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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
08 April 2021 (08.04.2021)

WIPO | PCT

(10) International Publication Number
WO 2021/066710 A1

(51) International Patent Classification:
A46B 13/00 (2006.01) *A46B 7/10* (2006.01)
A46B 7/04 (2006.01) *A46B 13/02* (2006.01)
E01H 1/05 (2006.01)

(21) International Application Number:
PCT/SE2020/050911

(22) International Filing Date:
29 September 2020 (29.09.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1951129-4 03 October 2019 (03.10.2019) SE

(71) Applicant: **SVENSKA INDUSTRIBORSTAR I VÄSTERÅS AB** [SE/SE]; Ödhumlagatan 4, SE-723 55 Västerås (SE).

(72) Inventors: **EINARSSON, Henrik**; Påtåkervägen 7, SE-186 40 Vallentuna (SE). **EKHOLM, Hans**; Reveljgatan 10, SE-723 50 Västerås (SE).

(74) Agent: **BJERKÉNS PATENTBYRÅ KB**; Box 1274, 801 37 Gävle (SE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,

(54) Title: A CASSETTE ELEMENT FEEDING DEVICE, A METHOD FOR FEEDING A CASSETTE ELEMENT AND USE OF A CASSETTE ELEMENT FEEDING DEVICE

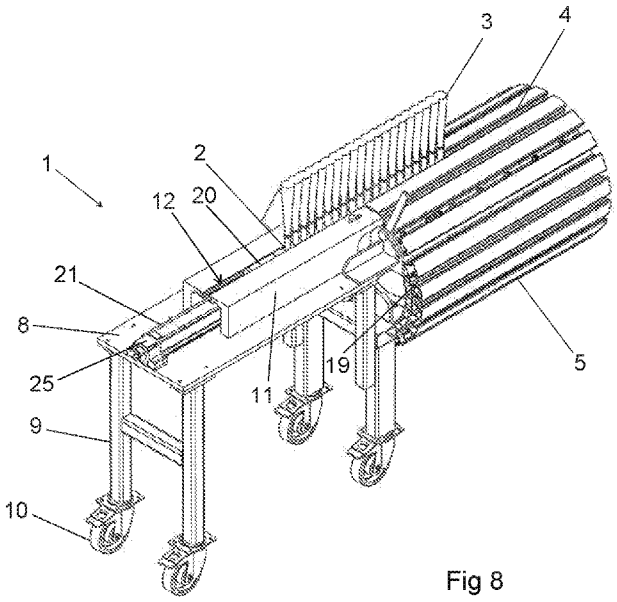

Fig 8

(57) Abstract: The invention relates to a device (1) for feeding a cassette element (2) provided with at least one bristle bunch (3) into an elongated groove (4) of a cassette element holding member (5) of a cassette brush intended for industrial use. The device (1) comprises a support and guide unit (11) configured to receive and support a said cassette element (2), a moving arrangement configured to move a cassette element (2) received by the support and guide unit (11) into a said groove (4), and a power arrangement (25) controllable to make the moving arrangement move a said cassette element (2) into a said groove (4). The invention also relates to a method for feeding a cassette element (2) by use of such a device (1), as well as use of such a device (1) for replacing cassette elements (2) of a cassette brush of an airport runway sweeper.

WO 2021/066710 A1

[Continued on next page]

UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

A cassette element feeding device, a method for feeding a cassette element and use of a cassette element feeding device

TECHNICAL FIELD OF THE INVENTION

The invention relates to the technical field of cassette brushes intended for industrial use.

Such a brush may be arranged on a tractor, a floor or street sweeping machine, an industrial machine or a robot, as a few examples, and is used for sweeping a surface. For example, such a brush arranged at an industrial machine may be used for removing disturbing particles from a conveyor and arranged at a floor sweeping machine the brush may be used for cleaning a concrete floor.

However, the invention relates especially to the technical field of cassette brushes arranged on some type of airport runway sweeper, which is used for sweeping a runway at an airport/airfield so as to keep this free from stones, dust, snow and other objects and substances that may disturb the starts and landings of airplanes. Hence, brushes arranged on airport runway sweepers may be mentioned as a typical example without restricting the invention thereto.

A typical brush of this type is composed of a circular cylindrical cassette element holding member (called “axle”, “core” etc.) of aluminium, which is provided with a plurality of elongated axial grooves in an outer surface thereof. The holding member is provided with plastic cassette elements, each having a plurality of bristle bunches arranged there along, which cassette elements are inserted one after another in the grooves of the holding member. A locking disc is mounted on each lateral end of the holding member to close the end openings of the grooves and thereby retain the cassette elements therein.

Brushes of this type are described in the documents US 4 302 863 A and US 2018/008033 A1.

BACKGROUND ART

The main advantage by a cassette brush over a brush of another type, such as a brush with bristles permanently attached to the holding member, is the ability to have the bristles of the brush replaced when these are worn down while the expensive holding member may be used over and over again.

For replacing the bristles/bristle bunches of a brush of this type, a said locking disc is firstly removed, whereafter the used cassette elements with worn down bristles are pulled out from the grooves of the holding member through the end openings thereof. The grooves are then filled with new cassette elements by inserting these through the respective end openings and pushing them into the respective grooves one after another (each groove is commonly provided with several cassette elements, but could also have only one element). Finally, the locking disc is re-mounted on the holding member and the brush is ready for use again. This entire replacement procedure may be performed while the cassette element holding member is held by the sweeping machine/vehicle.

However, although this procedure seems simple in theory, there are many problems related to the replacement of cassette elements of a brush of this type. There are no tools on the market custom made for facilitating the operations of pulling out or pushing in the cassette elements from and into the grooves of the holding member, respectively. This means that in practice the cassette elements are pulled out and pushed in by hand, or by means of regular tools which are not adapted for this purpose or self-made tools with no CE marking. It is usually a heavy work pulling out and pushing in the cassette elements due to dirt

particles in the grooves which causes the elements to slide badly and often get stuck therein. Bad working postures do not make the job easier. Moreover, it is not unusual that the operator performing the replacement gets scratched and wounded on the skin of the arms and hands by sharp metal bristles of the cassette elements, which are contaminated by chemical liquid used on the runways (in the case of a brush arranged on an airport runway sweeper).

SUMMARY OF THE INVENTION

The object of the present inventions is to come up with a solution to this problem, i.e. the heavy and dirty work of performing a said replacement procedure, so that such a procedure may be performed more rapidly and in a better work environment for the operator.

This object is according to the invention obtained by providing a device for feeding a cassette element provided with at least one bristle bunch into an elongated groove of a cassette element holding member of a cassette brush intended for industrial use, the device comprising

- a support and guide unit configured to receive and support a said cassette element while allowing the cassette element to be axially slid along a guide track provided in the support and guide unit, wherein the support and guide unit is configured to be positioned with the guide track aligned with an opening into a said groove at a lateral end of the cassette element holding member,
- a moving arrangement configured to move a cassette element received by the support and guide unit along the guide track and into a said groove, and
- a power arrangement controllable to make the moving arrangement move a said cassette element into a said groove.

The operator may by means of such a device easily feed a new cassette element into a groove of the cassette element holding member by simply placing the cassette element in the support and guide unit and controlling the power arrangement to make the moving arrangement move the cassette element into the respective groove. The operation of filling the grooves of the holding member with cassette elements may accordingly be performed in a good working posture for the operator and the heavy work of pushing these in by hand is eliminated. Furthermore, the time for performing this operation is reduced due to the force of the power arrangement making the cassette elements slide to a proper position in the respective grooves without getting stuck.

According to an embodiment of the invention the moving arrangement is configured to bear on a cassette element received by the support and guide unit, and the power arrangement is controllable to make the moving arrangement move in a direction along the guide track of the support and guide unit towards a discharge end thereof, at which a cassette element is to be discharged from said guide track into a said groove, and thereby urge a said cassette element received by the support and guide unit towards said discharge end of the guide track and into a said groove.

According to another embodiment of the invention the moving arrangement comprises a pusher arranged to be movable along the guide track of the support and guide unit between a retracted position, in which it allows a cassette element to be received by the support and guide unit, and an advanced position while pushing a said cassette element received by the support and guide unit into a said groove, and that the power arrangement is controllable to move the pusher from the retracted to the advanced position.

This device facilitates simultaneous removal of used cassette elements from and insertion of new cassette elements in the same groove of a said holding member, by removal of both locking discs from the holding member so as to make the grooves thereof open at both ends, and pushing a said cassette element into a said groove so that all elements located in that groove are displaced towards the opposite end thereof whereby the last element in the row drops out of the groove to be discarded. Hence, all operations which are heavy for the operator have been eliminated and the device accordingly creates a good working environment for him/her. Furthermore, the device of this type enables replacement of the cassette elements of a said holding member in a very short time.

According to another embodiment of the invention the pusher is configured to bear by a front end surface thereof on a rear end surface of a said cassette element received by the support and guide unit to push this cassette element from behind into a said groove in said advanced position.

According to another embodiment of the invention the pusher is slidably arranged along a rail extending along the guide track of the support and guide unit and defining a rectilinear path for the pusher between the retracted and advanced positions.

