



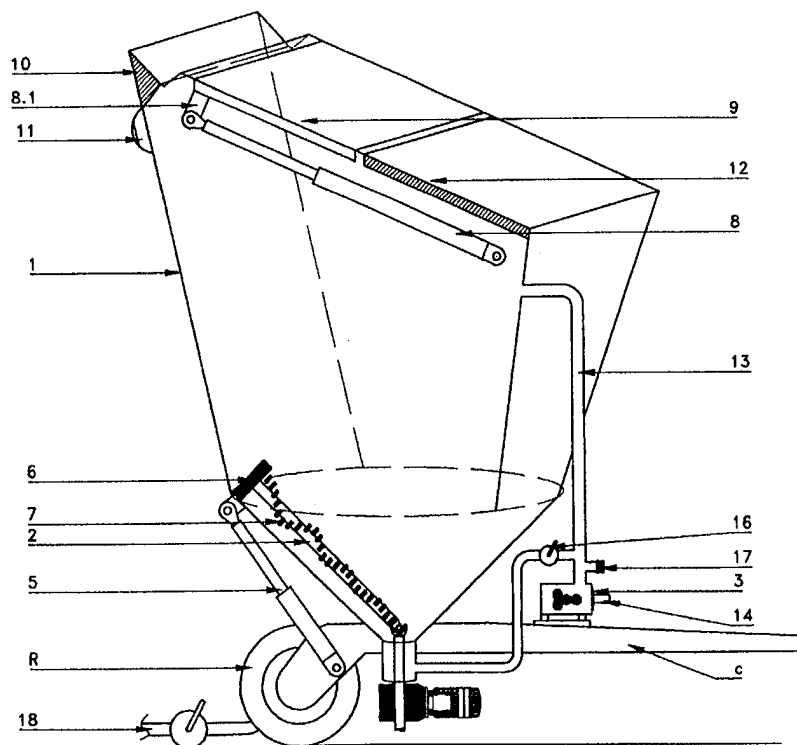
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: APPARATUS FOR DISPLACING A PRODUCT SUITABLE FOR PUMPING

## (57) Abstract

The invention relates to an apparatus for displacing a product suitable for pumping, comprising a storage container (1) having a funnel-shaped bottom provided with a discharge channel, and having at the top a sealable opening intended for filling the storage container. The storage container is at the funnel-shaped side provided with a rotatable element (2) to prevent coagulation of the product.



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Apparatus for displacing a product suitable for pumping

The present invention relates to an apparatus for displacing a product suitable for pumping, comprising a storage container provided with a discharge channel, and a sealable filling opening.

5           The present invention relates in particular to an apparatus for displacing a product suitable for pumping, comprising a storage container having a funnel-shaped bottom provided with a discharge channel, and having at the top a sealable opening for filling the storage  
10 container.

Such an apparatus is known from practice in the agricultural field, but also finds application elsewhere, and serves for pneumatically displacing products, which are hard to pump, such as chips, sawdust, wood rasp,  
15 feathers, litter, chopped straw, textiles or other fibres, plastic or paper shreds, and the like. The main problem in pneumatically pumping of a product is the occurrence of a blockage in the supply to the discharge channel. It is an objective of the invention to overcome this problem  
20 completely, and to achieve further advantages, which will be elucidated below.

To achieve the objective of the invention, the apparatus is characterized in that the storage container is at the funnel-shaped side provided with a rotatable  
25 element within the storage container to prevent coagulation of the product. This is easily to be achieved by forming the rotatable element as a bar or rod, which can be displaced along the funnel-sided wall of the storage container.

30           The blockage of the supply to the discharge channel will be optimally prevented when the rotatable element is a bar or rod, which can be rotated along its longitudinal axis. In that case it is also useful that scraping elements are provided on the rotatable element. These may  
35 be simple round or flat pieces of metal being welded perpendicularly onto the rotatable element and long enough to also prevent coagulation of the product.

These pins or blades may be distributed regularly or irregularly, but it is preferred that the scraping elements are positioned spirally on the rotatable element. This will induce an upwards movement of the product in the storage container. The blades also have the characteristic that they will aerate the product, which will result in an as loose as possible composition in the storage container.

In an alternative embodiment the rotatable element is provided with regularly distributed knife-blades. The product in the storage container will then also be ground.

For this grinding operation to produce a finer product, regularly distributed knives may be provided on the funnel-shaped side of the internal wall of the storage container, which knives are shifted with respect to the knife-blades on the rotatable element. Of course the fineness of the grinding can be determined by selecting the desired number of knives, as well as by an appropriate choice of the rotational speed of the rotatable element.

In yet another embodiment the rotatable element is provided with a spirally-shaped cover. This will impart a mixing function of the rotatable element. The spirally-shaped cover preferably has a sharp edge, which - contrary to a rounded edge - also grinds the product.

The drive of the rotatable element is preferably realized in such a way that the rotatable element is coupled via a cardan joint with a drive shaft partially extending through the discharge channel coupled to a drive aggregate. The drive as such can then be positioned outside the storage container, so that it is not hindered by the product in the storage container. Via the cardan joint the drive at any moment easily adapts to the position of the rotatable element in the storage container.

In addition it is desirable that the rotatable element is provided with a wheel to support the element at the funnel-sided wall of the storage container. The spirally-shaped cover or the knives provided on the rotatable element will then always maintain a spaced

relationship with the funnel-sided bottom wall of the storage container.

If the embodiments are equipped with knife-blades or the spirally-shaped cover, it is preferred that the wheel is coupled with the rotatable element via a reduction device, for instance an epicycloidal reduction allowing the rotatable element to rotate around its axis at a high speed, while the wheel and the axis itself rotate at a lower speed in the storage container.

In a certain aspect of the invention the apparatus is characterized in that an arm is attached to the drive shaft, and in that the discharge channel comprises a transport tube having a slot, which transport tube is provided with a coupling flange for coupling a flexible discharge hose, through which slot in the transport tube the arm moves during rotation of the drive shaft. In this embodiment an accumulation of the product in the opening of the transport tube is prevented, because the arm attached to the drive shaft removes a possibly formed blockage with every rotation while moving through the slot. Optionally further arms can be provided on the drive shaft at other positions in the discharge channel in order to prevent blockages. The blockage problem occurs more often when foreign objects are present in the product to be transported, such as pieces of wood, pieces of plastic, and the like. Since such foreign objects are removed with force, both the transport tube having a slot and the rotating arm must be solidly made. In order to prevent the blockage problem further, the transport tube as well as the flexible discharge hose should have an identical internal diameter along their entire lengths.

In order to allow for filling and discharging of the storage container in various ways, the apparatus according to the invention is further characterized in that the sealable opening for filling the storage container can be hermetically sealed, and in that means are provided for changing the pressure in the storage container. One embodiment of the apparatus according to the invention is therefore provided with a compressor

being connected to the storage container via a conduit, so that the storage container can be set at a certain pressure in order to be able to achieve the pneumatic transport of the product in the storage container.

5           It is sometimes advantageous to connect the compressor with a controllable coupling to a supply point on the transport tube for secondary air. This promotes the transport of the product through the transport tube. For proper control of the transport of the product a shut-off  
10 valve is incorporated in the transport tube. In another embodiment with improved ease of operation the apparatus according to the invention may be equipped with a flexible discharge hose incorporating a manually operated shut-off valve. It is further desirable that a pressure regulator  
15 is connected to the transport tube.

          Preferably said compressor is provided with a coupling for connecting a drive aggregate, preferably a tractor. Especially in the agricultural field, where the apparatus according to the invention may be conveniently  
20 employed, often a mobile apparatus according to the invention is used. The apparatus is usually moved by means of a tractor, which is already available and then can serve to drive the compressor at the same time.

          In an alternative embodiment of the apparatus  
25 according to the invention the compressor is operated as a vacuum pump to create a negative pressure in the storage container and a dust filter is connected to the storage container, which dust filter can be coupled to the vacuating side of the compressor, and the storage  
30 container is further provided with a suction hose. This allows the product later to be pumped, to be sucked into the storage container, and at the same time removes dust from the product being sucked.

          Yet another embodiment of the apparatus according  
35 to the invention is characterized in that the rotatable element is an upwards tapered screw-like spiral element. Such an embodiment is especially suitable for the automatic processing and dosing of ensilage, the ensilage being ground and intensively mixed. In this embodiment it

is desirable that knives are provided on the spirally-shaped element. Particularly when also additional knives are provided on the funnel-sided wall of the storage container, very efficient chopping of the feed will be ensured. In this embodiment it is further desirable that the drive shaft of the spiral element is provided with at least one fixed arm. In this way the product is prevented from coagulation in the storage container.

For all embodiments it may further be desirable that the storage container can be tilted between a substantially vertical position and a substantially horizontal position. The vertical position is intended for distribution of the product and the substantially horizontal position of the storage container is intended for filling. In that case the storage container is essentially shaped as a tipping bucket, serving in the horizontal position as a shovel for taking up the product from a pile.

The latter function is promoted by the embodiment, in which the storage container has a sharp shovel edge at the top of the storage container. In addition it is desirable that the storage container is at the external side close to the shovel edge provided with a protective rim for the protection of the sharp shovel edge.

The apparatus according to the invention can further be arranged in such a way that the storage container at the top is provided with an adjustable cutter for introducing the product into the storage container. The cutter as such is rotatable and preferably provided with pins at its surface to rake in the piled product. The cutter serves then for peeling the pile and for successively introducing the product into the storage container.

The embodiment equipped with an externally positioned drive aggregate for the rotatable element is in a preferred embodiment characterized in that the drive shaft is partially formed as a worm wheel shaft, and in that a worm wheel is positioned on the worm wheel shaft, which worm wheel is actuatingly connected with the shut-

off valve. In this way a very reliable dosing of the product is possible, because whether or not the drive shaft rotates determines that pumping of the product is taking place or is interrupted.

5           The invention has so far been described based on a storage container having a funnel-shaped bottom. However, the invention is also embodied in an apparatus provided with a cylindrically-shaped storage container. In this case the apparatus according to the invention is  
10 characterized in that it is provided with a centrally positioned rotatable element within the storage container. It is then advantageous when the apparatus has a rotatable spiral close to a wall of the storage container. This rotatable spiral serves for transporting the product in  
15 the storage container in the direction of the discharge channel, since the longitudinal axis in this embodiment usually horizontally positioned involves that gravitation cannot be employed for this kind of transport.

          This embodiment is further preferably characterized  
20 in that the rotatable element comprises axially extending pins being mounted on a central axis. Apart from preventing coagulation of the product, the spirally-shaped rods then also serve the function of mixing the product. Another embodiment of this latter variant of the apparatus  
25 according to the invention is characterized in that the rotatable element comprises axially extending pins mounted on a central axis.

