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(54) **Title:** VENTURI ASSISTED TRANSPORTATION SYSTEM AND METHOD FOR SOLID OBJECTS

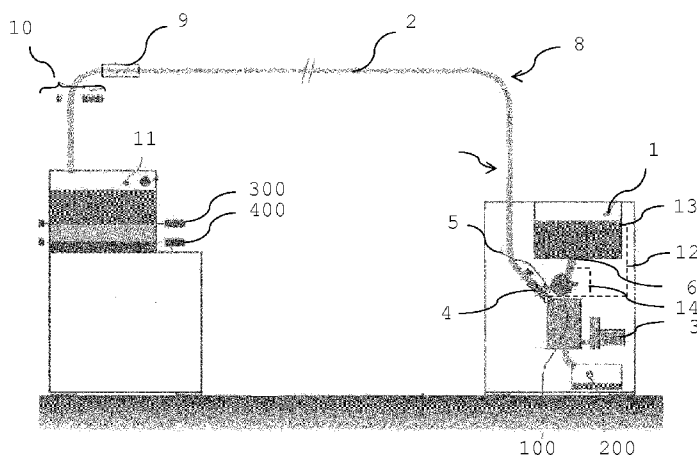


Fig. 1

(57) **Abstract:** A transportation system for use in a unit for making filters for smoking articles comprises a reservoir (1) for holding a plurality of solid objects. The reservoir (1) has an outlet (6) for the discharge of the solid objects from the reservoir (1), and a transportation duct (2) for transporting the solid objects discharged from the reservoir (1) to an object receiving unit. The transportation system further comprises a gas supply for providing a gas stream through the transportation duct (2), a Venturi nozzle (4) arranged in the transportation duct (2) and a release mechanism (9) arranged downstream of the Venturi nozzle (4). The Venturi nozzle (4) is in communication with the outlet (6) of the reservoir (1), such that upon operation of the gas supply solid objects are drawn from the outlet (6) of the reservoir (1) through the Venturi nozzle (4) into the transportation duct (2). The release mechanism (9) is provided for releasing pressure from the transportation duct (2).

VENTURI ASSISTED TRANSPORTATION SYSTEM AND METHOD FOR SOLID OBJECTS

The present invention relates to a transportation system for use in a unit for making filters for smoking articles. The transportation system according to the present invention may find particular use for the transportation of solid objects, such as capsules or beads, in the manufacture of filters for smoking articles, such as cigarettes.

Apparatuses and methods that are suitable for the transportation of solid objects are known. For example international patent application WO-A-2011/024068 discloses an object transportation system for capsules where the capsules are transferred from a reservoir to a horizontally rotating distribution wheel. Through rotation of the distribution wheel the capsules are transported to the peripheral portion of the distribution wheel where they are transferred into recesses in a vertically rotatable transfer wheel. The transfer wheel transfers the capsules to a location, where the capsules are released from the recesses and are inserted into filter tow.

The solid objects – for example capsules or beads - are provided into a hopper at the location of the filter making unit and are typically discharged from the hopper with the aid of gravitational forces. The hopper is typically arranged at an elevated level from the ground so as to be capable of making use of the gravitational forces during discharge of the solid objects. Due to the hopper being arranged at an elevated level, manual filling of the hopper may be time consuming and laborious.

It would be therefore desirable, to simplify the process of refilling a gravity-fed hopper for solid objects.

According to the invention there is provided a transportation system for solid objects. The transportation system comprises a reservoir for holding a plurality of solid objects. The reservoir has an outlet for the discharge of the solid objects from the reservoir. The transportation system further comprises a transportation duct for transporting the solid objects discharged from the reservoir to an object receiving unit. The system further comprises a gas supply for providing a gas stream

through the transportation duct and a Venturi nozzle arranged in the transportation duct. The Venturi nozzle is arranged in communication with the outlet of the reservoir, such that upon provision of a gas stream from the gas supply solid objects are drawn from the outlet of the reservoir through the Venturi nozzle into the transportation duct. The system further comprises a release mechanism for releasing pressure from the transportation duct. Preferably, the release mechanism is arranged downstream of the Venturi nozzle.

The transportation system according to the invention has several advantages. One advantage is, that the reservoir for the objects to be transported to the filter making unit may be positioned basically at a location which can be selected in accordance with the available space. A further advantage is that the reservoir of the transportation system can be positioned at a level at which the operator can conveniently fill or refill the reservoir. This significantly facilitates the filling of the hopper. Optionally, the reservoir of the transportation system may have a large volume so that it needs to be filled for example only once a day. Another advantage of a large volume reservoir of the transportation system is that it may serve as an object supply for more than only one filter making unit.