According to another embodiment of the invention the guide track is a recessed guide channel configured to receive at least a part of a said cassette element therein when this is received by the support and guide unit, and to guide said cassette element, while being moved by the moving arrangement, towards and into a said groove. The guide channel ensures that the cassette element is properly inserted into the groove which implies less need of control and intervention by the operator and by that a higher degree of automation.

According to another embodiment of the invention the guide channel has a cross-section, perpendicularly to the longitudinal extension thereof, allowing a base body of a said cassette element to be slidably received therein when this cassette element is received by the support and guide unit, an entry opening at one end and an exit opening at the other end thereof, stop surfaces configured to retain said base body in the guide channel while this is slid between the entry and exit openings thereof, and an elongated opening extending between said entry and exit openings allowing said at least one bristle bunch of the cassette element to project out of the guide channel when the base body is received therein, and the pusher has a part with a shape corresponding to said cross-section of the guide channel, which part is configured to enter into the guide channel through the entry opening thereof and be guided therein towards the exit opening while the pusher is moved from the retracted to the advanced position.

According to another embodiment of the invention the support and guide unit comprises two elongated support and guide members each having a substantially U-shaped groove along a longitudinal edge thereof, wherein the support and guide members are arranged with said grooves extending in parallel with and at a distance from each other, with the openings of the U-shapes facing each other, so as to together form said guide channel of the support and guide unit with a said elongated opening extending between said entry and exit openings both along a top and bottom portion of the guide channel.

According to another embodiment of the invention the device further comprises:

- securing means configured to interact with parts of a said cassette element holding member for fixedly securing the device thereto with the support and guide unit in said position while a said cassette element is

moved into a said groove of the cassette element holding member.

These securing means ensure that the device and the support and guide unit thereof are steadily kept in a suitable mutual position with respect to the cassette element holding member while a said cassette element is moved into a said groove of the holding member.

According to another embodiment of the invention the securing means comprises at least one locking pin movably arranged at the device between a locking position, in which it protrudes from a front surface of the device and is configured to be inserted in and engage with a recess on a lateral side of said cassette element holding member, and a releasing position, in which it is retracted into said front surface.

According to another embodiment of the invention the device further comprises:

- an arrangement for manipulating a said cassette element holding member in the form of a rotatably held circular cylindrical body, which arrangement comprises a locking member configured to, in an active state, protrude on a front side of the device and be inserted in and engage with a recess on a lateral side of said cassette element holding member, wherein the arrangement is controllable to move the locking member between at least a first and a second position, in a direction at least substantially perpendicular to a longitudinal extension of the locking member when this is in the active state, and a movement of the locking member between the first and second positions is configured to cause a rotational movement of the cassette element holding member when the locking member is in the active state.

Such an arrangement enables the operator to easily manipulate the cassette element holding member so as to feed a said groove to be provided with new cassette elements to the position in which a cassette element received by the support and guide unit is aligned with an opening thereof without having to grab the dirty holding member by hand or risk damaging it by using a non-suitable tool.

According to another embodiment of the invention the power arrangement comprises a motor, preferably an electric motor. A motor driven power arrangement implies a more automatic feeding of cassette elements by the device and accordingly a better working environment for the operator using it.

According to another embodiment of the invention the device further comprises a frame structure provided with wheels, by which the device is configured to rest on a ground. Such a frame structure simplifies operation of the device.

According to another embodiment of the invention the device comprises a support element configured to receive a part of a holding structure, by which the cassette element holding member is configured to be held, on an upper surface thereof so as to provide support for holding said holding structure and thereby the cassette element holding member in a suitable position during an operation of feeding a cassette element into a said groove of the holding member.

According to another embodiment of the invention the support element has receiving means, preferably a semicircular notch, in said upper surface, in which the part of the holding structure is configured to be received and placed to rest.

According to another embodiment of the invention the support element is configured to allow a part of the holding structure to grip over said upper surface and behind a rear surface of the

support element, so as to axially fix the cassette element holding member when the part of the holding structure is placed to rest on the support element.

The invention also relates to a method for feeding a cassette element by means of a device according to the invention according to the appended method claim. Realizations of, and advantages with, such a method clearly appears from the above and following description of embodiments of a device according to the invention.

The invention also relates to use of a device according to the invention according to the appended use claim.

Further advantages as well as advantageous features of the invention will appear from the following description of an embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a specific description of an embodiment of the invention cited as an example.

In the drawings:

Fig 1 is a simplified perspective view obliquely from a rear side of a device according to an embodiment of the invention,

Fig 2 is a perspective view obliquely from a front side of the device of Fig 1, showing a part of the support and guide unit in detail,

Fig 3 is a simplified perspective view of an airport runway sweeper provided with a cassette brush intended for industrial use,

Fig 4 is a simplified perspective view of a cassette element provided with a plurality of bristle bunches to be mounted in an elongated groove of a cassette element holding member of a cassette brush intended for industrial use,

Fig 5 is a simplified view showing a first step of an operation of replacing the cassette elements of a cassette element holding member of a cassette brush intended for industrial use by use of the device of Fig 1,

Fig 6 is a simplified view showing a second step of said replacement operation,

Fig 7 is a simplified view showing a third step of said replacement operation,

Fig 8 is a simplified view showing a fourth step of said replacement operation,

Fig 9 is a simplified view showing a fifth step of said replacement operation,

Fig 10 is a simplified view showing the fourth step of said replacement operation in more detail, and

Fig 11 is a simplified sectional view of a part of the device in the direction “A” in Fig 7.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

A device 1 according to an embodiment of the invention is illustrated in the appended figures 1-2 and 5-11 and will now be described while at the same time making reference to all these figures.

The device 1 is configured to be used for feeding a cassette element 2 into an elongated groove 4 of a cassette element holding member 5 of a cassette brush 6 intended for industrial use, especially a cassette brush arranged on an airport runway sweeper 7, and more specifically, for replacing used cassette elements of such a brush with new ones. Such a cassette element 2 has an elongated plank-like base body 18 provided with a plurality of bristle bunches 3 protruding from an upper surface thereof (see Fig. 4).

The device 1 comprises a frame structure in the form of a base plate 8 carried by legs 9 provided with wheels 10, by which the device is configured to rest on a ground.

The device 1 further comprises a support and guide unit 11 arranged on the base plate 8 and configured to receive and support a said cassette element 2 to be fed into a said groove 4 while allowing the cassette element to be axially slid, i.e. slid along a longitudinal axis thereof, along a guide track in the form of a recessed guide channel 12 provided in the support and guide unit.

The support and guide unit 11 comprises two elongated support and guide members 11a-b, each having a vertical wall attached to the base plate 8 and a horizontal wall extending from the top end of the vertical wall towards the other support and guide member, i.e. the support and guide members each has a cross-section with the shape of an “L” turned upside down, with the horizontal short legs pointing at each other (see Fig 11). The end surfaces of the support and guide members 11a-b facing each other are each provided with a substantially U-shaped groove

13a-b extending along the entire length of the respective support and guide member. “Substantially U-shaped” is here to be interpreted as having a bottom and two walls extending substantially perpendicularly away therefrom and defining an opening between the outer ends thereof, and shall also include a U-shape with square corners as is seen in Fig 11, as one example.

The support and guide members 11a-b are arranged with said grooves 13a-b extending in parallel with and at a distance from each other, with the openings of the U-shapes facing each other, so that the grooves together form the guide channel 12 of the support and guide unit 11. Due to the distance between the end surfaces of the support and guide members provided with grooves 13a-b, the guide channel has an elongated bottom opening 14 extending along a center of a bottom portion of the channel between an entry opening 15 at one end and an exit opening 16 at the other end thereof, and an elongated top opening 17 extending along a center of a top portion of the channel between said entry and exit openings thereof.

The guide channel 12 has a rectangular cross-section, perpendicularly to the longitudinal extension thereof, allowing a base body 18 of a said cassette element 2 to be slidably received therein when this cassette element is received by the support and guide unit 11. More specifically, the base body of the cassette element is inserted into the guide channel through the entry opening 15 thereof and rests slidingly on the lower walls of the grooves 13a-b of the support and guide members 11a-b when received therein. Accordingly, these lower walls provide stop surfaces for the base body 18 of the cassette element in the downward direction, and the upper walls of these grooves 13a-b provide stop surfaces for the base body in the upward direction, whereby the base body 18 is retained in the guide channel 12 by these stop surfaces and may be brought out therefrom by axially sliding out through one of the entry 15 and exit 16 openings only.

The elongated top opening 17 of the guide channel allows said at least one bristle bunch of the cassette element to project out of the guide channel when the base body 18 of the cassette element 2 is received and slid therein.

The support and guide unit 11 is thus configured to receive and support a said cassette element 2 to be fed into a said groove 4 of a cassette element holding member 5 by receiving this element in the guide channel 12. The support and guide unit is configured to be positioned such that a cassette element received by it has its front end 37 aligned with an opening 19 into a said groove at a lateral end of the cassette element holding member, namely in a position in which the exit opening 16 of the guide channel 12 is aligned with said opening 19 of the groove 4 of the cassette element holding member 5 (see Fig 7).

