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(71) Applicant: **Proyectos Y Realizaciones San Cristóbal S.L.**
31500 Tudela (Navarra) (ES)

(72) Inventor: **PÉREZ CALVO, Juan Antonio**
E-31500 Tudela (Navarra) (ES)

(74) Representative: **Schäfer, Matthias W.**
Patentanwalt
Schwanseestrasse 43
81549 München (DE)

(54) **CONTAINER-CLEANING SYSTEM**

(57) Container-cleaning system of the type used for the periodical washing and disinfection of containers used for collecting rubbish, industrial or agricultural waste, etc., **characterized in that** the interior and exterior cleaning of the containers is performed automatically by means of an anthropomorphic robot with a number of axes of rotation, provided, at the end of its arm, with brushes that are capable of reversible rotation through 360° and with a high-pressure circuit, the exterior cleaning being performed by means of a combined system of arcs of pressurised water, with cleaning rollers, at fixed installations or by means of the actual robot in the case of movable installations.

The invention presented affords the principal advantage of carrying out rapid, intensive cleaning and disinfecting, leaving no residues of any sort and being completely automatic, as well as being applicable to both fixed and to movable installations.

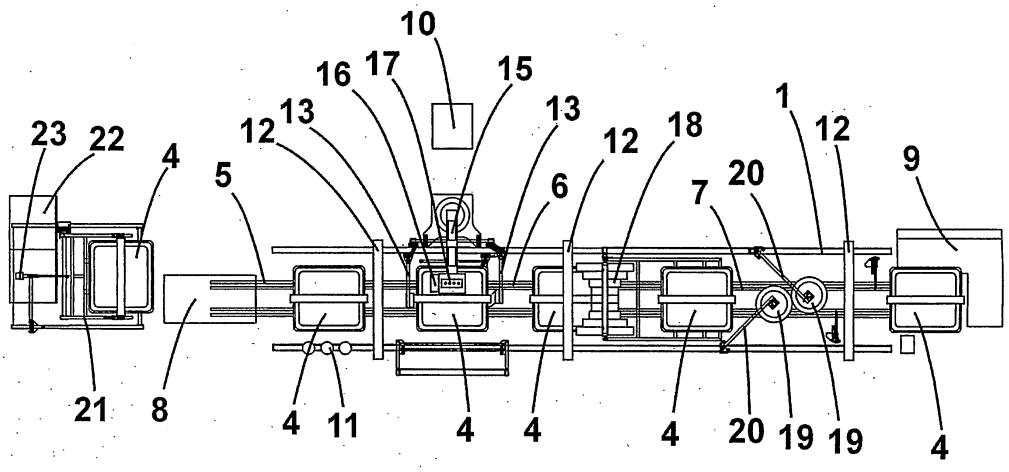

Fig. 1

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Description

[0001] As indicated in the title, the present description refers to a container-cleaning system of the type used for the periodical washing and disinfection of containers used for collecting rubbish, industrial or agricultural waste, etc, principally characterised in that the exterior and interior cleaning of the containers is performed automatically by an anthropomorphic robot with a number of axes of rotation, provided, at the end of its arm with brushes that are capable of reversible rotation through 360° and with a high-pressure circuit, the exterior cleaning being performed by means of a combined system of arcs of pressurised water with cleaning rollers, at fixed installations, or by means of the actual robot in the case of movable installations.

[0002] Containers of different types, although with common characteristics are currently more and more commonly used for collecting rubbish, industrial waste, agricultural waste, etc. These containers need periodical cleaning and disinfection to prevent the dirt and accumulation of organic waste from decomposing and generating bad smells or sources of bacteria that could propagate or transmit infections or diseases, as well as the unpleasant appearance of dirty containers in the street.

[0003] These containers have traditionally been (and still are) cleaned and disinfected by removing them from the street, replacing them with clean containers, and transporting them to a cleaning centre where they are cleaned manually using high pressure water jets and brushes, needing to have their lids opened and to be turned upside down manually to clean the inside. This procedure is very slow and costly, due to its labour intensive nature, in addition, the effectiveness of this cleaning process is poor, as it basically depends on the time taken and the interest of the worker carrying out the task, who cannot devote too much time to each container as this would be economically ruinous. Sometimes, to reduce the cost of the process, the cleaning is performed in situ with pressurized water, normally using the same trucks or public cleaning equipment, but this process, apart from soiling and contaminating the streets, carries out highly imperfect cleaning, especially in the inside of the containers.

[0004] Attempts have been made to improve these cleaning systems in different ways. For example: European Patent 88430026 *"Installation for semi-automatic cleaning of containers such as rubbish bins"* presents an installation which comprises a washing box with a flexible panel or bellows with a cleaning lance on one of its side walls, handled by a worker from outside the box, however, this is no more than an enclosed version of cleaning by hand, with the same disadvantages and problems mentioned above, and only improves the working conditions slightly. This self-propelled installation has the disadvantage of needing at least three workers (one to drive the vehicle, one to secure the containers to the rear of the vehicle and put them back when they are clean and a third to perform the actual washing). In addition, the washing work is very tedious for the worker, who must spend several hours in the washing cabin.

[0005] There have been attempts to develop other cleaning systems, such as the one presented in Patent 9300920 *"System for cleaning and disinfecting refuse containers"* or the one described in European Patent 88400215 *"Installation and cleaning of containers and vehicle fitted with this installation"*. Both present devices that clean with pressurized water with detergent, in a semi-automatic manner, but, despite being an improvement over manual systems, they have the disadvantage that the pressurized water with detergent is only able to clean superficially, frequently leaving traces of rubbish adhered to the container, especially inside, where it is very difficult, almost impossible, to completely clean every corner of the container.

[0006] As a significant improvement on these devices pressurized water nozzles are also used, being similar to those described in Utility Model 9001274 *"Device for cleaning cisterns and containers"* which uses a mechanical rotating pressurized water nozzle for cleaning the inside of containers, which greatly improves effectiveness, but has the disadvantage that its mechanical complexity impedes it from working with liquids at a very high pressure, thus reducing its cleaning capacity, added to which this mechanical complexity makes it prone to frequent breakdowns that spoil or slow down the cleaning process, making it notably more expensive.