          The invention will now be further elucidated based on a number of non-limiting exemplary embodiments of the  
30 apparatus according to the invention, which embodiments will be elucidated with reference to the drawings, in which:

          Fig. 1 shows a schematic elevation view of a first embodiment of the apparatus according to the invention in  
35 the distribution position;

          Fig. 2 shows the apparatus of Fig. 1 in the filling position;

          Figs 3A and 3B show alternative embodiments of the sealable opening at the top of the storage container;



Figs 4.1, 4.2 and 4.3 show different embodiments of a detail at the funnel-shaped bottom of the storage container of the apparatus according to the invention;

Fig. 5 shows a circuit diagram for a number of hydraulic cylinders being used for operation of the apparatus according to the invention;

Fig. 6 shows an alternative embodiment of the apparatus according to the invention, which can be used for filling the storage container and at the same time removing dust from the product;

Figs 7 and 8. show an alternative embodiment of the apparatus according to the invention in the distribution position and the filling position, respectively, which embodiment is provided with a storage container having a take-in cutter at the top;

Fig. 9 shows the funnel-shaped bottom of the storage container of the apparatus according to the invention in detail, in which an alternative pneumatic transport mode is applied;

Figs 10.1 and 10.2 show in detail the funnel-shaped bottom of the storage container, wherein the discharge channel is provided with a shut-off valve;

Figs 11.1, 11.2, 11.3 and 11.4 show in various views an alternative apparatus according to the invention.

Identical reference numerals used in the Figures refer to the same parts.

Figs 1, 2, 6, 7 and 8 show a main embodiment of the apparatus according to the invention, comprising a tipping bucket 1, which serves as a storage container and is provided with a funnel-shaped bottom and a sealable filling opening at the top. The storage container 1 must be constructed in such a way that it can withstand the pressure required for the pneumatic transfer of the product, which pressure depends on the product compactness, the length and diameter of the discharge hose 15 and the desired flow-rate. For example, for transporting stable litter through a discharge hose 15 with a diameter of 60 mm over a length of 30 m, a pressure of 1.4 kgs/cm<sup>2</sup> is required in the storage container. The

embodiment shown in the abovementioned Figures is at the bottom funnel-shaped with a conically-shaped bottom set at an angle of approximately 45°C. However, the exact angle is not crucial for the invention and may be arbitrarily varied. A cylindrical portion is positioned above the funnel-shaped bottom, which portion ends in a square or rectangular shape at the top for placing of a hermetically sealable lid 9. The top of the storage container 1 is preferably, as shown, placed under an angle, which allows filling of the storage container 1 after tilting the same. To this end the storage container 1 is put into the horizontal position shown in the Figs 2 and 8, after which the apparatus is moved backwards against a pile of the product to be taken in for filling of the storage container 1. At the top the storage container 1 is equipped with a lid 9, which can be operated with a mechanical or hydraulic system, for instance an operation cylinder 8. Fig. 3A shows in greater detail that the hinge system 8.1 is configured in such a way that the lid 9, when in the end position of its sideways movement, is moved upwards instead of sideways to improve sealing. Fig. 3B shows an embodiment of the lid in detail, which allows the top to be opened almost completely. In that case the lid consists of two hingingly-connected panels, which can be operated by an operation cylinder 8. At the sides of the respective lid parts contacting the storage container 1 rubber strips are fitted to provide hermetical sealing of the opening.

Referring to Fig. 4.1, the invention will now be further elucidated. At the internal side of the storage container 1 a rotatable element 2 is present, in this case a bar or rod. The rotatable element is via a cardan coupling 25 driven by a drive shaft 22 partially extending through the discharge channel at the bottom of the storage container 1, and coupled with a drive system 4 positioned outside the storage container 1. The drive system 4 may, for instance, be a hydraulic reduction motor, which is often used in the agricultural field. Such a motor has advantages with respect to reliability, noise level and

ease of control (torque limit, rotational speed). The rotating element 2 is in the embodiment shown in Fig. 4.1 provided with scrapers 7 for the litter in the storage container 1. These scrapers may be simple round or flat pieces of metal, which are welded perpendicularly onto the longitudinal axis of the rotating element 2, and are long enough to also inhibit coagulation of the product. The scrapers 7 may be distributed regularly or irregularly on the rotation element 2. However, the spirally-shaped distribution shown in Fig. 4 is preferred, causing the product in the storage container 1 to also experience an upwards movement. The scrapers 7 further have the function of aerating the product, which loosens its composition and promotes its discharge through the discharge channel 20.

The rotating element 2 rotates around its axis by means of said drive. Its rotation combined with the slope of the funnel-shaped bottom provides a regular flow of the product to the bottom of the storage container 1. The rotating element 2 will rest through its own weight upon the funnel-shaped wall with a wheel 6, which for instance may be made of corrugated rubber, causing it to move along the funnel-shaped bottom, even when the rotating element 2 encounters lumps of the product. In the latter case the configuration according to the invention will induce breaking up of the coagulation.

The discharge channel 20 comprises a transport tube having a slot, which transport tube is provided with a connecting flange 26 for coupling a flexible discharge hose 15. The arm 21 moves through said slot in the transport tube by rotation of the drive shaft 22, so that a possibly formed blockage will at each turn be removed by the rotating arm. It is important that the transport tube inclusive of the thereto connecting flexible discharge hose 15 are of a constant diameter along their entire lengths from the starting point, the storage container 1, to the end point, the end of the flexible discharge hose 15. A second blade or further blades 21bis may be provided for preventing blockages at other positions in the discharge channel 20 of the storage container 1. Such

blockages occur more often when the product to be transported contains foreign objects, such as pieces of wood, pieces of plastic, and the like. Concerning this, both the transport tube having a slot and the arm 21 moving in the slot should be re-enforced, since these parts also have the objective of crushing such more solid objects to a size appropriate for passing through the transport tube. If, in spite of this, a foreign object being too hard or too large causes a blockage, which cannot be broken by crushing with the arm 21, a pressure limiter 45 (see Fig. 4) coupled to the drive aggregate 4, will interrupt the drive. Said pressure limiter controls the maximum pressure of the drive aggregate 4. In that case the discharge of product from the storage container 1 is interrupted, and the pressure can be released from the storage container 1 and the lid 23 opened for removing the blocking foreign object.

Referring to Fig. 4.2, an embodiment of the apparatus according to the invention is shown, in which the rotating element 2 is provided with knife-blades 7.2 for grinding of the product in the storage container 1. A further refinement of the grinding operation can be achieved by providing the funnel-shaped bottom surface of the storage container 1 with knives 27. The grinding fineness can be adjusted by choosing an appropriate number of knives, and also by adjusting the rotational speed of the rotatable element 2. In the embodiment shown in Fig. 4.2, the rotatable element 2 is connected to the wheel 6 by an epicycloidal reduction 28, enabling the rotatable element 2 to rotate with a high speed around its longitudinal axis, while the wheel 6 rotates at a lower speed.

Referring to Fig. 4.3., an embodiment is shown, in which a mixing function is imparted to the rotatable element 2. To this end the element is provided with a spirally-shaped cover 7.3 having a rounded or sharp edge. The sharp edge is preferred if the product is to be ground at the same time. The embodiment shown in Fig. 4.3 is especially suitable for feed distribution for animals,

ensilage being pneumatically mixed with other products. The rotating spirally-shaped cover 7.3 displaces the product upwards from the funnel-shaped bottom of the storage container 1, after which it will drop at approximately the centre of the storage container 1.

Again referring to the Figs 1, 2, 6, 7 and 8, the means for the pneumatic transfer are mounted on the frame C. However, within the scope of the invention it is also possible to obtain the air for the pneumatic transport from an external source. Any blower or compressor can be used, for instance a Roots blower 3. The drive of this compressed air supply can be connected to a coupling 14, and may be obtained from various thermal, electrical, hydraulic or other drives. However, it is preferred that the power take-off of a tractor is coupled to the coupling 14, which especially in the agricultural field is a commonly used energy source. Depending on the desired rotational speeds, an acceleration or reduction box can be placed between the coupling of the air supply and the power source. This will be apparent for those skilled in the art and does not need to be shown in the drawings. The air supply is dimensioned in volume and pressure depending on the characteristics of the product to be transported, like compactness and particle size, as well as the length and the diameter of the distribution channel, of which the flexible discharge hose 15 forms a part, and on the desired flow rate. As an example it can be mentioned that for the transport chips through a flexible hose of 30 m in length and 60 mm in diameter a pressure level of 1.4 kgs/cm<sup>2</sup> is required in the storage container 1 for yielding a flow rate of 400 m<sup>3</sup> per hour. The air is introduced into the storage container 1 through at least one conduit 13, and is regulated with the aid of a pressure relieve valve 17, preferably set to 0.1 kgs/cm<sup>2</sup> above the pressure in the storage container 1, which is required for the transport. It may be advantageous to also supply the air at other positions, for instance near the point where the flexible hose 15 connects to the connecting flange 26 via the connection 24 (see Figs 4.1, 4.2 and 4.3). The amount of

air supplied at this position is then regulated with the aid of a control valve 16 (see Figs 1, 2, 6, 7 and 8).

Also referring to Fig. 5, the way in which the further operational cylinders 8 and 5 of the apparatus according to the invention are operated will now be elucidated. The two operational cylinders 8 and 5, as well as the hydraulic drive aggregate 4 can be operated by manually operated hydraulic shut-off valves or by electrical operation. In the latter case electromagnetic valves are required.

Referring to Fig. 5, a practical circuit is shown. The main circuit is protected by a pressure relief valve 45. For tilting of the storage container 1 and raising it upright again the coils of the electromagnetic valve 44.1 are energized. For operating the hermetically sealing lid 9 the coils of the electromagnetic valve 44.2 are energized. The coil 4.1 serves for controlling the drive aggregate 4. If a foreign object blocks the discharge channel 20 and especially the transport tube having a slit at its entrance, the coil 4.2 is energized to rotate the rotatable element 2 in the opposite direction for a short period of time. The hydraulic unit of the apparatus, not shown, is for instance coupled to the hydraulic system of a tractor used for moving the apparatus according to the invention. To this end the apparatus with the storage container 1 is put on a movable frame C provided with wheels R. The compressor 3 can then be coupled to a power take-off of the tractor. The electrical box for remote operation of the hydraulic unit is coupled to electrical manually operated switches being for this purpose present on the tractor. The tractor moves the apparatus backwards into a space where the product to be introduced, for instance stable litter, is stored. By energizing the electromagnetic valve 5.2 the operation cylinder 5 is moved inwards, so that the container is tilted flat to the ground. Subsequently, the coil 8.2 is energized to open the lid 9 of the storage container 1. Then the storage container 1 is moved against the product. When the tractor cannot be moved further backwards, the electromagnet 5.1

is energized to raise the container upright again. At the same time it is moved further backwards in order to further effect filling of the storage container 1 while tilting upwards. When the storage container has been  
5 raised completely, the tractor is advanced. Next, the storage container may, if required, again be tilted to the ground to fill it further.