For the avoidance of doubt, in the following the term "reservoir" is used in connection with the reservoir of the transportation system according to the invention, whereas the term "hopper" is used in connection with a reservoir of the filter making unit to which the solid objects are supplied during the filling or refilling process.

The term "solid objects" as used in connection with the present invention denotes objects that have a geometrical shape with well-defined boundaries, in contrast to liquids or gases. By way of example, solid objects include objects which are entirely made of solid state substances, objects having a shell made of a solid substance enclosing a liquid or gaseous core, and objects like gelatine capsules also having well-defined boundaries. For the avoidance of doubt, the solid object according to the invention may be elastic, deformable and crushable if a sufficiently high force is applied. Preferably, the solid object is a substantially spherical object. Preferably, the substantially spherical object has a diameter of between about 0.2 mm and about 6.5 mm; more preferably, the substantially

spherical object has a diameter of between about 2.5 mm and about 4.0 mm. Preferably, the substantially spherical object is a capsule. Preferably, the capsule comprises a liquid. Preferably, the liquid is flavorant, for example, menthol. Preferably, the capsule is crushable, that is, the capsule can release its content
5 when a sufficient crushing strength is applied. With like objects, it is particularly important to handle the objects carefully as not to release the liquid within the capsules during the manufacturing process.

According to the invention, the solid objects are drawn through the outlet of the reservoir by a Venturi nozzle, which is arranged in the transportation duct. For
10 this purpose, the Venturi nozzle is in communication with the outlet of the reservoir. Upon operation, a gas stream provided by a gas supply flows through the transportation duct and through the Venturi nozzle. The gas supply may be for example bottled gas or a pump. Gas flowing through the Venturi nozzle creates a negative pressure within the reservoir in the vicinity of the Venturi nozzle. The
15 negative pressure draws the solid objects in the reservoir towards and into the transportation duct. Within the transportation duct, the solid objects are further transported by the gas stream. The release mechanism is provided for regulating the transport speed of the solid objects within the transportation duct. Thus, the solid objects can be supplied to an object receiving unit of the filter making unit, for
20 example to a hopper of the filter making unit, at low speed to prevent the solid objects from getting damaged when being transported. By way of example, in one embodiment the release mechanism comprises at least one hole in a wall of the transportation duct. Preferably, the at least one hole is of a size that allows the gas stream to escape through the hole or holes while the solid objects are retained in
25 the transportation duct. In another embodiment, the release mechanism may comprise a tube portion having a diameter larger than the diameter of the transportation duct. Such an enlarged tube portion basically has the inverse function of a Venturi nozzle - it slows down the speed of the gas stream flowing through the tube portion with the enlarged diameter. The enlarged tube portion
30 may either be a separate part, which is attached to the transportation duct or may be an integral part of the transportation duct. Alternatively, the release mechanism may comprise a wall that is at least partially made out of material that is air

permeable like for example a suitable fabric or mesh. Also, combinations of these embodiments are possible.

In an embodiment of the transportation system according to the invention the outlet for the discharge of the solid objects is arranged at the bottom of the reservoir. The outlet may be arranged either in the bottom of the reservoir itself or
5 laterally in a lower portion of the reservoir, but close to the bottom. This arrangement of the outlet allows the reservoir to be more or less completely emptied with the aid of the negative pressure generated by the gas stream flowing through the Venturi nozzle. In addition, in this embodiment the discharge of solid
10 objects from the reservoir is supported by gravitational forces acting on the solid objects.

The transportation system according to the invention is especially suitable for application in units or apparatuses in which the solid objects have to be transported to an elevated level. Therefore, in one embodiment of the
15 transportation system according to the invention the transportation duct comprises a rising portion and a deflection portion. Preferably, the deflection portion is arranged at an upper end of the rising portion. Preferably, the release mechanism, where present, is arranged downstream of the deflection portion. During transport
20 through the rising portion of the transportation duct, the solid objects are transported to an elevated level. The solid objects are then deflected, preferably into the direction where the object receiving unit is arranged. After deflection, the speed of the solid objects may be reduced with the aid of the afore-mentioned release mechanism.

In a further embodiment of the transportation system according to the
25 invention, the transportation duct comprises a descending portion which is arranged downstream of the deflection portion and downstream of the release mechanism. After the speed of the solid objects has been reduced with the aid of the release mechanism, the solid objects may further be transported in the descending portion. In the descending portion, the transport of the solid objects
30 may be further assisted by gravitational forces acting on the solid objects. The descending portion may be arranged directly downstream of the deflection portion.

