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(54) APPARATUS AND METHOD FOR INTRODUCING OBJECTS INTO A FLOW OF FILTER MATERIAL

**VERFAHREN UND VORRICHTUNG ZUM EINFÜHREN VON OBJEKTEN IN EINEN FLUSS AUS
FILTERMATERIAL**

**PROCÉDÉ ET APPAREIL D'INTRODUCTION D'OBJETS DANS UN FLUX DE MATÉRIAUX DE
FILTRE**

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Description

[0001] The present invention relates to an apparatus, unit and method for introducing objects into a flow of filter material. For example, the objects may be capsules or beads which are to be introduced into the filter material of a smoking article during manufacture of the filter component of the smoking article.

[0002] Smoking articles, for example cigarettes, typically have a rod shaped structure and include a rod of a smokable material such as cut tobacco surrounded by a paper wrapper. Frequently, a cylindrical filter element is aligned in an end-to-end relationship with the tobacco rod. A filter element may for example comprise cellulose acetate tow as filter material. The tow may be circumscribed by a paper material known as plug wrap.

[0003] The sensory attributes of a smoking article, especially of cigarette smoke, can be modified by applying additives to the tobacco or by otherwise incorporating flavouring materials into various components of the smoking article. One well-known type of tobacco flavouring additive is menthol.

[0004] Several proposed methods for modifying the sensory attributes of cigarette smoke involve using filter elements as vehicles for adding flavour to the mainstream smoke in the cigarette. For example, it has been suggested to introduce objects such as capsules into filter material during manufacture of the filter elements. Various apparatuses for introducing such objects into smoking articles during the manufacture of filter elements are known. For example, in WO 2010/055120, capsules are transferred from a reservoir into a transfer chamber. The capsules are then transported to a peripheral surface of a vertically arranged rotatable transfer wheel. Subsequently, capsules are loaded into pockets of the rotatable transfer wheel. Through rotation of the rotatable transfer wheel the capsules are transported to an insertion location where they are released from the pockets and inserted into a flow of filter tow. EP 2 636 322 A2 is a further example of an apparatus for introducing objects into a flow of filter material. In mass production of cigarette filters there is still a need for the reliable introduction of objects into a filter material at very high speed. There is also a need for a reliable introduction of different objects into a filter material.

[0005] According to the present invention there is provided an apparatus for introducing objects into a flow of filter material. The apparatus comprises a reservoir for providing objects to be introduced into the flow of filter material. The apparatus further comprises a feeding wheel for receiving the objects discharged from the reservoir at a central portion of the feeding wheel, and for transporting the objects through rotation of the feeding wheel from the central portion to a peripheral portion of the feeding wheel. At the peripheral portion of the feeding wheel the objects are transferable for introduction of the objects into the flow of filter material. According to the invention, the feeding wheel is arranged vertically. Preferably,

the objects are supplied to the feeding wheel at least partially along the rotational axis of the feeding wheel.

[0006] The vertical arrangement of the feeding wheel with the central portion for receiving the objects from the reservoir is advantageous since it allows an easy supply of objects from the reservoir to the feeding wheel. No complicated transfer mechanism is needed to transfer the objects from the reservoir to the feeding wheel; the objects can simply be supplied to the central portion of the feeding wheel, either directly or with the aid of a tube. From the central portion of the feeding wheel the objects are transported to the peripheral portion of the feeding wheel with the aid of the centrifugal forces acting on the objects. At the peripheral portion of the feeding wheel, the objects can either be inserted directly into the flow of filter material, or the objects can be transferred to a transfer unit, which can then transport the objects to the location where they are inserted into the flow of filter material. In particular, the invention avoids an arrangement where objects, such as for example crushable, liquid filled capsules, need to be accelerated from a reservoir to the peripheral surface of a fast turning wheel. The differential speed between objects outside of the wheel and locations on the wheel is greatest at the periphery of the wheel, as the relative tangential speed depends on the radius of the wheel. Advantageously, the objects are introduced into the rotating wheel at the location where the relative tangential speed is the smallest, that is, close to the center of the wheel. The acceleration of the objects to the relative tangential speed is then performed on the wheel itself, such that no relative movement between the objects and the wheel occurs. Hence, straining forces that otherwise may damage the objects are significantly reduced. This is particularly advantageous where the objects are crushable, liquid filled capsules. The vertical arrangement of the feeding wheel with the supply of objects at the central portion thus allows a simple and reliable supply of objects from the reservoir to the feeding wheel and from the feeding wheel either directly into the flow of filter material or to a further transfer unit, for example to a transfer wheel. This allows to reliably introduce the objects at a very high speed either directly into the flow of filter material or to transfer the objects to a transfer unit, respectively.

[0007] In case the objects are directly introduced from the peripheral portion of the feeding wheel into the flow of filter material and this introduction of objects occurs in the lower half of the feeding wheel, in particular at or near the lowermost point of the peripheral portion of the feeding wheel, centrifugal forces and gravitational forces acting upon the objects assist in the introduction of objects into the flow of filter material and allow a higher even machine speed compared to systems that rely only on gravitational forces.

[0008] Similar considerations apply in case the objects are transferred to a transfer unit. In case the transfer unit is arranged below the feeding wheel both the centrifugal

forces as well as gravitational forces acting upon the objects assist in the transfer of the objects from the peripheral portion of the feeding wheel to the transfer unit.

[0009] A vertically arranged feeding wheel with the central portion for receiving the objects from the reservoir also allows an arrangement of more than one feeding wheel in combination with a transfer unit, thereby providing more flexibility in introducing objects, for example regarding the number, the size or the type of objects.

[0010] Instead or in addition to the arrangement of several feeding wheels, the supply of objects to the central portion of a feeding wheel also allows the supply of different kinds of objects to a central portion of one feeding wheel. Thus, with an apparatus according to the invention different objects may be arranged within a continuous flow of filter material with the use of only few movable components.

[0011] In this application the term "vertically arranged wheel" is to be understood as comprising an arrangement of the feeding wheel exactly in the vertical plane as well as arrangements in which the feeding wheel includes an angle of up to 15 degrees with the vertical plane. Also for arrangements of the feeding wheel including an angle with the vertical plane the above-identified advantages apply.

[0012] The term "central portion of the feeding wheel" is to be understood to designate a portion of the feeding wheel which extends from the center of the feeding wheel preferably to between about 20 percent and about 50 percent of the radius of the feeding wheel.

[0013] The term "peripheral portion of the feeding wheel" is to be understood as designating a portion located at the radial outer periphery of the feeding wheel from which the objects can be released and transferred either directly into the flow of filter material or to a transfer unit.

[0014] The feeding wheel comprises a plurality of transport channels for transporting the objects. Each transport channel extends from a channel inlet arranged at the central portion of the feeding wheel to a channel outlet arranged at the peripheral portion of the feeding wheel. With the aid of the transport channels the objects are guided to predetermined locations at the peripheral portion of the feeding wheel. The distribution of the objects to the individual transport channels at the central portion as well as their guided transport to the predetermined locations at the peripheral portion avoids jamming of objects both at the central portion of the feeding wheel as well as at the peripheral portion of the feeding wheel. It also allows for a very reliable transfer of the objects either directly into the filter material or to the transfer unit at very high speed.

[0015] The term "at the central portion" in connection with the location of the channel inlet is to be understood to include locations of the channel inlet which are within the central portion as well as locations of the channel inlet which are outside the central portion by an amount of between about 20 percent and about 30 percent of the

radius of the feeding wheel. Thus, the channels generally extend over a length corresponding to between about 20 percent and about 100 percent, preferably between about 40 percent and about 60 percent, of the radius of the feeding wheel. In case the transport channel inlets are located outside the central portion of the feeding wheel, the feeding wheel may have a central channel-free hub.

[0016] In a further embodiment of the apparatus according to the invention, the transport channels have channel inlets which are arranged at the central portion of the feeding wheel, and the channel inlets are arranged adjacent to one another when viewed in circumferential direction. In addition, the channel inlets are at least partly arranged non-equidistantly spaced from one another.

[0017] More preferably, the transport channels are grouped into a plurality of groups. Each group of channels comprises a plurality of transport channels. In addition, each group of channels is arranged equidistantly spaced from its adjacent groups. Within each group of channels the channel inlets are equidistantly spaced from one another.

[0018] The non-uniform arrangement of the channel inlets at the central portion is advantageous with respect to a reliable and fast filling of the channels with objects supplied to the central portion. The channel dimensions are preferably adapted to the size of an object, so that only one object at a time can enter the respective channel to prevent blocking of the channels. However, in case the channel inlets are spaced too far away from each other the objects do not easily enter the channels. This may lead to clogging. Generally, the distance of the channel inlets relative to each other can be reduced by arranging the channel inlets very close to the center of the feeding wheel. However, this reduces the size of the central portion where the objects are supplied to the feeding wheel, so that either the objects supply rate must be reduced or clogging may occur at the central portion of the feeding wheel. The non-uniform distribution of the channel inlets, in particular in groups, allows an arrangement of the channel inlets at a distance relative to each other which allows the objects to easily enter the channels. At the same time, the grouping of channels allows the channel inlets to be arranged at a certain radial distance from the center but still in the central portion of the feeding wheel. As a result a higher objects supply rate is possible while at the same time clogging at the central portion is prevented since the objects can easily enter the channels through the advantageously arranged channel inlets.

[0019] In the feeding wheel of the apparatus according to the invention, several channels of the plurality of channels are non-radially extending transport channels. Thus, several transport channels of the plurality of transport channels, for example at least one channel of a group of channels, may be leading channels or trailing channels.

[0020] In an embodiment of the apparatus according to the invention at least one transport channel is a trailing channel. The channel outlet of the trailing channel is ar-

ranged circumferentially behind the channel inlet of the trailing channel with respect to a direction of rotation of the feeding wheel. The provision of trailing channels allows for a reliable transport of the objects from the central portion to the peripheral portion of the feeding wheel. The feeding wheel may in addition to the trailing channels include channels which are leading channels or channels which are extending exactly radially, or both leading channels and exactly radially extending channels. With leading channels, the channel outlet of the leading channel is arranged circumferentially advanced to the leading channel inlet when seen in the direction of rotation of the feeding wheel. Accordingly, radially extending channels are herein understood as having a channel outlet, which is circumferentially arranged at a same position as the channel inlet. Advantageously, trailing, as well as leading channels allow the equidistant distribution of the peripheral channel outlets in combination with a non-equidistant distribution of the peripheral channel entries.

[0021] If channels are grouped and the objects shall be provided at equidistantly arranged locations at the peripheral portion of the feeding wheel, the channels can no longer run in the radial direction. Thus, in embodiments with grouped channels, preferably at least one channel of the group is a trailing channel. In the same group of channels another channel may for example be a leading channel.

[0022] In a preferred embodiment of the apparatus according to the invention, all transport channels of a feeding wheel are non-radially extending channels, preferably all trailing channels.

[0023] In a further preferred embodiment of the apparatus according to the invention all transport channels are straight channels, but generally it is also possible that the channels are curved.