The device 1 further comprises a moving arrangement configured to move a cassette element 2 received by the support and guide unit 11 along the guide channel 12 and into a said groove 4 of a cassette element holding member 5. The moving arrangement comprises a carriage-like pusher 20 slidably arranged along a rail 21 arranged on the base plate 8 and extending along the guide channel 12 of the support and guide unit 11, namely under the guide channel, and defining a rectilinear path for the pusher between a retracted position (see for instance Fig 7), in which it allows a cassette element 2 to be received in the guide channel 12 of the support and guide unit 11, and an advanced position (see Fig 8) while pushing a said cassette element received in the guide channel 12 of the support and guide unit 11 into a said groove 4.

More specifically, the rail 21 extends from a region of the exit opening 16 of the guide channel 12, along the entire length of the guide channel and past the entry opening 15 thereof by a part with a greater length than the length of the pusher 20, and the pusher in the retracted position is located at an end of the rail 21

opposite to the end located at the region of the exit opening 16 of the guide channel 12, so as to allow a cassette element to be inserted through the entry opening 15 of the guide channel 12 to be received therein in a position between a front end surface 22 of the pusher 20 and said exit opening 16. The pusher 20 is accordingly configured to bear by the front end surface 22 thereof on a rear end surface 23 of a said cassette element 2 received in the guide channel 12 of the support and guide unit 11 to urge this cassette element from behind towards a discharge end of the guide channel, namely said exit opening 16, and into a said groove 4 in the advanced position.

The pusher 20 has a part 24 with a shape corresponding to said cross-section of the guide channel 12. More specifically, the pusher has a T-shape and the upper horizontal part 24 of the T has a cross-section substantially corresponding to the cross-section of the guide channel 12 (see Fig 11). This part 24 of the pusher is configured to enter into the guide channel through the entry opening 15 thereof and be guided therein towards the exit opening 16 while the pusher 20 is moved from the retracted to the advanced position. The vertical part of the T-shape of the pusher 20 interconnecting the upper part 24 and a part in contact with the rail 21 projects through the bottom opening 14 of the guide channel 12 when said upper part 24 is located therein.

The device 1 further comprises a power arrangement 25, comprising an electric motor, controllable to make the moving arrangement move a said cassette element 2 into a said groove 4 of a cassette element holding member 5, and more specifically, controllable to move the pusher 20 from the retracted to the advanced position. The power arrangement may for instance operate the pusher by means of a ball screw arrangement, which is well known in the art and will therefore not be further described in this disclosure.

The power arrangement 25 may be controllable to move the pusher 20 back and forth between said retracted and advanced positions along the rail 21 by means of control buttons (not shown), but it is also possible that the power arrangement is configured to be used for moving the pusher from the retracted to the advanced position only, and thus that the operator of the device needs to bring the pusher back to the retracted position by hand. The power arrangement could also be fully automatic, such as be controlled by information provided by position sensors. Furthermore, it is also possible that the power arrangement is manually operable, i.e. may be driven without a motor, such as by means of a crank handle or the like.

The device 1 further comprises securing means in the form of two locking pins 26 slidably arranged in a respective channel-like recess in a front surface 27 of the device, and more specifically each slidably arranged in a recess in a front surface of one of the two support and guide members 11a-b. Each locking pin 26 is movable between a locking position, in which it is slid out of the recess to protrude from said front surface 27 and configured to be inserted in and engage with a recess on a lateral side of a said cassette element holding member 5, and a releasing position, in which it is retracted into the recess in said front surface. These recesses on the lateral side of the holding member may for instance be guide holes prepared therein, i.e. which facilitate guiding of the holding member 5 to a suitable position for a cassette element feeding operation by insertion of said locking pins 26 therein. Each locking pin is connected to and operated by a sliding knob 28. The locking pins are used to fixedly secure the device 1 to a cassette element holding member 5 in the locking position, with the support and guide unit 11 in said position, i.e. with the exit opening 16 of the guide channel 12 aligned with an opening 19 into a said groove 4 of the holding member 5. Thus, a rotatable circular cylindrical cassette element holding member is in this way held in a non-rotatable state during a said feeding operation.

The device 1 further comprises an arrangement for manipulating a said cassette element holding member 5 in the form of a rotatably held circular cylindrical body. The manipulating arrangement comprises a locking member in the form of a locking pin 29 configured to, in an active state, protrude on a front side of the device 1 and be inserted in and engage with a recess on a lateral side of said cassette element holding member 5. The locking pin 29 is slidably received in a guide slot 30 arranged in a plate element attached to the base plate 8 at a front end thereof. The guide slot is curved in such a way that the locking pin 29 is moved along a part of an imagined circle, with the axis of rotation of the cassette element holding member 5 to be manipulated as the center, when this is slid in the guide slot.

The locking pin 29 is connected to a lever 31 by which it is movable in the guide slot 30 between at least a first and a second position, in a direction at least substantially perpendicular to a longitudinal extension of the locking pin (and to the axis of rotation of the cassette element holding member 5), and thereby causes a rotational movement of the holding member 5 when the locking pin 29 is in the active state. The locking pin 29 has a head part 32 located on a rear side of the plate element, by which the locking pin may be pulled through the guide slot 30 out of engagement with a said recess of the cassette element holding member 5, to be slid in the guide slot to a position in which it is aligned with and may be inserted in another such recess of the holding member.

Hereinafter, a method of replacing used cassette elements 2b with worn down bristle bunches (see Fig 5) of a cassette element holding member 5 by means of a device 1 is to be described, with reference especially to the figures 5-10. The cassette element holding member has a circular cylindrical body with elongated axial grooves 4 in an outer surface thereof. The holding member

5 is part of a cassette brush 6 which is rotatably mounted on a shaft 33 held by front arms 34 of an airport runway sweeper 7.

Firstly, the locking discs 35 (see Fig 5) mounted on each lateral end of the holding member 5 are removed so as to clear the openings 19 into the grooves 4 of the holding member at both ends thereof (see Fig 6). Each of these locking discs consists suitably by two halves, so as to allow removal thereof while the holding member is held by the airport runway sweeper 7, and are attached to the holding member by screws.

Thereafter, a part of the holding structure, by which the cassette element holding member 5 is held (comprising the shaft 33 on which the holding member 5 is mounted, the front arms 34 of the airport runway sweeper 7 as well as components attached thereto), is received and placed to rest on an upper surface of a support element 36 arranged on a front side of the frame structure of the device 1, so that the cassette element holding member is vertically fixed by the device 1 with the groove 4 located at the top of the holding member 5 located at the same height as the exit opening 16 of the guide channel 12 of the support and guide unit 11 of the device 1 (see Fig 7). The support element 36 has receiving means in the form of a semicircular notch 40 in said upper surface, in which the part of the holding structure is configured to be received and placed to rest. Furthermore, the support element 36 is configured to allow a gripping part (not shown) of the holding structure to grip over said upper surface and behind a rear surface 41 of the support element, so as to axially fix the cassette element holding member 5 when the part of the holding structure is placed to rest on the support element 36.

The wheels 10 of the device are then put into a lock position so as to immobilize the device. Preferably, the opposite end of the shaft 33 is also placed to rest on some external support surface,

such as at a support carriage 39, to keep the holding member 5 steady in a horizontal position.

The two locking pins 26 on the support and guide unit 11 are moved, by actuation of the sliding knobs 28, to their locking position in engagement with a respective recess at a lateral side of the cassette element holding member 5 so as to lock the holding member 5 in a non-rotatable position with the opening 19 into the groove 4 located at the top of the holding member aligned with the exit opening 16 of the guide channel 12 of the support and guide unit 11. Furthermore, the head part 32 of the locking pin 29 of the manipulating arrangement is gripped and pulled in a direction away from the cassette element holding member 5 allowing the locking pin 29 to be slid to a first position in the guide slot 30, at the top thereof, and inserted into a recess on the lateral side of the holding member by bringing the head part 32 back into contact with the plate element in this position.

The cassette element holding member 5 is now axially and radially fixed by the device 1, and more specifically by the support element 36 and the two locking pins 26 on the support and guide unit 11 thereof.

A cassette element 2 is placed in and received by the support and guide unit 11, and more specifically inserted into the guide channel 12 through the entry opening 15 thereof and slid in said channel to a position in which a front end surface 37 of the cassette element 2 is located at the exit opening 16 of the guide channel 12, i.e. aligned with the opening 19 into the groove 4 located at the top of the holding member 5, and the rear end surface 23 of the cassette element is located at the entry opening 15 of the guide channel. The pusher 20 is located in the retracted position, and may also be folded down on one side of the rail 21, so as to provide space for allowing this insertion of the cassette element into the guide channel. It should be mentioned that the placing of the cassette element 2 in the support and guide unit 11

may of course be done at an earlier stage of this method, such as in a first stage, as is understood from Fig 5.