In this embodiment, the release mechanism, where present, preferably forms a part of the descending portion.

In a further embodiment of the transportation system according to the invention, the object receiving unit is arranged at a level, which is higher than the level where the outlet of the reservoir is arranged. The difference in height is overcome as the solid objects are transported through the rising portion of the transportation duct. Thus, it is possible that the reservoir can be arranged on the floor level, while the solid object receiving unit is arranged at an elevated level, for example at the top of a unit for inserting the solid objects into filter material.

In another embodiment of the transportation system according to the invention, the solid object receiving unit comprises a hopper, which is smaller than the reservoir from which the solid objects are discharged. Usually, a hopper is the reservoir of a unit for making filters for smoking articles, in particular of a unit for the introduction of the solid objects into the filter material. This hopper generally has limited capacity and requires refilling of the reservoir from time to time. On the other hand, continuous operation of the filter making unit is desirable. The transport unit according to the invention allows for both the batch-wise supply of solid objects to the reservoir of the filter making unit or for the continuous supply of solid objects at a rate such that the hopper of the filter making unit does not get empty, such that continuous operation of the filter making unit is possible.

In one embodiment of the transportation system according to the invention, an object flow control valve is arranged at the end of the transportation duct. With the aid of the flow control valve the flow rate of solid objects from the transportation duct to the object receiving unit can be controlled, in particular, the flow rate can be temporarily interrupted, for example when operation of the filter making unit must be interrupted.

A further embodiment of the transportation system according to the invention comprises a first branch tube branching off of the transportation duct at a location upstream of the Venturi nozzle. The first branch tube extends from the transportation duct into the reservoir. With the aid of this first branch tube a part of the gas stream in the transportation duct can be branched off at a location upstream of the Venturi nozzle and be directed into the reservoir holding the solid

objects. This branched-off part of the gas stream may serve to agitate the solid objects in the reservoir of the transportation system. This agitation may significantly reduce the friction of the solid objects with each other or the boundaries of the reservoir. The introduction of the gas may thus significantly improve the fluid characteristics of the solid objects. This allows for a reliable discharging of solid objects from the reservoir through the outlet of the reservoir and prevents the solid objects from sticking together. In particular, this advantageously prevents clumping of the solid objects and a jamming of the reservoir or the transportation duct.

A variant of this embodiment of the transportation system comprises a second branch tube branching off of the first branch tube. Preferably, the second branch tube extends from the first branch tube to a solid object sucking portion of the Venturi nozzle. This second branched off part of the gas stream into the sucking portion of the Venturi nozzle advantageously supports the flow of solid objects discharged from the reservoir into the Venturi nozzle and further into the transportation duct.

Alternatively, the second branch tube may directly branch off of the transportation duct at a location upstream of the Venturi nozzle, independent from the first branch tube or even independent from the existence of a first branch tube.

Preferably, the transportation duct comprises additional branch tubes that can be selectively activated to change the transportation of the solid objects into different hoppers.

The invention is also directed to a method for transporting solid objects from a reservoir to an object receiving unit. The method may be used in a unit for making filters for smoking articles. The method comprises the steps of providing a reservoir containing a plurality of solid objects, and drawing the solid objects from the reservoir into a transportation duct with the aid of a negative pressure generated by a gas stream flowing through a Venturi nozzle arranged in the transportation duct. The method further comprises the step of transporting the solid objects through the Venturi nozzle into the transportation duct and to an object receiving unit with the aid of the gas stream. The method also comprises the step of releasing pressure from the transportation duct at a location

downstream of the Venturi nozzle in order to slow down the transport speed of the solid objects.

In an embodiment of the method according to the invention, the method further comprises the step of releasing pressure from the transportation duct at a location downstream of the Venturi nozzle in order to slow down the transport speed of the solid objects.

Another embodiment of the method further comprises the step of branching off of a part of the gas stream in the transportation duct at a location upstream of the Venturi nozzle, and directing the branched off part of the gas stream into the reservoir holding the solid objects. A variant of this embodiment comprises the step of branching off a portion of the branched off part of the gas stream, and directing the branched off portion of the branched off part of the gas stream to an object sucking portion of the Venturi nozzle.

The advantages of the embodiments of the method according to the invention have already been discussed above in connection with the transportation system, so that they are not discussed again.

Further advantageous aspects of the invention are described in more detail with reference to the following drawings, in which

Fig. 1 shows an embodiment of the transportation system according to the invention;
Fig. 2 shows a Venturi nozzle region in a perspective view;
Fig. 3 shows the Venturi nozzle of Fig. 2 in a sectional view and
Fig. 4 shows an embodiment of a release mechanism of the transportation system.