[0024] Both measures, the grouping of channels as well as the arrangement of channels in a non-radial or an at least not exclusively radial arrangement of transport channels, enable a faster and more reliable feeding of the feeding wheel and of a subsequent transfer of the objects into a flow of filter material or into a transfer unit, respectively. The two measures can be applied individually or in combination. Preferably, where the channels are arranged in groups, the channels are arranged and shaped such that the channel outlets at the peripheral portion of the feeding wheel are equidistantly arranged. An equidistant arrangement of the channel outlets at the peripheral portion of the feeding wheel is preferred to allow a simple regular transfer of the objects from the feeding wheel into the flow of filter material or to a transfer unit. For example, the seats of a cooperating transfer wheel may in such an arrangement also be distributed equidistantly on the periphery of the transfer wheel, which may simplify construction of the transfer wheel. This further allows, where desired, the equidistant placement of objects into the filter tow material. While the non-regular distribution of the channels according to the invention is particularly advantageous where the feeding wheel is

vertical, it is obvious, that the non-regular distribution of the channels also has significant advantages for feeding wheels that are arranged substantially horizontal.

[0025] In an embodiment of the apparatus according to the invention the feeding wheel at least partly has a conical shape. The conical shape supports a radial distribution of objects in the feeding wheel due to the centrifugal force acting on the objects. Due to the fact that the transport channels extends over a longer distance in a conical wheel compared to a flat wheel, a higher number of objects are sorted and aligned for being transported to the peripheral portion for being transferred. The higher number of objects being "stored" in the transport channels provides for a reliable transfer of objects into a filter tow or to a transfer unit even if the feeding of objects into the transport channels may become interrupted for short periods of time, for example due to a temporary jamming or a temporary interruption of the supply of objects.

[0026] The feeding wheel may further comprise an external cover. The external cover is arranged to at least partly cover the feeding wheel and is adapted to prevent the objects from falling off the feeding wheel. Due to the fact that the feeding wheel is vertically arranged and the transport channels are preferably open channels, the objects are retained on the feeding wheel and especially in the channels by the external cover. Such an external cover may be a separate part or may also be integrally formed with the feeding wheel so as to form closed transport channels. The external cover may be provided with an opening at a transfer location to allow for a transfer of objects as they are in transfer location and to prevent the objects from being transferred as they are not in transfer location.

[0027] In another embodiment of the invention, the feeding wheel comprises a central body having a rotational axis coinciding with the rotational axis of the feeding wheel. According to this embodiment of the invention, the central body is arranged to project toward the reservoir. The central body provides for an improved distribution of the objects discharged from the reservoir and supplied to the central portion of the feeding wheel to the transport channels by deflecting the objects to the circumference of the central body. The central body preferably has air nozzles arranged in a top surface of the central body. These air nozzles are connected to an air source. Through the air nozzles in the top surface of the central body an air flow may be directed for example in a direction different from the direction of transport of objects. Such an air flow additionally assists in the improved distribution of the objects supplied from the reservoir to the transport channels, thereby facilitating the feeding of the objects into the transport channels of the feeding wheel. Alternatively, or in addition, a transport air flow is provided to transport the objects from the reservoir to the feeding wheel. In this embodiment, the transport air flow also adds to the agitation of the objects along the transport path, creating an air cushion between objects and

thus facilitating the prevention of jamming of objects. Further, this transport air flow can be further used to transport the objects through the channels to the periphery of the feeding wheel.

[0028] According to another embodiment of the apparatus according to the invention, the apparatus comprises a stationary separator cam next to the peripheral portion of the feeding wheel, the separator cam being adapted to separate the object at the peripheral end of a channel from the adjacent object, before the object at the peripheral end of a channel is removed from the feeding wheel. Advantageously, this allows for a more secure transfer of the object at the peripheral end of a channel. In particular, this can prevent the inadvertent transfer of two objects from the peripheral section. Where the transfer of an object from the feeding wheel to a subsequent wheel or filter material uses a mechanical separation from the object from the feeding wheel, this separation may cause adjacent objects in the channel to be pushed back into the channel. This may lead to jamming of the objects in the channel, in particular where the objects are elastic or crushable.

[0029] Preferably, singularizing of objects is performed gradually, that is a separator or a part thereof, respectively, is made to gradually extend further into the passage of the object and preferably to also gradually leave the passage after the object has been completely transferred from the feeding wheel to the transfer unit. For example, the stationary separator cam may itself be circumferentially gradually enlarge and decrease, for example in width and height, wherein the enlarging and decreasing part of the separator is arranged to be able to extend into the passage of the object leaving the transfer wheel. Alternative to a stationary separator cam, an active actuator may be used to separate objects at the end of the channels. For example, a relative movement of a separator performing the singularizing action may be perpendicular to the movement direction of an object leaving the feeding wheel.

[0030] A gradual singularizing process allows for a smooth separation of objects following each other without the risk of damaging the objects by introduction of the separator into the passage of the object. A separator may for example be or comprise a rim or nose, for example on a separator wheel, which is synchronized with the feeding wheel. The rim may begin to extend into the passage at the transfer location such that the object to be transferred is still allowed to move into the direction of the transfer unit. Preferably, this movement is supported by the rim and at the same time the rim pushes back following objects.

[0031] In accordance with a further embodiment of the apparatus of the invention, the apparatus comprises a transfer unit having a vertically arranged rotatable transfer wheel for receiving objects from the peripheral portion of the feeding wheel. In this embodiment the objects are transferred from the vertically arranged feeding wheel to a peripheral surface of the vertically arranged rotatable

transfer wheel. For example, the objects are loaded into pockets provided in the peripheral surface of the rotatable transfer wheel. Through rotation of the rotatable transfer wheel the objects are then transported in the pockets to an insertion location where they are released from the pockets and inserted into a flow of filter material, or where the objects are transferred to yet a further transfer unit.

[0032] A transfer from the feeding wheel to the transfer wheel may be actively supported by a fixedly or movably arranged pusher element as a part of the transfer unit. Such a pusher element pushes an object from a transfer location at the peripheral portion of the feeding wheel into the direction of the transfer wheel, for example into a pocket provided in the peripheral surface of the transfer wheel. In order to further support the transfer of the objects, suction means may be provided in order to suck the objects into the pockets provided in the peripheral surface of the transfer wheel. These suction means may comprise a vacuum source and vacuum channels connected to the pockets of the transfer wheel, so as to suck the objects into the pockets and to retain them in the pockets until the objects reach a location where they are to be released from the pockets. Alternatively or in addition, a positive air flow may be provided to assist the transfer of objects from the feeding wheel to the transfer wheel.

[0033] According to an embodiment of the apparatus according to the invention, the apparatus comprises a second reservoir. According to this embodiment, the second reservoir is adapted for providing objects to the feeding wheel. Preferably, the objects from the second reservoir are different from the objects of the reservoir. According to the invention, the reservoir and the second reservoir are connected via separate supply lines to the central portion of the feeding wheel such that objects from the reservoir and objects from the second reservoir are dischargeable together or simultaneously at the central portion of the feeding wheel. Accordingly, objects from the different reservoirs may be transferred to the peripheral portion of the feeding wheel, preferably in an alternate manner. Preferably, a first set of channels are associated to the first reservoir and a second set of channels are associated to the second reservoir. Preferably, the first set of channels and the second set of channels on the feeding wheel are arranged alternately on the feeding wheel. Thus, it is possible to provide different objects to the feeding wheel and thus manufacture a product with different objects arranged therein, however requiring only one feeding wheel. An arrangement may basically remain unchanged with the exception of an adapted discharge portion at the central portion of the feeding wheel for discharging the objects provided by the two reservoirs and for aligning or distributing the objects from the two different reservoirs on the feeding wheel.

[0034] According to a variant of this embodiment, one feeding wheel is provided per kind of object to be inserted into a flow of filter material.

[0035] According to another aspect of the invention

there is provided a unit for introducing objects into a flow of filter material. The unit comprises at least two apparatuses according to the invention and as described in this application, and in particular it comprises at least two vertically arranged feeding wheels. The unit further comprises a vertically arranged rotatable transfer wheel that is arranged adjacent to the at least two vertically arranged feeding wheels. The vertically arranged transfer wheel is adapted for receiving the objects from the peripheral portions of the at least two feeding wheels and for introducing the objects into the flow of filter material. Preferably, the unit further comprises a synchronization device for synchronizing the rotational speed of the transfer wheel and the rotational speeds of the at least two feeding wheels. For example, a synchronization device may be a mechanical coupling or an electronic coupling.

[0036] The advantages of the apparatus according to the invention comprising a vertically rotatable feeding wheel and a central portion for receiving the objects have already been described above. The at least two apparatuses of the unit may all be configured according to one of the afore-described embodiments or may be configured according to a combination of different aspects of the afore-described embodiments. With the provision of at least two apparatuses and in particular of at least two feeding wheels, more flexibility of feeding of objects into the filter material is possible. For example, the at least two apparatuses according to the invention may be loaded with different kinds of objects, in order to obtain sequences of different kinds of objects. By way of example, these different kinds of objects may contain different flavours, but may also have different sizes, appearances, surface properties or combinations thereof.

[0037] With two or more feeding wheels, also the process of loading the pockets of the transfer wheel may be performed more effectively than with only one feeding wheel. For example, when using two feeding wheels only every second pocket in the peripheral surface of the transfer wheel needs to be filled by each of the two feeding wheels so as to completely fill the pockets of the transfer wheel. With an unchanged number of pockets in each of the feeding wheels and the transfer wheel this allows to double the rotational speed of the transfer wheel. Alternatively, the feeding wheels may be designed smaller. Further, the two feeding wheels may be used in a redundant arrangement, such that maintenance or jam recovery can be performed on one of the wheels while the other wheel continues to supply objects to subsequent stations.

[0038] By increasing the rotational speed of the transfer wheel, it is either possible to insert a higher number of objects into a unit of filter material which later on forms one filter element. Alternatively, a higher rotational speed of the transfer wheel may result in an increase of the manufacturing speed of the filters, since the filter material may pass the transfer wheel at higher speed while due to the increased rotational speed of the transfer wheel there is still one object inserted into one unit of filter ma-

terial which later on forms one filter element. As a further alternative, a shorter pocket-to-pocket distance in a transfer wheel is conceivable which may result in twice the total number of pockets being provided in a transfer wheel. Thus, the rotational speed of the transfer wheel may remain unchanged but still either twice the number of objects are inserted into a unit of filter material corresponding to one filter element (speed of filter material remains unchanged) or twice the number of filters can be produced (speed of filter material is twice as much as the original speed).

[0039] Advantageously, the synchronization of the two or more feeding wheels and the transfer wheel allows for example an exact alignment of the transfer location of the objects at the peripheral portion of the one or more feeding wheels with the pockets in the peripheral surface of the transfer wheel, and with a predefined position of a transfer unit allows for a fast and reliable transfer of objects from the one or more feeding wheels to the transfer wheel. For that purpose, a synchronization device as known in the art is present for synchronization of the two or more feeding wheels and the transfer wheel or the transfer unit, respectively.

