



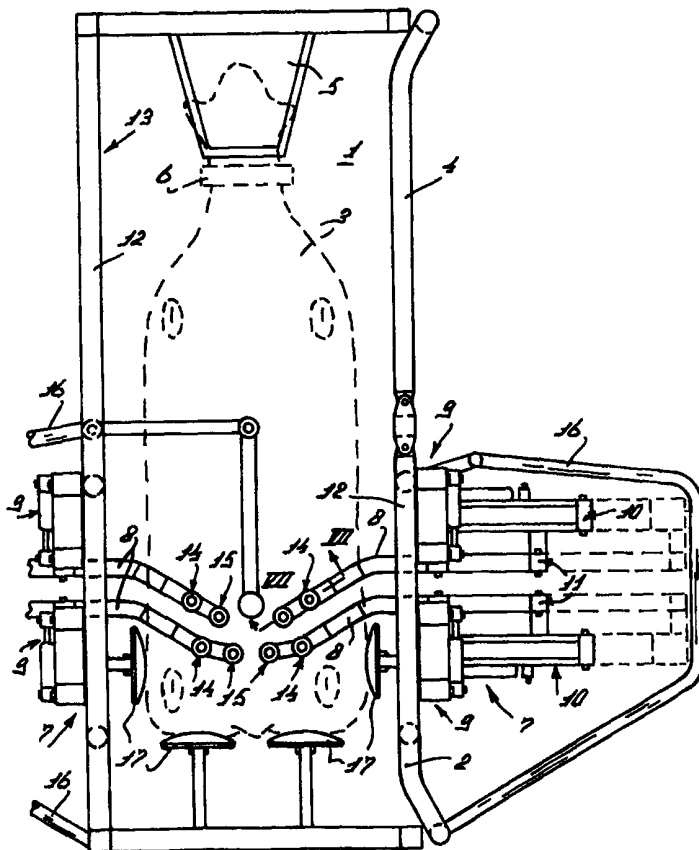
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: AN IMPLEMENT FOR MILKING ANIMALS

(57) Abstract

In an implement for milking animals, which implement comprises a milkbbox (1) and a milking robot (7) including a number of robot arms (8) for the positioning of means for treating the teats of an animal (3) to be milked, either at least one robot arm (8) is provided with one single milking member (14) and at least one separate pre-treatment member (15), or at least one robot arm (8) is provided with at least one milking member (14) and at least two separate pre-treatment members (15), or at least two robot arms (8) are each provided with a milking member (14) and a separate pre-treatment member (15). The implement can be controlled in a simple and accurate manner on the one hand and is adapted to operate quickly and efficiently on the other hand.



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AN IMPLEMENT FOR MILKING ANIMALS

The invention relates to an implement for milking animals as described in the preamble of claim 1.

5 Implements are known in which the milking members are also used for pre-treatment of the teats of an animal to be milked. This has inter alia the disadvantage that the milking members are contaminated, so that they have to be cleaned before milking, which is a time-consuming and laborious process. Furthermore implements are known in which
10 pre-treatment members are positioned with the aid of separate robot arms. Such implements are laborious and expensive. Finally implements are known in which one single robot arm is used to position milking members and a pre-treatment member.

15 The invention aims at obviating the above-mentioned drawbacks and to provide an implement which on the one hand can be controlled in a simple and accurate manner and on the other hand is adapted to operate quickly and efficiently. According to the invention this is achieved by means of the measures mentioned in the characterizing part of claim 1 or
20 claim 2 or claim 3. An implement having per robot arm one single milking member and a separate pre-treatment member can be controlled accurately and renders an efficient milking process possible. Moreover the robot arm is multifunctional and still compact. An implement having per robot arm at least
25 two pre-treatment members enables a quick and efficient pre-treatment stage. Several robot arms having both a milking member and a pre-treatment member offer on the one hand the possibility of performing the pre-treatment stage and the subsequent milking stage in a flexible and efficient manner
30 and have on the other hand the advantage that positioning of

the milking members for the milking stage is very simple.

According to an inventive feature, at least one of said pre-treatment members is adapted to clean and/or to stimulate and/or to foremilk the relevant teat. According to a further inventive feature, at least one pre-treatment member is fastened to the robot arm so as to be movable relative to at least one milking member (e.g. in a manner in which it is rotatable or in which it is movable upwards and downwards). Because of this measure the pre-treatment member can be positioned during the milking stage so as not to form an obstacle. According to a further inventive feature, the relative movement of the pre-treatment member in relation to the milking member can be realized by means of a driving mechanism.

In accordance with a further inventive feature, the pre-treatment member is provided with a movable, substantially cylindrical or conical case that can be rotatable or movable in upward and downward direction and possibly capable of being driven. According to a further inventive feature, the inside of the case is provided with a profile that facilitates the pre-treatment of the teats. For that purpose the profile may extend substantially as a spiral. According to a further inventive feature, the inside of the case consists predominantly of a soft material, such as rubber or a soft synthetic material.

According to a further aspect of the invention, the pre-treatment member is provided at its lower side with a discharge opening. As a result thereof, material that has been used or has appeared during the pre-treatment of the teats can be discharged in a simple manner. According to a further inventive feature, the teat opening of the milking member and that of the pre-treatment member are located almost at the same level. This simplifies the positioning of the milking members for the milking stage.

In accordance with a further inventive feature, the pre-treatment member is provided with at least one supply line for cleaning and/or disinfecting fluid for the relevant teat. The pre-treatment member can be provided with a connecting piece for the supply line, said connecting piece

being bearing-supported so as to be rotatable and/or slidable. Because of this measure the relative movement of the pre-treatment member in relation to the milking member can be carried out without encountering any problems.

