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(54) **High-pressure cleaning device**

(57) A high-pressure cleaning device, for instance for cleaning of soiled enclosures such as pigsties, is disclosed, the device comprising at least one nozzle section (8) provided with drive means for movement hereof in two separate directions in space, for instance horizontally and vertically, whereby a predetermined portion of the surroundings of the device can be provided with high-pressure cleansing fluid. The drive means for said movements are driven solely by the high-pressure fluid itself, thereby providing a simple, yet safe and reliable device. According to one embodiment of the device, a nozzle (8) is rotated in a stepwise manner in the horizontal plane of the device, while the nozzle (8) simultaneously undergoes pivotal movements in the vertical plane, thereby sweeping a certain, predetermined angular range in the vertical plane.

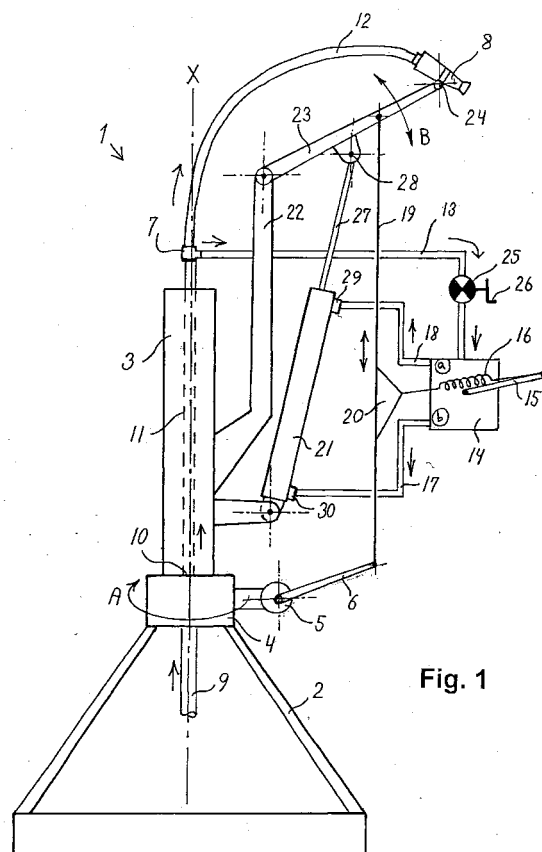


Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to high-pressure cleaning devices for use in soiled surroundings or enclosures such as pigsties.

BACKGROUND OF THE INVENTION

[0002] Programmable devices or robots for carrying out cleansing operations for instance in large-scale agricultural plants or slaughterhouses are known within the art, which are able to move a nozzle section in a pre-programmed and complicated manner for instance throughout a row of enclosures, such as pigsties, and thereby performing complicated cleansing operations. In order to benefit optimally from such devices or robots, the surroundings in which they operate must, however, be designed accordingly, allowing for instance a robot to move automatically from one enclosure to the next. Unintended obstacles along the paths of movement of such robots are of course not allowed, and may even lead to hazardous situations. Furthermore, such devices may be unnecessarily complicated and hence expensive for use except in said large-scale plants, and they furthermore generally need to be supplied not only with the appropriate high-pressure fluid but also with electricity either via a direct connection to the AC mains supply or via built-in batteries.

[0003] Hence, for many applications it would be desirable to have access to a simple and yet efficient and reliable cleaning device, which could be driven by the supply of high-pressure fluid itself.

DISCLOSURE OF THE INVENTION

[0004] Based on the above background it is an object of the present invention to provide a high-pressure cleaning device for use in soiled enclosures, which is able to provide a desired coverage with a high-pressure cleaning fluid of a surface area totally surrounding the device in one plane, for instance the horizontal plane hereof, and with a coverage region - or angle - in another plane, for instance the vertical plane, which may be chosen according to the specific needs.