[0040] The sizes of the two or more feeding wheels and also their arrangement relative to a transfer wheel may vary. For example, one feeding wheel is preferably positioned vertically above the transfer wheel and with its peripheral portion adjacent to the peripheral portion of the transfer wheel. However, all feeding wheels may also be positioned adjacent to the transfer wheel with their respective peripheral portion but at a position other than vertically above the transfer wheel.

[0041] With the apparatus and unit according to the invention, many variations and embodiments may be envisaged, especially with reference - but not limited - to the number of feeding wheels used, different sizes of feeding wheels, loading of feeding wheels with different objects, loading of different objects to one feeding wheel, different positions of feeding wheels relative to the transfer wheel, or constructional optimizations due to a close arrangement of the feeding wheels relative to one another.

[0042] A further aspect of the invention relates to a method for introducing objects into a flow of filter material. The method comprises the step of providing a plurality of objects to be introduced into the flow of filter material. The method further comprises the steps of providing a vertically arranged rotatable feeding wheel comprising a plurality of transport channels, wherein several transport channels of the plurality of transport channels are non-radially extending transport channels, and supplying the objects to a central portion of the vertically arranged rotatable feeding wheel. Still further, the method comprises the steps of rotating the vertically arranged feeding wheel to transport the objects in the plurality of transport channels from the central portion to a peripheral portion of the vertically arranged feeding wheel, transferring the objects from the peripheral portion of the feeding wheel to

a transfer unit, and introducing the objects into the flow of filter material with the aid of the transfer unit.

[0043] In a preferred embodiment of the method according to the invention, the method further comprises the step of supplying air to the central portion of the feeding wheel. Preferably, the method according to the invention further comprises the step transporting the objects from a reservoir to the central portion of the feeding wheel using transport air. Preferably still, the step of supplying air to the central portion of the feeding wheel comprises using the transport air of the transporting step. Alternatively or in addition the step of supplying air to the central portion of the feeding wheel comprises supplying air in a direction counter to the direction of supply of the objects to the central portion of the feeding wheel. By this means the supplied flow of objects is agitated, thereby facilitating a feeding of the objects into the channel inlets of the transport channels of the feeding wheel. The supply of air to the central portion may be achieved, for example, by providing an air stream through the center of the feeding wheel or through air nozzles, for example holes, arranged in the central portion of the feeding wheel or in separate parts combined with the feeding wheel.

[0044] In a further embodiment of the method according to the invention, the transfer unit comprises a vertically arranged rotatable transfer wheel. This embodiment further comprises the step of transferring the objects from the peripheral portion of the feeding wheel to the vertically arranged rotatable transfer wheel, and rotating the vertically arranged transfer wheel in order to transport the objects to a location where the objects are introduced into the flow of filter material.

[0045] According to another embodiment of the method according to the invention, the step of transferring the objects from the peripheral portion of the feeding wheel to a transfer unit comprises singularizing an object that is being transferred to the transfer unit at a transfer location, thereby separating the object that is being transferred from objects preferably directly following the object that is being transferred to the transfer unit in a transport channel towards the periphery of the feeding wheel.

[0046] According to an aspect of the method according to the invention, the method further comprises the steps of supplying different kind of objects to the central portion of the vertically arranged feeding wheel, and transporting the different kind of objects from the central portion to the peripheral portion of the vertically arranged feeding wheel. This is done such that the different kinds of objects are arranged in turns at the peripheral portion of the feeding wheel, for example form a repeatable series.

[0047] In addition or alternatively to the supply of different kind of objects to the central portion of the feeding wheel, the method according to the invention comprises the steps of providing a further vertically arranged rotatable feeding wheel and supplying objects to the central portion of the further rotatable feeding wheel. Preferably, the further objects are different from the objects supplied to the feeding wheel. The method further comprises the

steps of transferring the objects from the peripheral portion of the further rotatable feeding wheel to the vertically arranged rotatable transfer wheel and rotating the vertically arranged transfer wheel in order to transport the objects from the feeding wheel and from the further feeding wheel to a location where the objects are introduced into the flow of filter material. The objects and the further objects are transported via the transfer wheel to the location where the objects and the further objects are introduced into the flow of filter material preferably in an alternating manner.

[0048] Advantages and further aspects of the method according to the invention have been described relating to the apparatus and unit according to the invention and will therefore not be repeated.

[0049] The invention is further described with regard to embodiments, which are illustrated by means of the following drawings, wherein

- Fig. 1 shows an exploded view of an apparatus for introducing objects into a flow of filter material;
- Fig. 2 shows the feeding wheel of the embodiment of the apparatus of Fig. 1 with a central body mounted to the feeding wheel;
- Fig. 3 shows the feeding wheel of Fig. 2 without the central body;
- Figs. 4-7 depict different channel arrangements in feeding wheels;
- Fig. 8 is an embodiment of a feeding wheel comprising a sorting cone;
- Fig. 9 shows the transfer process of objects from the peripheral portion of the feeding wheel to a transfer wheel;
- Fig. 10 shows an enlarged detail of an object being transferred from the feeding wheel to the transfer wheel;
- Fig. 11 is an embodiment of a unit according to the invention comprising two feeding wheels and one transfer wheel;
- Fig. 12 is an embodiment of a unit with one feeding wheel suitable for providing two different objects to a flow of filter material;
- Fig. 13 shows a separator unit for singularizing objects before being transferred from the feeding wheel to a transfer wheel.

[0050] In Fig. 1 an embodiment of the apparatus is shown by which the general principle of the present invention may be understood. Substantially spherical objects, in the shown embodiment capsules 1, are discharged from a reservoir (not shown) and supplied through a supply tube 2 to a central portion 15 of a vertically rotatable feeding wheel 3. The transport from the reservoir to the feeding wheel may be assisted by a stream of transport air or another fluid. The central portion 15 extends from the center of the feeding wheel 3 to between about 30 percent and about 40 percent of the

radius of the feeding wheel 3. Feeding wheel 3 has substantially radially extending transport channels 4 in a conically shaped portion of the feeding wheel. The transport channels 4 extend over about one third of the radius of the feeding wheel. The transport channel outlets 14 (see Fig. 3) are arranged in the peripheral portion of the feeding wheel 3 and are arranged equidistantly along the circumference of feeding wheel 3. Feeding wheel 3 further has a circular recess 5 in the central portion 15 for receiving a central body 6. When being mounted to the feeding wheel 3, the central body 6 projects from the feeding wheel in the direction towards the reservoir or the supply tube 2, respectively. The central body 6 assists in deflecting the capsules 1 exiting the supply tube 2 to a flat region 22 (see Fig. 3) of the feeding wheel 3. This flat region 22 is arranged between the central body 6 and the channel inlets 24.

[0051] An external wall forming a cover 7 extends over a main part of the upper side of the feeding wheel 3. Cover 7 extends at least over the transport channels 4 and may also extend over the flat region 22 of the feeding wheel 3. The cover 7 prevents the capsules from falling off the feeding wheel 3 or off the flat region 22 after they have been distributed to this flat region 22 with the aid of the central body 6. In this embodiment the cover 7 is at least partially conically shaped to correspond to the shape of the feeding wheel 3 and has a rim 8 extending around the circumference of the feeding wheel 3. The rim 8 prevents capsules at the channel outlets 14 located at the peripheral portion of the feeding wheel 3 to fall off the feeding wheel 3 when not in a transfer location. The rim 8 is provided with an opening 9. The opening 9 defines a transfer region where capsules can be transferred either directly into a flow of filter tow or to a transfer unit, for example to a transfer wheel. In the latter case, the transfer wheel receives the capsules from the feeding wheel 3 and transfers the capsules to a location where they are introduced into the filter tow used for making filters for smoking articles. An external ring section 10 arranged along a part of the circumference of the feeding wheel 3 is provided to additionally limit the comparatively large opening 9 in the rim 8 of cover 7 to more precisely define the transfer location where the capsules are transferred either into the filter tow or to the transfer wheel.

[0052] Additional elements, such as a ring-shaped fixed cam member 11 may be arranged inside a recess arranged at the underside of the feeding wheel 3. Cam member 11 may be configured such that a protruding part of the cam member actively supports the transfer of a capsule out of the feeding wheel by pushing the capsule at the time it is in the transfer location. This will be explained in more detail below.

[0053] A bottom wall 12 which is also ring-shaped may be arranged circumferentially along the underside of the feeding wheel in the peripheral portion thereof in order to prevent capsules from falling off the underside of feeding wheel.

[0054] Feeding wheel 3 and central body 6 are shown

in more detail in **Fig. 2 and Fig. 3**. Fig. 2 shows the feeding wheel 3 with the central body 6 centrally arranged thereon. Between the central body 6 and the channel inlets 24 the flat region 22 is provided for reception of a plurality of capsules before they enter into the channels with the aid of the centrifugal forces acting on them by rotation of the feeding wheel. In Fig. 3 the feeding wheel 3 is shown without the central body 6 being mounted onto the feeding wheel. The central body 6 has a cylindrical body portion and a dome-shaped top portion. In the dome-shaped top portion several holes may be provided which act as air nozzles. The holes have a diameter smaller than the diameter of the capsules, for example a diameter in the range of between about 0.5 millimeter (mm) and about 1.5 millimeter (mm). Preferably, the holes have a diameter of about 1 mm while the diameter of a capsule typically is in the range of 3 mm to 4 mm. The holes may be regularly arranged in the dome-shaped top portion, for example at an angular position of 120 degrees, 240 degrees and 360 degrees about a longitudinal rotational axis of the central body 6. An air flow or gas flow is directed through the air nozzles essentially counter to or at an acute angle to the direction of the general supply direction of the capsules. Such an air flow generates a good mixing of the capsules at the location where the capsules are supplied and creates an air cushion between the capsules and the central body, thus facilitating the distribution of the capsules to the flat region 22. From there the capsules may then easily enter into the channels 4. Compressed air with a pressure in the range of, for example, between about 0.5 bar and about 6 bar, preferably of about 1 bar, is used to generate the air flow through the holes. The number, size and positions of the air nozzles may vary according to the specific needs. Also, the shape of the central body may vary and may for example be of conical, hemispherical or cylindrical shape or combinations of these shapes. In addition, the central body may not be a separate part which is to be assembled with the feeding wheel 3 but rather the central body 6 may form an integral part of the feeding wheel. In conically-shaped feeding wheels, transport channels may start at or near the center of the respective feeding wheel.

[0055] **Fig. 4, Fig. 5, Fig. 6 and Fig. 7** show different arrangements of the transport channels of the feeding wheel 31, 32, 33, 34. All these embodiments comprise groups of channels 304, 305, 306 in which one or more channels run in a non-radial direction. Each feeding wheel comprises three groups and each group comprises six channels. Each of the feeding wheels comprises a total number of eighteen channels. The channel inlets 36 are arranged at the central portion 35 of the respective feeding wheel 31, 32, 33, 34. The channel inlets 36 in their entirety are not equidistantly arranged, however, within each group the channel inlets 36 are equidistantly arranged. Also, the three groups taken as a whole are equidistantly arranged relative to one another.