5 According to a further inventive feature, the milking member is provided with means for detecting milk that is suitable for consumption and with means for discharging this consumable milk separately. According to another aspect of the invention, the milking robot comprises a control
10 mechanism for the robot arms, which control mechanism is adapted to connect the pre-treatment members to the teats in a pre-treatment stage, and to connect the milking members to the teats in a subsequent milking stage.

15 In a preferred embodiment of the invention, the milking robot is provided with means for detecting the condition of the teats of an animal to be milked, while the control mechanism, depending on the detected condition, connects the pre-treatment members to the relevant teats. According to an aspect of the invention, the control
20 mechanism, depending on the detected condition, regulates the sequence and/or the duration of the connection of the pre-treatment members to the teats. In this manner there can be applied a longer pre-treatment, e.g. in case of highly contaminated teats, while less contaminated teats can already
25 be milked simultaneously. It is also possible first to connect the pre-treatment members to highly contaminated teats, while at the end of the pre-treatment stage the pre-treatment members can be disconnected almost simultaneously.

30 According to a further aspect of the invention, in the implement for milking animals the robot arms comprise at least one hingeable construction, such as a quadrangular hinge construction or a parallelogram construction, of which at least one hinge point is provided with a ball bearing.
35 Such ball bearings enable the hingeable construction to carry out the movements imposed by the control mechanism of the milking robot more quickly. Moreover such bearings only need to be greased once.

 In accordance with a further inventive feature, all

hinge points of the hingeable construction are provided with ball bearings, so that the entire robot arm can move more quickly. According to a further inventive feature, at least one hinge point of the hingeable construction is provided with a clinometer for determining the orientation of the robot arm.

The invention will be explained in further detail with reference to the accompanying drawings.

Figure 1 is a side view of the implement for automatically milking animals;

Figure 2 is a plan view of the implement shown in Figure 1;

Figure 3 is a rear view of the implement of Figures 1 and 2;

Figure 4 is a schematic side view of a robot arm;

Figure 5 is a cross-section taken on the line V - V in Figure 4;

Figure 6 is a plan view of a detail of the robot arm of Figure 4 according to the arrow VI in the latter figure;

Figure 7 is a schematic cross-section taken on the line VII - VII in Figure 2, and

Figure 8 shows schematically another embodiment of the implement.

Figures 1, 2 and 3 are a side view, a plan view and a rear view respectively of the implement for automatically milking animals according to the invention. The implement comprises a milk stand in a milkbox 1 which is provided in longitudinal direction at one lateral side with an entrance door 2 via which an animal 3 to be milked can enter the milkbox 1, and an exit door 4 via which the animal 3 can leave the milkbox 1. In the front part of the milkbox 1 there is provided a feed trough 5 in which fodder, such as e.g. concentrate, can be fed to the animal 3 by means of a (non-shown) fodder metering system. The entrance door 2 and the exit door 4 can be operated automatically by means of a non-shown computer. The animal 3 is provided with a collar 6 with a transponder which is adapted to cooperate with a (non-shown) animal identification system, so that the animal 3 in

the milkbox 1 can be automatically identified. Of course it is also possible to connect the transponder to the animal 3 in another manner, e.g. by injecting same.

5 The milkbox 1 further comprises a milking robot 7 having a number of (e.g. four) robot arms 8 for positioning means for treating the teats of the animal 3 to be milked. The robot arms 8 are each fastened to upper beams 12 of a frame 13 of the milkbox 1 by means of three hingeable constructions, such as e.g. parallelogram constructions 9, 10 and 11. The parallelogram constructions 9, 10 and 11 can be automatically controlled by means of non-shown control means and enable each of the robot arms 8 to carry out movements in three dimensions. The control means may comprise servo-pneumatic and/or servo-hydraulic cylinders (see Figures 15 1 - 3) and/or stepper motors.

In the embodiment shown all four robot arms 8 are each provided with one milking member 14 and a separate pre-treatment member 15. Each milking member 14 is adapted to milk one of the teats of the animal 3 to be milked and comprises for that purpose a teat cup (known per se) for collecting and conveying the milk yielded, the inside of said teat cup being provided with pulsation means, as will be explained in further detail with reference to Figure 7. Each pre-treatment member 15 is adapted to clean and/or to stimulate and/or to foremilk one of the teats of the animal 3 to be milked, as will be explained in further detail, also with reference to Figure 7.

Protective brackets 16 (see Figure 2) ensure the protection of the parallelogram constructions 9, 10, 11 with the robot arms 8. The robot arms 8 are also provided with non-shown detectors for an accurate determination of the position of the teats of the animal 3 to be milked in relation to the relevant robot arms 8. The milkbox 1 is further provided with sensors 17 for determining the position of the animal 3 in relation to the milkbox 1. On the basis of this position, again with the aid of a non-shown computer, the control means are capable of post-controlling the milking members 14 and/or the pre-treatment members 15 for the purpose of tracking possible movements of the animal 3 in the

milkbox 1. As shown, the four mechanical sensors 17 are located beside and behind the animal 3. For example with the aid of stepper motors, they are kept with an adjustable light pressure against the animal 3, so that they remain permanently in contact with the animal 3 and every movement can be tracked accurately. To that end the sensors 17 are connected to non-shown receiving elements which generate control signals for the control means of the parallelogram constructions 9, 10, 11.