[0005] According to the invention, the device is driven solely by means of the high-pressure fluid itself, i.e. the high-pressure fluid is used both for cleaning purposes and for attaining the necessary movements of parts of the device, such as a nozzle section, during the cleaning operation. Thus, with the device according to the invention only a suitable high-pressure fluid source is required and not for instance connections to the AC mains, thereby simplifying the use of the device and increasing its reliability and safety.

[0006] The above objects and advantages are attained according to the invention by providing a cleaning

device, in which at least one nozzle section for delivering high pressure cleaning fluid is provided with means for simultaneous movement in two dimensions in space, each of these means requiring only a supply of high pressure fluid to attain their movements and by which means cleaning fluid is provided to a region in space surrounding the cleaning device.

[0007] According to a first class of specific embodiments of the invention, the cleaning fluid is provided to a region completely surrounding the device in the horizontal plane hereof, whereas the provision of cleaning fluid is restricted to a certain predetermined region in the vertical plane.

[0008] According to a second class of specific embodiments of the invention, the cleaning fluid is provided to a region completely surrounding the device in the vertical plane hereof, whereas the provision of cleaning fluid is restricted to a certain predetermined region in the horizontal plane.

[0009] According to the invention, the movement of the nozzle section in the horizontal and vertical planes can either take place continuously in both planes or alternatively continuously in one plane and in a stepwise manner in the other.

[0010] A presently preferred embodiment of the invention comprising stepwise rotation of the nozzle section in the horizontal plane and simultaneous continuous pivotal movement within a predetermined vertical range is defined by claim 4. According to this embodiment of the invention, the nozzle is rotated about a vertical axis in steps, and for each of these steps a vertical sweep of the nozzle is performed between predetermined elevation angles, i.e. angles relative to the horizontal plane. The stepwise rotation about the vertical axis is continued over — and as a possibility beyond — a complete 360 degrees revolution in the horizontal plane with the effect that a complete cylindrical surface surrounding the device is being provided with cleansing fluid.

[0011] A possible alternative would be to move the nozzle section stepwise in the vertical plane and rotate it continuously in the horizontal plane.

[0012] By moving the nozzle section in the described combined stepwise and continuous manner, a full coverage of a predetermined area surrounding the device is ascertained, which would not have been the case if the nozzle section had been moved continuously and simultaneously in both dimensions in space. In the latter case the fluid leaving the nozzle would cover the surroundings in a kind of sinusoidal pattern, thus providing some parts of the surroundings with more cleansing fluid than other parts of the surroundings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Two alternative embodiments of the invention will now be described with reference to the accompanying drawing, where:

Figure 1 shows a schematic representation of a preferred embodiment of the present invention embodying stepwise rotation in the horizontal plane and continuous pivotal movement in the vertical plane; and

Figure 2 shows a schematic representation of the part of an alternative embodiment providing continuous rotational movement in the horizontal plane.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Referring now to Figure 1, there is shown a schematic representation of an embodiment of the cleaning device according to the present invention. According to this embodiment the nozzle 8 delivering the cleansing fluid is moved in an oscillating manner continuously over a certain, predefined angular range in the vertical plane, whereas the horizontal movement around the longitudinal axis X takes place in a stepwise manner over and beyond the entire 360 degrees azimuth interval. As mentioned above, other modes of movement of the nozzle 8 would also fall within the general inventive concept, as defined by the independent claim 1.

[0015] As shown in Figure 1, the nozzle 8 is supported for oscillatory movement in the vertical plane, as indicated by the arrow B, on a pivot arm 23 via a pivot joint 24. By means of this joint 24, the vertical angle of the nozzle 8 relative to the pivot arm 23 can be adjusted, thereby determining the limits of the vertical coverage angle of the nozzle in accordance with the specific requirements during use of the device. The pivot arm 23 is pivotally connected to a supporting arm 22 attached to the vertical column 3, such that the arm 23 can rotate in the horizontal direction.