[0056] In Fig. 4 all channels within one group are

curved at least to some extent. Some of the channels are trailing channels 39, that is to say their channel outlet is located "behind" their channel inlet when viewed in the direction of rotation 100 of the feeding wheel. Other channels are leading channels 37 meaning that their channel outlet is located "in front of" or "advance to" their channel inlet when viewed in the direction of rotation 100 of the feeding wheel. Fig. 5 shows an arrangement of channels similar to Fig. 4. However, the channels have softer curves with more rounded transitions when compared to the channels shown in Fig. 4. In the embodiment shown in Fig. 6 there are no leading channels at all. The first channel 38 within each group is extending radially and is straight while the remaining channels in the respective group are all trailing channels 39 and are curved. In Fig. 7 all channels are trailing channels and are straight. The arrangement of channels according to Fig. 7 is preferred, especially in connection with the following exemplary values: a number of eighteen to thirty-six channels, a capsule diameter of about 3.5 mm, a channel diameter of between about 4 mm and 6 mm, a diameter of the central portion of about 40 mm, a distance from channel inlet to channel inlet of smaller than or equal to 2.4 mm, preferably of 2 mm. In such an arrangement, the feeding wheel 3 may have a rotational speed of for example about 300 meters per minute (m/min).

[0057] In order to increase the supply rate of objects to the vertically rotatable feeding wheel the two measures grouping of channels and arrangement of non-radially extending and leading as well as trailing channels may be chosen individually or may be combined. In all embodiments shown in Figs. 4 to 7 the channel outlets are equidistantly arranged at the peripheral portion of the feeding wheel along the circumference.

[0058] Conventional filter making apparatuses are capable of operating at a speed of about 400 m/min. Conventional capsule feeding apparatuses, however, typically are only capable of operating at a speed of about 100 m/min. The apparatus according to the invention allows operating speeds of at least about 200 m/min to 300 m/min, with contact forces between capsules below 5 Newton (N). This value is well below a value of 10 N or more for the typical crushing forces of capsules.

[0059] Fig. 8 shows a partially sectional side view of an embodiment of a feeding wheel 53 comprising a sorting cone 503. A reservoir 52 or hopper is connected to the central portion of the sorting cone 503 of feeding wheel 53, for example by a tube 502. This allows a continuous supply of capsules 1 to the central portion of the sorting cone 503 of feeding wheel 53. From the central portion of the sorting cone 503 the capsules 1 are guided in transport channels 54 to the peripheral portion of feeding wheel 53. Feeding wheel 53 including sorting cone 503 are surrounded by an external cover 57 to prevent capsules from falling off the feeding wheel 53 or from falling off the sorting cone 503, respectively. At the peripheral portion of feeding wheel 53, the individual capsules 1 are arranged in a transfer location or in a position

close to the transfer location (the latter ones of the capsules "are arranged in the queue" to get through to the transfer location). The capsules 1 are held in position between essentially axially extending protrusions 55 provided at the peripheral portion of the feeding wheel (in the space between the "teeth" formed by the protrusions), see also Fig. 9. These protrusions extend over the end face 58 of the feeding wheel remote from the sorting cone, so that the protrusions 55 surround an open recess. Inside (seen in a radial direction) this recess a transfer cam member 511 is fixedly arranged in a position such that it actively pushes the capsule 1 off the feeding wheel as soon as the capsule 1 reaches the transfer location through rotation of the feeding wheel 53. The cam member 511 supports and controls the transfer of the capsule 1, which otherwise is caused by centrifugal forces, possibly also by gravitational forces and possibly the forces exerted by the air flow of transport air.

[0060] The feeding wheel 53 including sorting cone 503 is rotatable around a rotational axis 59, which in operation is positioned horizontally in order for the feeding wheel to be arranged vertically. The rotational direction is indicated by arrow 100. For the rotation of the feeding wheel a drive 50, such as an electric motor, is provided.

[0061] Preferably, the transport channels 54 along the sorting cone 503 are embodied as equally distanced helical trailing channels.

[0062] Fig. 9 shows a detail of an embodiment of the apparatus comprising a feeding wheel 53 and a transfer wheel 74. As already explained above, the capsules 1 are held in slots 80 in between the protrusions 55 (they are held in the space between the "teeth"). The external cover 57 surrounds the feeding wheel 53 for preventing capsules 1 from falling off the feeding wheel when the capsules are not in the transfer location. At the said transfer location the external cover has an opening 79 (similar to opening 9 of the cover 7 in Fig. 1) allowing a capsule 1 to be transferred to a corresponding recess or pocket 75 of the transfer wheel 74. The transfer process is supported by fixedly arranged cam member 511 actively pushing the capsule 1a in the transfer location into the direction of the transfer wheel 74 as the feeding wheel 53 rotates and causes capsule 1a to reach the transfer location. The cam member 511 can be formed as a ring or a disk having a projection 512 enlarging the diameter of the ring or disk at the transfer location. The transfer of the capsules may further be assisted by suction applied to the corresponding pocket 75 of the transfer wheel 74 which is in transfer location. For this purpose, the pockets 75 in the transfer wheel 74 may be connected to a suction device by suction channels 76. Thus, the transferred capsules 1a are captured and held in the pockets 75 of the transfer wheel 74 until they are to be released from the pockets 75 at a location where they are to be introduced into a flow filter material.

[0063] Fig. 10 the situation at the transfer location during transfer of the capsule 1a from the feeding wheel 53 to the transfer wheel 74 is shown. The capsule 1a is al-

ready pushed out of the slot and has almost entered pocket 75 of the transfer wheel 74. In the transfer wheel 74 the capsule 1a is further sucked into the pocket 75 by suction applied to a suction channel 76 which is connected to pocket 75.

[0064] Fig. 11 shows a unit for introducing capsules into a flow of a filter material of a smoking article. The unit comprises two feeding wheels 133 and one transfer wheel 134. The feeding wheels 133 may be configured according to any of the embodiments as described above. Capsules are provided to the central portions 135 of the feeding wheels 133, for example from one reservoir (not shown) to each of the two feeding wheels 133. The capsules are then transferred to the transfer wheel 134 from each of the feeding wheels 133. The transfer wheel 134 transports the capsules to a location where the capsules may be introduced into filter material. The transfer wheel is provided with suction openings 137, where suction may be applied to pockets in the transfer wheel 134 to keep the capsules in the pockets after having been transferred to the transfer wheel 134 and until the location where the capsules shall be introduced into the filter material.

[0065] The feeding wheels 133 are arranged along the circumference of the transfer wheel 134, with the peripheral portions of the feeding wheels 133 arranged adjacent to the peripheral portion of the transfer wheel 134. The feeding wheels are arranged in an upper portion of the transfer wheel 124 such that gravitational force may support a transfer of capsules from the feeding wheels to the transfer wheel. The feeding wheels 133 may be supplied with different kinds of capsules. The capsules preferably contain different flavours, but may also have different sizes, appearances, surface properties, different contents or combinations thereof. With more than one feeding wheel it is possible to provide different objects into a flow of material with a simple arrangement of capsule feeding to a feeding wheel. In addition, with two feeding wheels 133 the transfer of capsules to the transfer wheel 134 may be performed in a different manner when compared to an apparatus having only one feeding wheel. Adjacent pockets in the transfer wheel are loaded with capsules coming from different feeding wheels. In the embodiment shown comprising two feeding wheels, by each of the two feeding wheels 133 a capsule is supplied to every second pocket of the transfer wheel 134 only. For example, each of the two feeding wheels may comprise thirty-two channel outlets and the transfer wheel may comprise sixty-four pockets.

[0066] As already discussed above, due to the transfer wheel being capable of being rotated at higher speed more than one capsule can be inserted into a predetermined length of filter material corresponding to one filter element, so that either a higher number of capsules of the same kind or a number of capsules of a different kind can become part of one filter element.

[0067] Synchronization means (not shown) well-known in the art are provided for matching the rotational

speeds of the feeding wheels 133 and the transfer wheel 134. This secures that the respective feeding wheel always provides a capsule at the transfer location at the time the respective (second) pocket of the transfer wheel 134 is arranged at the said transfer location.

[0068] In Fig. 11, the diameter of the feeding wheels 133 is half the diameter of the transfer wheel 134. In order to synchronize the angular speeds of the feeding wheels having thirty-two channel outlets and the transfer wheel having sixty-four pockets the angular speed of the feeding wheels 133 and the angular speed of the transfer wheel 134 are the same. By this, a capsule of each feeding wheel is transferred to every second pocket of the transfer wheel. If the number of the channel outlets of each of the feedings wheels 133 is chosen to be identical to the number of pockets of the transfer wheel, then the angular speed of the feeding wheels 133 is one half of the angular speed of the transfer wheel 134. For the transfer of capsules between the feeding wheel and the transfer wheel, the tangential speed of both wheels is preferably the same in the transfer zone.

[0069] In case the unit comprises three feeding wheels and one transfer wheel, the transfer wheel may for example have forty-eight pockets, while each of the feeding wheels may have sixteen channel outlets. In this configuration again, the angular speed of the feeding wheels is the same as the angular speed of the transfer wheel.

[0070] It is evident that it is also possible to have more than two or three feeding wheels arranged adjacent to the transfer wheel along the circumference thereof and that the numbers of channels outlets and pockets in a transfer wheel must then be chosen correspondingly.

[0071] In Fig. 12 a unit with one feeding wheel 113 and one transfer wheel 114 is shown. However, the unit is adapted to provide two different kind of capsules into a flow of filter material 124.

[0072] In the unit, the feeding wheel 113 is arranged adjacent and above the transfer wheel 114. Filter material 124 is guided underneath the transfer wheel 114 through the guiding cone 125 where it is compressed. The transfer of capsules from the transfer wheel 114 into the filter material may be performed as known in the art, for example with the aid of a scraper entering into a space between capsule and pocket, thereby interrupting or weakening a vacuum otherwise holding the capsules in the pockets, as this is described for example in WO 2010/055120.

[0073] The unit comprises two reservoirs 112, which are connected via two individual supply lines 117 to an inlet portion 118 of the feeding wheel 113. In the inlet portion 118 the supply lines 117 are arranged such that the two kind of capsules from the two reservoirs 112 are distributed onto the feeding wheel 113 in a regular manner, for example in alternating manner. For example, the supply lines 117 may be arranged in a concentric manner in the inlet portion 118 such that for example capsules from an outer tube formed in the inlet portion 118 and capsules from an inner tube are received by every other

channel in the feeding wheel. Thus it is possible to provide a continuous filter material with different capsules, however using one feeding wheel 114 only. By specifically designing the inlet portion 118, a chosen series of different capsules may be realized at the peripheral portion of the feeding wheel and thus also on the transfer wheel and in the filter material.

[0074] The supply lines 117 are each provided with supply means 120, such as for example pressurized air sources and valves in order to enable and control a supply of capsules from the reservoirs 112 into the supply lines 117 and to the inlet portion 118 of feeding wheel 113.