Figure 4 is a schematic side view of a robot arm in a milking position. The robot arm 8 is connected to the frame 13 of the milkbox 1 via the parallelogram constructions 11, 10 and 9 (non-shown in the present figure; see Figures 1 - 3). The parallelogram construction 9 ensures substantially the movement of the robot arm in the longitudinal direction of the milkbox 1. The parallelogram constructions 10 and 11 allow a movement perpendicular to said longitudinal direction and predominantly horizontal, vertical respectively.

The parallelogram constructions 9, 10 and 11 each comprise four arms 18 which are arranged in the shape of a parallelogram via hinge points 19. Furthermore controllable servo-pneumatic (and/or servo-hydraulic) cylinders 20 are hingeably fastened to two opposite sides of the parallelogram, in such a manner that the relevant parallelogram construction is movable by a movement of the piston in the cylinder 20.

At its end being the left-hand one in Figure 4, the robot arm 8 is provided with a milking member 14 and a separate pre-treatment member 15, the latter being fastened to the robot arm 8 so as to be movable relative to the milking member 14. In the embodiment shown the pre-treatment member 15 is rotatably disposed about a central axis of the almost cylindrical milking member 14, as will be explained in further detail with reference to Figure 7.

Figure 5 shows a cross-section taken on the line V - V in Figure 4. The hinge point 19 between the arms 18 of the parallelogram construction 11 is provided with ball bearings 21. Because of the small frictional forces in the ball bearings 21, the hinge point, and along therewith the

entire parallelogram construction, can move more quickly, so that a quicker control of the milking robot 7 is possible. In Figure 5 the upper arm 18 is bearing-supported in the hinge point 19 by means of a central pin, represented as a horizontal one, which is bearing-supported in the ball bearings 21 and which is rigidly connected to the upper arm 18. For the purpose of determining the orientation of the robot arm 8, the hinge point 19 is further provided with a clinometer 22 that cooperates with the aforementioned pin. Consequently, a high degree of accuracy in the movement of the robot arm 8 can be obtained. Instead of the parallelogram constructions 9, 10, 11, there may also be used, of course, other hingeable constructions, such as quadrangular hinge constructions.

Figure 6 shows a plan view of a detail of the robot arm of Figure 4 according to the arrow VI in said figure. The milking member 14, which is substantially cylindrical, and the pre-treatment member 15, which is substantially cylindrical as well, are fastened to the robot arm 8 so as to be almost parallel to each other, the pre-treatment member 15 being rotatably disposed around the milking member 14 and being provided with a supply line 23 for cleaning and/or disinfecting fluid for the relevant teat. For the purpose of enabling a rotating movement of the pre-treatment member 15 around the milking member 14 without encountering any problems, the supply line 23 is provided with a connecting piece that is rotatably bearing-supported, as will be explained in further detail with reference to Figure 7.

Figure 7 is a schematic cross-section taken on the line VII - VII in Figure 2. The end of the robot arm 8 is provided with a milking member 14 and a separate pre-treatment member 15 which is fastened to the robot arm 8 so as to be movable (rotatably or slidably) relative to the milking member 14. In the embodiment shown the pre-treatment member 15 is rotatably disposed about a central axis of the substantially cylindrical milking member 14.

Each milking member 14 is adapted to milk one of the teats of the animal 3 to be milked and comprises for that purpose a teat cup 24 (known per se) for collecting and conveying the milk yielded, the inside of said teat cup 24

being provided with (non-shown) pulsation means, such as a flexible, transformable inner case which, with the aid of air-pressure changes produced by a pulsation line 25, alternately milks and releases the relevant teat. Via a milk line 26, in which there is a permanent vacuum (i.e. a lower pressure than the atmospheric pressure), the milk is discharged from the teat cup 24 to a valve 27 which, depending on a signal supplied by a milk quality sensor 28, guides the consumable milk into the production milk line 29 and the other substances (such as e.g. foremilk if any or cleaning fluid) into the residue line 30.

A motor 31 (e.g. a stepper motor) is adapted to drive an annular sleeve 32 that is rotatably bearing-supported around the teat cup 24, to which annular sleeve 32 the pre-treatment member 15 is fastened. Each of the pre-treatment members 15 is adapted to clean and/or to stimulate and/or to foremilk one of the teats of the animal 3 to be milked. To that end the pre-treatment member 15 is provided with a movable, substantially cylindrical or conical case 33. This case 33 is movable in upward and downward direction or, like in the embodiment shown, rotatably bearing-supported in the housing 34 of the pre-treatment member 15 and drivable with the aid of a motor 35 (e.g. a stepper motor).

For the purpose of improving the cleaning and/or the stimulating process of the teat, the inside of the case 33 is provided with a profile 36 which extends substantially as a spiral. The inside of the case 33 preferably consists of a soft material, such as rubber or a soft synthetic material. The lower side of the pre-treatment member 15 is provided with a discharge opening 37 via which cleaning and/or disinfecting fluid and/or foremilk if any can be discharged without the milking member 14 being contaminated. The teat opening of the milking member 14 and that of the pre-treatment member 15 are located almost at the same level.

The supply line 23 for cleaning and/or disinfecting fluid is provided with a connecting piece 38 which is rotatably bearing-supported and whose orientation at a rotation of the pre-treatment member 15 around the milking member 14 remains almost equal. Of course, in the situation

of a slidable pre-treatment member 15, the connecting piece 38 can be bearing-supported so as to be slidable as well, in order to avoid problems with the supply line 23 at a sliding movement of the pre-treatment member 15.