The operator performing the replacement method then actuates the power arrangement, for instance by a control button (not shown), to move the pusher 20 to the advanced position, i.e. to slide along the rail 21 so that the upper part 24 of the pusher is moved into the entry opening 15 of the guide channel and is slid therein towards the exit opening 16 while bearing by the front end surface 22 on the rear end surface 23 of the cassette element 2 so as to push the cassette element through the guide channel 12 and out of the exit opening 16 thereof into said opening 19 of the groove 4 of the cassette element holding member 5 (see Fig 8).

Each groove 4 of a cassette element holding member 5 of this type is typically provided with 4-6 (in the example shown 4) cassette elements 2 arranged one after another therein. This means that the length of a said groove substantially corresponds to the length of four cassette elements combined. When a new cassette element is pushed into the opening 19 of a said groove 4 by the pusher 20, this new element abuts a first one in the row of used cassette elements 2b located in that groove. While being pushed further into the groove 4 by the pusher 20, this new cassette element 2 will in turn push the entire row of used cassette elements 2b towards the opening of the groove at the opposite lateral end of the holding member 5, and once the new cassette element 2 is fully inserted in the groove 4, the last used cassette element 2b in the row will drop out from said opening at the opposite end and into a collecting container 38 (see Fig 10).

This procedure is then repeated, i.e. a new cassette element 2 placed in the support and guide unit 11 of the device 1 and pushed into the groove 4 of the holding member 5, until this groove is filled with new cassette elements only. Thus, with this method there is no need to separately pull out the used cassette elements 2b from a groove 4, as the removal of these is managed

automatically by the feeding of new cassette elements therein, which substantially reduces the time needed for a process of replacing the cassette elements of a cassette element holding member of this type.

When a groove 4 of the cassette element holding member is completely filled with new cassette elements 2, the operator pulls the locking pins 26 of the support and guide unit 11 back to the releasing position whereby the holding member 5 is allowed to rotate, and then simply pulls the lever 31 of the manipulating arrangement to make the locking pin 29 thereof slide in the guide slot 30 to a second position, at the bottom thereof, whereby the cassette element holding member 5 is rotated and a new groove 4 thereof fed to a position in which the opening 19 thereof is aligned with the exit opening 16 of the guide channel (see Fig 9).

This procedure is repeated until all the grooves 4 of the cassette element holding member 5 are filled with new cassette elements 2, whereafter this is lifted from the support element 36 of the device 1 and the support carriage 39, the locking discs 35 are re-mounted at the lateral ends of the holding member and the brush 6 is ready for use.

Accordingly, the present invention offers a solution to the problem described in the introduction, by providing a device 1 as well as a method of using it enabling replacement of cassette elements of a cassette element holding member 5 of a cassette brush 6 intended for industrial use in less time and in a substantially better working environment for the operator compared to the replacement procedures used today.

The invention is of course not in any way restricted to the embodiment thereof described above, but many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the scope of the invention as defined in the appended claims.

A cassette element holding member with a body having a circular cylindrical shape is one type of such a holding member. However, the body of the holding member may for instance have the shape of a cone or be substantially flat.

The moving arrangement may comprise other components than a pusher, such as rotatable wheels, or a belt fed in an endless loop, arranged along the guide track and configured to bear on a cassette element received therein so as to move said element by friction force between the rotatable wheels/belt and the element, as a few examples.

The device could also be configured for feeding two or more cassette elements at a time, either in series (into the same groove) or in parallel (into two or more adjacent grooves).

The phrase “industrial use” as used in this disclosure refers to such use that is not commonly performed in a regular household. For example, use of a handheld broom is considered to not be included in this definition, even if it is used in an industrial facility.

The steps a) and b) in the appended method claim may also be performed in the reversed order, i.e. the support and guide unit firstly positioned so that a cassette element then placed therein is directly aligned with said opening into said groove.

A said guide track is not to be limited to comprising a recessed track or channel, but could for instance consist of a flat surface along which a cassette element is guided.

The terms upper, lower, front, rear, horizontal and vertical as are used in this disclosure for defining various components, or parts thereof, are to be interpreted as valid for a device placed on a horizontal ground, as shown for instance in Fig 2. The front side

of the device as shown in Fig 2 is directed obliquely to the right and obliquely towards the viewer of the drawing.

It is of course also possible to use the device for feeding cassette elements into empty grooves of for instance a brand new cassette element holding member, i.e. without simultaneously pushing out used cassette elements therefrom. Furthermore, it is possible to use the device for emptying a said groove of a cassette element holding member without providing this with new cassette elements, by pushing cassette elements, with or without bristle bunches, or bodies with similar shape, into the groove in order to push out used cassette elements therefrom. Those cassette elements or bodies pushed into the groove may thereafter be pushed/pulled out therefrom and the groove is empty.

A cassette brush is in this disclosure to be interpreted as a brush comprising a cassette element holding member provided with at least one cassette element, which is provided with at least one bristle bunch. Such a brush may however also comprise other components, such as locking discs etc. Although the bristles of a said cassette element are usually arranged in one or more bunches, it is of course also possible that a cassette element to be fed by the device is provided with separate bristles scattered over a surface thereof.

Claims

1. A device (1) for feeding a cassette element (2) provided with at least one bristle bunch (3) into an elongated groove (4) of a cassette element holding member (5) of a cassette brush (6) intended for industrial use, the device (1) comprising
   - a support and guide unit (11) configured to receive and support a said cassette element (2) while allowing the cassette element (2) to be axially slid along a guide track provided in the support and guide unit (11), wherein the support and guide unit (11) is configured to be positioned with the guide track aligned with an opening (19) into a said groove (4) at a lateral end of the cassette element holding member (5),
   - a moving arrangement configured to move a cassette element (2) received by the support and guide unit (11) along the guide track and into a said groove (4), and
   - a power arrangement (25) controllable to make the moving arrangement move a said cassette element (2) into a said groove (4).

2. A device (1) according to claim 1, **characterized** in that the moving arrangement is configured to bear on a cassette element (2) received by the support and guide unit (11), and that the power arrangement (25) is controllable to make the moving arrangement move in a direction along the guide track of the support and guide unit (11) towards a discharge end thereof, at which a cassette element (2) is to be discharged from said guide track into a said groove (4), and thereby urge a said cassette element (2) received by the support and guide unit (11) towards said discharge end of the guide track and into a said groove (4).

3. A device (1) according to claim 1 or 2, **characterized** in that the moving arrangement comprises a pusher (20) arranged to be movable along the guide track of the support and guide unit (11) between a retracted position, in which it allows a cassette element (2) to be received by the support and guide unit (11), and an advanced position while pushing a said cassette element (2) received by the support and guide unit (11) into a said groove (4), and that the power arrangement (25) is controllable to move the pusher (20) from the retracted to the advanced position.

4. A device (1) according to claim 3, **characterized** in that the pusher (20) is configured to bear by a front end surface (22) thereof on a rear end surface (23) of a said cassette element (2) received by the support and guide unit (11) to push this cassette element (2) from behind into a said groove (4) in said advanced position.

5. A device (1) according to claim 3 or 4, **characterized** in that the pusher (20) is slidably arranged along a rail (21) extending along the guide track of the support and guide unit (11) and defining a rectilinear path for the pusher (20) between the retracted and advanced positions.

6. A device (1) according to any of the preceding claims, **characterized** in that the guide track is a recessed guide channel (12) configured to receive at least a part (24) of a said cassette element (2) therein when this is received by the support and guide unit (11), and to guide said cassette element (2), while being moved by the moving arrangement, towards and into a said groove (4).

7. A device (1) according to claims 3 and 6, **characterized** in that the guide channel (12) has a cross-section, perpendicularly to the longitudinal extension thereof, allowing a base body (18) of a said cassette element (2) to

be slidably received therein when this cassette element (2) is received by the support and guide unit (11), an entry opening (15) at one end and an exit opening (16) at the other end thereof, stop surfaces configured to retain said base body (18) in the guide channel (12) while this is slid between the entry (15) and exit (16) openings thereof, and an elongated opening (17) extending between said entry (15) and exit (16) openings allowing said at least one bristle bunch (3) of the cassette element (2) to project out of the guide channel (12) when the base body (18) is received therein, and that the pusher (20) has a part (24) with a shape corresponding to said cross-section of the guide channel (12), which part (24) is configured to enter into the guide channel (12) through the entry opening (15) thereof and be guided therein towards the exit opening (16) while the pusher (20) is moved from the retracted to the advanced position.

8. A device (1) according to claim 7, **characterized** in that the support and guide unit (11) comprises two elongated support and guide members (11a-b) each having a substantially U-shaped groove (13a-b) along a longitudinal edge thereof, wherein the support and guide members (11a-b) are arranged with said grooves (13a-b) extending in parallel with and at a distance from each other, with the openings of the U-shapes facing each other, so as to together form said guide channel (12) of the support and guide unit (11) with a said elongated opening (14, 17) extending between said entry (15) and exit (16) openings both along a top and bottom portion of the guide channel (12).

9. A device (1) according to any of the preceding claims, **characterized** in that the device (1) further comprises:
   - securing means configured to interact with parts of a said cassette element holding member (5) for fixedly

securing the device (1) thereto with the support and guide unit (11) in said position while a said cassette element (2) is moved into a said groove (4) of the cassette element holding member (5).