[0016] The stepwise horizontal rotation is achieved by the application of a hydraulic gearmotor 4 carrying the column 3 and mounted on a stand 2 which may be provided with (not shown) wheels or rollers to facilitate transport of the device. High-pressure fluid is entered via the inlet 9 for driving the gearmotor 4, whereupon the fluid leaves the gearmotor 4 at an outlet 10 hereof and passes through the column 3 via a pipeline 11.

[0017] The gearmotor 4 is provided with an actuator device 5 comprising an actuator arm 6. When the free end of the actuator arm 6 is in its lowermost position, the gearmotor 4 is able to undergo a rotation by one azimuthal step in the direction of the arrow A, whereupon it remains in this position until the actuator arm 6 again resumes its lowermost position. The gearmotor then rotates another azimuthal step and so on.

[0018] After leaving the column 3 at the upper end hereof, the pipeline 11 is terminated by a T-connection in which the flow of high-pressure fluid is split up into a portion delivered to the nozzle 8 via a suitable flexible connection, such as the hose 12 and a portion leaving the T-connection through the pipeline 13. This portion

of the fluid is used to drive the vertical and horizontal movements of the device, as described below.

[0019] After passage of a valve 25 in the pipeline 13, this portion of the fluid enters a flow switch 14 provided with two outlets a and b. The switch 14 is provided with an arm 15 for directing the fluid to either one or the other of the outlets a and b. The outlet a is connected via a pipeline 18 to an upper inlet 29 of a hydraulic cylinder 21, whereas the outlet b is connected via a pipeline 17 to a lower inlet 30 of the hydraulic cylinder 21. When the cylinder 21 receives fluid under pressure at the upper inlet 29, the piston of the cylinder is driven in a downward direction and when pressurised fluid is received via the lower inlet 30, the piston is driven in an upwards direction in the cylinder 21. The cylinder 21 is pivotally attached to the column 3 and the distal end of the piston rod 27 from the piston in the cylinder is pivotally connected to the pivot arm 23. Thus, a reciprocating movement of the piston of the hydraulic cylinder 21 is transformed to an oscillating movement of the arm 23 carrying the nozzle 8.

[0020] A connecting arm 19 passes between a point on the pivot arm 23 carrying the nozzle 8 and the actuator arm 6 of the gear motor 4. Thus, the actuator arm 6 follows the oscillatory motion of the pivot arm 23, and whenever the pivot arm 23 is in its lowermost position, the gearmotor thus rotates one step in the direction of the arrow A.

[0021] The flow switch 14 switches between its two states, thereby directing the flow of fluid to either the outlet a or the outlet b, controlled by the movement of the connecting arm 19. To accomplish this, the flow switch actuator arm 15 is connected to a connecting member 20 on the connecting arm 19 by means of a tension member 16, for instance a helical spring. In this manner the switch acts as a bistable switch, which practically momentarily switches between its two states at the appropriate position of the connecting arm 19.

[0022] The rate of flow of fluid through the pipeline 13 is controlled by means of the valve 25 provided with a suitable adjustment means 26. By this adjustment, the speed of the oscillatory movement of the nozzle 8 and hence the rotational speed of the device around the longitudinal axis X through the vertical column 3 can be varied according to the specific needs.

[0023] Referring now to Figure 2, there is shown a schematic representation of the part of an alternative embodiment providing continuous rotational movement in the horizontal plane. This mechanism is thus to be regarded as an alternative to the stepwise mechanism for horizontal rotation of the column 3 provided by the gearmotor 4 and associated controlling means according to the first embodiment described above.