5 In Figure 7 the robot arm 8 is shown in a pre-treatment position: the teat can be pre-treated in the pre-treatment member 15. When the pre-treatment stage has ended, in the subsequent milking stage the milking member 14 is connected to the relevant teat by the control mechanism.
10 After the pre-treatment member 15 has been disconnected from the teat, said pre-treatment member 15 is rotated away by means of the motor 31, whereafter the robot arm 8 brings the milking member 14 to the place that was previously occupied by the pre-treatment member 15. This positioning is very
15 simple because of the fact that the position of the pre-treatment member 15 is already known. By rotating the pre-treatment member 15 away, the latter is prevented from forming an obstacle in the milking stage and e.g. from obstructing the other robot arms 8. In Figures 4 and 6 the
20 robot arm 8 is shown in a milking position: the pre-treatment member 15 has been rotated away and the teat can be milked in the milking member 14. For the purpose of assuming the pre-treatment position, the pre-treatment member 15 is pivoted back into the position shown in Figure 7 by means of
25 the motor 31.

Figure 8 shows schematically another embodiment of the implement. Two robot arms 8 are each provided with two milking members 14 and two separate pre-treatment members 15. This embodiment has the advantage that the pre-treatment
30 stage can be performed quickly. The control is simple because of the fact that there are provided only two robot arms 8. Moreover the movable pre-treatment members 15 enable a highly accurate and quick positioning.

35 The implement according to the invention makes it possible to perform the pre-treatment stage quickly and efficiently while making use of simple means. Furthermore the pre-treatment stage and the milking stage for different teats can be performed in a different manner and be attuned to the specific conditions. Moreover, because of the mutual

movability of the pre-treatment member 15 and the milking member 14, the robot arms 8 are compact and not unnecessarily large in size.

CLAIMS

1. An implement for milking animals, which implement comprises a milking robot (7) including a number of robot arms (8), characterized in that at least one robot arm (8) is provided with one single milking member (14) and at least one separate pre-treatment member (15).
2. An implement for milking animals, which implement comprises a milking robot (7) including a number of robot arms (8), characterized in that at least one robot arm (8) is provided with at least one milking member (14) and at least two separate pre-treatment members (15).
3. An implement for milking animals, which implement comprises a milking robot (7) including a number of robot arms (8), characterized in that at least two robot arms (8) are each provided with at least one milking member (14) and at least one separate pre-treatment member (15).
4. An implement as claimed in any one of claims 1 - 3, characterized in that the pre-treatment member(s) (15) is/are adapted to clean and/or to stimulate and/or to foremilk the relevant teat.
5. An implement as claimed in any one of claims 1 - 4, characterized in that at least one pre-treatment member (15) is fastened to the robot arm (8) so as to be movable relative to at least one milking member (14).
6. An implement as claimed in claim 5, characterized in that the pre-treatment member (15) is fastened to the robot arm (8) so as to be rotatable or movable in upward and downward direction.
7. An implement as claimed in any one of claims 5 or 6, characterized in that the relative movement of the pre-treatment member (15) in relation to the milking member (14) can be realized by means of a driving mechanism (31).
8. An implement as claimed in any one of claims 1 - 7, characterized in that the pre-treatment member (15) is provided with a movable, substantially cylindrical or conical case (33).
9. An implement as claimed in claim 8, characterized in that the case (33) is rotatable or movable in upward and

downward direction.

10. An implement as claimed in any one of claims 8 or 9, characterized in that the case (33) is drivable.

11. An implement as claimed in any one of claims 8 - 10, characterized in that the inside of the case (33) is provided with a profile (36).

12. An implement as claimed in claim 11, characterized in that the profile (36) extends substantially as a spiral.

13. An implement as claimed in any one of claims 8 - 12, characterized in that the inside of the case (33) consists predominantly of a soft material, such as rubber or a soft synthetic material.

14. An implement as claimed in any one of claims 1 - 13, characterized in that the lower side of the pre-treatment member (15) is provided with a discharge opening (37).

15. An implement as claimed in any one of claims 1 - 14, characterized in that the teat opening of the milking member (14) and that of the pre-treatment member (15) are located almost at the same level.

16. An implement as claimed in any one of claims 1 - 15, characterized in that the pre-treatment member (15) is provided with at least one supply line (23) for cleaning and/or disinfecting fluid for the relevant teat.

17. An implement as claimed in claim 16, characterized in that the pre-treatment member (15) is provided with a connecting piece (38) for the supply line (23), said connecting piece being bearing-supported so as to be rotatable and/or slidable.

18. An implement as claimed in any one of claims 1 - 17, characterized in that the milking member (14) is provided with means (28) for detecting milk that is suitable for consumption and with means (27, 29, 30) for discharging this consumable milk separately.

19. An implement as claimed in any one of claims 1 - 18, characterized in that the milking robot (7) comprises a control mechanism for the robot arms (8), which control mechanism is adapted to connect the pre-treatment members (15) to the teats in a pre-treatment stage, and to connect

the milking members (14) to the teats in a subsequent milking stage.

20. An implement as claimed in claim 19, characterized in that the milking robot (7) comprises means for detecting the condition of the teats of an animal (3) to be milked, while the control mechanism, depending on the detected condition, connects the pre-treatment members (15) to the relevant teats.

