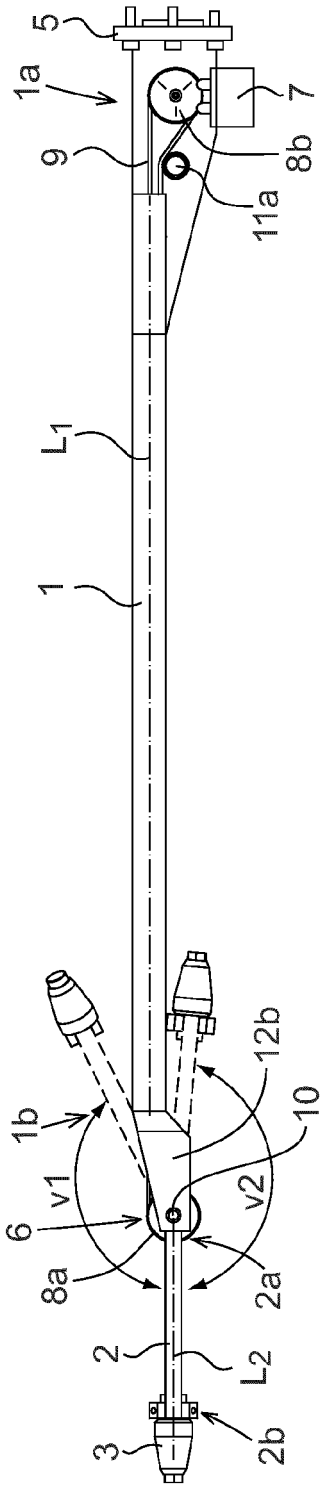
10. The tool according to claim 9, wherein said rotational axis (A) is displaced relative the longitudinal axis (L1) of the inner arm section, and the displacement of the rotational axis (A) and the longitudinal axis (L1) of the inner arm section is between 15 and 45 mm, preferably 20 and 40mm, and most preferably between 25 and 35 mm.

11. Use of the tool according to any of the claims 1-10 for cleaning the interior of IBC containers.

12. A system for cleaning the interior of containers, wherein the system comprises an industrial robot (25) movable about at least four joints and a cleaning tool mounted to the robot, **characterized in that** said cleaning tool is a tool according to any of the claims 1-10.

13. A method for cleaning the interior of an IBC container (30) having an opening (32), **characterized in that** the method comprises:

- mounting a tool according to any of the claims 1 - 10 to an industrial robot (25) positioned outside the container,
- moving the tool through the opening of the container by means of the robot so that the nozzle (3), the outer arm section (2) and at least a part of the inner arm section (1) is positioned inside the container, and the actuator (4) is positioned outside the container, and
- rotating the inner arm section relative the opening by means of the robot and moving the outer arm section with respect to the inner arm section by means of said actuator while ejecting fluid from the nozzle on the walls of the container.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7
8b
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Fig. 1