[0024] According to this embodiment, the vertical column 3 of the cleaning device is provided with a chain wheel 31 connected for rotational movement to a second chain wheel 32 generally of a larger diameter by means of a chain 42. It is, however, understood that in

principle the chain wheel mechanism as shown in Figure 2 could also be replaced by various mechanical equivalent means such as a tooth belt, a rack and pinion mechanism, direct engagement between two gear wheels etc. without departing from the scope of the invention. The rotational movement of the larger diameter chain wheel 32 is attained by a pivotally mounted hydraulic cylinder 34, the piston rod 43 of which is connected to the larger diameter chain wheel 32 at a point 33. By proper choice of the diameters of the chain wheels 31 and 32, it is possible to obtain a full 360 degrees rotation of the vertical column 3 for a limited rotation of the larger chain wheel 32, as indicated by the angle δ in Figure 2. The mechanism is driven by the high-pressure fluid entering at the inlet 37 to a flow switch 36, which directs the flow of fluid either to one end of the hydraulic cylinder 34 via a first fluid outlet 38 or to the other end of the cylinder via the other outlet 39 of the flow switch 36. The flow switch 36 is controlled by an actuator arm 41, whenever this arm is actuated by an actuating member 40 on the vertical column 3. This mechanism is merely schematically indicated in Figure 2, but can easily be devised by a person skilled in the art. As shown in Figure 2, the vertical column 3 has been rotated in the direction of the arrow α to a point just prior to the activation of the flow switch. When the flow of fluid is brought to enter the cylinder 34 via the outlet 39, the piston rod 43 is displaced towards the cylinder 34, whereby the chain wheels 31 and 32 are rotated in the opposite direction. Thus, by proper choice of the diameter of the chain wheels 31 and 32, the column 3 is rotated once in the direction indicated by the arrow δ , whereafter the direction of rotation is reversed and the column 3 rotates a full 360 degrees in the opposite direction and so on.

[0025] Simultaneously with the above described continuous horizontal rotation, the pivot arm 23 carrying the nozzle section 8 oscillates in the vertical plane as described in connection with the first embodiment and according to the second embodiment, the ray of washing fluid leaving the nozzle section 8 of the cleaning device thus describes a kind of sinusoidal pattern within a given vertical region surrounding the cleaning device.

REFERENCE NUMERALS

[0026]

1. Cleaning device according to first embodiment
2. Stand
3. Vertical column
4. Hydraulic gearmotor
5. Actuator for gearmotor
6. Actuator arm
7. T-connector
8. Nozzle
9. Inlet for high-pressure fluid
10. Outlet from gear motor

11. Pipeline through vertical column
12. Hose
13. Pipeline
14. Flow switch
- 5 15. Flow switch actuator arm
16. Tension member
17. Pipeline
18. Pipeline
19. Connecting arm
- 10 20. Connecting member
21. Hydraulic cylinder
22. Supporting arm
23. Pivot arm for nozzle
24. Pivot joint for nozzle
- 15 25. Valve
26. Adjustment means for valve
27. Piston rod of hydraulic cylinder
28. Pivot joint for piston arm
29. Upper inlet of cylinder
- 20 30. Lower inlet of cylinder
31. Small diameter chain wheel
32. Large diameter chain wheel
33. Connection of piston rod to large diameter chain wheel
- 25 34. Hydraulic cylinder
35. Pivot point of hydraulic cylinder 34
36. Flow switch
37. Fluid inlet
38. First fluid outlet
- 30 39. Second fluid outlet
40. Flow switch actuating member on rotatable column 3
41. Actuator arm of flow switch
42. Chain
- 35 43. Piston rod of hydraulic cylinder
- A. Horizontal rotation
- B. Vertical oscillation
- X. Longitudinal axis through vertical column.

Claims

1. High-pressure cleaning device for cleaning pigsties and other contaminated enclosures comprising at least one nozzle section (8) for the provision of a high-pressure cleansing fluid and means for changing the orientation of the at least one nozzle section (8) in two different spatial dimensions, **characterised in that** said means for changing the orientation are driven solely by the high-pressure cleansing fluid itself.
2. High-pressure cleaning device according to claim 1, **characterised in that** said device is provided with means for changing the orientation of said at least one nozzle section (8) in a first of said dimensions continuously and with means for changing the orientation of said at least one nozzle section (8) in

the second of said dimensions in a stepwise manner.