[0007] Other washing systems are also known, such as the one described in Patent 9800769 *"Automatic washing tunnel for external and internal cleaning and disinfecting of containers"* or, in the Utility Model 200300325 *"Machine for cleaning rubbish containers",* which add to the previously described devices with towers or lances projecting foam and water with rollers that clean the inside and outside, but the interior cleaning of the containers is poor, due to the limitation and rigidity of movements of the cleaning rollers, which often leave dead angles incorrectly cleaned inside the containers, in which several layers of dirt accumulate over time. In addition, this type of washing device can only be used in fixed stations or wash tunnels, as their mechanical complexity impedes them from being used as a mobile station, on a truck for example, and they must be made to measure for a specific type of container, so if a different type of container is used, of a different size, the size or the rollers needs to be modified, with the consequent downtime in the work line.

[0008] A vehicle for the automatic washing of containers described in French Patent 2585303 is also known, comprising a washing box with an opening to insert the containers, loading means to place the containers inside the mentioned container through the mentioned opening, means for hermetically closing this opening, and a plurality of wash-heads in the aforementioned box, one of the mentioned heads being placed so as to project pressurized water inside the container/s that have been

placed inside the box and at least one of the other wash-heads being placed to project pressurized water onto the external walls of the container/s. These wash-heads are rotating, but they are in a fixed position inside the box, during container washing.

[0009] Cleaning performed by means of such installations is frequently highly imperfect due to the fact that the water jets projected from the static although rotary wash-heads, are not as efficient depending on the distance of the surfaces explored by said jets, in relation to the location of the said wash-heads. This disadvantage is worsened by the fact that each rubbish container presents a particular state of dirtiness. Thus, the external surfaces, and above all the internal surfaces of the rubbish containers are normally covered with different types of congealed matter forming deposits of widely varying thicknesses, more or less adhered to the surfaces and distributed over them irregularly, from one container to another, in such a manner that a more or less significant part of these deposits has not been dislodged and remains adhered to the walls of the containers if the water jets produced by the wash-heads do not impact on the deposits with sufficient force.

[0010] Most of the cleaning systems and devices mentioned share the added problem that they all need the lid of the container to be opened manually, which implies extra labour, as well as normally creating an external dead zone that is not properly cleaned.

[0011] To resolve the existing problems in relation to the problem of container cleaning, the container-cleaning system that is the object of the present invention has been designed, cleaning the inside of the containers automatically by means of an anthropomorphic robot with a number of axes of rotation, provided, at the end of its arm with brushes that are capable of reversible rotation through 360° and with a high-pressure circuit of nozzles to spray the fluids necessary for cleaning, carrying out the cleaning of the exterior by means of a combined system of arcs of pressurized water with vertical and horizontal cleaning rollers, in fixed installations, or carrying out all the operations, both inside and outside, using the same robot in the case of mobile installations, mounted, for example on a truck bed.

[0012] The cleaning system presented consists of a series of sequential phases, controlled by an electronic control module with dedicated software:

- PHASE 1 - Product spray arc
- PHASE 2 - Opening of the lid
- PHASE 3 - Cleaning of the interior
- PHASE 4 - Closing of the lid
- PHASE 5 - Cleaning of the exterior

[0013] It is planned that optionally and prior to phase 1, a prior pre-wash tipper phase can be added, during which any large-sized remains of rubbish, waste or similar materials that may remain inside the containers are eliminated.

[0014] This container-cleaning system offers many advantages over the systems currently available, the most important being that it performs rapid and intensive cleaning and disinfection, without leaving any traces of waste on the inside or outside of the container, in a completely automatic manner.

[0015] It is important to highlight that thanks to the use of an anthropomorphic robot with a number of axes of rotation, provided, at the end of its arm with brushes that are capable of reversible rotation through 360° and with a circuit of high pressure nozzles, it is possible to achieve perfect cleaning of the interior of any existing type of container, large or small, as well as those of the igloo type, needing just a minimum adjustment of the dedicated control software. This versatility enables the cleaning of any type of container that exists in a municipality, with a single installation, either fixed or mobile.

[0016] Another advantage of this invention is that it has been designed for implementation in both fixed and mobile installations, which permits great adaptation of its application.

[0017] Another important advantage is that it is totally automatic; therefore only one person is needed to supervise the process, loading the dirty containers and unloading the clean containers, with the resulting economic and labour savings.

[0018] We can also highlight the fact that the opening of the lid is automatic, with the consequent improvement in performance and reduction in labour.

[0019] Another advantage of the present invention is that the quality of the cleaning and disinfection is the same for all containers, thanks to its automation.

[0020] Yet another added advantage is that during the main process, the container is at no time tipped, enabling the cleaning system to be much simpler and more reliable, significantly reducing the rate of failures and breakdowns.

[0021] In order to better understand the object of the present invention, a preferential practical embodiment of the container-cleaning system has been portrayed in the drawing attached.

[0022] In said drawing, figure - 1 - shows a schematic top view of the transport mechanism with all the phases of the procedure.

[0023] Figure - 2 - shows a side view of the transport mechanism.

[0024] Figure - 3 - shows a profile view of the passage through one of the product spray arcs.

[0025] Figure - 4 - shows a profile view of the phase of the cleaning of the interior, carried out by the robot and its associated elements

[0026] Figure - 5 - shows a top view of the side attachment arms and the arms for opening the container lid.

[0027] Figure - 6 - shows views of the passing of the

container through the rollers for cleaning the container exterior.

[0028] Figure - 7 - shows a side view of the optional pre-wash tipper.

[0029] Figure -8- shows a schematic view of the alternative embodiment of the cleaning system mounted on a truck.

[0030] The container-cleaning system that is the object of the present invention, is basically formed, as can be seen in the annexed drawing, by a linear transport mechanism (1), preferably a conveyor belt or a drag chain (2) driven by one or several motors (3), preferably of the hydraulic type, the necessary reduction gears and some sprockets or rollers, at the beginning of which, the container (4) to be cleaned is placed, either manually or by means of an automatic feeder, which transports the container (4) automatically through the entire cleaning process until it is expelled at the exit end, completely clean. This linear transport mechanism (1) can be physically divided into several sections, so as to provide better control of the phases of the cleaning process, the preferred number of sections being three: Entry belt (5), intermediate belt (6) and exit belt (7), as well as an access ramp (8) and an exit ramp (9).