In the Figures also a protective rim 11 is shown at the top of the storage container 1 serving for the  
10 protection of the sharp edge 10, which facilitates the taking in of the product. When filling is stopped, the electromagnetic valve 8.1 is subsequently energized for closing the lid 9. Next, the apparatus may be transported to the building or the surroundings for the distribution  
15 of the contents of the storage container. To this end the compressor 3 must be started and the flexible discharge hose 15 must be connected to the connecting flange 26. The electromagnetic valve 4.1 will then be energized by a manually or electrically operated remote control for  
20 controlling the drive aggregate 4, causing the rotatable element 2 to rotate. From that moment on the product in the storage container 1 can be distributed via the discharge channel 20 and the discharge hose 15. This distribution may be interrupted by deactivation of the elec-  
25 tromagnetic valve 4.1, causing the drive aggregate 4 and the rotatable element 2 to stop rotating. Because the product in the storage container 1 tends to coagulate and is generally hard to pump, a blockage at the bottom of the funnel-sided bottom of the storage container 1 occurs. The  
30 air, which is additionally supplied to the connecting point 24 induces propulsion of the product and emptying of the flexible discharge hose 15. Maybe the product can be pumped more easily, like for instance sawdust, so that stopping the rotatable element is not enough to interrupt  
35 the flow of the product in the discharge channel 20. It is then possible to provide an automatic valve 18, which, for instance, can be operated by a hydraulic operation cylinder connected to the drive aggregate 4. When the electromagnet 4.1 is activated, the valve 18 will open

simultaneously when starting the drive aggregate 4. For closing the valve 18, it is required that the coil 4.2 is energized for a short period of time, by which the direction of rotation of the drive aggregate 4 is reversed and the valve 18 is closed. This interrupts the transport of the product. Meanwhile the compressor 3 is in continuous operation, however, the air which it introduces cannot escape via the non-return 24 shown in Figs 4.1, 4.2 and 4.3, or the discharge hose 15, so that the pressure in the storage container 1 increases and finally is blown off through the pressure relieve valve 17. Another possibility, which may be used for products with very good flow characteristics and a low tendency to form a blockage, such as powders, is the following. The flexible discharge hose 15 may at its end be provided with a manually operated shut-off valve 18bis (see Figs 1 and 6). After coupling of the flexible discharge hose 15 to the coupling flange 26 the shut-off valve 18 can be manually opened, however, the product will still block, because the valve 18bis is still closed. Distribution of the the product may then start by opening the valve 18bis. Interruption of the transport is easily achieved by closing the valve 18bis again. By closing the valve 18bis a pressure rise is induced in the storage container 1 since the compressor 3 is still in operation, which pressure rise, in this case, also may be limited by the pressure relief valve 17.

The apparatus may further be used in the following way, in which the function of the pressure regulator 29, shown in the Figs 4.1, 4.2 and 4.3, is discussed. For this method the apparatus is provided with the shut-off valve 18, the manually operated valve 18bis and the flexible discharge hose 15 and said pressure regulator 29 which is set to a pressure being somewhat in excess of the pressure required for transport of the product. Energizing of the electromagnetic valve 43 (see Fig. 5) takes place via the closed contact of the pressure regulator 29. When the pressure in the transport system is higher than the pressure level set in the pressure regulator 29, the



contact is broken and the electromagnetic valve 43 is not further energized. The method is as follows:

The compressor 3 is switched on prior to switching on the operation circuit. Consequently, the pressure rises  
5 to the maximum pressure level set in the pressure regulator 29, causing the contact of the pressure regulator 29 to be broken. Subsequently, the operation circuit is set to a voltage, but the coil 4.1 cannot be energized since the contact of the pressure regulator 29  
10 is broken. By opening the manually operated shut-off valve 18bis the pressure in the system can start to drop until the pressure regulator 29 again makes contact and the coil 4.1 can be energized. Consequently, the drive aggregate 4 is energized and the rotatable element 2 starts to rotate.  
15 By the counterpressure induced in this way the operation cylinder of the valve 18 is opened and the product can start to flow. Stopping is initiated by closing the manually operated valve 18bis. The pressure in the system rises immediately until the pressure regulator 29  
20 interrupts the current to the coil 4.1 and the drive aggregate 4 stops.

Referring to Fig. 6, an embodiment of the apparatus according to the invention is shown, in which the storage container 1 is operated at a negative pressure. This makes  
25 further functions possible when using the apparatus according to the invention. A negative pressure is created in the storage container 1 via a conduit 56, which is connected via a dust filter 55 and a conduit 59 to the storage container 1 and is further connected to the  
30 compressor 3 provided with a vacuum position. In the embodiment shown a shut-off valve 51 is used, with which the circuit formed by the conduits 56 and 59 and the dust filter 55 can be connected between the compressor 3 and the storage container 1. As soon as the shut-off valve 51  
35 is put into the appropriate position and the compressor 3 is put into the vacuum position, a hose 54, also connected to the storage container 1, can be used for sucking up the product to be introduced, as well as outside air when the shut-off valve 52 is opened. This can be realized, because

the compressor 3 has created a negative pressure in the storage container 1. The sucked-in product remains in the storage container 1, while the sucked-in air with dust particles therein is passed via the conduit 59 through the dust filter 55. As a dust filter 55, for instance, a cyclone can be used. After passing the filter, dust-free air is sucked via the conduit 56 to the compressor vacuum pump 3, which discharges the air into the atmosphere. As soon as the storage container 1 is filled, the compressor 3 can be switched off and the lid 9 can be opened to allow the storage container 1 to reach atmospheric pressure. By opening the shut-off valve 75, the dust caught in the cyclone 55 can be discharged. A further possibility of use of this apparatus is the following.

When the product is stored in the storage container 1, the lid 9 can be opened and the compressor 3 can be started to introduce atmospheric air via the conduit 16. Subsequently the rotatable element 2 can be actuated. By doing so the air blown in at the bottom of the storage container 1 combined with movement of the rotatable element 2 induces the release of dust in the product. The air introduced together with the released dust is discharged via the open lid 9 to the atmosphere, causing the dust in the product in the storage container 1 to be removed completely.

Usually a discharge hose 15 to be used is present in every building where the apparatus according to the invention is used. This is for hygienical reasons. However, for economical reasons the apparatus according to the invention, as shown in Fig. 7, may be provided with a manually operated or automatic roll-up mechanism for a flexible discharge hose attached to the apparatus. The length required for the discharge hose 15 is then easily rolled off a spool 61 attached to the apparatus. The product can flow through the spool via a rotating, well-sealing coupling 62. Fig. 7 further shows an embodiment of the apparatus according to the invention suitable for the automatic processing and distribution of ensilage as required by certain breeders of cattle and sheep. To this

end the apparatus according to the invention is provided with a vertically positioned mixer, which takes the form of a screw-like spiral 64 being mounted on a conical shaft 66. This kind of configuration prevents that long fibres  
5 became caught through rotation in the mixer. Knives 65 can be attached to the spiral and opposite these knives other knives 67 may be provided, which knives 67 are attached to the walls of the storage container 1, which interact to chop the feed. In addition, one or two fixed arms 60 may  
10 be provided on the drive shaft which prevent coagulation of the product.

The Figure further shows a rotating cutter 68 attached to the top of the storage container 1. This cutter 68 serves a function in the filling position shown  
15 in Fig. 8. In this horizontal filling position the cutter 68 is first moved upwards. With the aid of an operational cylinder 70 the lid 9 is opened and then the apparatus is moved backwards against the pile of ensilage.

Subsequently, the cutter 68 is moved downwards, and the  
20 rotation of the cutter 68 induces raking in of the ensilage. The cutter is provided with teeth having a form, which is appropriate for a uniform movement of the ensilage to the storage container 1.

Fig. 9 shows a detail of the storage container 1,  
25 namely the funnel-shaped bottom of the pneumatic means making the apparatus appropriate for an application, in which the storage container 1 is not hermetically sealable at the top. In this alternative embodiment discharge of the product from the storage container 1 is not effected  
30 by realizing an overpressure in the storage container 1, but the product is sucked from the external side the storage container 1 by the application of a venturi system 70. The air required for the operation of the venturi 70 can originate from a turbine 71 which sucks air from the  
35 centre 73 of the turbine by rotation of its vanes 72 and blows it at a pressure into the venturi 70. Increasing the efficiency of this system is possible by using a compressor 3 instead of a turbine 71.

In yet another embodiment the venturi 70 is omitted. In this embodiment (not shown) the product is sucked directly via the suction opening of the turbine 71 and blown into the flexible discharge conduit 15 by the vanes 72. This modification may be of special interest when the product to be transported must be chopped further. In that case it is advantageous to replace the turbine 71 by a chopping device with a built-in blower.

Figs 10.1 and 10.2 are intended for illustrating a measure suitable for interrupting the flow of the product when stopping the rotation of the rotatable element 2 is not sufficient. As already described above, a shut-off valve 18 may be used in that case. It is then advantageous to open and close the shut-off valve 18 by using the rotation of the drive shaft 22. The end of the drive shaft 22 is for this reason machined in such a way that it can function as a worm wheel, the two outer windings of the worm wheel as such running free. A bush with a ball can be positioned on the worm wheel so that an upward and downward movement along the spiral 81 of the worm wheel may be carried out. The bush 85 is coupled with the shut-off valve 18 via a lever 84, two springs 82 and 83 being used for balancing the lever 84 between its two ends.

Fig. 10.2 shows schematically that rotation of the worm wheel combined with the force of the spring 83 leads to the upward movement of the bush 85, opening the shut-off valve 18 via the lever 84. When the bush 85 reaches its highest position, it will maintain this position due to the fact that the top winding as such runs free.

Referring to Fig. 10.1, it is shown that reversing the direction of rotation of the drive shaft 22 is sufficient for closing the shut-off valve 18 until the bush 85 again tilts the lever 84 by the force of the spring 82 on the lever 84 and the action of the worm wheel drive. The moment the bush 85 reaches the bottom winding, the reverse rotation of the drive shaft 22 can be stopped.

Referring to the Figs 11.1, 11.2, 11.3 and 11.4, yet another apparatus is shown, in which the invention is

also embodied and which is provided with an essentially cylindrically-shaped container with a horizontally positioned longitudinal axis. The storage container 1 is rotatable around a central axis 95 by a hydraulically operational cylinder 5. Fig. 11.1 shows the storage container 1 in the filling position. To this end the container is provided with a shovel 96 to create a filling provision. As shown in Fig. 11.1 the lid 9 is open and the machine ready to be filled with the product. When filling is completed the storage container 1 is tilted almost 90° and the hermetically sealable lid 9 will close by means of the operation cylinder 8. The distribution position then reached is shown in Fig. 11.2. The apparatus is further provided with a centrally positioned rotatable element 7, which via an acceleration box 97 may be driven by a drive aggregate 4. This rotatable element 7 preferably takes the form of a plurality of slightly spirally-shaped rods, which simultaneously function to mix the product in the storage container 1. Fig 11.3 shows another embodiment which, instead of with slightly spirally-shaped rods in the longitudinal direction of the storage container 1 is provided with pins which are positioned axially to the central axis 2, which pins are, for instance, attached by welding. In both embodiments the apparatus is further provided with a spiral 7bis, which may be driven by the drive aggregate 4 and which serves for displacing the product in the direction of the discharge channel 20. In this case is also a pin 21 is provided rotating at the beginning of the discharge channel 20, which pin moves through a slot of the transport tube, which begins at that point. In the present embodiment it suffices to stop the drive aggregate 4 for interrupting transport of the product. However, when products are displaced having a very low viscosity, so that they keep flowing after stopping the drive aggregate 4, a shut-off valve may be installed in the discharge channel 20. It will be apparent to those skilled in the art that within the scope of the invention several variants to the non-limiting embodiments

discussed above are possible, which all fall under the protection of the accompanying claims.