3. High-pressure cleaning device according to claim 1, **characterised in that** said device is provided with means for changing the orientation of said at least one nozzle section (8) in a first of said dimensions continuously and with means for changing the orientation of said at least one nozzle section (8) in the second of said dimensions in a continuous manner. 5
4. High-pressure cleaning device according to claim 2, **characterised in that** said at least one nozzle section (8) is mounted and driven for pivotal movement, thereby sweeping over a given range in the vertical plane, and where the at least one nozzle section (8) is furthermore mounted and driven for stepwise rotational movement in the horizontal plane about a vertical axis (X), where the drive means (21) for said pivotal movement is coupled to the drive means (4) for said stepwise rotation in such a manner that the at least one nozzle section (8) moves one step further in the horizontal plane at the completion of each of said pivotal movements in the vertical plane. 10 20 25
5. High-pressure cleaning device according to claim 4, **characterised in that** said drive means for the pivotal movement is a hydraulic cylinder (21), the piston of which is connected (27) to a pivot arm (23) carrying the at least one nozzle section (8). 30
6. High-pressure cleaning device according to claim 4 or 5, **characterised in that** said drive means (4) for the stepwise rotation is a controllable gearmotor (4) attached to a structure (3, 22) carrying said pivot arm (23). 35
7. High-pressure cleaning device according to claim 6, **characterised in that** said gearmotor (4) is provided with actuator means (5, 6) for controlling the gearmotor (4), said actuator means (5, 6) being connected (19) to and activated by said pivot arm (23). 40 45
8. High-pressure cleaning device according to any of the preceding claims 4 to 7, **characterised in that** said hydraulic cylinder (21) is provided with an upper (29) and a lower (30) inlet for high-pressure fluid, whereby the piston in the hydraulic cylinder (21) is moved in one direction when fluid is applied via said upper inlet (29) and in the opposite direction when fluid is applied via said lower inlet (30), said inlets (29, 30) being provided with fluid via a flow switch (14) receiving high-pressure fluid from a high-pressure fluid source. 50 55
9. High-pressure cleaning device according to claim 8, **characterised in that** the supply of fluid to said flow switch (14) can be adjusted by means of a valve (25), whereby the rate of movement of the at least one nozzle section (8) can be adjusted.
10. High-pressure cleaning device according to claim 8 or 9, **characterised in that** said flow switch (14) via activating means (15) is connected (20) for switching to said connecting arm (19) by means of a tension member (16).
11. High-pressure cleaning device according to claim 3, **characterised in that** said at least one nozzle section (8) is mounted and driven for pivotal movement, thereby sweeping over a given range in the vertical plane, and where the at least one nozzle section (8) is furthermore mounted and driven for continuous rotational movement in the horizontal plane about a vertical axis (X), where the drive means for said continuous rotational movement in the horizontal plane comprises a wheel (31) mounted on the vertical column (3) and coupled to a second wheel (32) driven for rotation over a given, predetermined angle (δ).
12. High-pressure cleaning device according to claim 11, **characterised in that** said second wheel (32) is driven by a hydraulic cylinder (34).
13. High-pressure cleaning device according to claim 11 or 12, **characterised in that** said first and second wheels (31, 32) are chain wheels and said coupling between these wheels is a chain (42).
14. High-pressure cleaning device according to any of the preceding claims 11 to 13, **characterised in that** said hydraulic cylinder (34) is driven for reciprocating movement of the piston and rod (43) by the high-pressure fluid being supplied alternately at either end of the cylinder (34) via a flow switch (36).
15. High pressure cleaning device according to claim 14, **characterised in that** said flow switch (36) is activated by the rotational movement of the vertical column (3) by activation means (40, 41) attached to the vertical column (3) and to the flow switch (36), respectively.
16. High-pressure cleaning device according to any of the preceding claims 11 to 15, **characterised in that** the diameters of said first and second wheel (31, 32) are chosen such that said rotation of the second wheel (32) causes a predetermined rotation angle (α) of the vertical column (3).
17. High-pressure cleaning device according to claim 16, **characterised in that** said rotation angle (α) is

substantially 360 degrees.