[0031] The cleaning procedure consists of a sequential series of phases, controlled by an electronic control module (10) provided with dedicated software:

PHASE 1 - Product spray arc

[0032] As a prior step, the drain plug located at the bottom of the container (4) is manually removed. When the container (4) is placed on the entry belt (5), through the access ramp (8), this automatically starts up, simultaneously detecting, by means of size sensors (11), preferably optical, the type and size of the container (4), informing the electronic control module (10) so it can carry out the necessary adjustments in the whole of the process and then moving the container (4) under a spray arc (12), provided with a plurality of sprayers (13) that project the cleaning descaling products all over the outside part to clean it.

PHASE 2 - Opening of the lid

[0033] The container (4), impregnated in this way with cleaning products, reaches the end of the entry belt (5). Here is it held by side attachment arms (13) to stop the container moving during the subsequent phase of cleaning the interior, at the same time carrying out the opening of the lid of the container (4) by means of articulated arms (14) governed by the electronic control module (10) according to the type of container (4) detected in the previous phase.

PHASE 3 - Cleaning of the inside

[0034] Following this, an anthropomorphic robot (15) with multiple axes of rotation, preferably 6, located beside the conveyor belt and being provided, at the end of its arm, with brushes (16), preferably two, cylindrically-shaped and positioned perpendicularly one to the other, working at the front and sides at the same time, being capable of reversible rotation through 360° and with a high pressure circuit provided with moveable nozzles (17) preferably ceramic to withstand the high pressure of the water, carries out the cleaning of the whole of the interior of the container (4). The reversible rotation capacity of the cleaning brush (16) together with the high pressure nozzles (17) that spray descaling cleaner product, rinsing liquid, disinfectant or any other element necessary, enable the removal of all the dirt from the inside, which is evacuated through the container (4) drain along with the rinsing water.

[0035] The internal cleaning itinerary performed by the arm of the robot (15) is controlled by the software of the electronic control module (10), optimised for each of the possible types of containers (4), and being able to be adapted at any moment to new types of containers (4) or new cleaning cycles.

PHASE 4 - Closing of the lid

[0036] Once the interior cleaning has been completed, the robot (15) stops , the articulated arms (14) close the container lid and the side attachment arms (13) holding the container (4) release it so it can continue the cleaning process, going to the intermediate conveyor belt (6).

PHASE 5 -Exterior cleaning

[0037] From the intermediate conveyor belt (6), it moves to the exit belt (7), where the exterior cleaning is carried out by means of a combined system of a second spray arc (12) of pressurized descaling cleaner product with cleaning rollers, one preferably horizontal (18) located on the top part, of variable height according to the type of container (4), which allows the cleaning of the top part, and two vertical rollers (19), attached to two rotating arms (20) that with their combined movements, allow the four sides of the container (4) to be cleaned. The itinerary ends with a spray arc (12) for final cleaning, which sprays rinsing liquid and disinfectant, and the clean and disinfected container (4) is then placed on the exit ramp (9), where it can be collected by the operator, putting the drain plug that was previously removed back in place, and leaving the container (4) ready for distribution to its point of use.

[0038] It is foreseen that, in an alternative embodiment, prior to PHASE 1, a prior phase of pre-wash tipping is added, in which, before beginning the actual washing process, a pre-wash is carried out in a tipper (21), with the aim of eliminating any possible large remains of rubbish that may still be inside the containers and could subsequently block the drains. For this purpose, the container (4) is moved to the tipper (21) which grips it laterally,

lifts it with a rotating movement whilst opening the lid, and places the open mouth of the container over a waste tank (23), destined for the collection of rubbish and over a pressurized water lance (22) that automatically performs a horizontal and vertical movement sweeping the inside, which causes the largest remains to be dragged by gravity into the waste tank (23). When the sequence is over, the container (4) is again placed on the ground, where it is moved to the beginning of the entry belt (8).

[0039] Also foreseen is a mobile embodiment of the invention for implementation on, for exampled, a truck (24) bed, in which both the entry and exit spray arcs (12) as well as the exterior cleaning rollers (18,19) are eliminated. In this alternative embodiment, the robot arm (15), with its cleaning brushes (16) and the high pressure nozzles (17) that spray descaling cleaner, rinsing liquid, disinfectant or any other element needed, performs both the interior and exterior cleaning of the container (4). For this purpose, the truck (24) has a elevating platform (30), located on the side or at the rear of the truck (24) and which positions the container (4) on a rotating support (29) that can rotate up to 360° to facilitate the work of the robot (15). In this case only the elements mentioned in Phase 3 are necessary, the control unit (10) with its dedicated software being integrated into the corresponding control sets (28) (pressure, electric, hydraulic and robotic) for this mobile application, and a series of complementary elements among which we can highlight the dirty water tank (25), the clean water tank (26) and the sludge tank (27). This solution, despite the fact that it does not clean at the speed of the previously described complete solution for a fixed installation, is much more compact and transportable.

[0040] A detailed description of the rest of the features of the system presented or of its component elements is purposely omitted, given that it is not considered that the rest of the features are the object of any claim.

[0041] Having described the nature of the present invention in sufficient detail, in addition to a means for putting it into practice, all that remains to be added is that its description is not restrictive, and that some variations in materials, shapes or sizes can be made provided that said variations do not alter the essential nature of the characteristics claimed below.

Claims

1. Container-cleaning system, of the type used for periodical washing and disinfection of containers used for collecting rubbish, industrial or agricultural waste, and similar, **characterised by** having at least one anthropomorphic robot (15) with multiple axes of rotation, preferably 6, being provided at the end of its arm with brushes (16), preferably two, cylindrically-shaped and positioned perpendicularly one to the other, working at the front and sides at the same time, capable of reversible rotation through 360° and with a high pressure circuit provided with moveable nozzles (17) preferably ceramic to withstand the high pressure of the water, that carries out the cleaning of the whole of the inside of the container (4), combined with a plurality of spray arcs (12) of pressurized liquids and horizontal and vertical cleaning rollers to clean the outside of the container (4).

2. Container-cleaning system, according to the preceding claim, wherein it comprises a linear transport mechanism (1), preferably a conveyor belt or drag chain (2) driven by one or several motors (3), preferably hydraulic, the necessary reduction gears and sprockets or rollers, at the beginning of which the container (4) to be cleaned is placed, either manually or by means of an automatic feeder, which is responsible for transporting said container (4) automatically through the entire cleaning process until it is expelled at the exit end, completely clean, this linear transport mechanism (1) being preferably physically divided into several sections, with the aim of providing a better control of the phases of the cleaning procedure, the number of said sections being preferably three: Entry belt (5), intermediate belt (6) and exit belt (7), as well as an access ramp (8) and an exit ramp (9).