[0075] Fig. 13 schematically shows a singularising process by means of a separator wheel 20 while transferring a capsule 1b from the feeding wheel 53 to the transfer wheel 74. Feeding wheel 53, cover 57, transfer wheel 74 and cam member 511 may be arranged and designed as for example described and shown in figs. 9 and 10.

[0076] The separator wheel 20 is arranged adjacent and parallel to the rotational axis of the feeding wheel 53, either with its rotational axis coaxial or parallel to the rotational axis of the feeding wheel. The separator wheel 20 comprises an at least partially circumferentially running rim 201. The rim 201 extends into the passage 540 of the capsule 1b that leaves the channel 54 of the feeding wheel 53 and that is transferred to the cam member 511. The rim 201 is provided with a sharp edge 202 directing versus the feeding wheel 53 and a rounded edge 203 arranged opposite the feeding wheel 53. The sharp edge 202 provides a rather strict barrier for the capsule 1b to be held back by the rim 201. The rounded edge 203 allows for a smooth passing of the capsule 1b next to the rim 201.

[0077] The drawing shows the transfer process at the peripheral portion of the feeding wheel 53 in the transfer location. For simplicity reasons the transfer and singularizing process is shown for several capsules 1, 1a, 1d, 1b, 1c of different sizes. While capsules of different sizes 1, 1b, 1c are held back by the rim 201, capsules 1a, 1d are in the process of being transferred to the transfer wheel 74. By the rim of the separator wheel 20, the passage 540 is narrowed such that also smaller capsules 1b are held back. Good singularizing results are achieved by a rim 201 extending into the passage 540 maximally to about half the diameter of the passage.

[0078] Preferably the rim gradually increases to its maximum height or is gradually inserted into the passage 540 and is formed by a stationary cam. By this a smooth insertion of the rim is provided such that no capsules are damaged by the rim.

Claims

1. Apparatus for introducing objects (1) into a flow of filter material, comprising:

a reservoir (52, 112) for providing objects (1) to be introduced into the flow of filter material; and a vertically arranged feeding wheel (3,31,32,33,34,53,101,102,103,113,133),

characterized by the feeding wheel for receiving the objects (1) discharged from the reservoir at a central portion (15,35,115,135) of the feeding wheel, and for transporting the objects through rotation of the feeding wheel from the central portion to a peripheral portion of the feeding wheel, from where the objects are transferable for introduction of the objects into the flow of filter material,

in that the feeding wheel comprises a plurality of transport channels (4,54) for transporting the objects, each transport channel extending from a channel inlet (24,36) arranged at the central portion of the feeding wheel to a channel outlet (4) arranged at the peripheral portion of the feeding wheel, and in that several transport channels of the plurality of transport channels are non-radially extending channels.

2. Apparatus according to claim 1, wherein the transport channels (4,54) have channel inlets (24,36) which are arranged at the central portion (15,35,115,135) of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133) and adjacent to one another when viewed in circumferential direction, and wherein the channel inlets are at least partly arranged non-equidistantly spaced from one another.
3. Apparatus according to any one of the preceding claims, wherein the transport channels (4,54) are grouped into a plurality of groups (304,305,306), each group comprising a plurality of transport channels, wherein each group is arranged equidistantly spaced from its adjacent groups, and wherein within each group the channel inlets (24,36) are equidistantly spaced from each another.
4. Apparatus according to any one of the preceding claims, wherein at least one transport channel (4,54) is a trailing channel (39), the channel outlet (14) of the trailing channel being arranged circumferentially behind the channel inlet (24,36) of the trailing channel with respect to a direction of rotation (100) of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133).
5. Apparatus according to any one of the preceding claims, wherein a transport air flow is provided to transport the objects (1) from the reservoir (52,112) to the feeding wheel (3,31,32,33,34,53,101,102,103,113,133).
6. Apparatus according to any one of the preceding

claims, further comprising a central body (6) having a rotational axis coinciding with the rotational axis (59) of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133), the central body (6) being arranged to project toward the reservoir (52,112).

7. Apparatus according to any one of the preceding claims, further comprising a stationary separator cam next to the peripheral portion of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133), the separator cam being adapted to separate the object (1) at the peripheral end of a transport channel (4,54) from the adjacent object, before the object at the peripheral end of a transport channel is removed from the feeding wheel.
8. Apparatus according to any one of the preceding claims, further comprising a transfer unit having a vertically arranged rotatable transfer wheel (74,104,124,134) for receiving objects (1) from the peripheral portion of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133).
9. Apparatus according to claim 8, wherein the transfer unit further comprises a fixedly arranged pusher element (511) for actively transferring the objects (1) from the feeding wheel (3,31,32,33,34,53,101,102,103,113,133) to the transfer wheel (74,104,124,134).
10. Apparatus according to any one of the preceding claims, comprising a second reservoir (52,112) for providing objects (1), wherein the reservoir (52,112) and the second reservoir are connected via separate supply lines (117) to the central portion (15,35,115,135) of the feeding wheel (3,31,32,33,34,53,101,102,103,113,133).
11. Apparatus according to claim 10, wherein a first set of transport channels (4,54) are associated to the first reservoir (52,112) and wherein a second set of transport channels (4,54) are associated to the second reservoir (52,112).
12. A unit for introducing objects into a flow of filter material, the unit comprising at least two apparatuses according to any one of claims 1 to 7, and further comprising:

a vertically arranged rotatable transfer wheel (74,104,124,134) which is arranged adjacent to the at least two feeding wheels (3,31,32,33,34,53,101,102,103,113,133), the transfer wheel being adapted for receiving objects (1) from the peripheral portions of the at least two feeding wheels and for introduction of the objects into the flow of filter material, and a

synchronization device for synchronizing the rotational speed of the transfer wheel and the rotational speeds of the at least two feeding wheels.

13. A method for introducing objects into a flow of filter material, comprising the steps of:

providing a plurality of objects (1) to be introduced into the flow of filter material;
providing a vertically arranged rotatable feeding wheel (3,31,32,33,34,53,101,102,103,113,133) comprising a plurality of transport channels (4,54), wherein several transport channels of the plurality of transport channels are non-radially extending transport channels;
supplying the objects (1) to a central portion (15,35,115,135) of the vertically arranged rotatable feeding wheel;
rotating the vertically arranged feeding wheel to transport the objects (1) in the plurality of transport channels from the central portion to a peripheral portion of the vertically arranged feeding wheel;
transferring the objects from the peripheral portion of the feeding wheel to a transfer unit, and introducing the objects into the flow of filter material with the aid of the transfer unit.

14. A method according to claim 13, further comprising the steps of providing a further vertically arranged rotatable feeding wheel; supplying objects (1) to the central portion of the further rotatable feeding wheel; transferring the objects from the peripheral portion of the further rotatable feeding wheel to a vertically arranged rotatable transfer wheel (74,104,124,134) of the transfer unit;
rotating the vertically arranged transfer wheel in order to transport the objects from the feeding wheel (3,31,32,33,34,53,101,102,103,113,133) and from the further feeding wheel to a location where the objects are introduced into the flow of filter material.

45 Patentansprüche

1. Vorrichtung zum Einbringen von Gegenständen (1) in einen Filtermaterialstrom, aufweisend:

einen Vorratsbehälter (52, 112) zum Bereitstellen von Gegenständen (1), die in den Filtermaterialstrom eingebracht werden sollen; und ein senkrecht angeordnetes Zuführrad (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), **gekennzeichnet, durch** das Zuführrad zum Aufnehmen der vom Vorratsbehälter an einem zentralen Abschnitt (15, 35, 115, 135) des Zuführrads abgegebene Gegenstände (1), und zum

- Transportieren der Gegenstände durch Drehbewegung des Zuführrads vom zentralen Abschnitt zu einem peripheren Abschnitt des Zuführrads, von dem die Gegenstände zum Einbringen der Gegenstände in den Filtermaterialstrom übergebbar sind,
 dass das Zuführrad mehrere Transportkanäle (4, 54) zum Transportieren der Gegenstände aufweist, jeder Transportkanal sich von einem Kanaleinlass (24, 36), der am zentralen Abschnitt des Zuführrads angeordnet ist, zu einem Kanalauslass (4), der am peripheren Abschnitt des Zuführrads angeordnet ist, erstreckt, und dass einige Transportkanäle der mehreren Transportkanäle sich nicht radial erstreckende Kanäle sind.
2. Vorrichtung nach Anspruch 1, wobei die Transportkanäle (4, 54) Kanaleinlässe (24, 36) aufweisen, die in der Umfangsrichtung gesehen am zentralen Abschnitt (15, 35, 115, 135) des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) und benachbart angeordnet sind, und wobei die Kanaleinlässe mindestens teilweise nicht in gleichem Abstand voneinander beabstandet angeordnet sind.
3. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Transportkanäle (4, 54) in mehrere Gruppen (304.305.306) gruppiert sind und jede Gruppe mehrere Transportkanäle aufweist, wobei jede Gruppe in gleichem Abstand von ihrer benachbarten Gruppe beabstandet angeordnet ist, und wobei innerhalb jeder Gruppe die Kanaleinlässe (24, 36) in gleichem Abstand zueinander beabstandet sind.
4. Vorrichtung nach einem der vorstehenden Ansprüche, wobei mindestens ein Transportkanal (4, 54) ein nachlaufender Kanal (39) ist und der Kanalauslass (14) des nachlaufenden Kanals in Umfangsrichtung hinter dem Kanaleinlass (24, 36) des nachlaufenden Kanals in Bezug auf eine Drehrichtung (100) des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) angeordnet ist.
5. Vorrichtung nach einem der vorstehenden Ansprüche, wobei ein Transportluftstrom vorgesehen ist, um die Gegenstände (1) vom Vorratsbehälter (52, 112) zum Zuführrad (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) zu transportieren.
6. Vorrichtung nach einem der vorstehenden Ansprüche, weiter aufweisend einen Zentralkörper (6) mit einer Drehachse, die mit der Drehachse (59) des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) zusammenfällt, wobei der Zentralkörper (6) derart angeordnet ist, dass er zum Vorratsbehälter (52, 112) vorsteht.
7. Vorrichtung nach einem der vorstehenden Ansprüche, weiter aufweisend eine stationäre Trennnocke neben dem peripheren Abschnitt des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), wobei die Trennnocke angepasst ist, den Gegenstand (1) am peripheren Ende eines Transportkanals (4, 54) von dem angrenzenden Gegenstand zu trennen, bevor der Gegenstand am peripheren Ende eines Transportkanals vom Zuführrad entfernt wird.
8. Vorrichtung nach einem der vorstehenden Ansprüche, weiter aufweisend eine Übergabeeinheit mit einem senkrecht angeordneten drehbaren Übergaberad (74, 104, 124, 134) zum Aufnehmen von Gegenständen (1) von dem peripheren Abschnitt des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133).
9. Vorrichtung nach Anspruch 8, wobei die Übergabeeinheit weiter ein starr angeordnetes Drückerelement (511) zum aktiven Übergeben der Gegenstände (1) vom Zuführrad (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) auf das Übergaberad (74, 104, 124, 134) aufweist.
10. Vorrichtung nach einem der vorstehenden Ansprüche, aufweisend einen zweiten Vorratsbehälter (52, 112) zum Bereitstellen von Gegenständen (1), wobei der Vorratsbehälter (52, 112) und der zweite Vorratsbehälter über getrennte Versorgungsleitungen (117) mit dem zentralen Abschnitt (15, 35, 115, 135) des Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) verbunden sind.
11. Vorrichtung nach Anspruch 10, wobei ein erster Satz von Transportkanälen (4, 54) mit dem ersten Vorratsbehälter (52, 112) verbunden ist, und wobei ein zweiter Satz von Transportkanälen (4, 54) mit dem zweiten Vorratsbehälter (52, 112) verbunden ist.
12. Einheit zum Einbringen von Gegenständen in einen Filtermaterialstrom, wobei die Einheit mindestens zwei Vorrichtungen nach einem der Ansprüche 1 bis 7 aufweist und weiter aufweist:
 ein senkrecht angeordnetes drehbares Übergaberad (74, 104, 124, 134), das neben den mindestens zwei Zuführrädern (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) angeordnet ist, wobei das Übergaberad zum Aufnehmen von Gegenständen (1) von den peripheren Abschnitten der mindestens zwei Zuführräder und zum Einbringen der Gegenstände in den Filtermaterialstrom angepasst ist, und eine Synchronisationsvorrichtung zum Synchronisieren der Drehzahl des Übergaberads und der Drehzahlen der mindestens zwei Zuführräder.