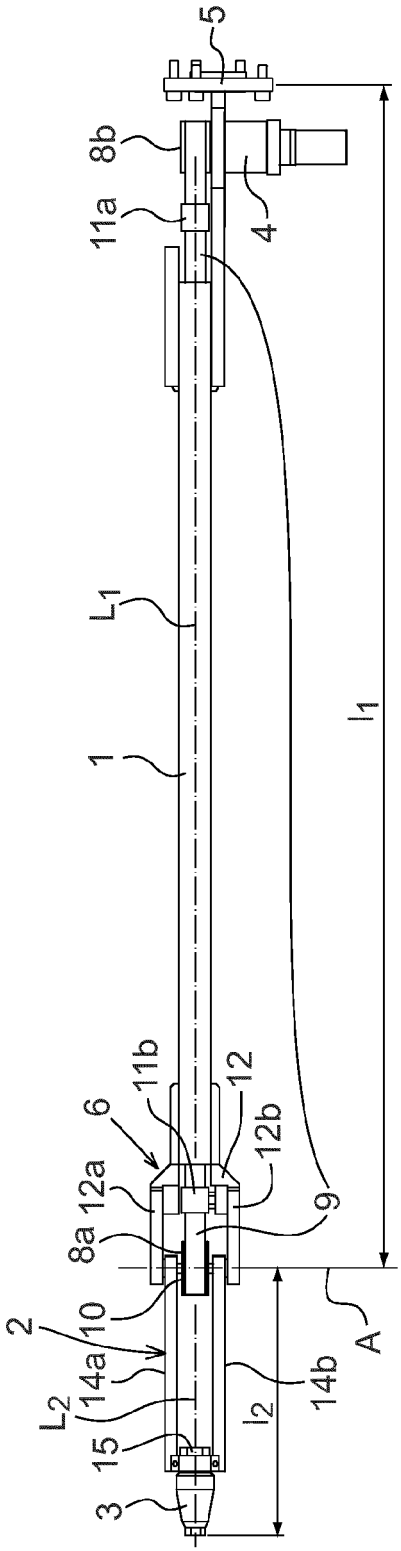
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Fig. 2