3. Container-cleaning system, according to the preceding claims, wherein the cleaning process consists of a sequence of phases, regulated by an electronic control module (10) using dedicated software, beginning with a Phase 1 of product spray arc, followed by a Phase 2 of opening the container lid, continuing with a Phase 3 of the cleaning of the inside by the robot, and following on with a Phase 4 of closing the lid and ending with a Phase 5 of the external cleaning of the container.

4. Container-cleaning system, according to the previous claims, wherein, in an alternative embodiment, a phase prior to Phase 1 is foreseen, consisting of a prior pre-wash tipper phase, in which before starting the actual cleaning process, a pre-wash with a pressure lance (22) in a tipper (21) is carried out, to eliminate any possible large-sized remains of rubbish, waste or similar.

5. Container-cleaning system, according to claims 1, 2 and 3, wherein in another alternative embodiment it is implemented on a truck (24) bed or similar mobile device, in which both the entry and exit spray arcs (12), as well as the exterior cleaning rollers (18,19) are eliminated, the robot arm (15), with its cleaning brushes (16) and the high pressure nozzles (17) that spray descaling cleaner, rinsing liquid, disinfectant or any other element necessary, being responsible for both the interior cleaning and exterior cleaning of the container (4),

6. Container-cleaning system, according to claim 5, wherein, in this alternative embodiment, the truck (24) has an elevating platform (30), located on the side or at the rear of the truck (24) that positions the container (4) on a rotating support (29) with capacity to rotate 360° so as to facilitate the work of the robot (15), the control unit (10) with its dedicated software being integrated into the corresponding control sets (28) (pressure, electric, hydraulic and robotic) for this mobile application, also being provided with a dirty water tank (25), a clean water tank (26) and a sludge tank (27).