CLAIMS

1. Apparatus for displacing a product suitable for pumping, comprising a storage container having a funnel-shaped bottom provided with a discharge channel, and having at the top a sealable opening intended for filling  
5 the storage container, **characterized in that** the storage container (1) is at the funnel-shaped side provided with a rotatable element (2) within the storage container (1) to prevent coagulation of the product.

2. Apparatus according to claim 1, **characterized in**  
10 **that** the rotatable element (2) is a bar or rod (2) which can be displaced along the funnel-sided wall of the storage container (1).

3. Apparatus according to claim 1 or 2, **characterized in that** the rotatable element (2) is a bar  
15 or rod which can be rotated around its longitudinal axis.

4. Apparatus according to anyone of the claim 1-3, **characterized in that** scraping elements (7) are provided on the rotatable element (2).

5. Apparatus according to claim 4, **characterized in**  
20 **that** the scraping elements (7) are positioned spirally on the rotatable element (2).

6. Apparatus according to claim 4, **characterized in that** the rotatable element (2) is provided with regularly distributed knife-blades (7.2).

25 7. Apparatus according to claim 6, **characterized in that** regularly distributed knives (27) are provided on the funnel-shaped side of the internal wall of the storage container (1), which knives are shifted with respect to the knife-blades (7.2) on the rotatable element (2).

30 8. Apparatus according to claim 4, **characterized in that** the rotatable element (2) is provided with a spirally-shaped cover (7.3).

9. Apparatus according to claim 8, **characterized in that** the spirally-shaped cover (7.3) has a sharp edge.

35 10. Apparatus according to anyone of the claims 1-9, **characterized in that** the rotatable element (2) is

coupled via a cardan joint with a drive shaft (22) which partially extending through the discharge channel (20) and which is coupled to a drive aggregate (4).

11. Apparatus according to anyone of the claims 1-  
5 10, **characterized in that** the rotatable element (2) is provided with a wheel (6) to support the element (2) at the funnel-sided wall of the storage container (1).

12. Apparatus according to anyone of the claims 6,  
7, 8 or 9 and claim 11, **characterized in that** the wheel  
10 (6) is coupled with the rotatable element (2) via a reduction apparatus (28).

13. Apparatus according to anyone of the claims 10-  
12, **characterized in that** an arm (21) is attached to the drive shaft (22), and in that the discharge channel (20)  
15 comprises a transport tube having a slot, which transport tube is provided with a coupling flange (26) for coupling a flexible discharge hose (15), through which slot in the transport tube the arm (21) moves during rotation of the drive shaft (22).

20 14. Apparatus according to claim 13, **characterized in that** the transport tube as well as the flexible discharge hose (15) have an identical internal diameter along their entire lengths.

15. Apparatus according to anyone of the claims  
25 1-14, **characterized in that** the sealable opening for filling of the storage container (1) can be hermetically sealed and in that means are provided for changing the pressure in the storage container (1).

16. Apparatus according to claim 15, **characterize**  
30 **din that** a compressor (3) is provided which is connected to the storage container (1) via a conduit (13).

17. Apparatus according to claim 16, **characterized**  
**in that** the compressor (3) is connected with a controllable coupling (16) to a supply point (24) on the  
35 transport tube for secondary air.

18. Apparatus according to anyone of the claims 13-  
17, **characterized in that** a shut-off valve (18) is incorporated in the transport tube.



19. Apparatus according to anyone of the claims 13-18, **characterized in that** a manually operated shut-off valve (18bis) is incorporated in the flexible discharge hose (15).

5           20. Apparatus according to anyone of the claims 13-19, **characterized in that** a pressure regulator (29) is connected to the transport tube.

          21. Apparatus according to anyone of the claims 16-20, **characterized in that** the compressor (3) is provided  
10 with a coupling (14) for connecting a drive aggregate, preferably a tractor.

          22. Apparatus according to claim 15 or 16, **characterized in that** the compressor (3) is operated as a vacuum pump to create a negative pressure in the storage  
15 container (1), and in that a dust filter (55) is connected to the storage container (1), which dust filter can be coupled to the vacuuming side of the compressor (3), and in that the storage container (1) is further provided with a suction hose (53).

20           23. Apparatus according to claim 1, **characterized in that** the rotatable element (2) is an upwardly tapered screw-like spiral element (64).

          24. Apparatus according to claim 23, **characterized in that** knives (65) are provided on the sp[iral element  
25 (64).

          25. Apparatus according to claim 23 or 24, **characterized in that** additional knives (67) are provided on the funnel-sided wall of the storage container (1).

30           26. Apparatus according to anyone of the claims 23-25, **characterized in that** the drive shaft of the spiral element (64) is provided with at least one fixed arm (60).

          27. Apparatus according to anyone of the preceding claims, **characterized in that** the storage container (1) can be tilted between a substantially vertical position  
35 and a substantially horizontal position.

          28. Apparatus according to claim 27, **characterized in that** the storage container (1) has a sharp shovel edge (10) at the top of the storage container (1).

29. Apparatus according to claim 28, **characterized in that** the storage container (1) is at the outside close to the shovel edge (10) provided with a protective rim (11).

5           30. Apparatus according to anyone of the claims 1-29, **characterized in that** the storage container (1) at the top is provided with an adjustable cutter (68) for introducing the product into the storage container (1).

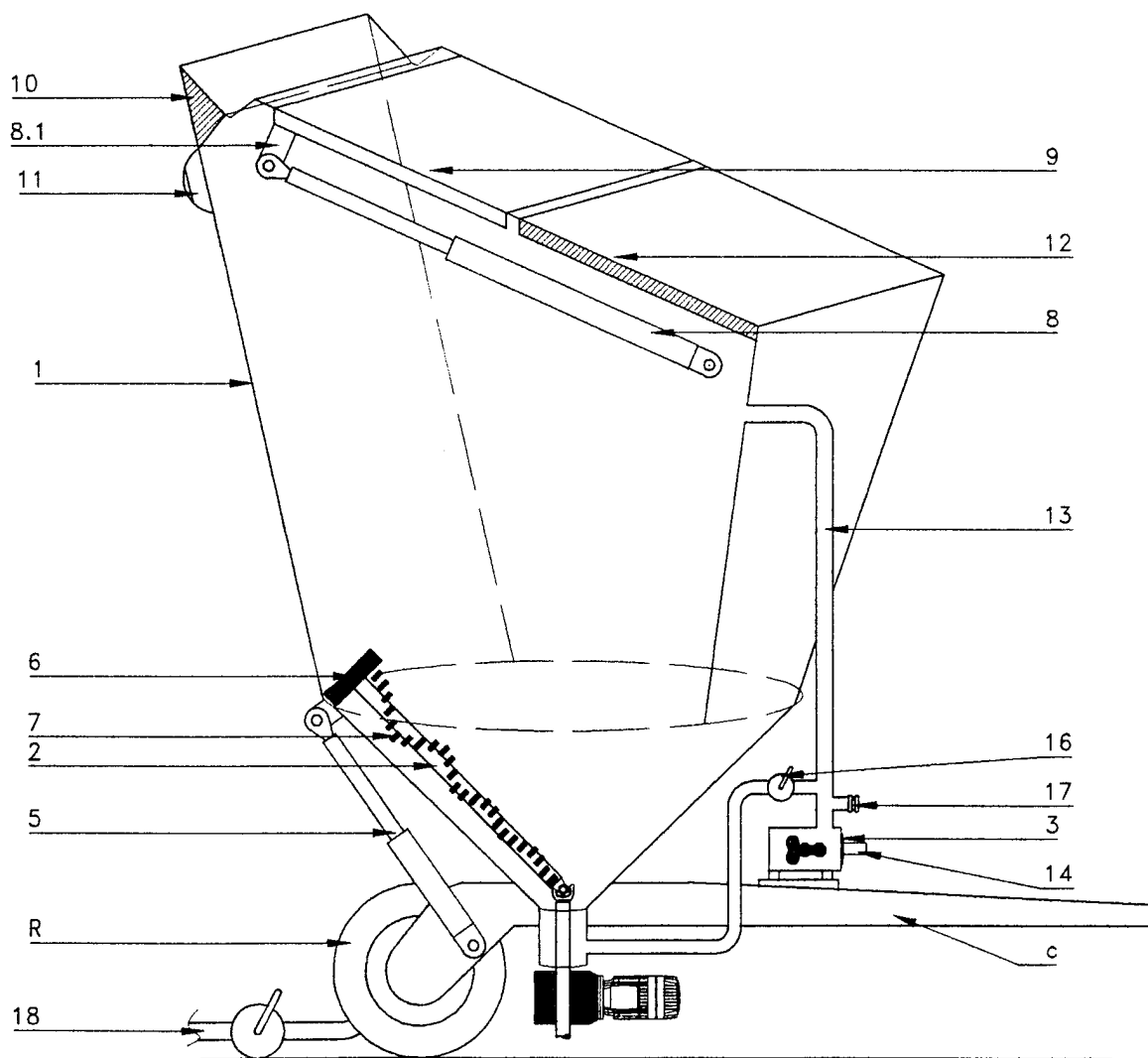
10           31. Apparatus according to anyone of the claims 13-17 and 18, **characterized in that** the drive shaft (22) is partially formed as a worm wheel shaft (81), and in that a worm wheel (85) is positioned on the worm wheel shaft (81), which worm wheel is actuatingly connected with the shut-off valve (18).

15           32. Apparatus for displacing a product suitable for pumping, comprising a storage container (1) provided with a discharge channel, and a sealable filling opening, **characterized in that** the apparatus is provided with a centrally positioned rotatable element (2) within the  
20 storage container (1).

33. Apparatus according to claim 32, **characterized in that** the apparatus has a rotatable spiral close (7bis) to a wall of the storage container (1).

25           34. Apparatus according to claim 32 or 33, **characterized in that** the rotatable element (2) comprises spirally-shaped rods.