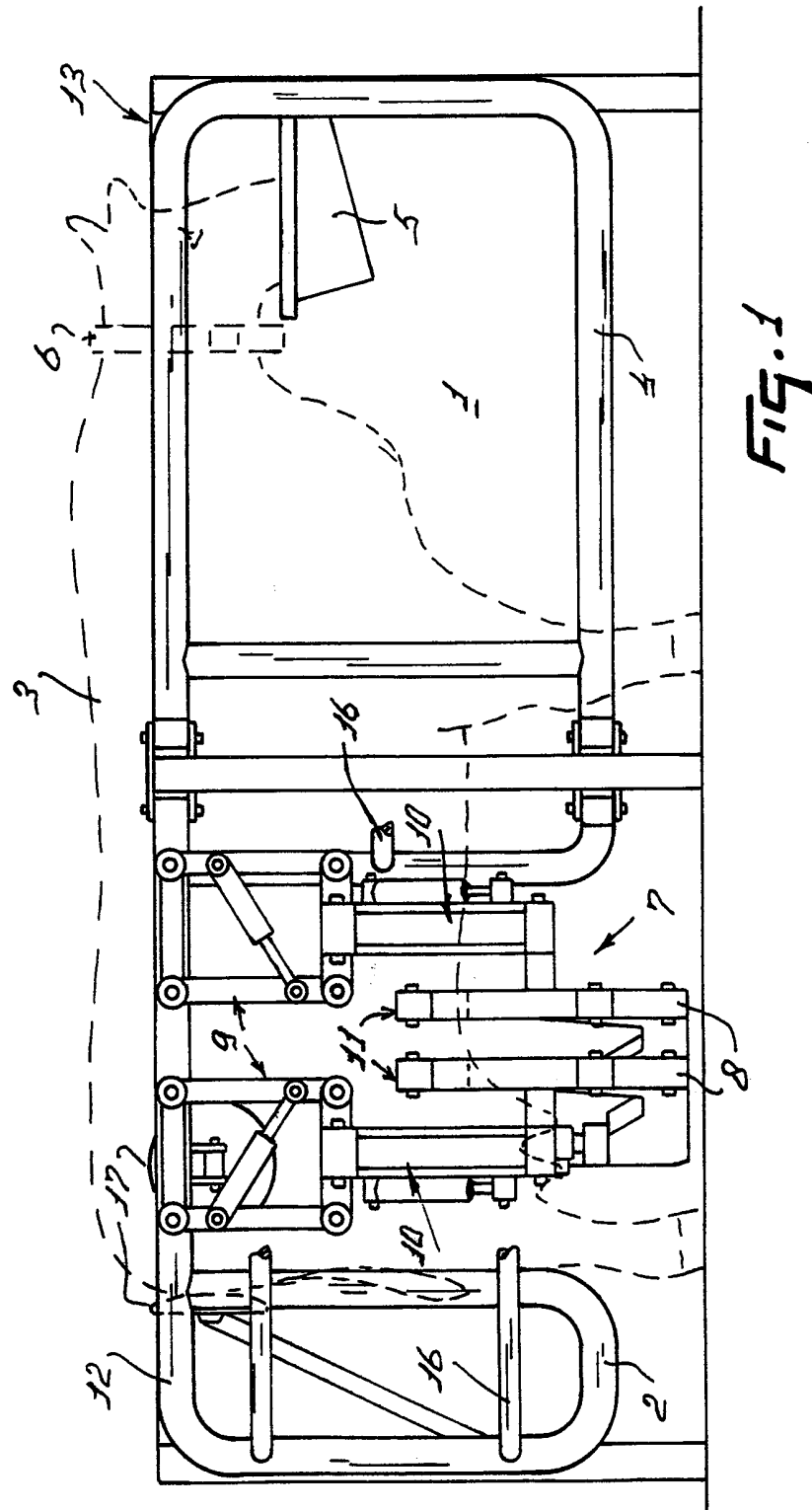
21. An implement as claimed in claim 20, characterized in that the control mechanism, depending on the detected condition, regulates the sequence and/or the duration of the connection of the pre-treatment members (15) to the teats.