13. Verfahren zum Einbringen von Gegenständen in einen Filtermaterialstrom, das die Schritte aufweist:

Bereitstellen mehrerer Gegenstände (1), die in den Filtermaterialstrom eingebracht werden sollen; 5
 Bereitstellen eines senkrecht angeordneten drehbaren Zuführrads (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), das mehrere Transportkanäle (4, 54) aufweist, wobei einige Transportkanäle der mehreren Transportkanäle sich nicht radial erstreckende Transportkanäle sind; 10
 Liefern der Gegenstände (1) zu einem zentralen Abschnitt (15, 35, 115, 135) des senkrecht angeordneten drehbaren Zuführrads; 15
 Drehen des senkrecht angeordneten Zuführrads, um die Gegenstände (1) in den mehreren Transportkanälen vom zentralen Abschnitt zu einem peripheren Abschnitt des senkrecht angeordneten Zuführrads zu transportieren; 20
 Übergeben der Gegenstände von dem peripheren Abschnitt des Zuführrads an eine Übergabeeinheit, und
 Einbringen der Gegenstände in den Filtermaterialstrom mithilfe der Übergabeeinheit. 25

14. Verfahren nach Anspruch 13, weiter aufweisend die Schritte Bereitstellen eines weiteren senkrecht angeordneten drehbaren Zuführrads 30
 Liefern von Gegenständen (1) zum zentralen Abschnitt des weiteren drehbaren Zuführrads;
 Übergeben der Gegenstände vom peripheren Abschnitt des weiteren drehbaren Zuführrads auf ein senkrecht angeordnetes drehbares Übergaberad (74, 104, 124, 134) der Übergabeeinheit; 35
 Drehen des senkrecht angeordneten Übergaberads, um die Gegenstände vom Zuführrad (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) und von dem weiteren Zuführrad zu einem Ort zu transportieren, an dem die Gegenstände in den Filtermaterialstrom eingebracht werden. 40

Revendications

1. Appareil pour l'introduction d'objets (1) dans un écoulement de matière filtrante, comprenant :

un réservoir (52, 112) destiné à fournir des objets (1) à être introduits dans l'écoulement de matière filtrante; et 50
 une roue d'alimentation disposée verticalement (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), **caractérisé par** la roue d'alimentation pour la réception des objets (1) évacués du réservoir au niveau d'une partie centrale (15, 35, 115, 135) de la roue d'alimentation, et pour le transport d'objets par le biais de la rotation de la roue 55

d'alimentation depuis la partie centrale à une partie périphérique de la roue d'alimentation, d'où les objets peuvent être transférés pour leur introduction dans l'écoulement de matière filtrante,

en ce que la roue d'alimentation comprend une pluralité de canaux de transport (4, 54) pour le transport des objets, chaque canal de transport s'étendant d'une entrée de canal (24, 36) disposée au niveau de la partie centrale de la roue d'alimentation à une sortie de canal (4) agencée au niveau de la partie périphérique de la roue d'alimentation,

et en ce que plusieurs canaux de transport de la pluralité de canaux de transport ne sont pas des canaux qui s'étendent radialement.

2. Appareil selon la revendication 1, dans lequel les canaux de transport (4, 54) ont des entrées de canaux (24, 36) qui sont disposées au niveau de la partie centrale (15, 35, 115, 135) de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) et adjacentes l'une à l'autre lorsqu'elles sont vues dans une direction circonférentielle, et dans lequel les entrées de canaux sont au moins en partie disposées l'une à l'autre de manière non équidistante.

3. Appareil selon l'une quelconque des revendications précédentes, dans lequel les canaux de transport (4, 54) sont regroupés en une pluralité de groupes (304, 305, 306), chaque groupe comprenant une pluralité de canaux de transport, dans lequel chaque groupe est disposé à équidistance espacé de ses groupes adjacents, et dans lequel dans chaque groupe les entrées de canaux (24, 36) sont espacées de manière équidistante l'un avec l'autre.

4. Appareil selon l'une quelconque des revendications précédentes, dans lequel au moins un canal de transport (4, 54) est un canal arrière (39), la sortie de canal (14) du canal arrière étant disposée de manière circonférentielle à l'arrière de l'entrée de canal (24, 36) du canal arrière par rapport à une direction de rotation (100) de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133). 45

5. Appareil selon l'une quelconque des revendications précédentes, dans lequel un écoulement d'air de transport est fourni pour transporter les objets (1) du réservoir (52, 112) à la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133).

6. Appareil selon l'une quelconque des revendications précédentes, comprenant en outre un corps central (6) ayant un axe de rotation coïncidant avec l'axe de rotation (59) de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), le corps central (6)

étant disposé pour faire saillie vers le réservoir (52, 112) .

7. Appareil selon l'une quelconque des revendications précédentes, comprenant en outre une came de séparateur stationnaire à côté de la partie périphérique de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), la came de séparateur étant adaptée pour séparer l'objet (1) au niveau de l'extrémité périphérique d'un canal de transport (4, 54) de l'objet adjacent, avant que soit retiré l'objet au niveau de l'extrémité périphérique d'un canal de transport de la roue d'alimentation. 5
8. Appareil selon l'une quelconque des revendications précédentes, comprenant en outre une unité de transfert ayant une roue de transfert rotative disposée verticalement (74, 104, 124, 134) pour la réception d'objets (1) de la partie périphérique de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133). 10
9. Appareil selon la revendication 8, dans lequel l'unité de transfert comprend en outre un élément de poussée disposé fixement (511) pour le transfert actif des objets (1) depuis la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) à la roue de transfert (74, 104, 124, 134). 15
10. Appareil selon l'une quelconque des revendications précédentes, comprenant un deuxième réservoir (52, 112) destiné à fournir des objets (1), dans lequel le réservoir (52, 112) et le deuxième réservoir sont raccordés via des canalisations d'alimentation séparées (117) à la partie centrale (15, 35, 115, 135) de la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133). 20
11. Appareil selon la revendication 10, dans lequel un premier ensemble de canaux de transport (4, 54) est associé au premier réservoir (52, 112) et dans lequel un deuxième ensemble de canaux de transport (4, 54) est associé au deuxième réservoir (52, 112). 25
12. Unité pour l'introduction d'objets dans un écoulement de matière filtrante, l'unité comprenant au moins deux appareils selon l'une quelconque des revendications 1 à 7, et comprenant en outre : 30

une roue de transfert rotative disposée verticalement (74, 104, 124, 134) qui est disposée de manière adjacente à au moins deux roues d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133), la roue de transfert étant adaptée pour la réception d'objets (1) des parties périphériques des au moins deux roues d'alimentation et pour l'introduction des objets dans l'écoulement de matière filtrante, et un dispositif de 35

synchronisation pour synchroniser la vitesse de rotation de la roue de transfert et les vitesses de rotation d'au moins deux roues d'alimentation.

13. Procédé pour l'introduction d'objets dans un écoulement de matière filtrante, comprenant les étapes de : 40
 - fournir une pluralité d'objets (1) à être introduits dans l'écoulement de matière filtrante;
 - fournir une roue d'alimentation rotative disposée verticalement (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) comprenant une pluralité de canaux de transport (4, 54), dans lequel plusieurs canaux de transport de la pluralité de canaux de transport ne sont pas des canaux de transport s'étendant radialement;
 - fournir les objets (1) à une partie centrale (15, 35, 115, 135) de la roue d'alimentation rotative disposée verticalement;
 - tourner la roue d'alimentation disposée verticalement pour transporter les objets (1) dans la pluralité de canaux de transport depuis la partie centrale à une partie périphérique de la roue d'alimentation disposée verticalement;
 - transférer les objets de la partie périphérique de la roue d'alimentation à une unité de transfert, et introduire les objets dans l'écoulement de matière filtrante à l'aide de l'unité de transfert.
14. Procédé selon la revendication 13, comprenant en outre les étapes de 45
 - fournir une roue supplémentaire d'alimentation rotative disposée verticalement;
 - fournir objets (1) à la partie centrale de la roue d'alimentation rotative supplémentaire;
 - transférer les objets de la partie périphérique de la roue d'alimentation rotative supplémentaire à une roue de transfert rotative agencée verticalement (74, 104, 124, 134) de l'unité de transfert;
 - tourner la roue de transfert disposée verticalement pour transporter les objets depuis la roue d'alimentation (3, 31, 32, 33, 34, 53, 101, 102, 103, 113, 133) et depuis la roue d'alimentation supplémentaire à un emplacement où les objets sont introduits dans l'écoulement de matière filtrante.