10. A device (1) according to claim 9, **characterized** in that the securing means comprises at least one locking pin (26) movably arranged at the device (1) between a locking position, in which it protrudes from a front surface (27) of the device (1) and is configured to be inserted in and engage with a recess on a lateral side of said cassette element holding member (5), and a releasing position, in which it is retracted into said front surface (27).

11. A device (1) according to any of the preceding claims, **characterized** in that the device (1) further comprises:

- an arrangement for manipulating a said cassette element holding member (5) in the form of a rotatably held circular cylindrical body, which arrangement comprises a locking member (29) configured to, in an active state, protrude on a front side of the device (1) and be inserted in and engage with a recess on a lateral side of said cassette element holding member (5), wherein the arrangement is controllable to move the locking member (29) between at least a first and a second position, in a direction at least substantially perpendicular to a longitudinal extension of the locking member (29) when this is in the active state, and a movement of the locking member (29) between the first and second positions is configured to cause a rotational movement of the cassette element holding member (5) when the locking member (29) is in the active state.

12. A device (1) according to any of the preceding claims, **characterized** in that the power arrangement (25) comprises a motor, preferably an electric motor.

13. A device (1) according to any of the preceding claims, **characterized** in that the device (1) further comprises a frame structure (8, 9) provided with wheels (10), by which the device (1) is configured to rest on a ground.

14. A method for feeding a cassette element (2) provided with at least one bristle bunch (3) into an elongated groove (4) of a cassette element holding member (5) of a cassette brush (6) intended for industrial use, by use of a device (1) according to any of the claims 1-13, the method comprising

a) placing the cassette element (2) in the support and guide unit (11),
b) positioning the support and guide unit (11) with the guide track aligned with an opening (19) into a said groove (4),
c) controlling the power arrangement (25) to make the moving arrangement move the cassette element (2) along the guide track and into the groove (4).

15. Use of a device (1) according to any of the claims 1-13 for replacing said cassette elements (2) of a cassette element holding member (5) of a cassette brush (6) of an airport runway sweeper (7).

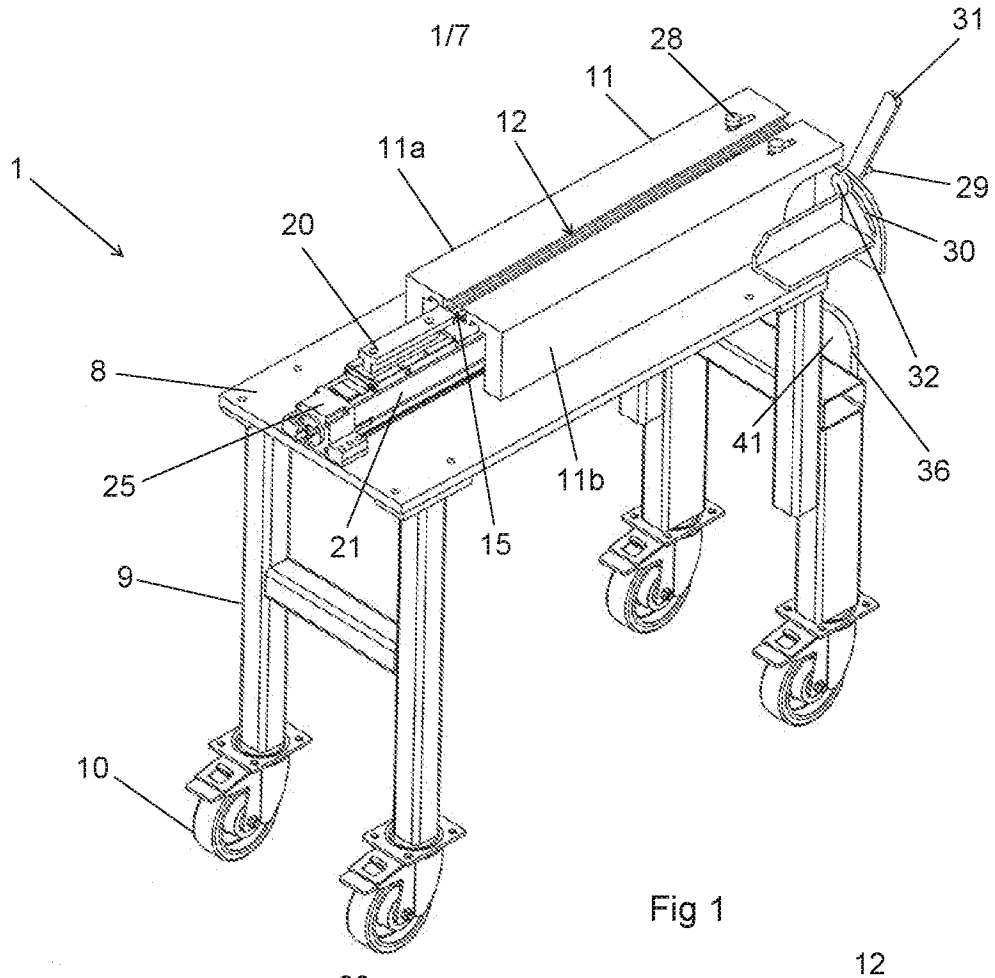
1
8
9
10
11
11a
11b
12
15
20
21
25
28
29
30
31
32
36
41

Fig 1

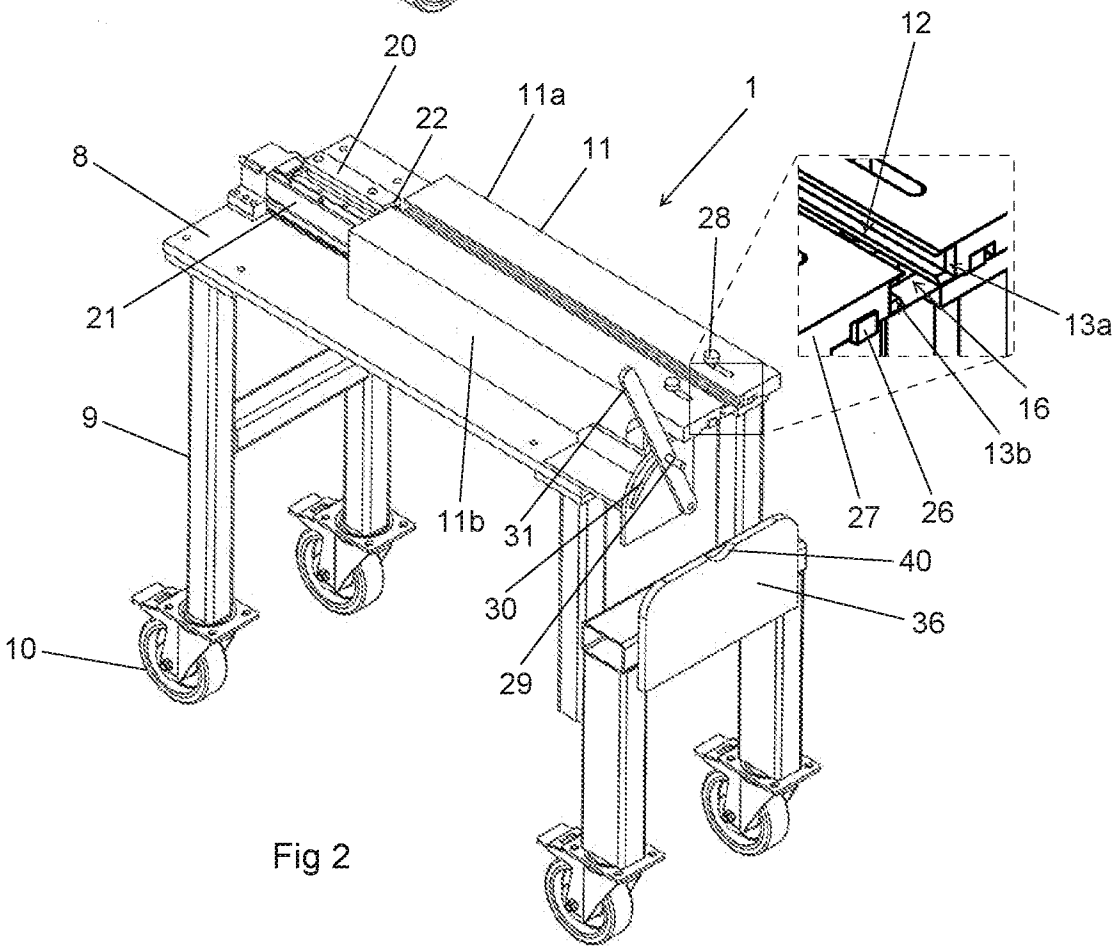
1
8
9
10
11
11a
11b
12
13a
13b
16
20
21
22
26
27
28
29
30
31
36
40