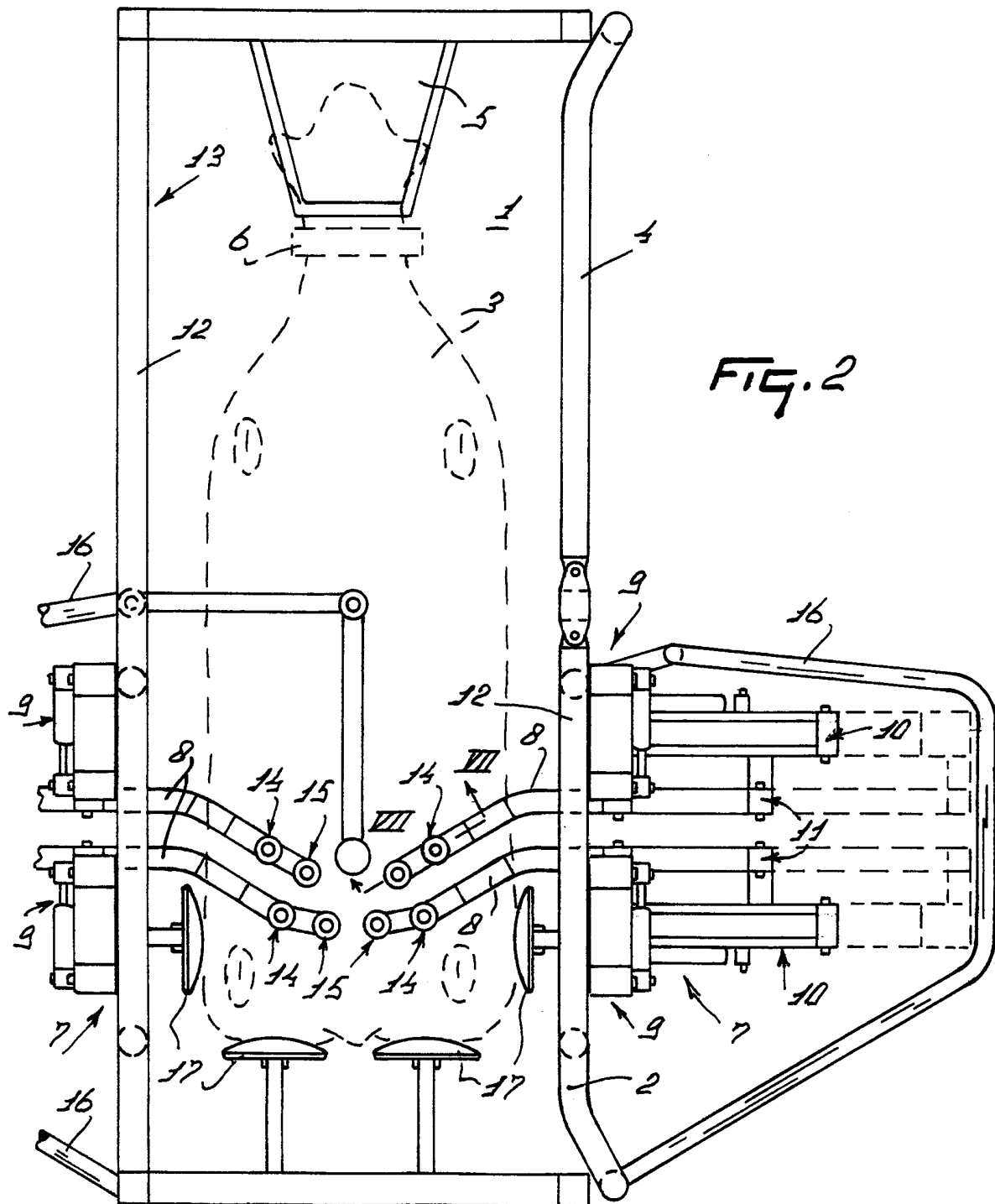
22. An implement for milking animals, which implement comprises a milking robot (7) including a number of robot arms (8), characterized in that the robot arms (8) comprise at least one hingeable construction (9, 10, 11), such as a quadrangular hinge construction or a parallelogram construction, of which at least one hinge point (19) is provided with a ball bearing (21).

23. An implement as claimed in any one of claims 1 - 21, characterized in that the robot arms (8) comprise at least one hingeable construction (9, 10, 11), such as a quadrangular hinge construction or a parallelogram construction, of which at least one hinge point (19) is provided with a ball bearing (21).

24. An implement as claimed in claim 22 or 23, characterized in that all hinge points (19) of the hingeable construction (9, 10, 11) are provided with ball bearings (21).

25. An implement as claimed in any one of claims 22 - 24, characterized in that at least one hinge point (19) of the hingeable construction (9, 10, 11) is provided with a clinometer (22) for determining the orientation of the robot arm (8).