18. High-pressure cleaning device according to any of the preceding claims **characterised in that** said two dimensions are substantially orthogonal. 5
19. High-pressure cleaning device according to any of the preceding claims, **characterised in that** said first dimension is substantially vertical and said second dimension is substantially horizontal. 10
20. High-pressure cleaning device according to any of the preceding claims, **characterised in that** said first dimension is substantially horizontal and said second dimension is substantially vertical. 15
21. High-pressure cleaning device according to any of the preceding claims, **characterised in that** said nozzle (8) is connected to said pivot arm (23) by a pivot joint (24), whereby the orientation of the nozzle (8) relative to pivot arm (13) is made adjustable. 20

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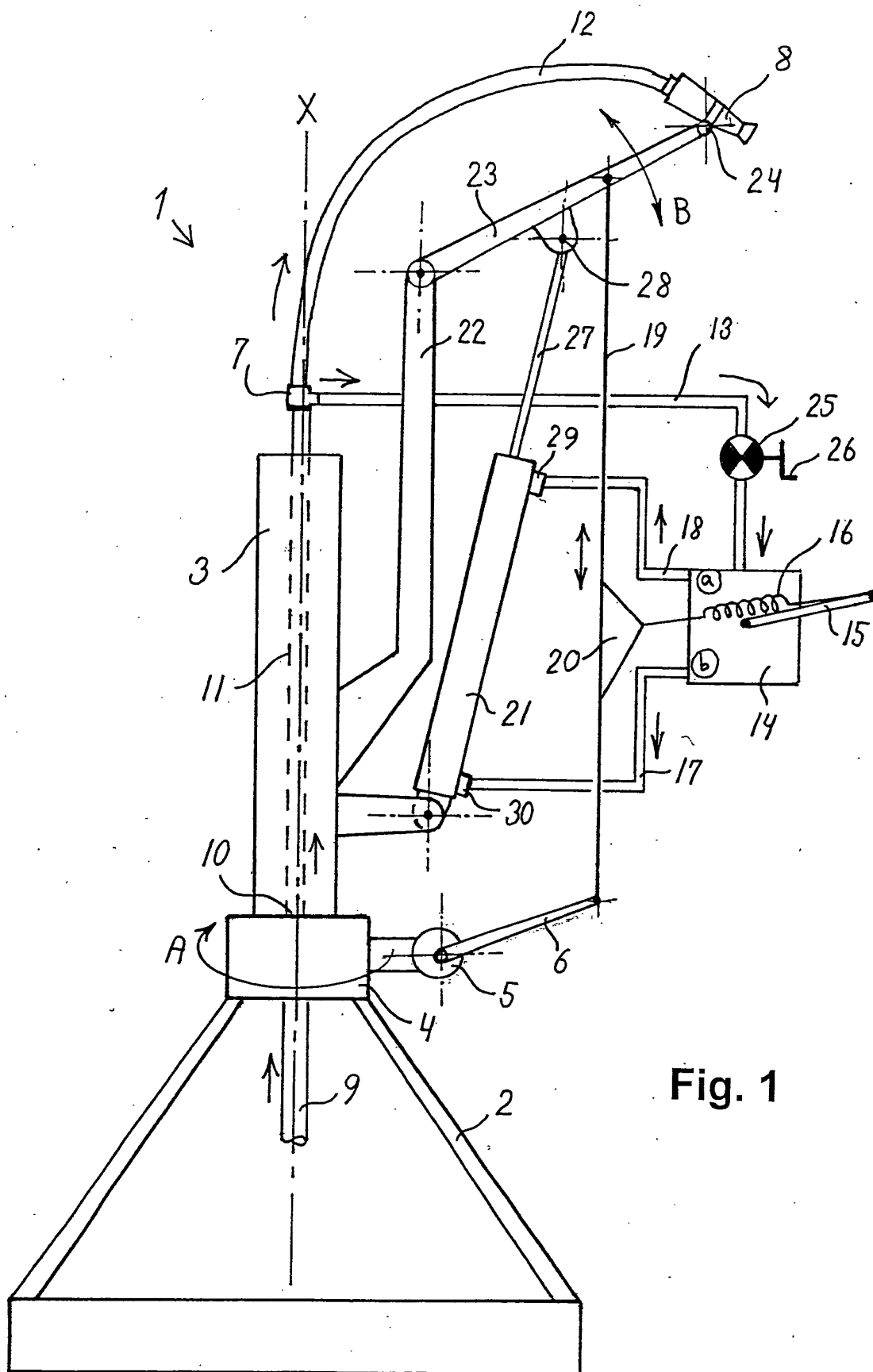