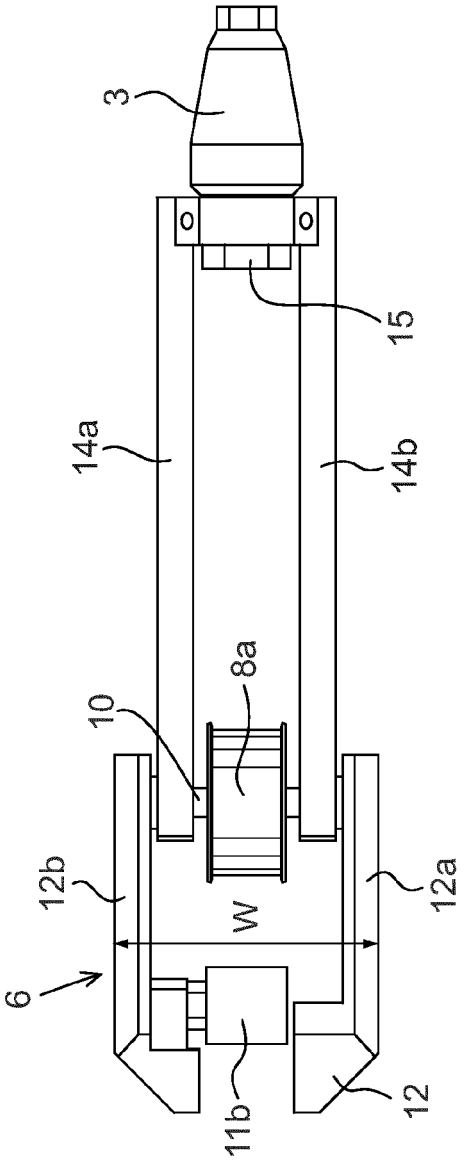

Fig. 3

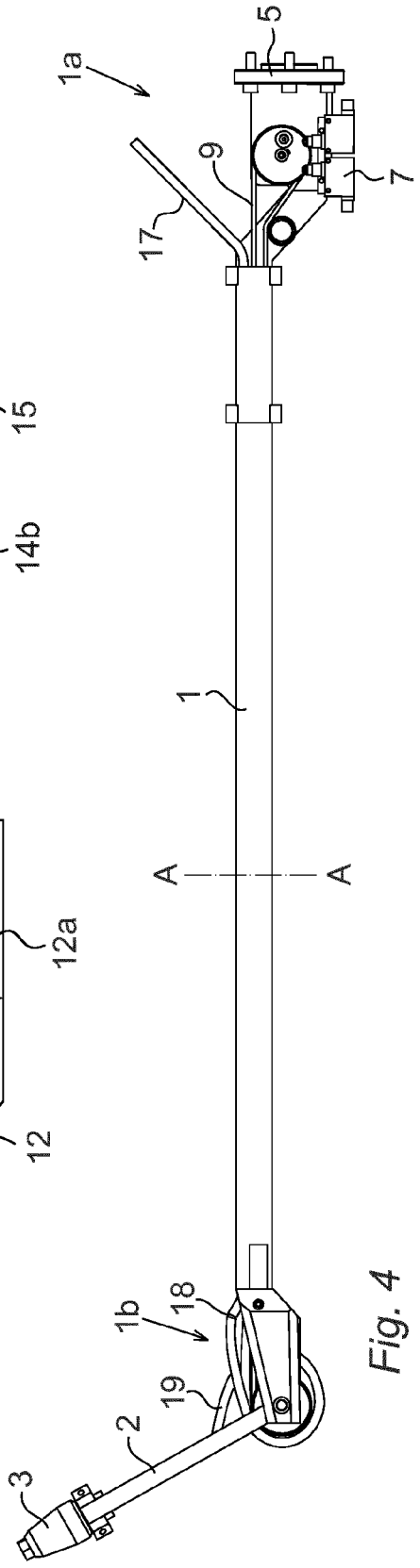

Fig. 4

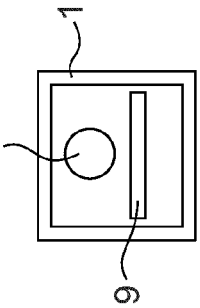

Fig. 5

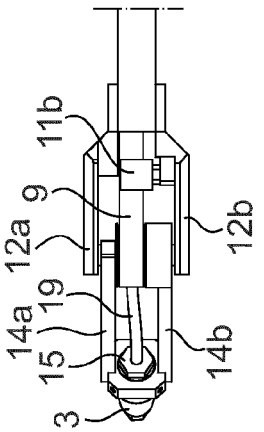

Fig. 6

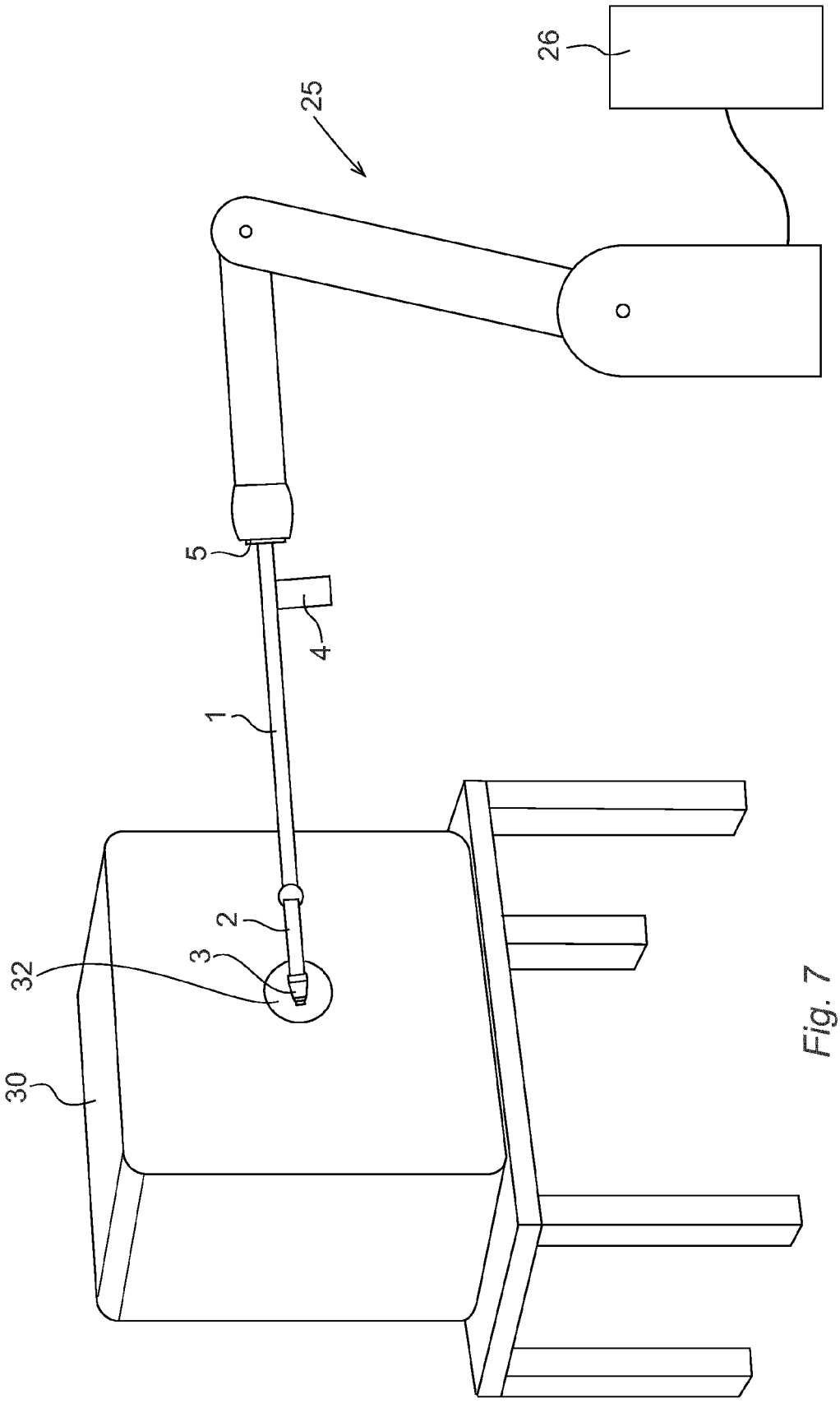

Fig. 7

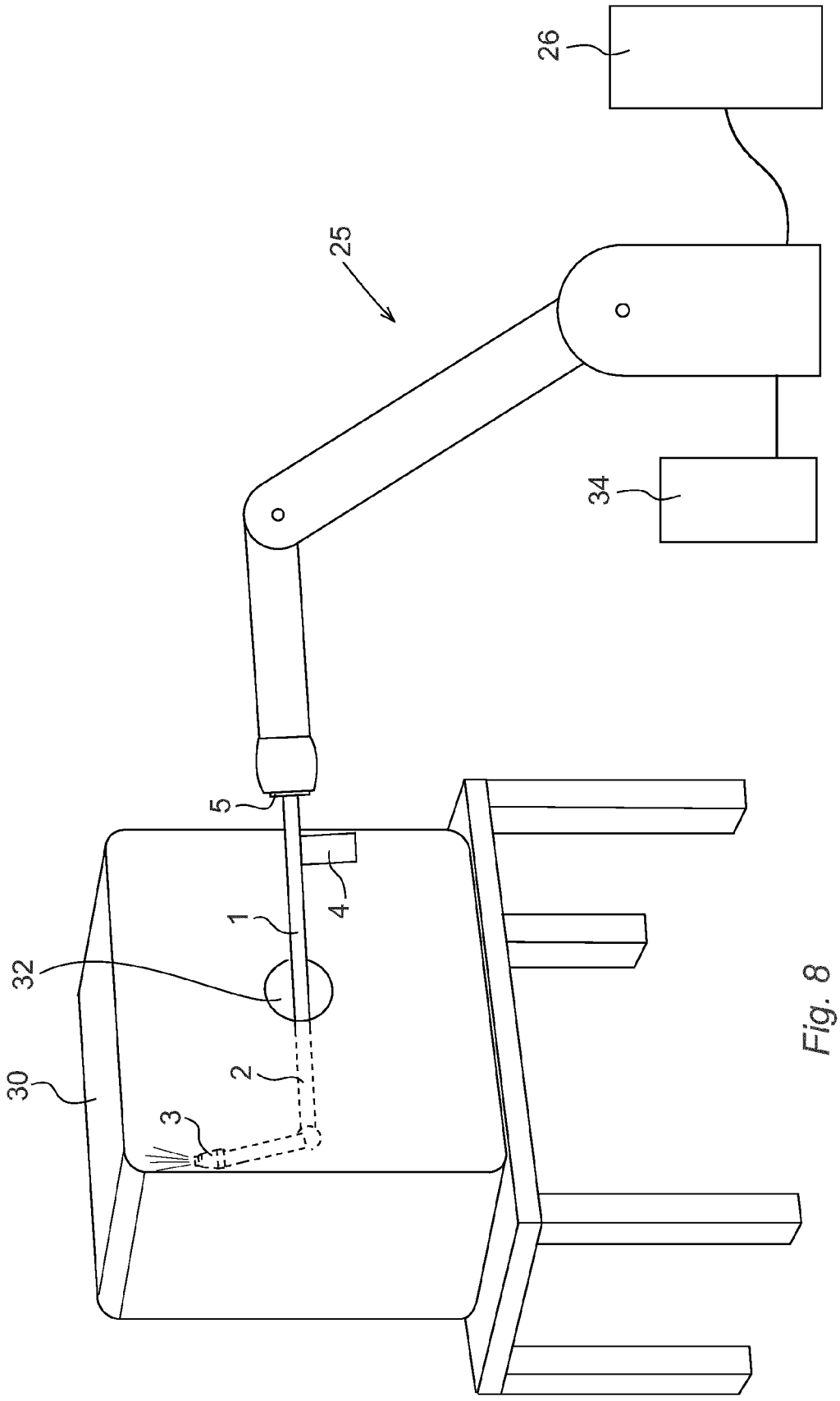

Fig. 8

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 3 027 095 A (PAASCHE JENS A) 27 March 1962 (1962-03-27) * column 6, line 38 - line 68; figures 9-11 *	1-11,13	INV. B05B13/06 B08B9/093
Y	JP S51 120363 U (HITACHI LTD) 29 September 1976 (1976-09-29) * figure 2 *	1-13	
Y	JP S48 76932 A (SHINKOU FUAUDORA KK) 16 October 1973 (1973-10-16) * figures *	1-13	