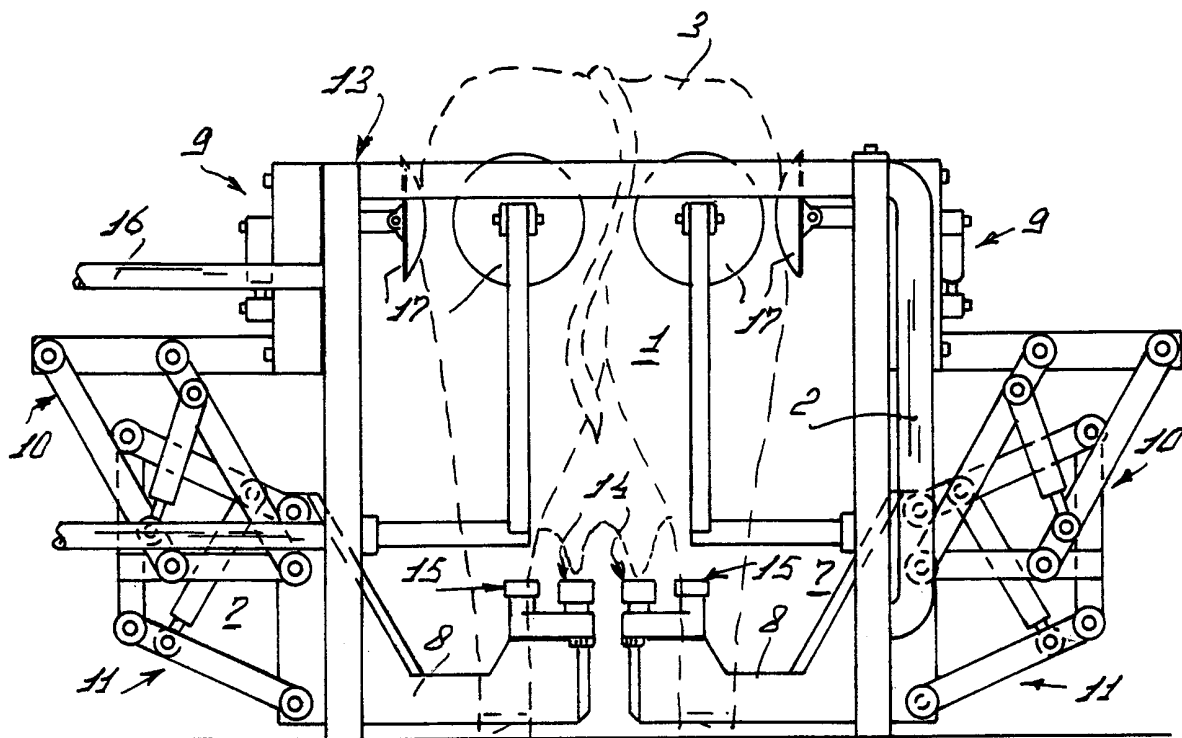


FIG. 3

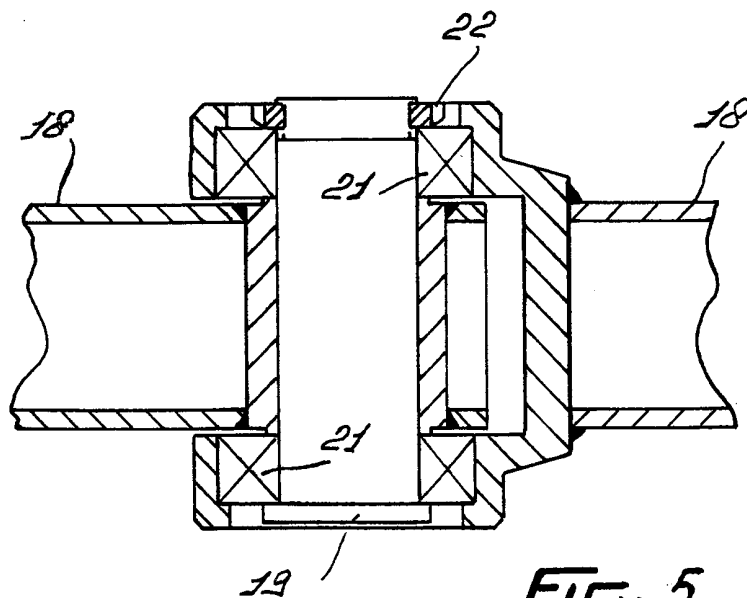
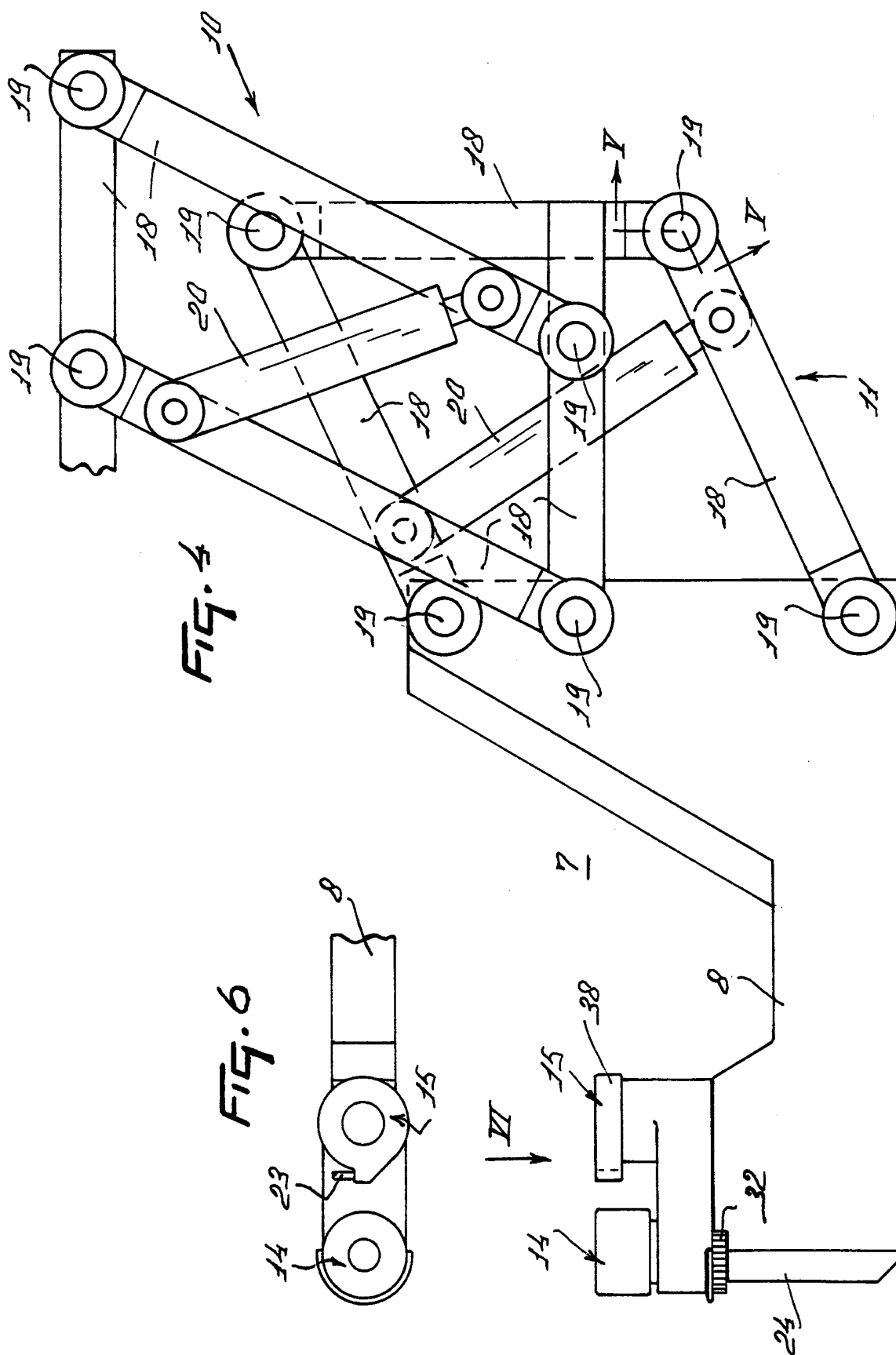
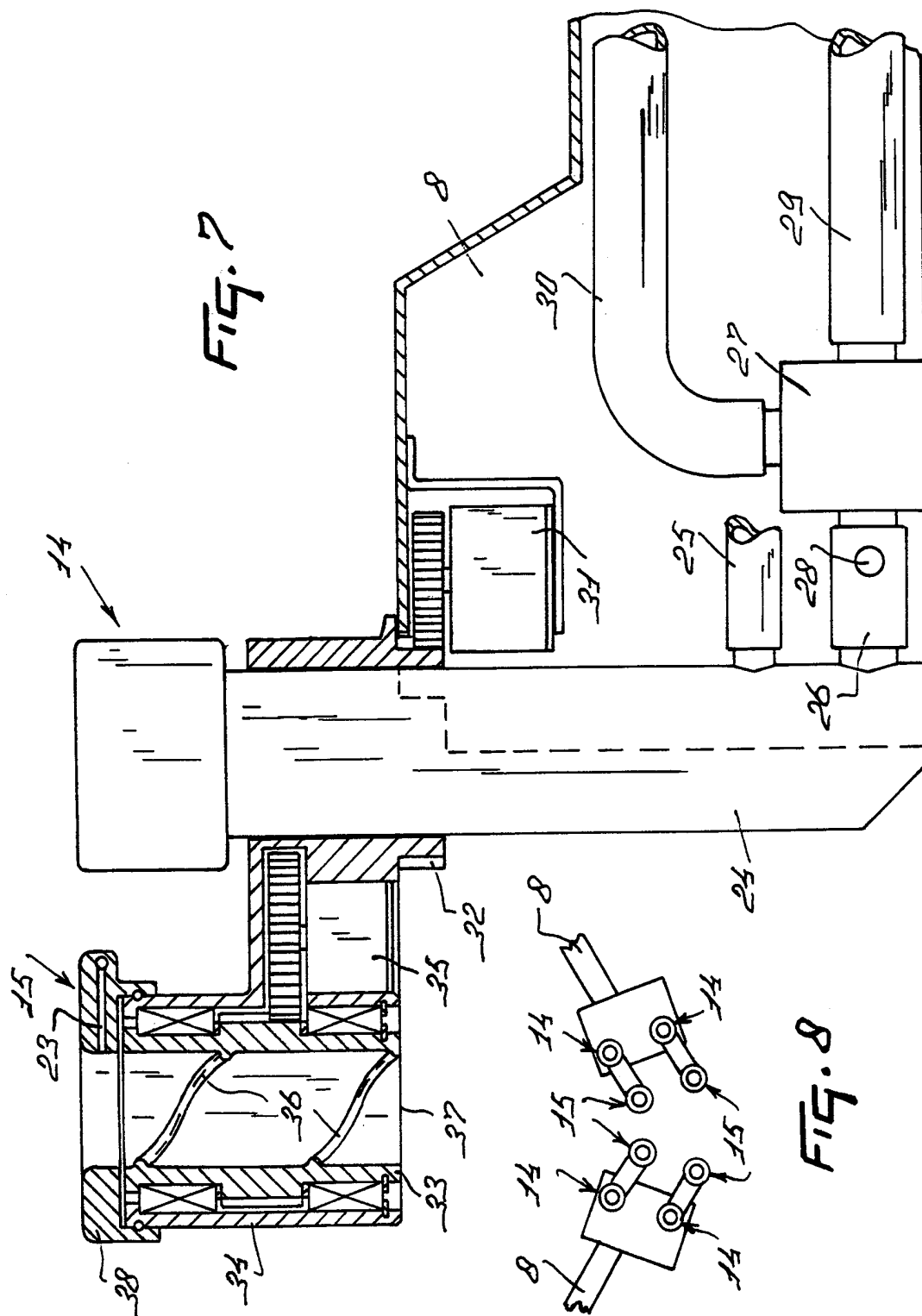