Fig. 1

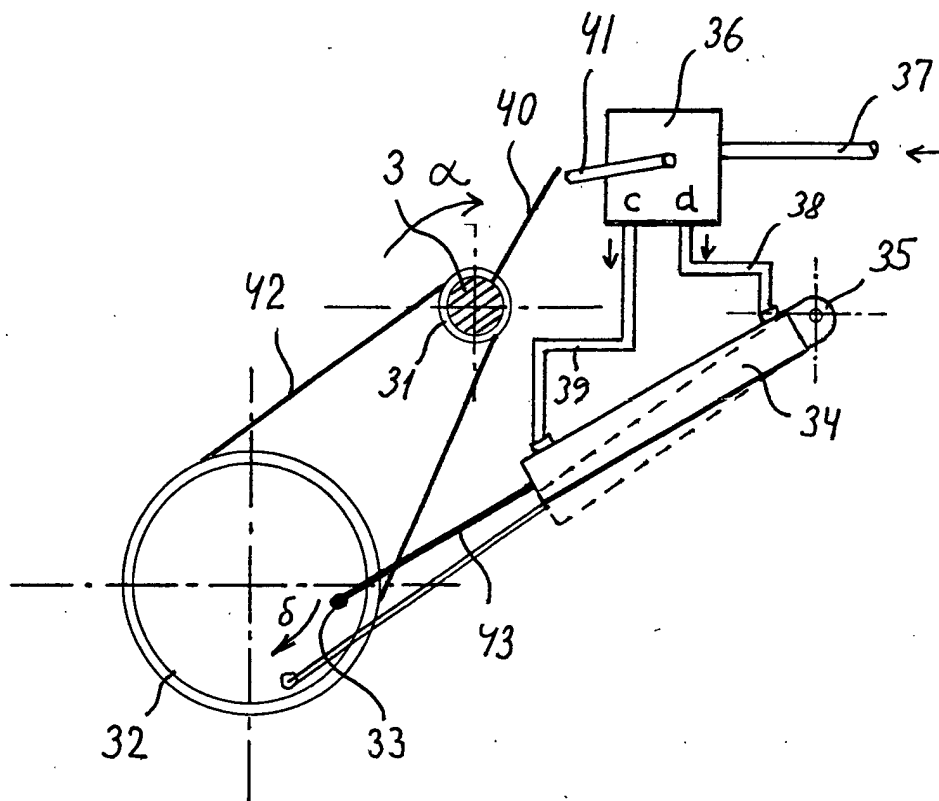


Fig.2



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 03 00 0865

DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	US 5 462 227 A (PING WU K) 31 October 1995 (1995-10-31) * figures 7,8 *	21	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B05B B08B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 May 2003	Examiner Brévier, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 00 0865

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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20-05-2003

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