Y	WO 93/09880 A1 (WOUDE MEINO JAN V D [NL]) 27 May 1993 (1993-05-27) * page 2, line 17 - page 6, line 7; figures *	12	
A	EP 2 008 723 A1 (GALANDRINO AGOSTINO [IT]) 31 December 2008 (2008-12-31) * paragraph [0013] - paragraph [0018]; figures *	1,13	TECHNICAL FIELDS SEARCHED (IPC) B05B B08B
A	DE 92 06 410 U1 (JERKEL RUDOLF) 13 August 1992 (1992-08-13) * page 5, line 13 - page 9, line 28; figures *	1,13	
A	US 2 857 201 A (PALMER JOHN E) 21 October 1958 (1958-10-21) * column 1, line 56 - column 3, line 15; figures *	1,13	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 May 2015	Innecken, Axel

CATEGORY OF CITED DOCUMENTS

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04-05-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3027095 A	27-03-1962	NONE	
JP S51120363 U	29-09-1976	NONE	
JP S4876932 A	16-10-1973	JP S4876932 A	16-10-1973
		JP S5225415 B2	07-07-1977
WO 9309880 A1	27-05-1993	EP 0567639 A1	03-11-1993
		JP H06504951 A	09-06-1994
		NL 9101939 A	16-06-1993
		NO 932478 A	07-07-1993
		US 5377913 A	03-01-1995
		WO 9309880 A1	27-05-1993
EP 2008723 A1	31-12-2008	NONE	
DE 9206410 U1	13-08-1992	NONE	
US 2857201 A	21-10-1958	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- GB 2446739 A **[0003]**
- US 3895756 A **[0004]**
- EP 2008728 A **[0005]**
- US 3472451 A **[0006]**