35. Apparatus according to claim 32 or 33, **characterized in that** the rotatable element (2) comprises axially extending pins mounted on a central axis.



figuur 1



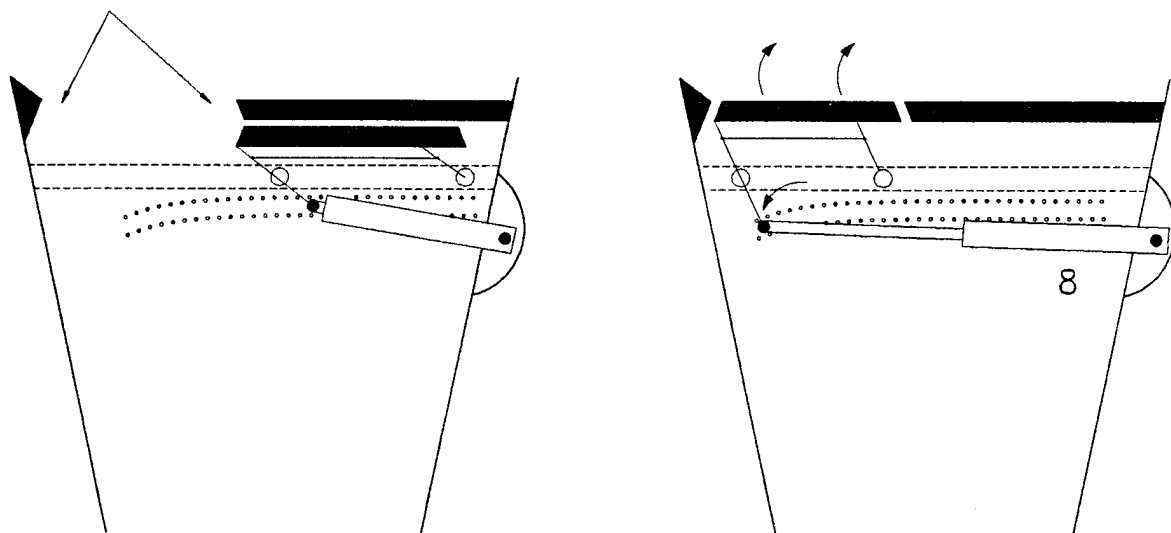


FIG. 3A

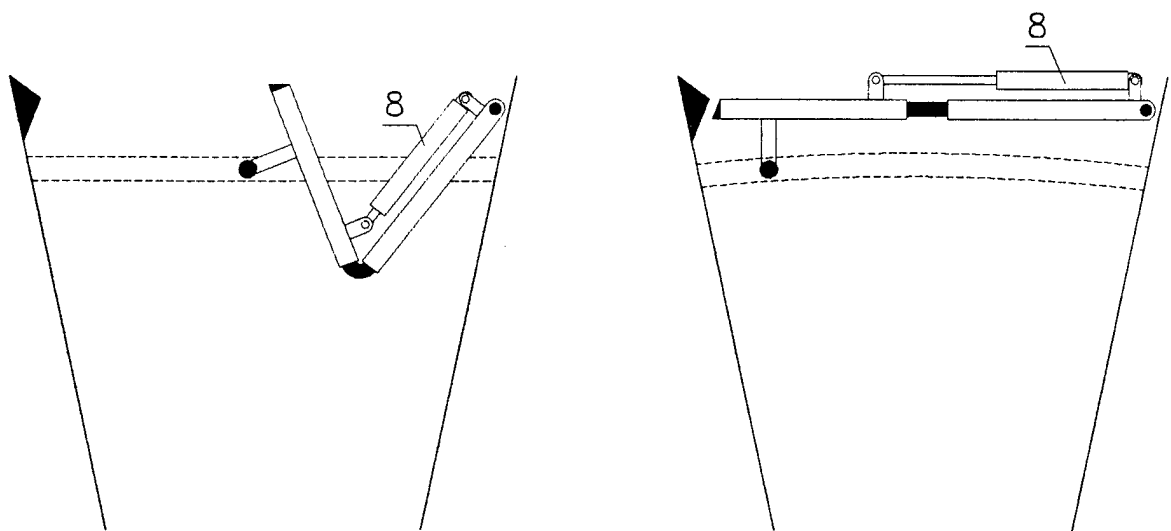


FIG. 3B