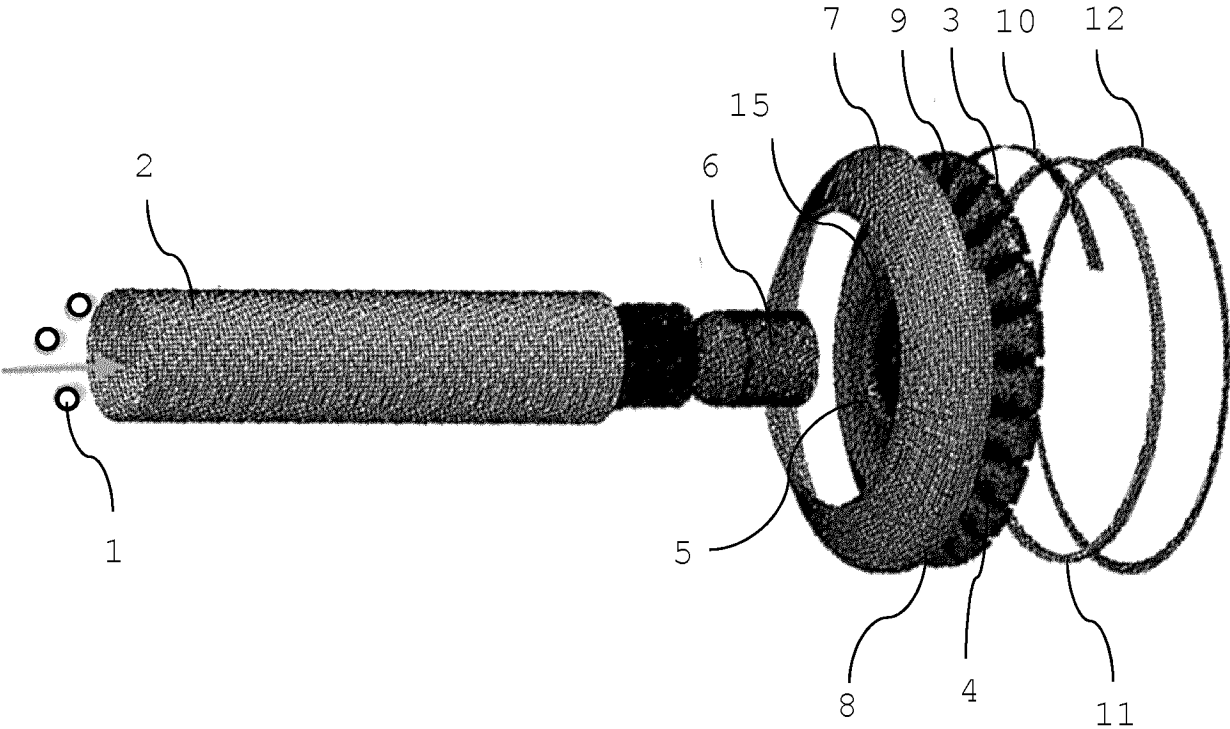


Fig. 1

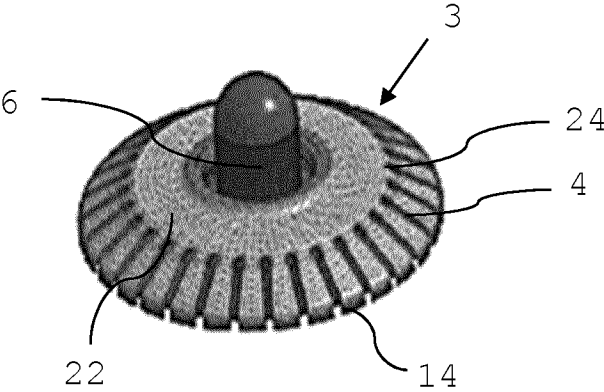


Fig. 2

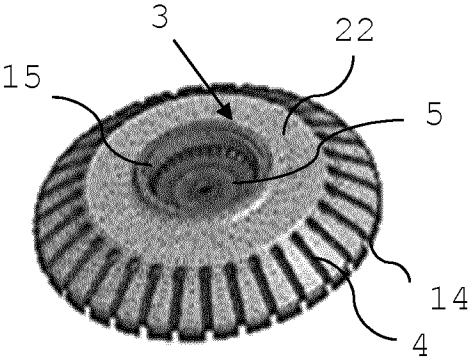
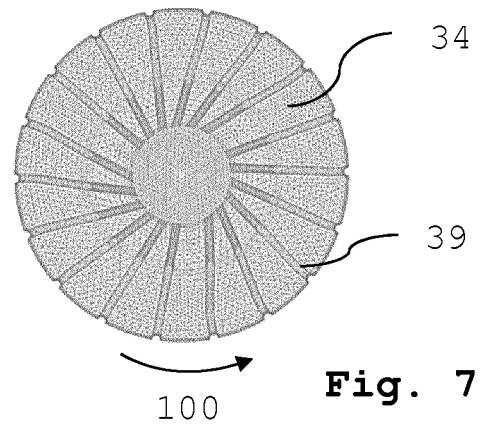
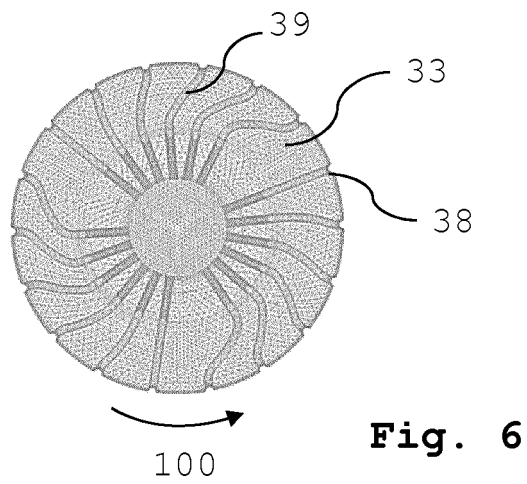
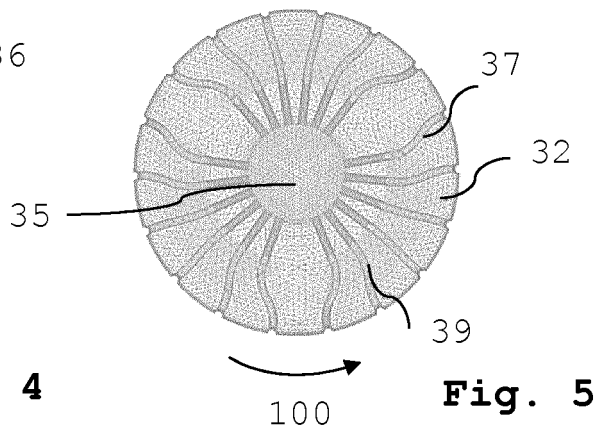
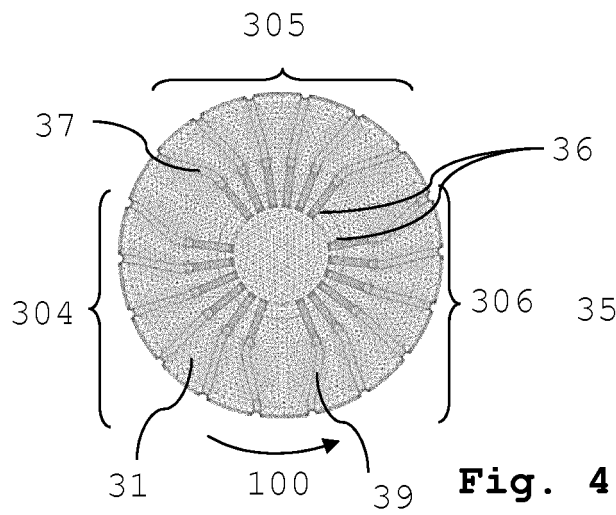