FIG. 5





INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 98/00669

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A01J5/017 A01J7/04

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)

IPC 6 A01J

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 789 995 A (MAASLAND NV) 20 August 1997	1,4-7,19
A	see column 1, line 20 - line 29 see column 4, line 54 - column 5, line 58 see claims; figures	2,3
A	--- EP 0 801 893 A (MAASLAND NV) 22 October 1997 see column 1, line 23 - column 2, line 10 see column 4, line 15 - column 6, line 19 see claims; figures	1-6
A	--- EP 0 728 412 A (MAASLAND NV) 28 August 1996 see column 1, line 6 - line 24 see column 1, line 39 - column 2, line 10 see column 4, line 43 - column 5, line 13 see claims; figures	1-4
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

2 February 1999

Date of mailing of the international search report

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 11568 A (MAASLAND NV ;LELY CORNELIS V D (CH)) 25 April 1996 see claims; figures -----	1-4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NL 98/ 00669

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-21, 23-25

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-21 and 23 to 25 as far as related to 1-21

An implement for milking animals, comprising a milking robot including a number of robot arms, whereby at least one robot arm is provided with one single milking member and at least one separate pre-treatment member

2. Claims: 22

An implement for milking animals, comprising a milking robot including a number of robot arms, whereby the robot arms comprise at least one hingeable construction

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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