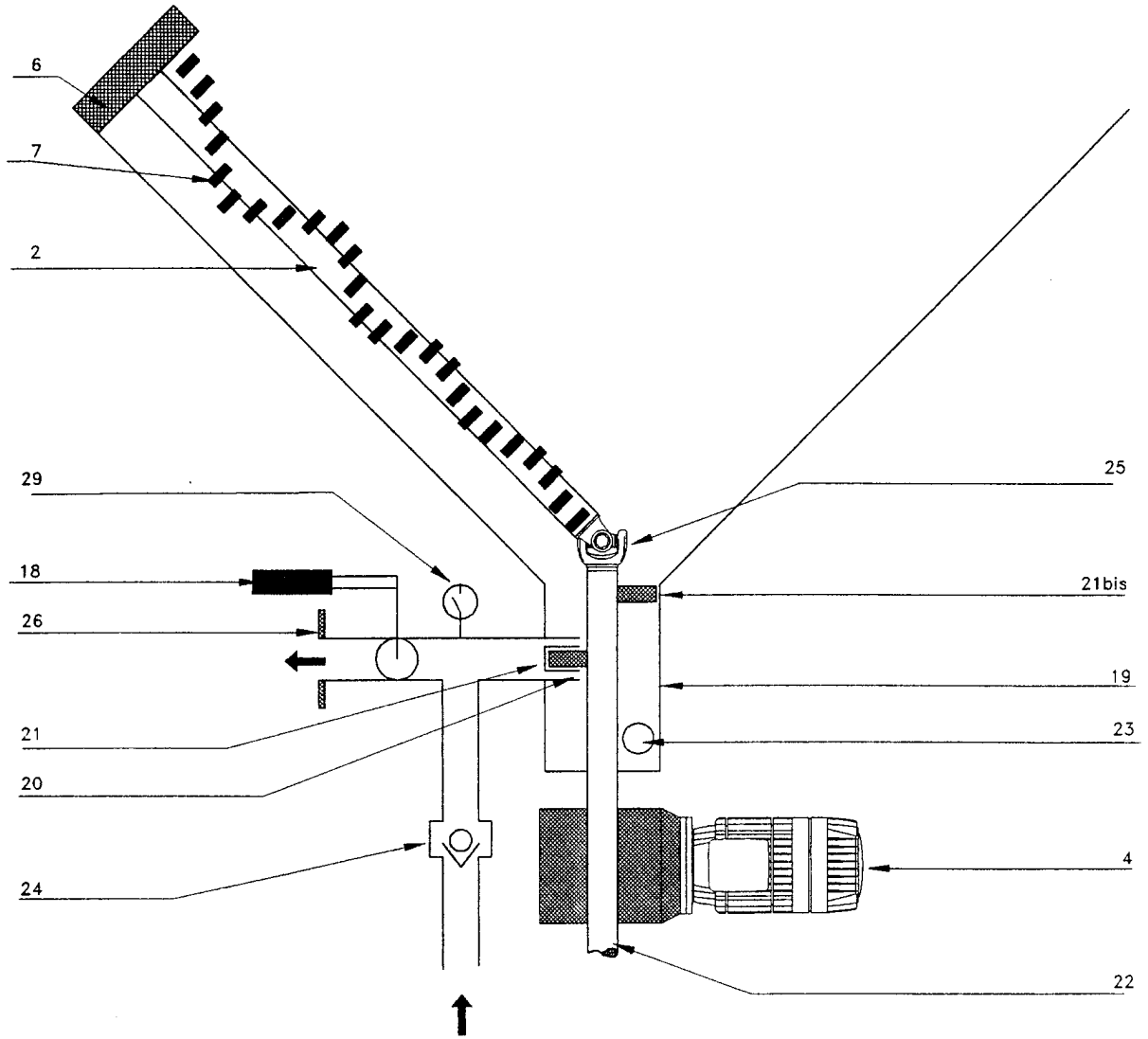


FIG. 4.1

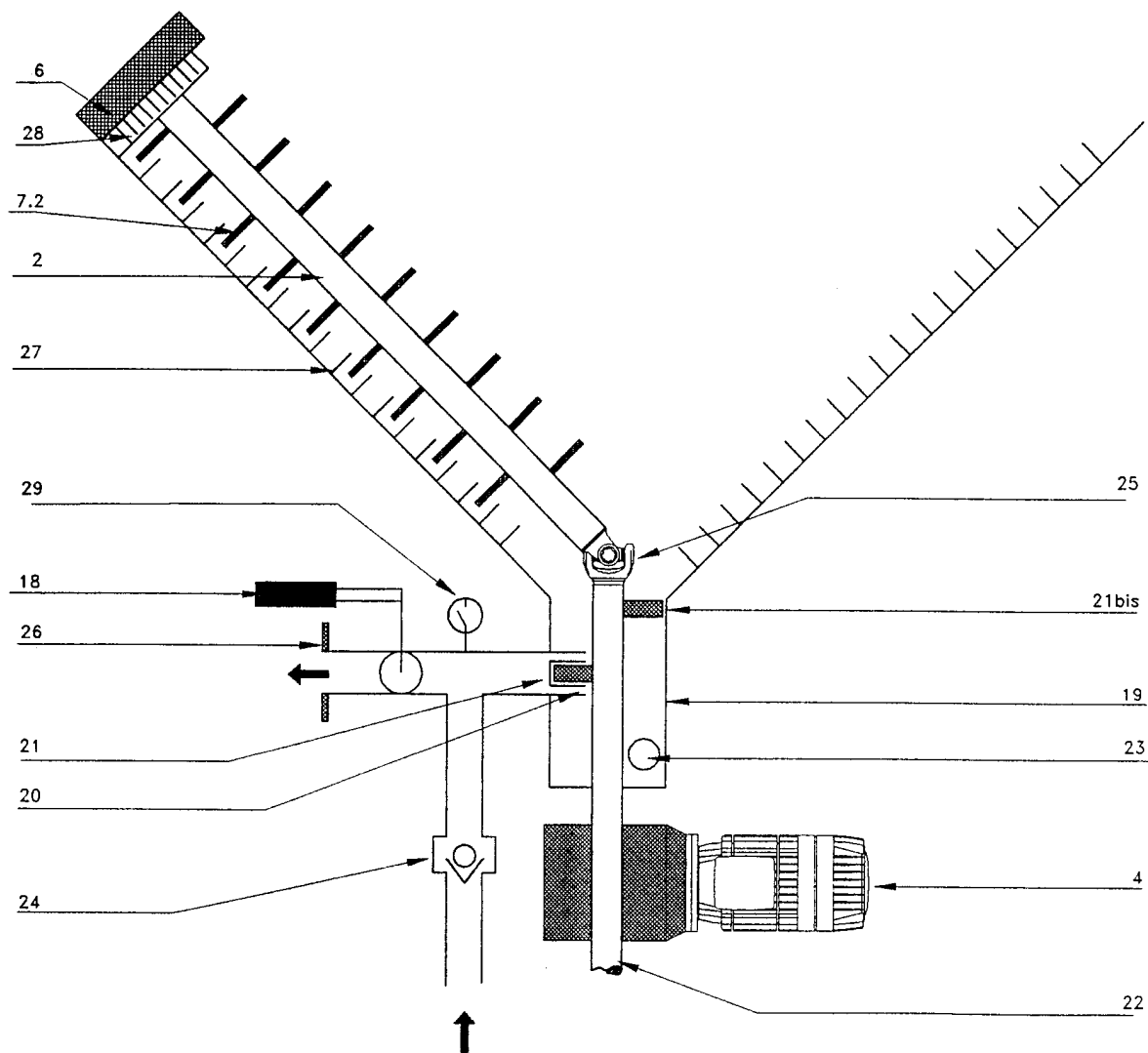


FIG. 4.2

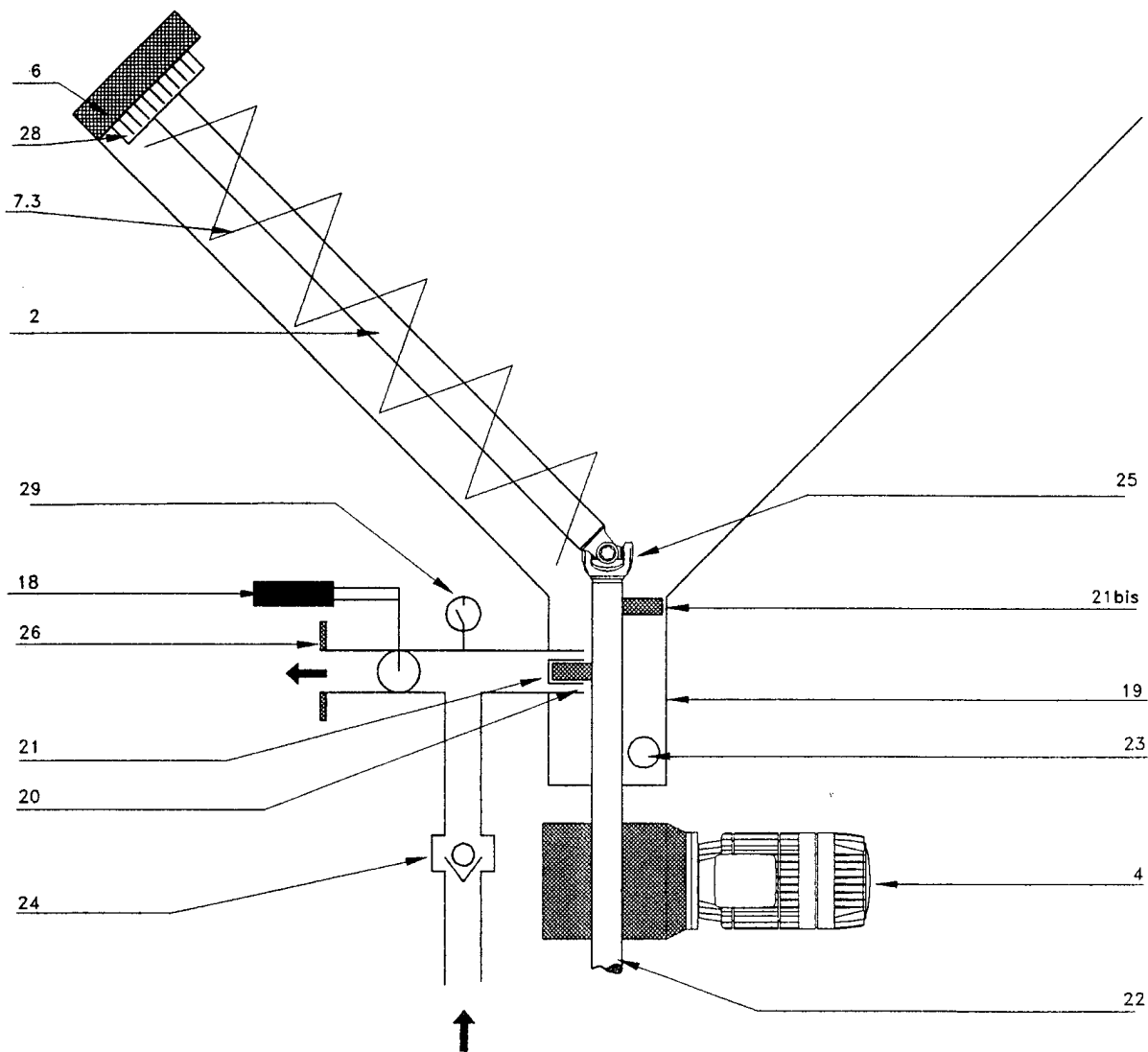


FIG. 4.3



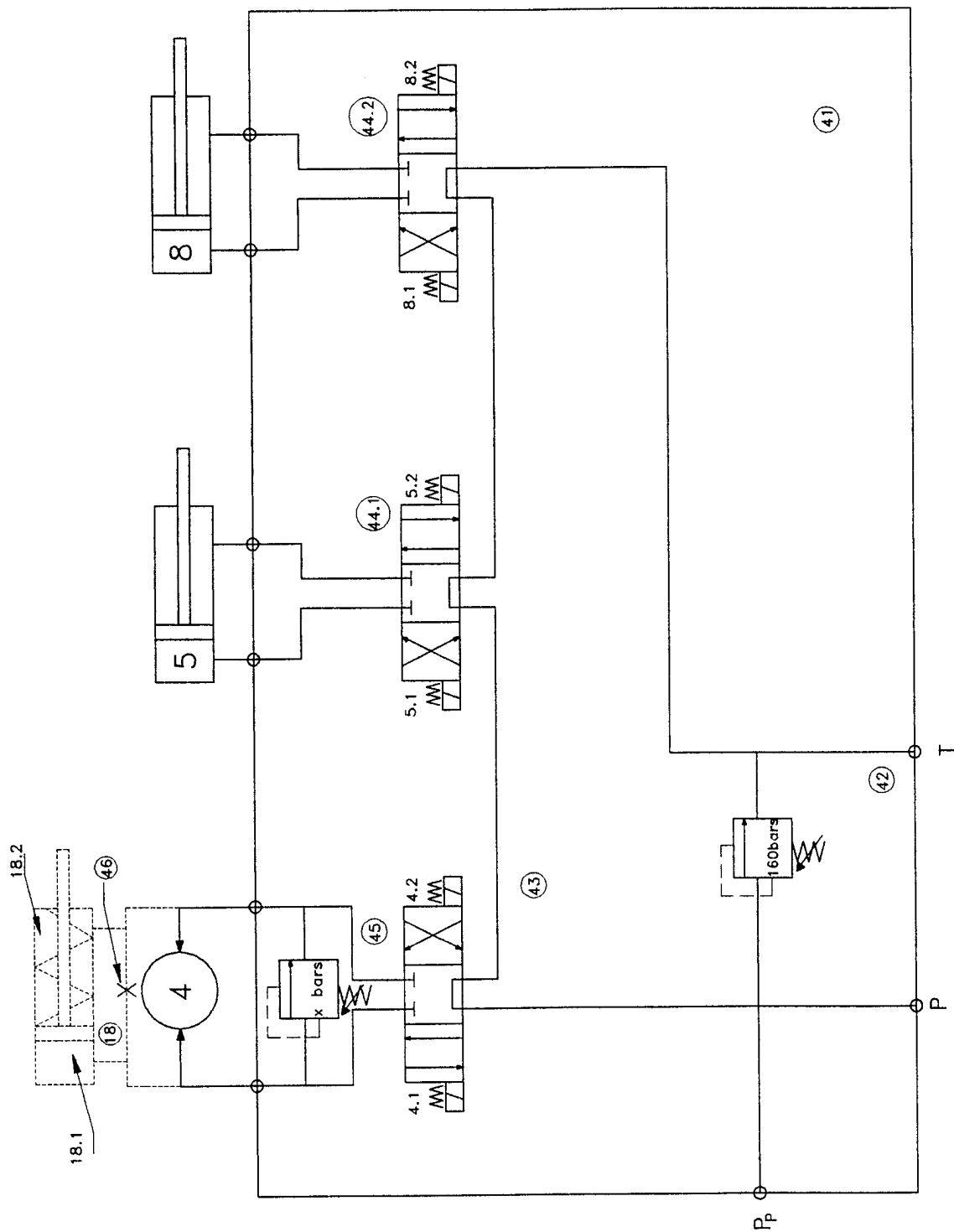
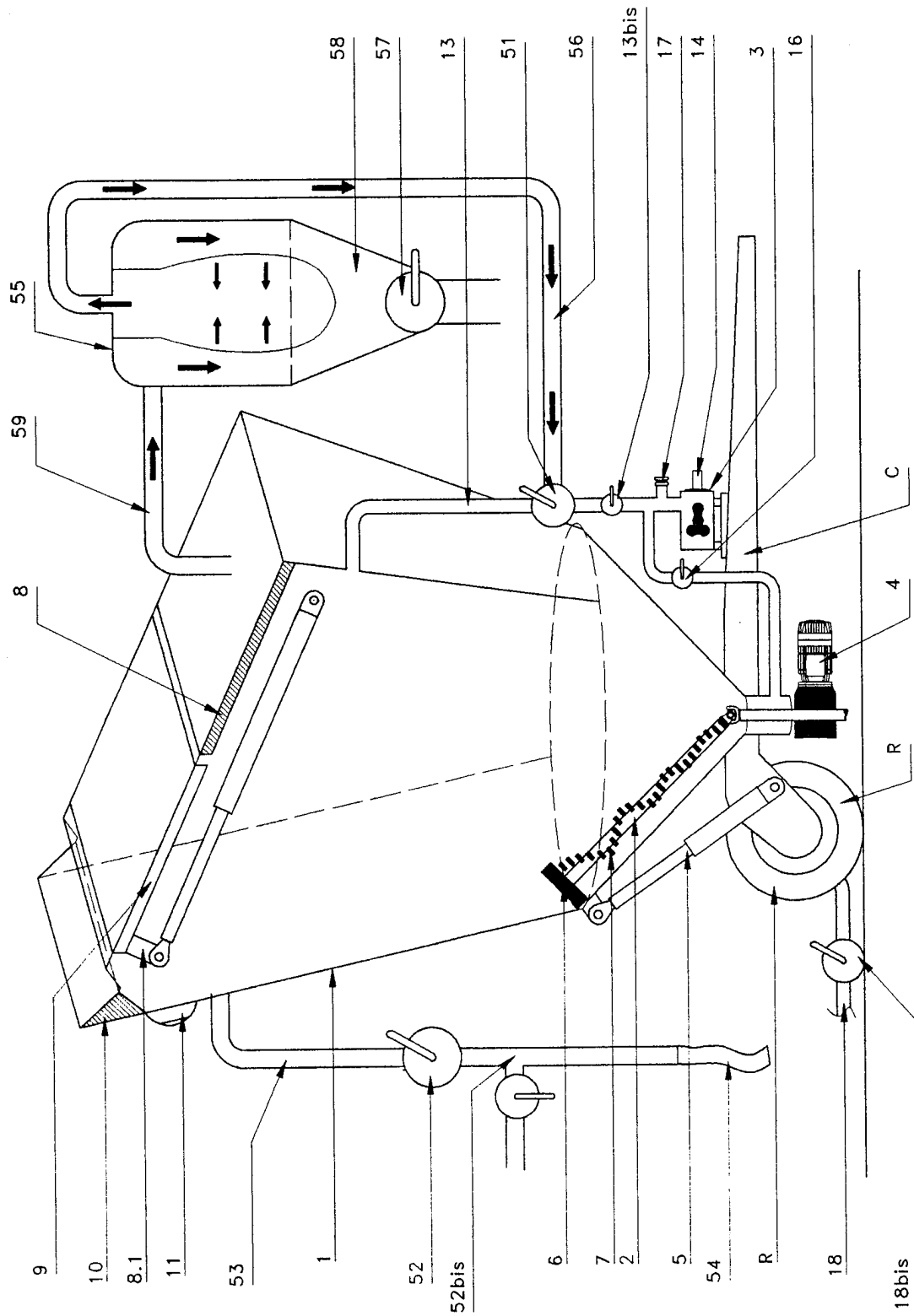
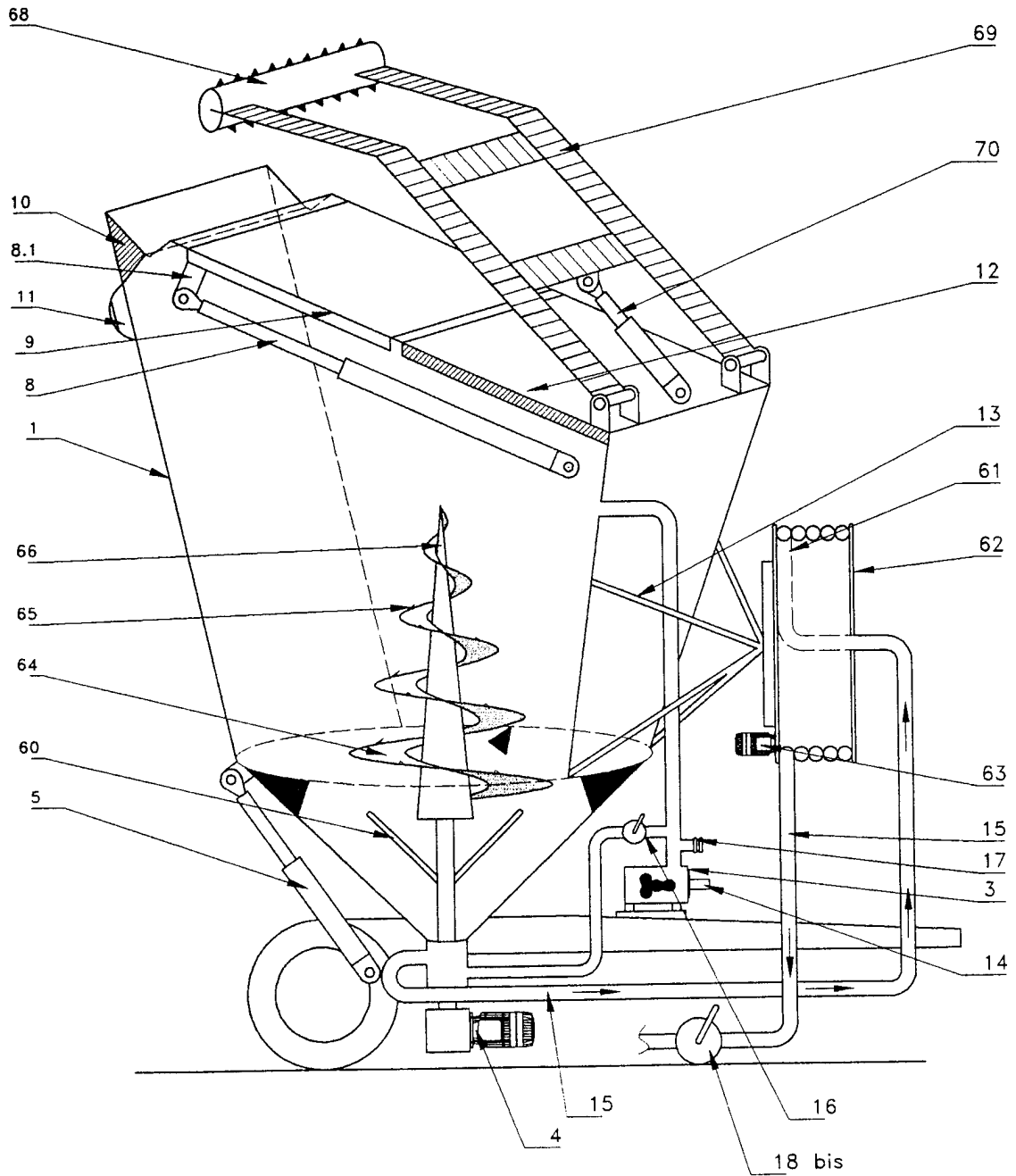