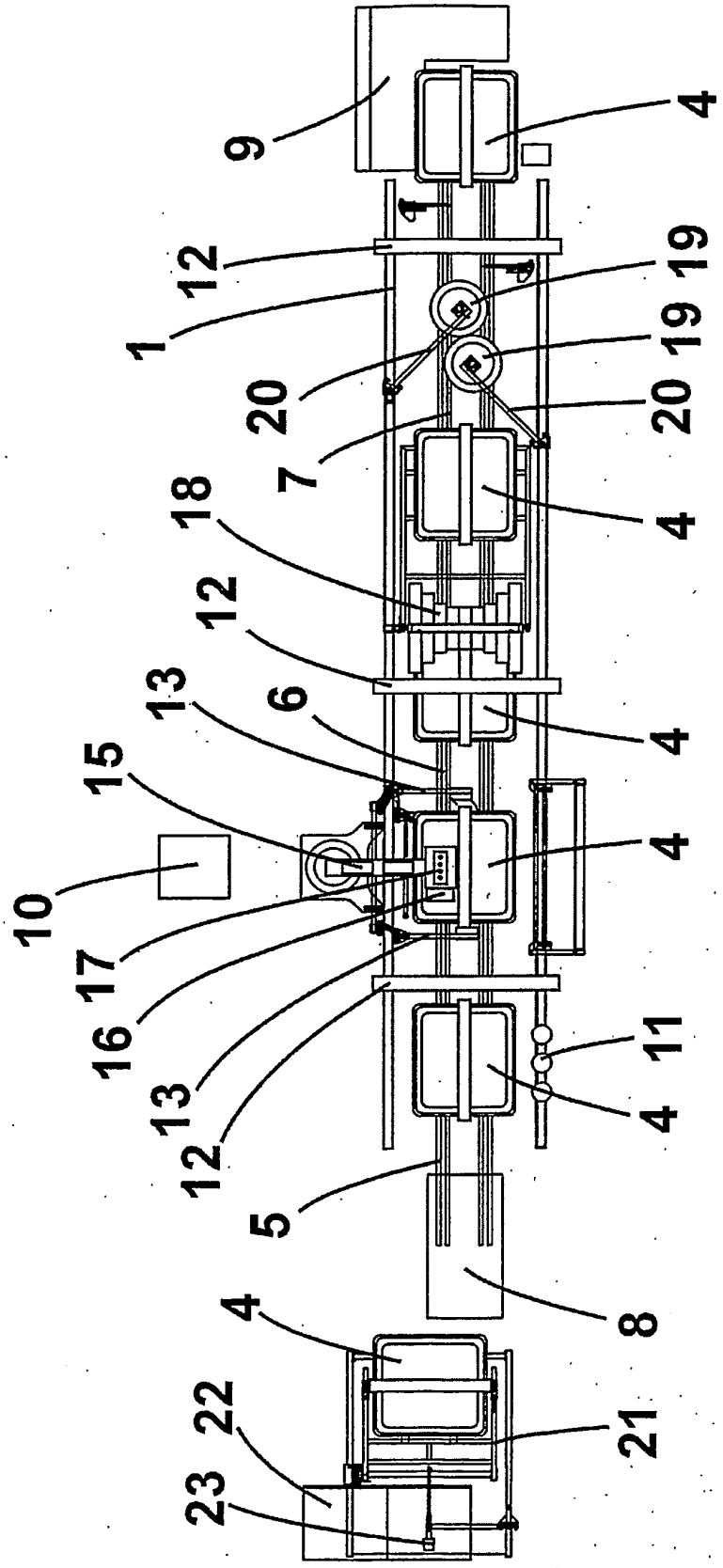

Fig. 1

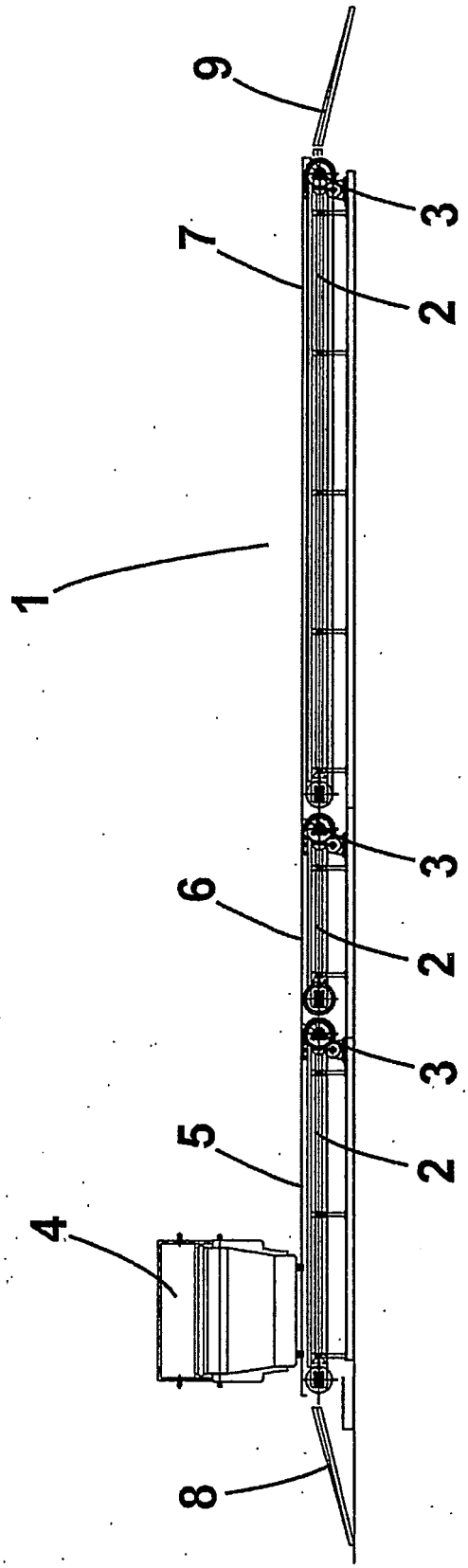

Fig. 2

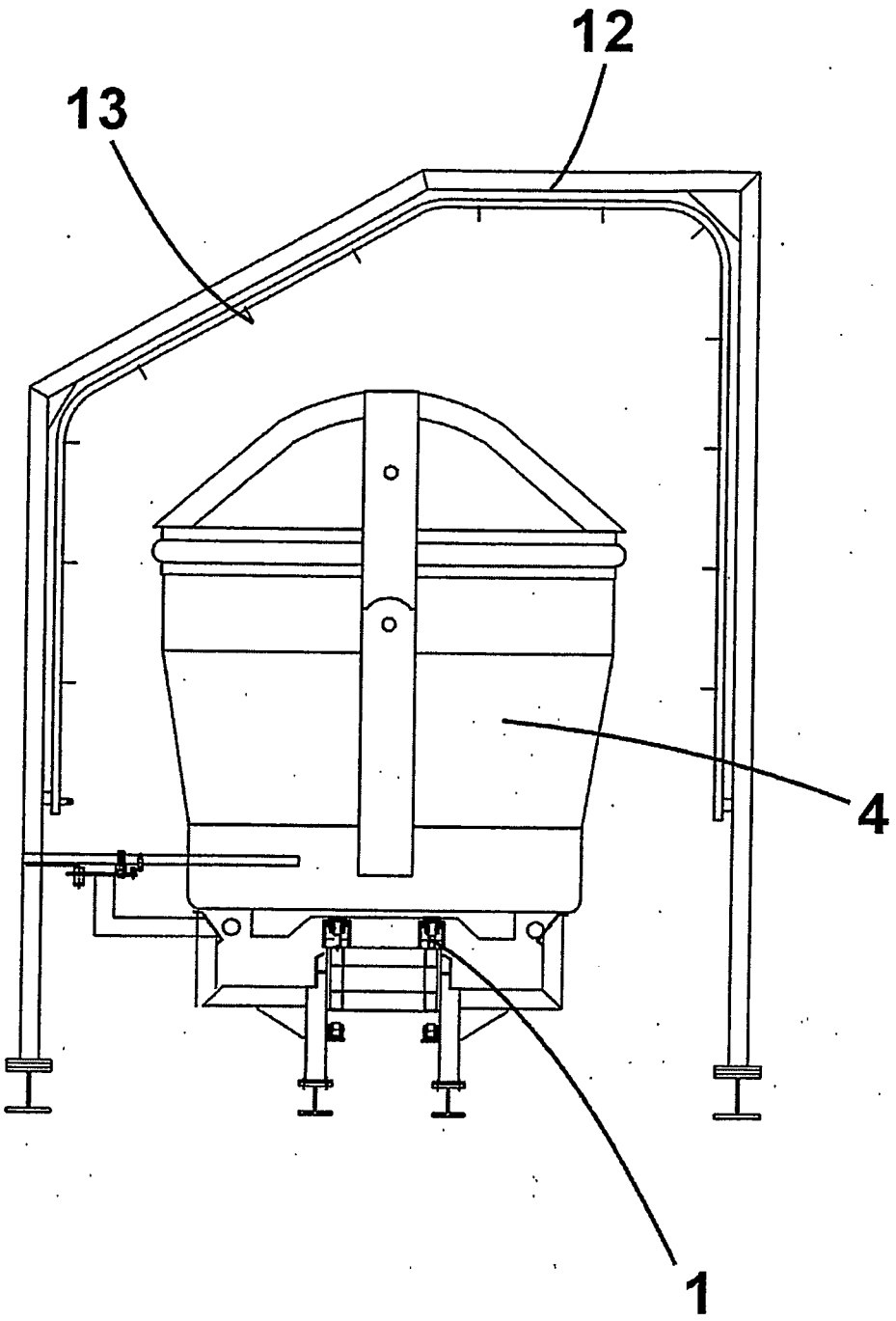

Fig. 3

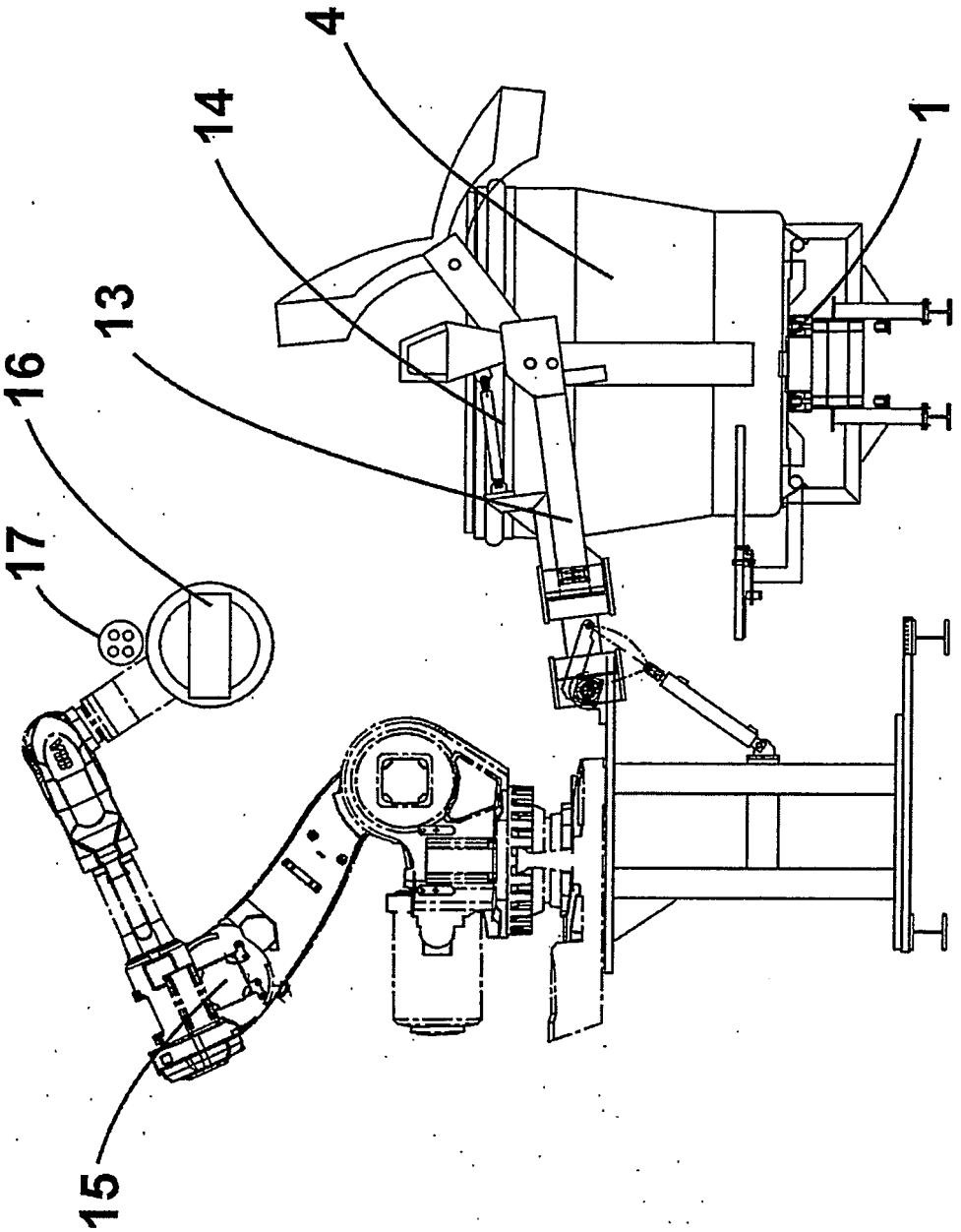

Fig. 4

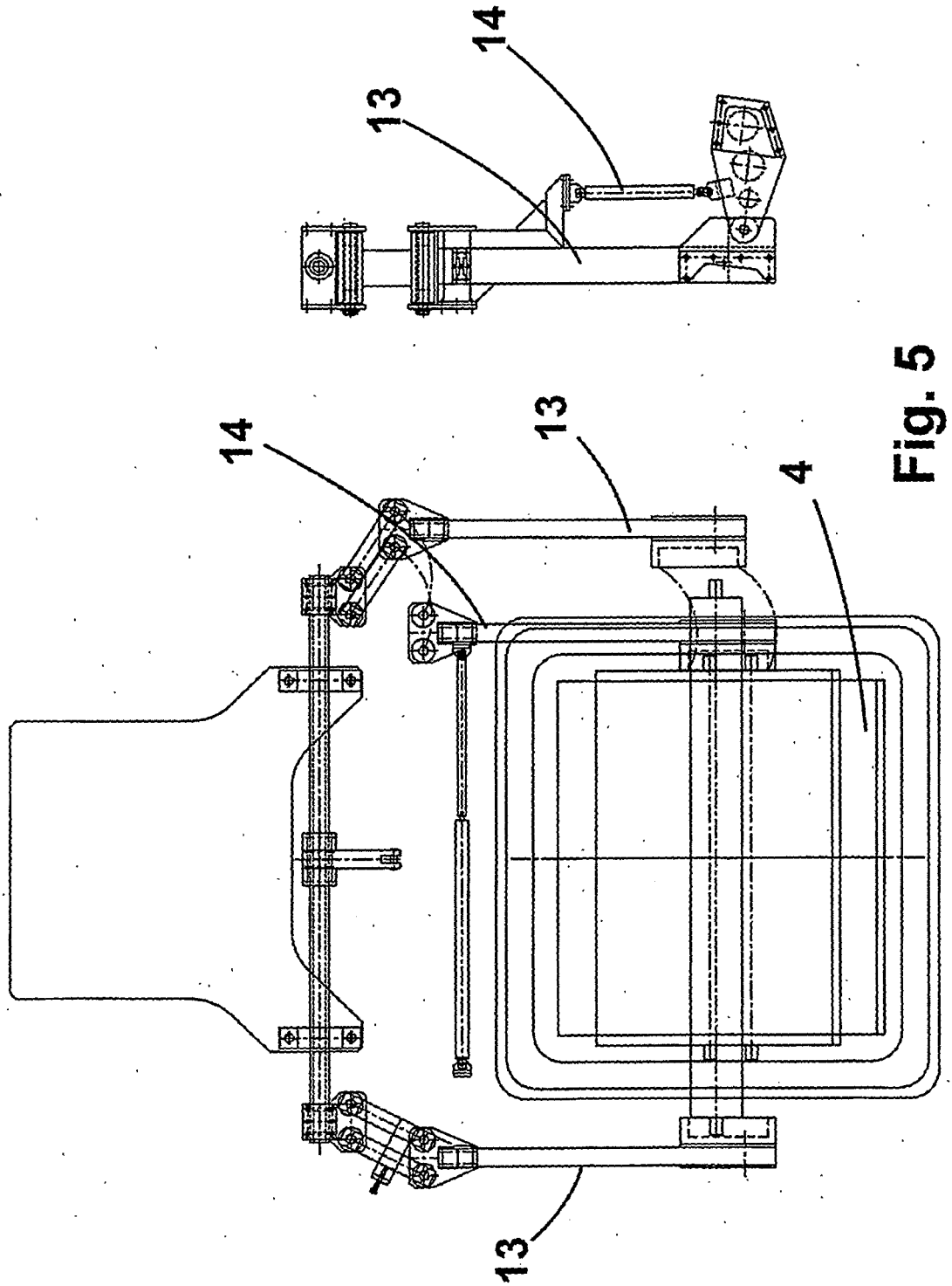

Fig. 5

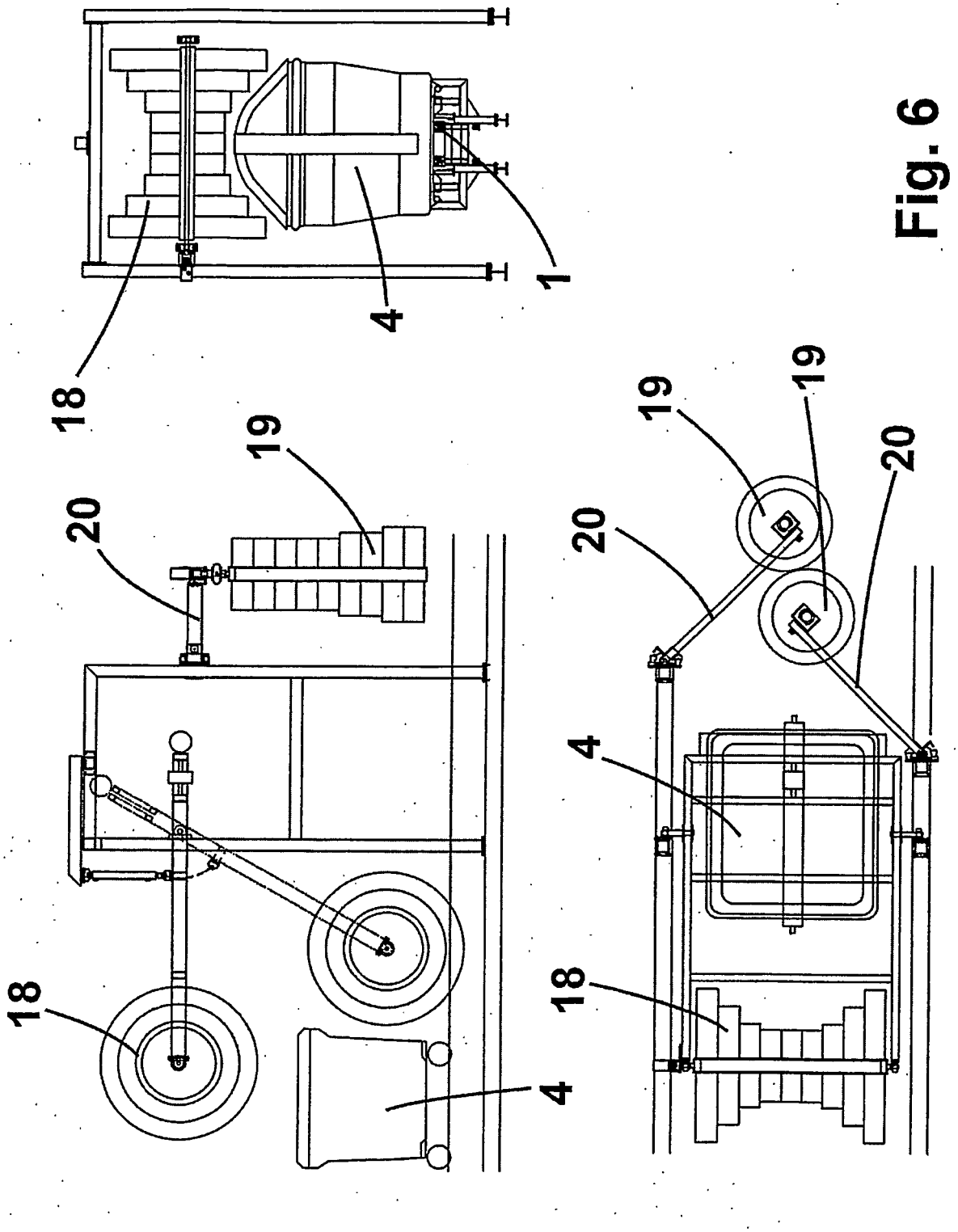

Fig. 6

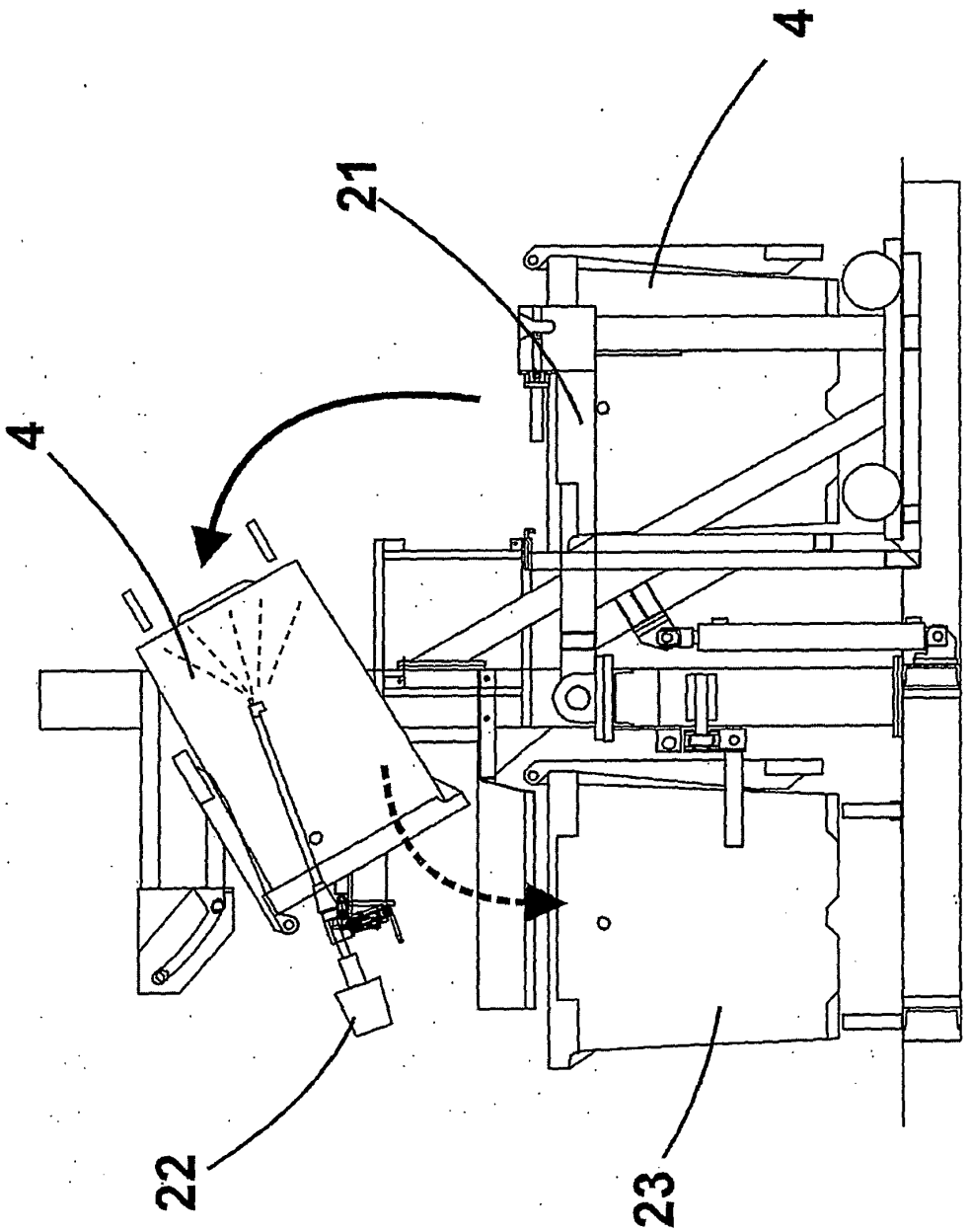