Fig. 3



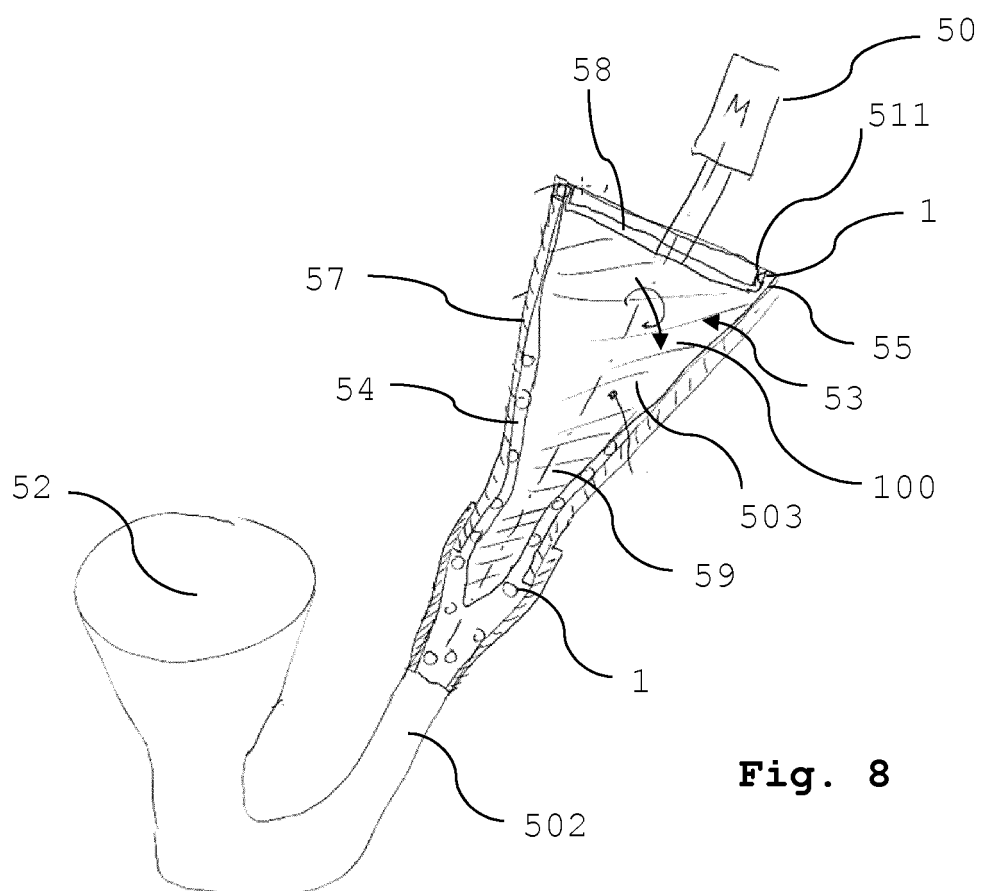


Fig. 8

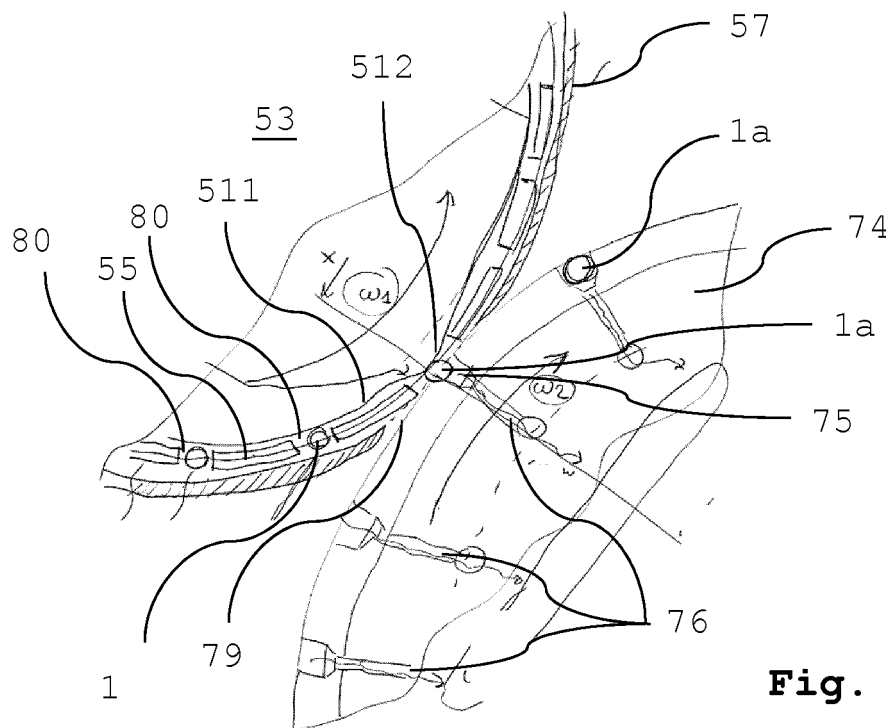
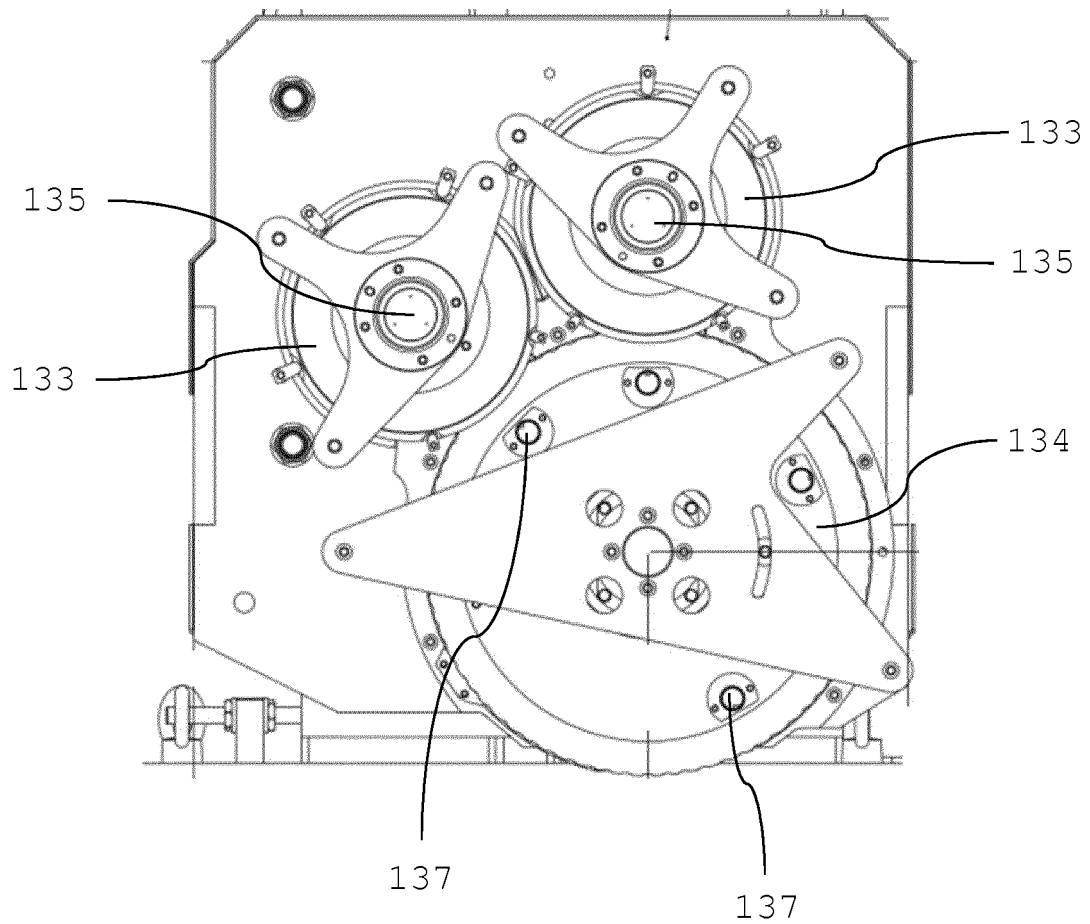
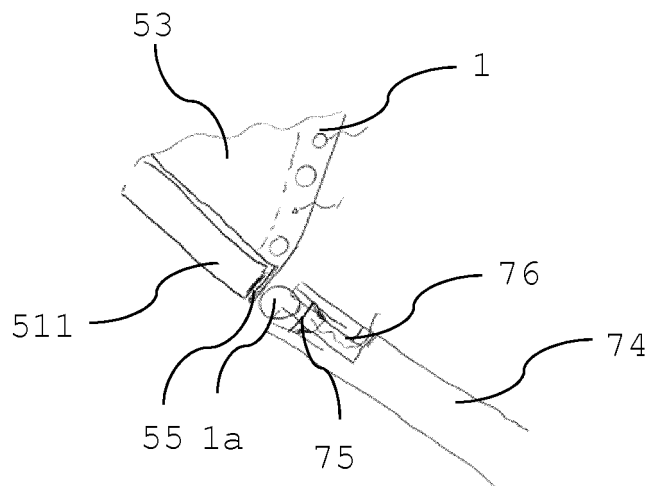


Fig. 9



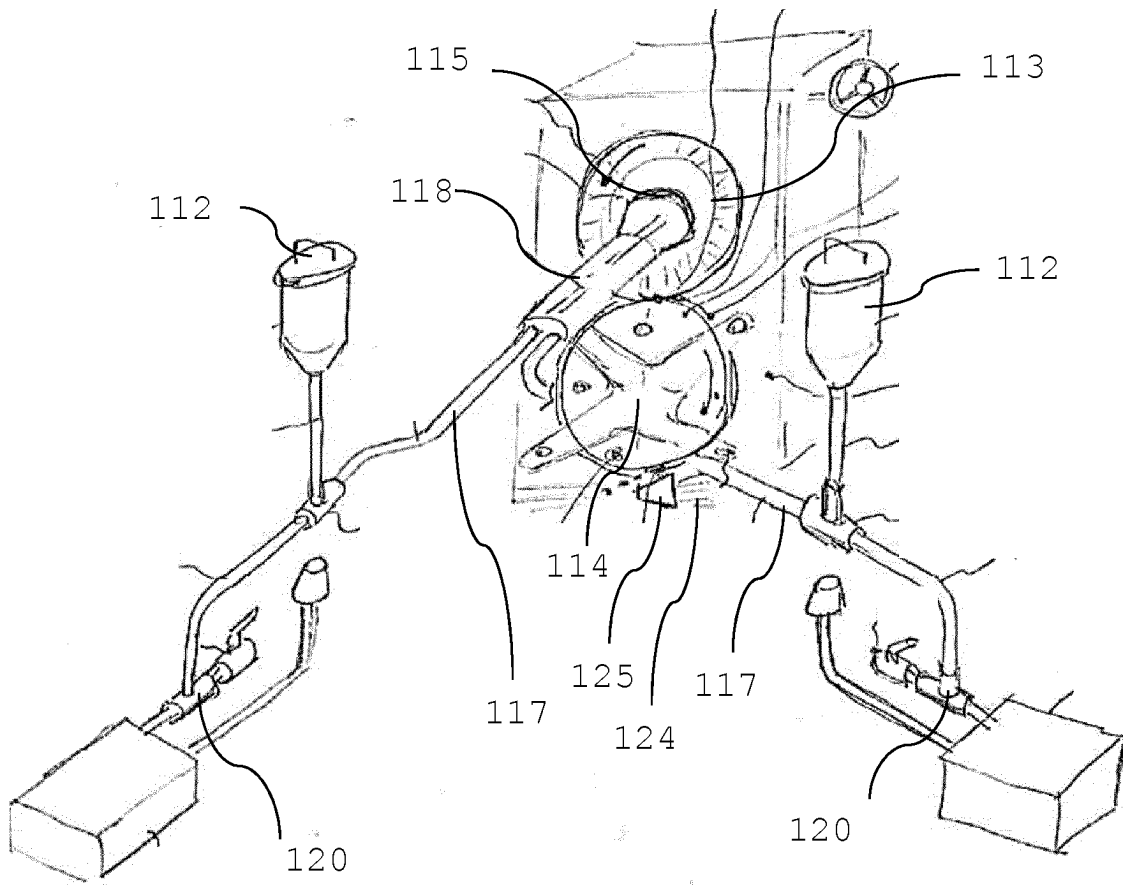


Fig. 12

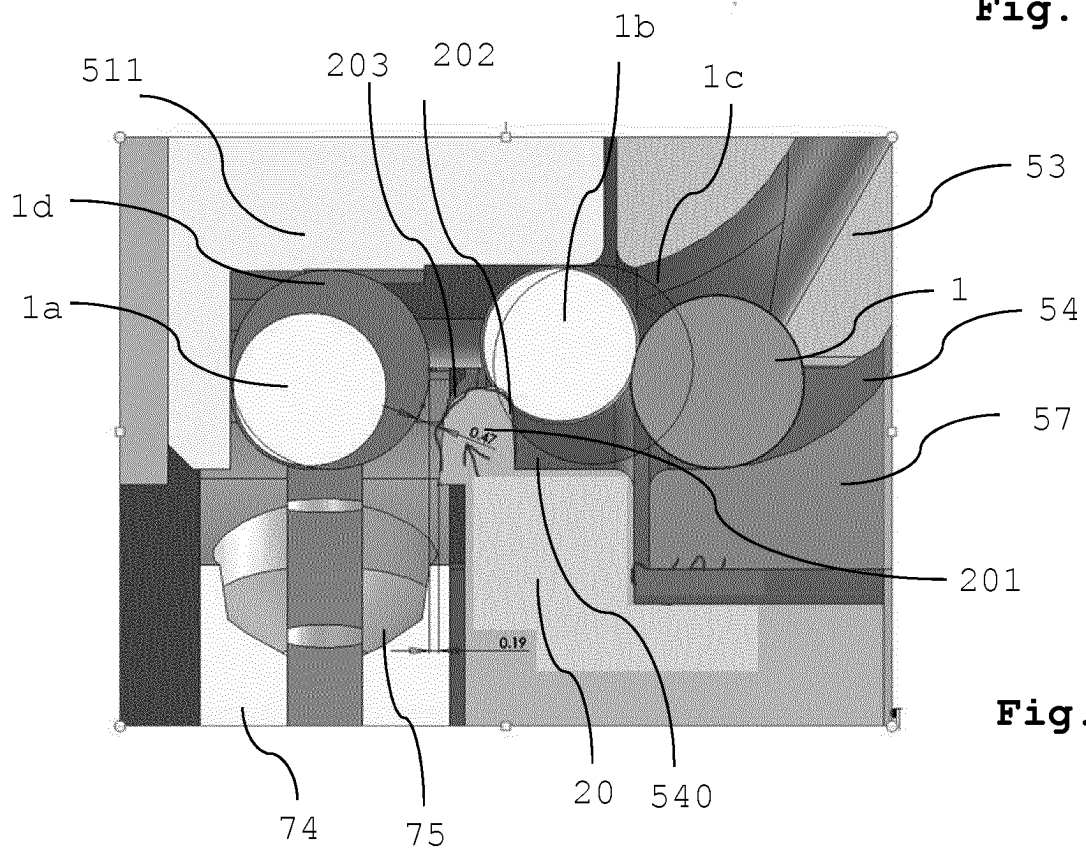


Fig. 13

REFERENCES CITED IN THE DESCRIPTION

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