FIG. 5

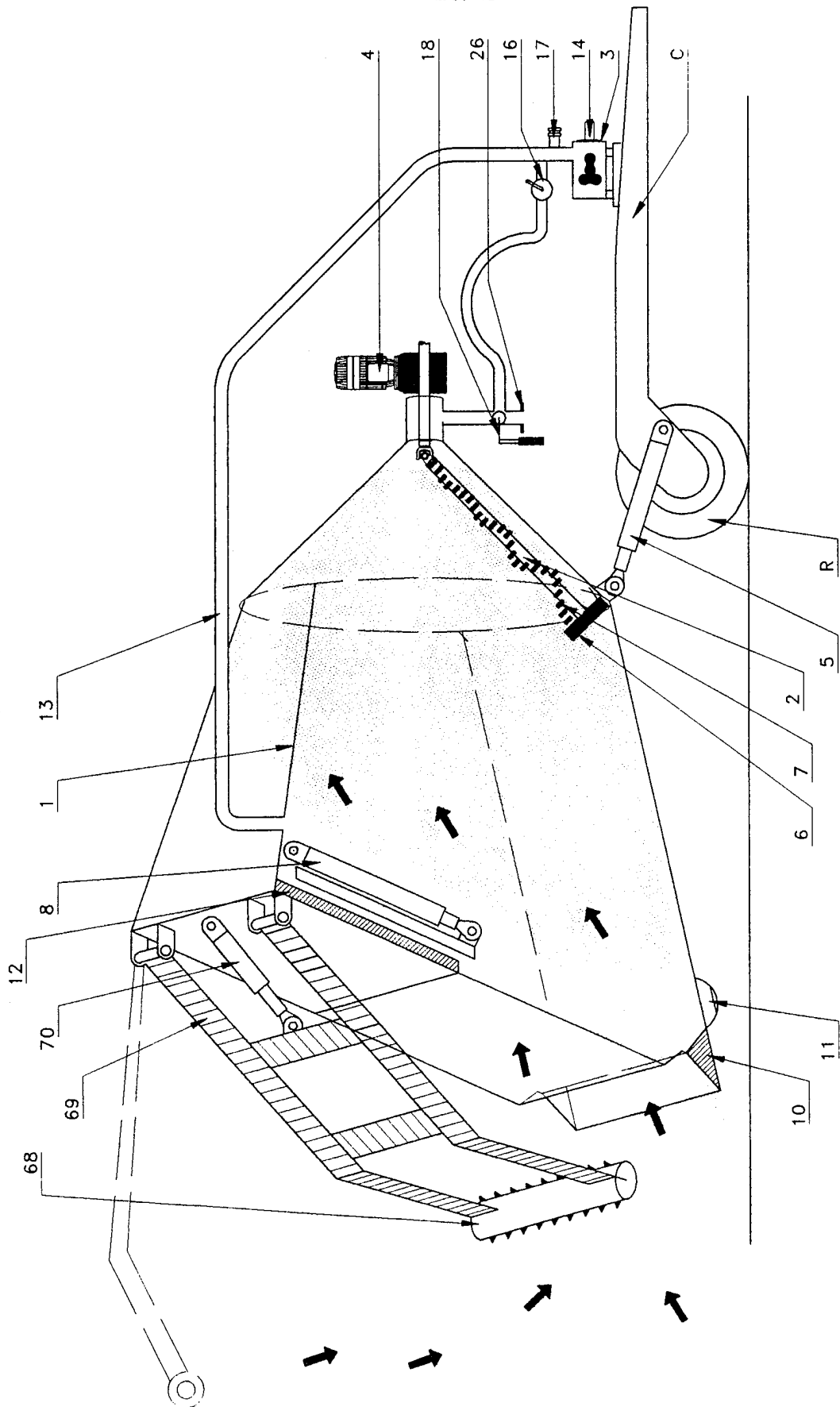


figuur 6



figuur 7

10/13



figuur 8

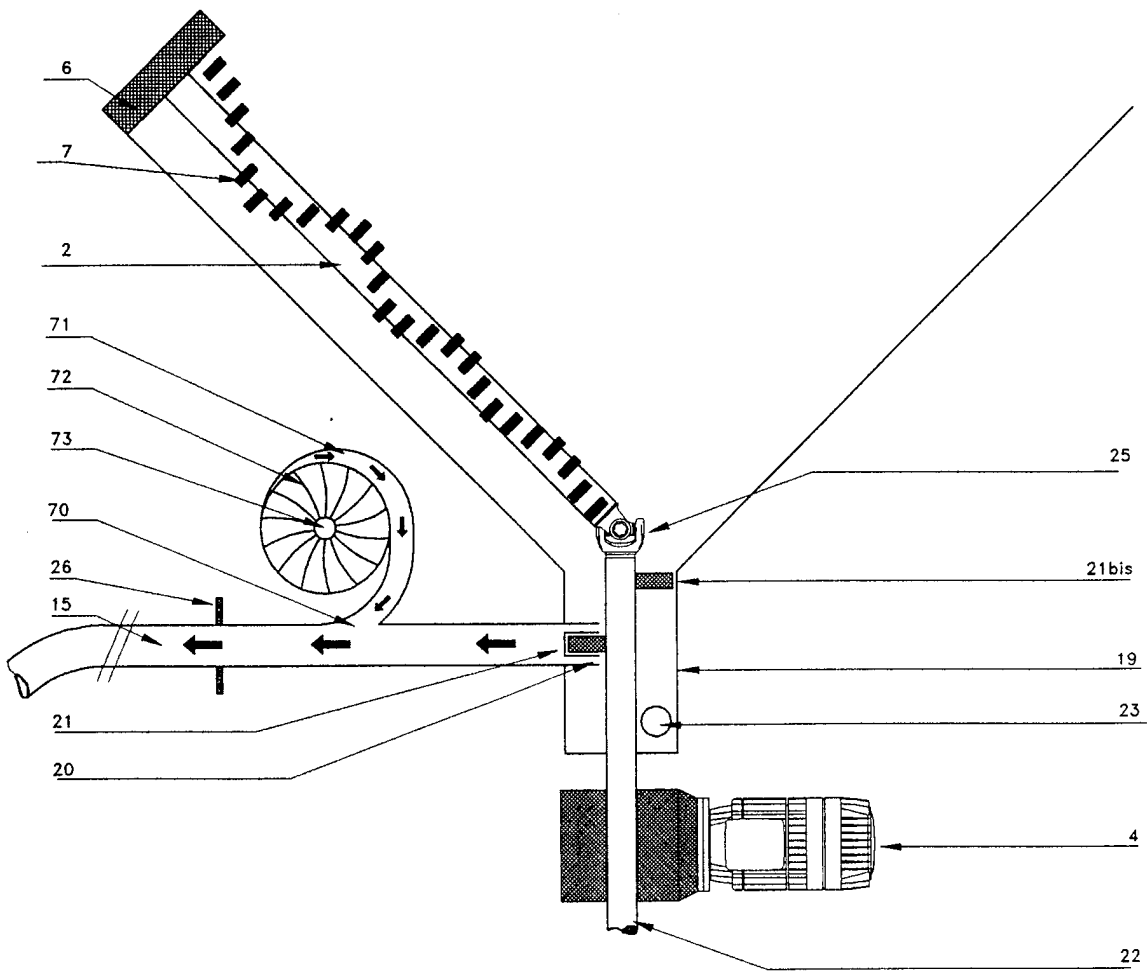


FIG. 9

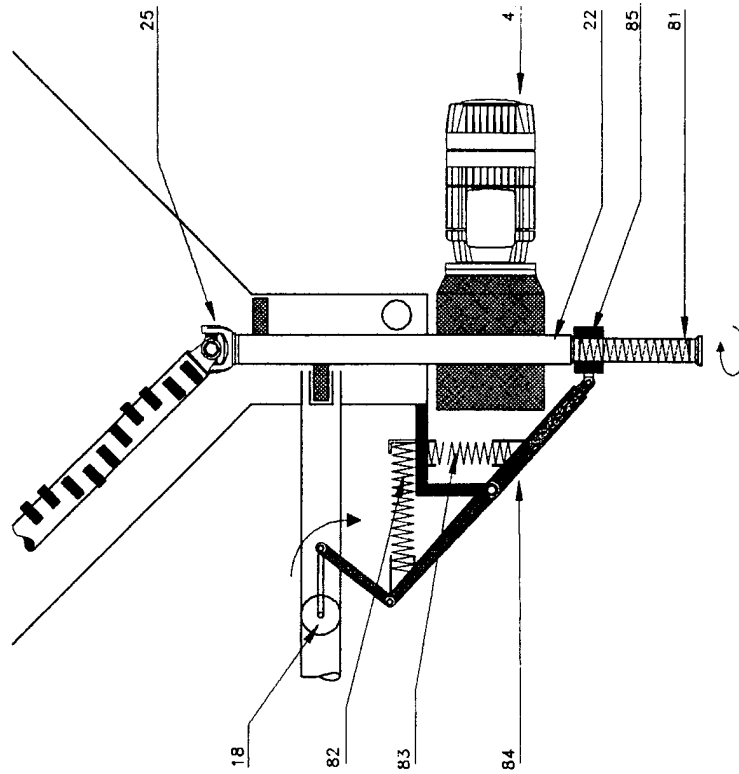


FIG. 10.2

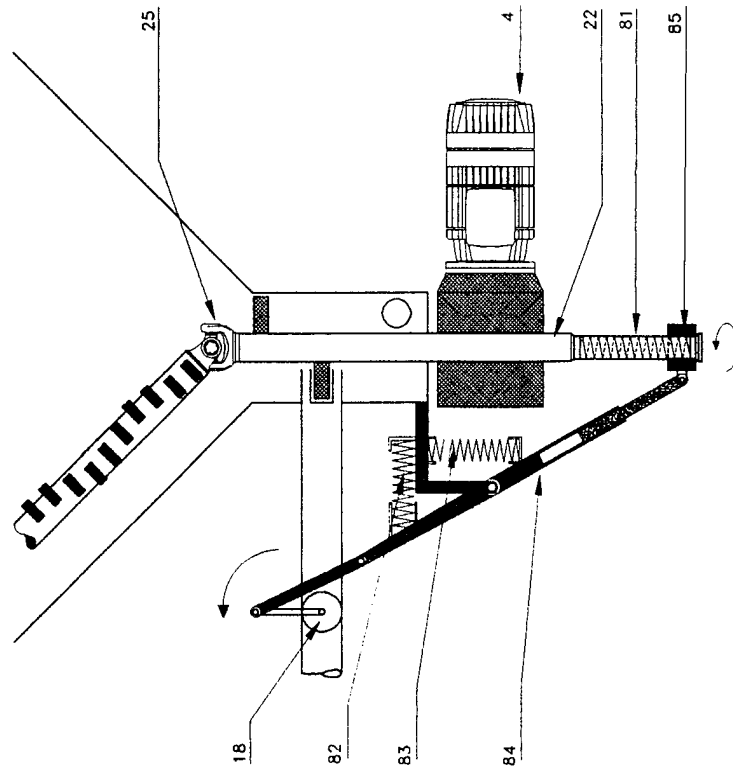
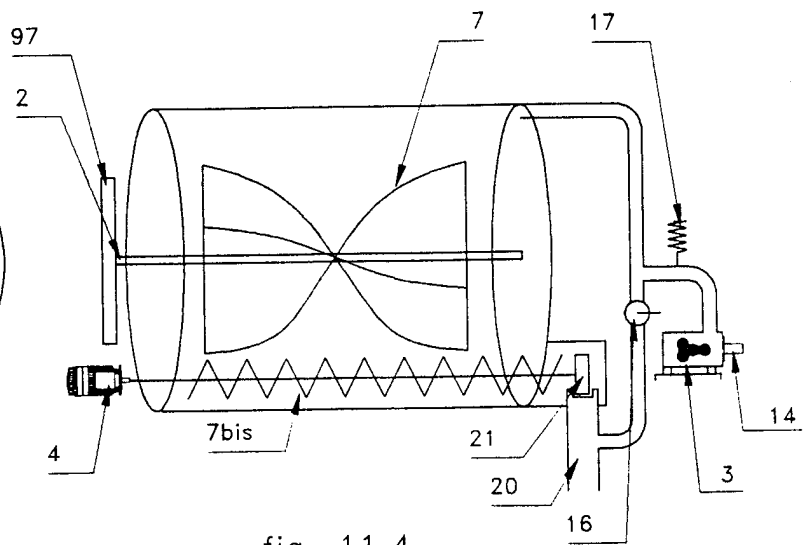
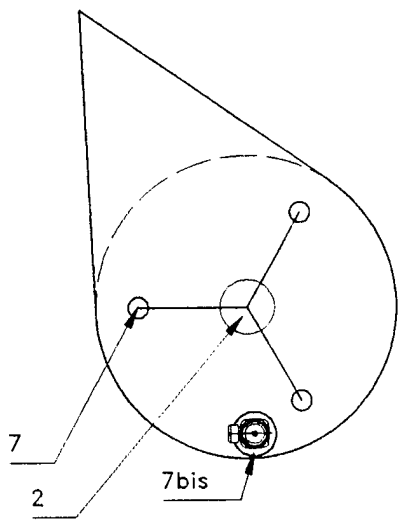
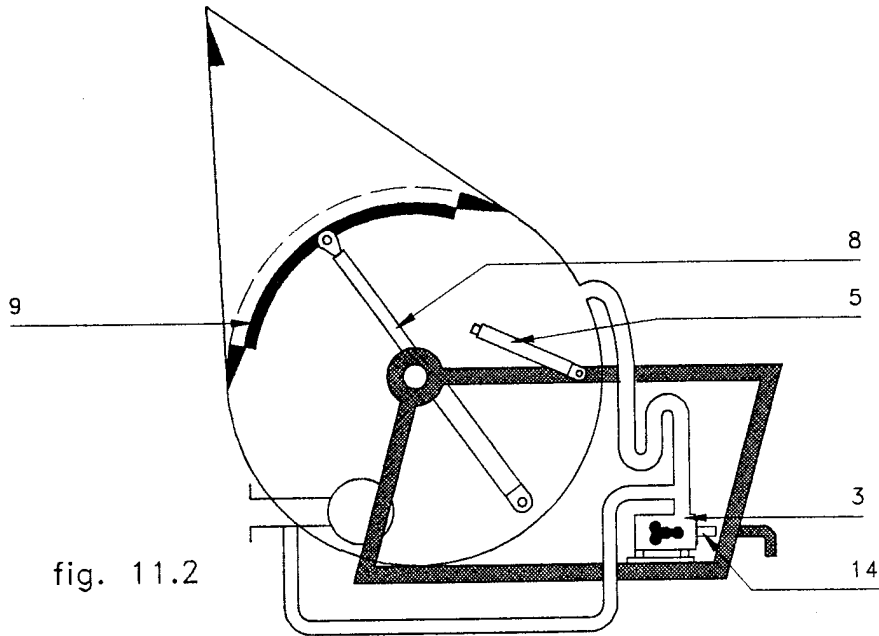
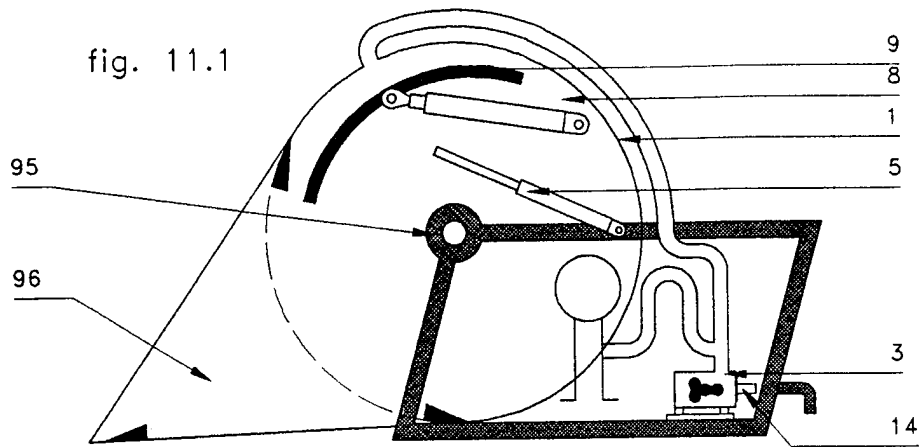


FIG. 10.1



# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/NL 97/00664

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 6 B65D88/68 A01F25/20 A01K5/00				
According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b>				
Minimum documentation searched (classification system followed by classification symbols) IPC 6 B65D A01F A01K B60P				
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)				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
Category <sup>o</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	DE 19 41 351 A (LUDWIG SPITZER) 25 February 1971 see the whole document ---	1-5, 10, 11, 15-17		
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A	FR 2 490 605 A (LAZARETH BERNARD) 26 March 1982 see claims; figures ---	8		
-/--				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.				
<input checked="" type="checkbox"/> Patent family members are listed in annex.				
<sup>o</sup> Special categories of cited documents :				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;">                     "A" document defining the general state of the art which is not considered to be of particular relevance                      "E" earlier document but published on or after the international filing date                      "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)                      "O" document referring to an oral disclosure, use, exhibition or other means                      "P" document published prior to the international filing date but later than the priority date claimed                 </td> <td style="width: 50%; border: none; vertical-align: top;">                     "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                      "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                      "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.                      "&amp;" document member of the same patent family                 </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family			
Date of the actual completion of the international search	Date of mailing of the international search report			
6 March 1998	23/03/1998			
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	Authorized officer  Van Rollegem, F			



# INTERNATIONAL SEARCH REPORT

Inte. onal Application No  
PCT/NL 97/00664

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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