Fig 2

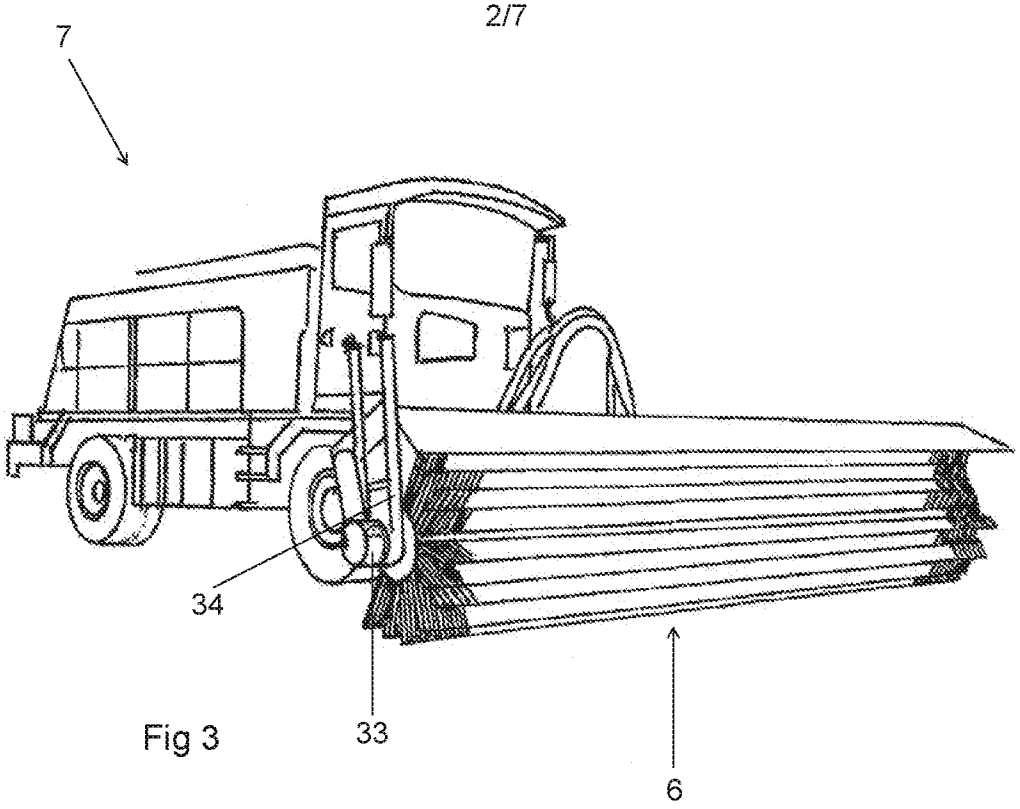

Fig 3

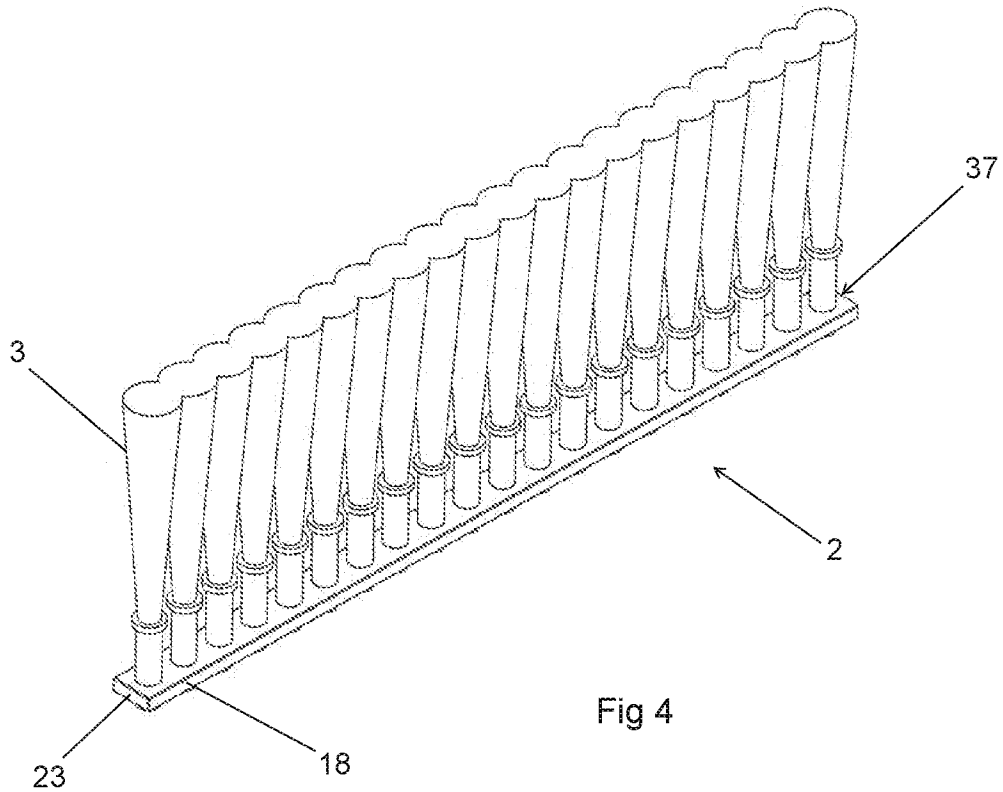

Fig 4

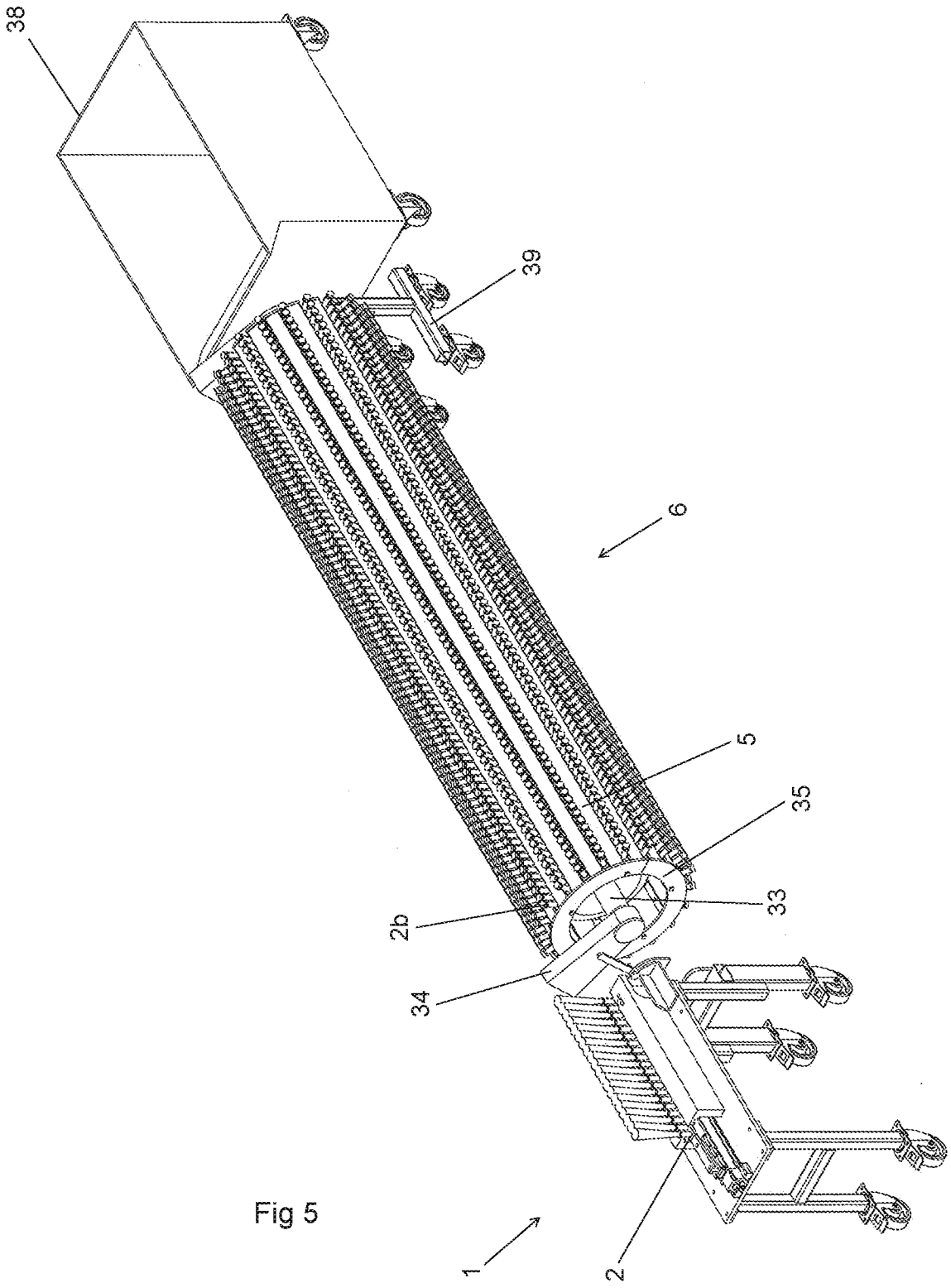

Fig 5