Fig. 7

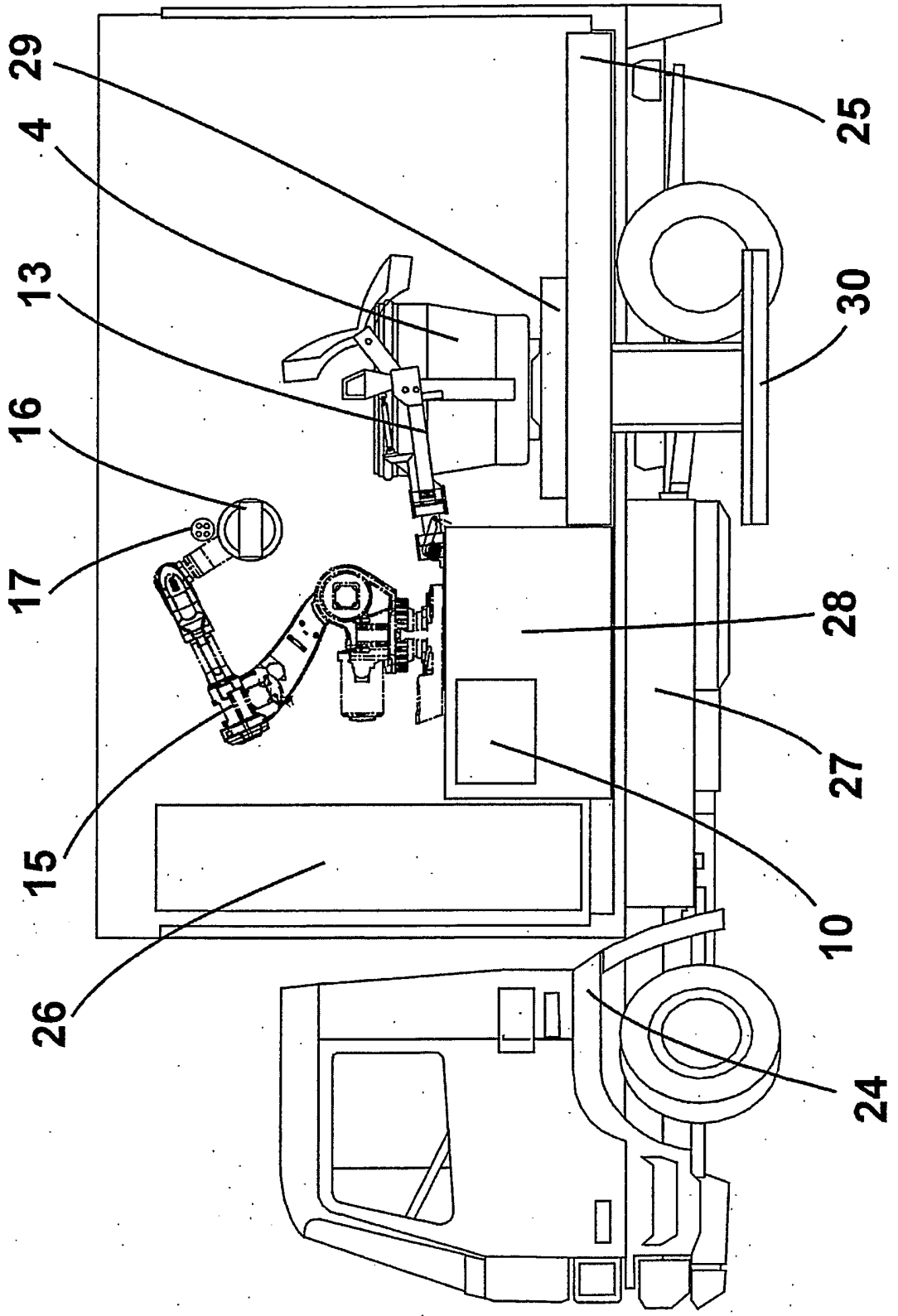

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2007/000219

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B08B+, B65F+, B25J+,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CIBEPAT, EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 3589134 A (HACKMANN et al.) 29.06.1971, column 1, line 71 - column 2, line 18; figure 1.	1, 5

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
13 August 2007 (13.08.2007)	(22/08/2007)
Name and mailing address of the ISA/ O.E.P.M. Paseo de la Castellana, 75 28071 Madrid, España. Facsimile No. 34 91 3495304	Authorized officer J. Merello Arvilla Telephone No. +34 91 349 84 52

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 2007/000219

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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REFERENCES CITED IN THE DESCRIPTION

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