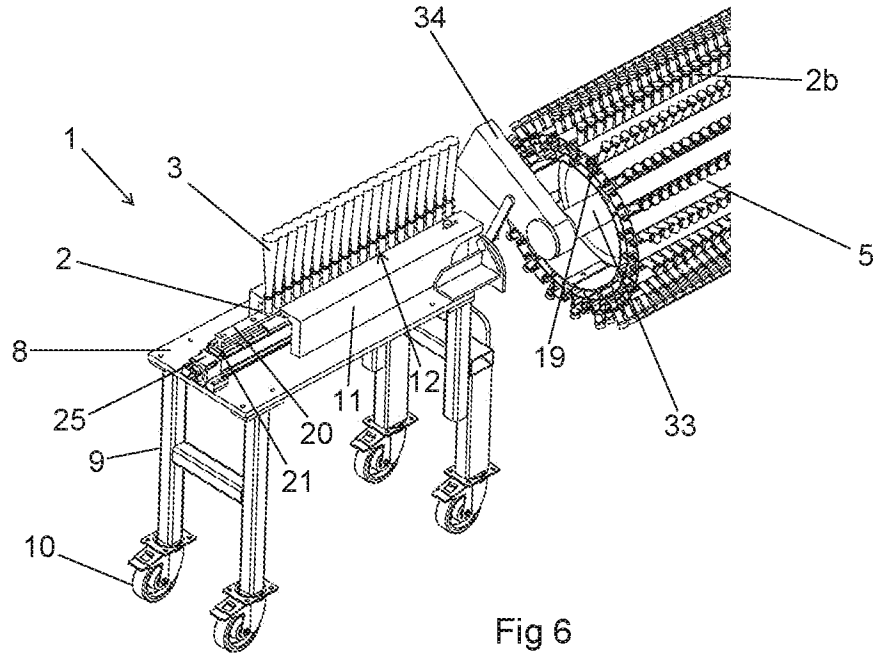
34
2b
1
3
5
2
8
19
12
11
33
25
20
9
21
10

Fig 6

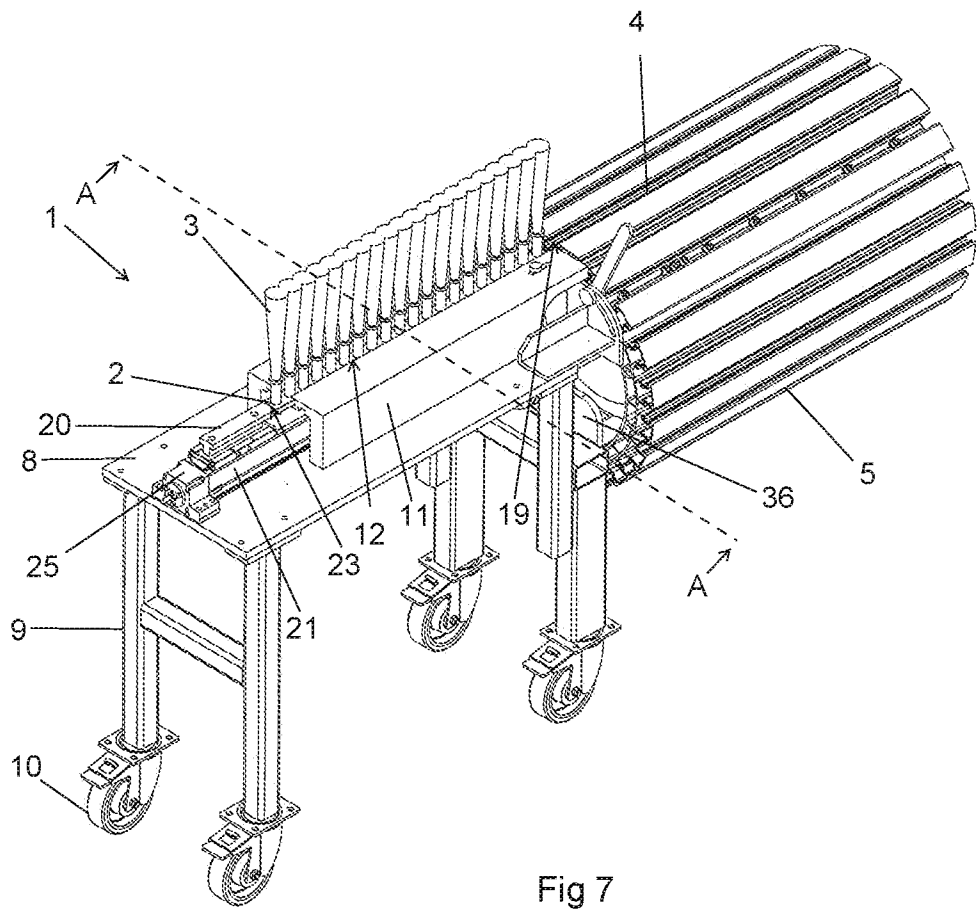
4
A
1
3
2
20
8
5
36
12
11
19
25
23
A
9
21
10

Fig 7

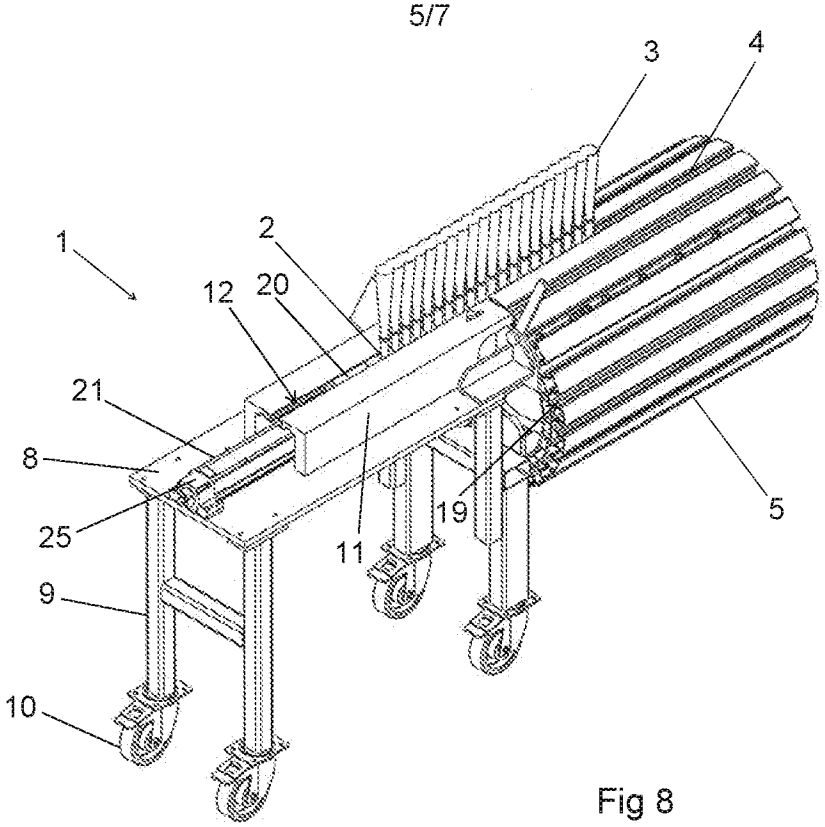

Fig 8

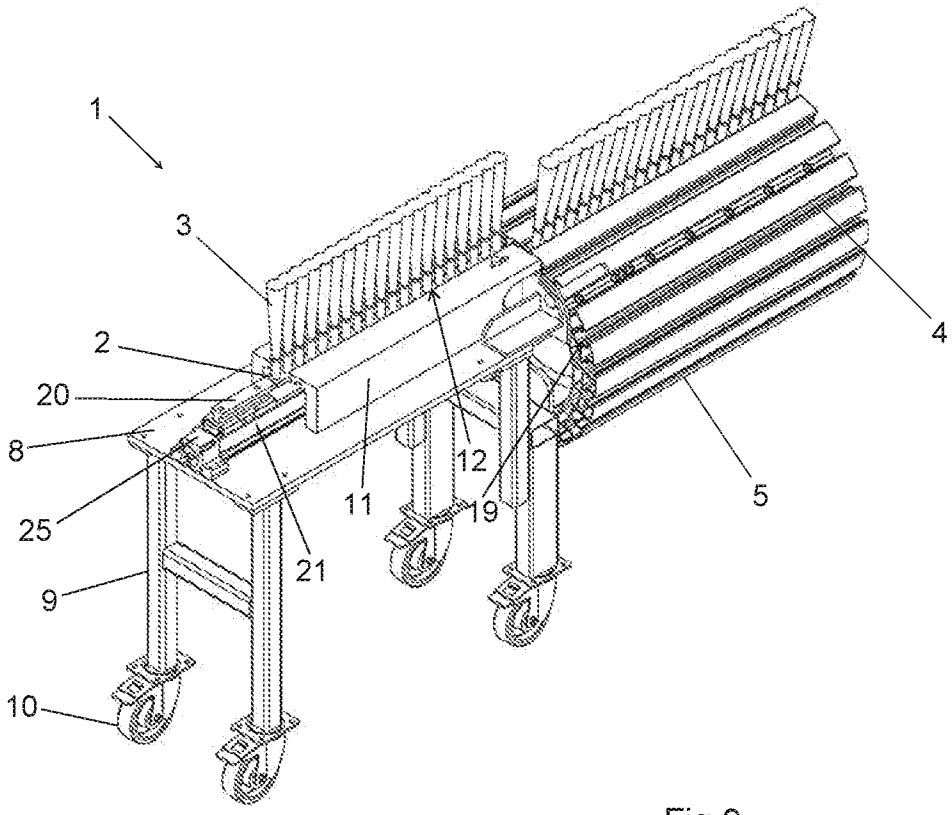

Fig 9

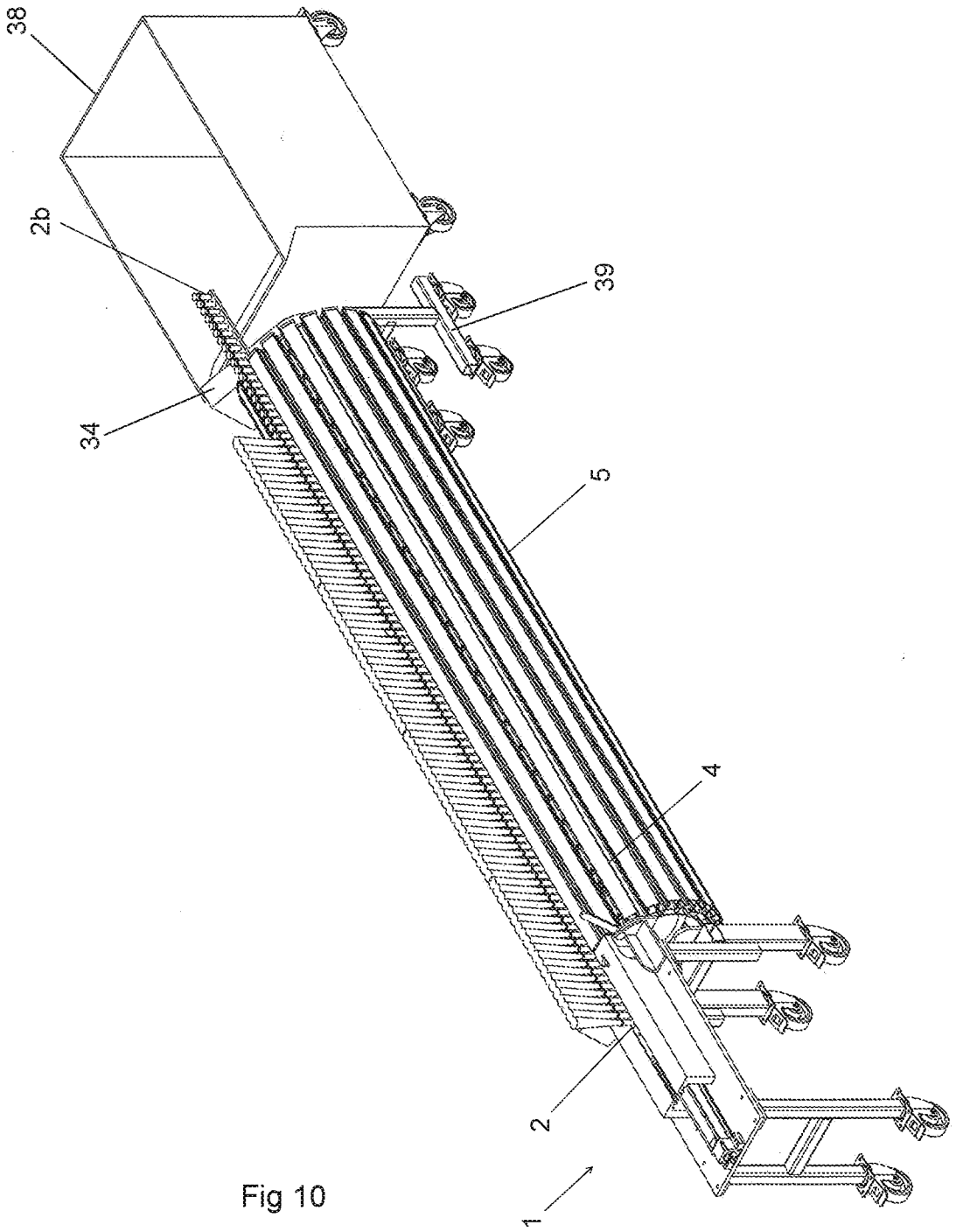

Fig 10

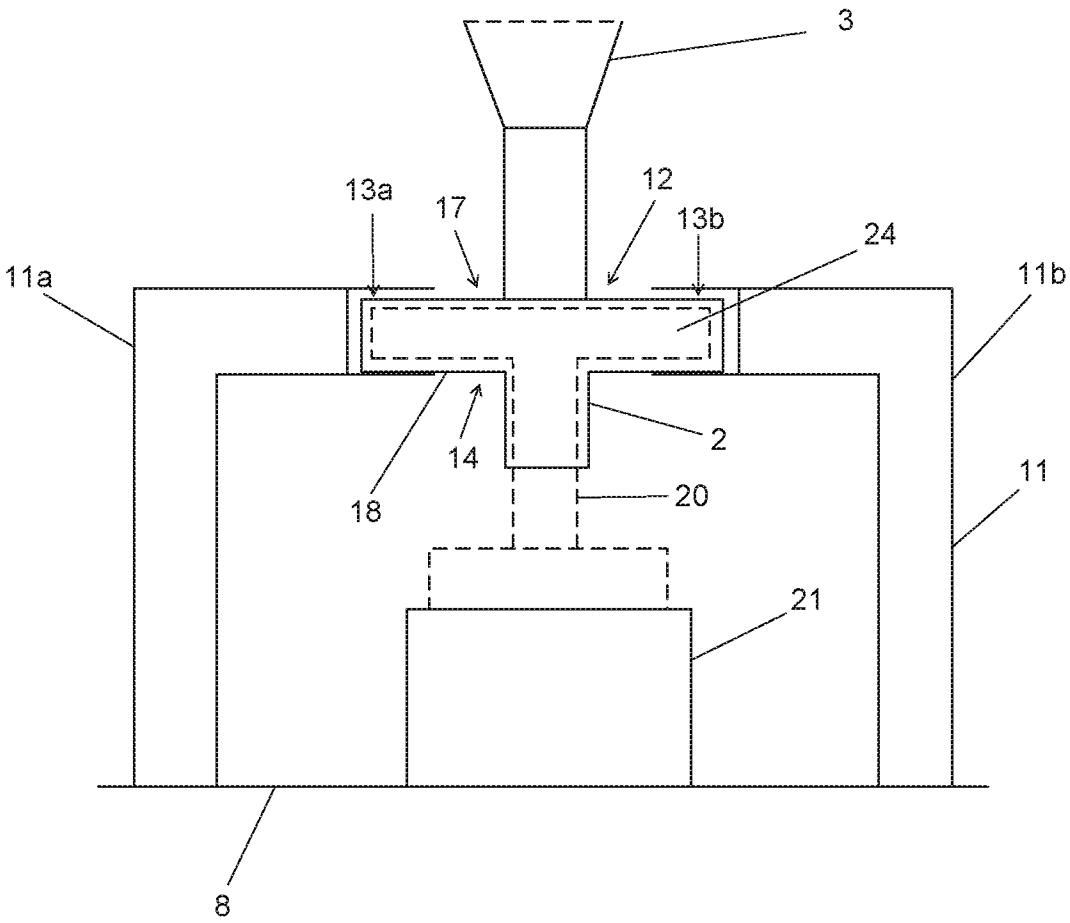

Fig 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050911

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A46B, E01H

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20010052158 A1 (LEWIS SCOTT ET AL), 20 December 2001 (2001-12-20); paragraphs [0015], [0027], [0030]; figures 1,4; claims 1,4,5,8	1-15
	--	
A	US 20180055204 A1 (NAFTAL BRIAN), 1 March 2018 (2018-03-01); whole document	1-15
	--	
A	US 20110258798 A1 (NAFTAL BRIAN), 27 October 2011 (2011-10-27); paragraphs [0011]-[0013], [0050]; figure 11; all claims	1-15
	--	
A	WO 2004009338 A1 (SAJAKORPI OY ET AL), 29 January 2004 (2004-01-29); whole document	1-15
	--	

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent 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
11-12-2020	11-12-2020

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Svetlana Borodulina Telephone No. + 46 8 782 28 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050911

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.

Continuation of: second sheet

International Patent Classification (IPC)

A46B 13/00 (2006.01)
A46B 7/04 (2006.01)
E01H 1/05 (2006.01)
A46B 7/10 (2006.01)
A46B 13/02 (2006.01)

US	20010052158	A1	20/12/2001	NONE			
US	20180055204	A1	01/03/2018	NONE			
US	20110258798	A1	27/10/2011	US	8495786	B2	30/07/2013
				US	8708423	B2	29/04/2014
				US	20130305473	A1	21/11/2013
WO	2004009338	A1	29/01/2004	AT	458420	T	15/03/2010
				AU	2003240902	A1	09/02/2004
				DE	60331439	D1	08/04/2010
				EP	1534498	A1	01/06/2005
				FI	20021401	A0	23/07/2002