Fig. 1 shows an embodiment of a transportation system according to the invention. The transportation system comprises a reservoir 1 for holding a plurality of solid objects, such as capsules, and a transportation duct 2 for transporting the solid objects to an object receiving unit, such as a hopper 11. The hopper 11 may be part of an apparatus for introducing the solid objects into the filter material from which filters for smoking articles are made. The transportation duct 2 is supplied with a pressurized gas stream, preferably pressurized air, provided by a pump 3.

The gas stream enables solid objects discharged from the reservoir 1 to be transported through the transportation duct 2 to the solid objects receiving unit.

A Venturi nozzle 4 is arranged in the transportation duct 2. The Venturi nozzle 4 comprises a sucking portion 5, which is connected to an outlet 6 of the reservoir 1. Upon operation of the pump 3, negative pressure is generated in the sucking portion 5 of the Venturi nozzle 4 by the gas stream passing through Venturi nozzle 4. Due to the negative pressure created by the Venturi nozzle 4 solid objects 31 are drawn from the reservoir 1 through the sucking portion 5 into the Venturi nozzle 4. A valve 100 is arranged between the reservoir 1 and the Venturi nozzle 4. The valve 100 allows to stop the flow of capsules 31 into the transportation duct 2, for example during the time the gas stream is ramped up or down or for other maintenance work. These solid objects are further transported by the gas stream flowing through transportation duct 2 upwards along a rising portion 7 of the transportation duct to a deflection portion 8, where the solid objects are redirected. The deflection portion 8 also forms the uppermost point of the transportation duct 2. Downstream of the deflection portion 8 a release mechanism 9 is arranged for releasing pressure from the transportation duct. Due to this pressure decrease, the transport speed of the solid objects is decreased so as to prevent damages as the solid objects are discharged into the hopper 11.

The release mechanism 9 may be formed by a portion of the transportation duct 2 that has at least one hole in the duct wall, more preferably a plurality of holes. For example, an array of holes is arranged in the duct wall along the circumference of the transportation duct. Alternatively, the release mechanism 9 may comprise a wall that is at least partially made out of fabric that is air permeable. The release mechanism may also be formed by a duct portion having a diameter which is larger than the diameter of the transportation duct. In this enlarged diameter duct portion the speed of the gas stream and, consequently, the transport speed of the solid objects is reduced. Also, holes in the duct wall and an enlarged diameter duct portion may be combined. The release mechanism 9 may be formed as a separate component or can be an integral part of the transportation duct. An example for such a release mechanism 9 is shown in **Fig. 4**. The release mechanism 9 is formed from a piece of material, for example

plastic or metal that is connecting two portions of the transportation duct 2. The release mechanism 9 has an upstream diameter 91 on the upstream side that is larger than the diameter 26 of the transportation duct 2. On the downstream side, the downstream diameter 92 of the release mechanism is smaller than the diameter 26 of the transportation duct 2. This has the aforementioned advantage of slowing down the solid objects 31. In addition, due to a stepwise increase at both connection points of the release mechanism, the capsules traveling with a first speed 95 into the release mechanism do not encounter a ridge or step that may for example catch the solid object 31 or create a kinetic force that may rupture the solid object 31. The gas stream may at least partially escape through the permeable walls of the release mechanism 9 as indicated by the arrows with reference numeral 93. The capsules 31 leave the release mechanism 9 with a second speed 96, which second speed 96 is lower than the first speed 95.

Downstream of the deflection portion 8 the transportation duct is provided with a substantially horizontal portion of variable length such as to cover a distance between reservoir and hopper. Further downstream of the deflection portion 8 or the horizontal portion, respectively, the transportation duct 2 is inclined downwardly in a descending portion, so that gravitational forces acting on the solid objects are assisting the transport of the solid objects to the object receiving unit. Preferably, where the transportation duct downstream of the deflection portion 8 and the release mechanism 9 are arranged horizontally or even in slight ascending direction, the release mechanism is dimensioned such that the remaining gas stream with the reduced speed is still sufficient to transport the solid objects in the ascending direction to the object receiving unit. In the area of the bend in the transportation duct between the substantially horizontal portion and the descending portion, a further release mechanism (not shown) may be provided, such that the gas stream carrying most of the kinetic energy passes straight through the bend and the solid objects continue the path of the transportation duct 2 substantially only under the influence of gravity.

At the end of the transportation duct a flow control valve 10 is arranged. Such a valve may control the flow of solid objects into the hopper 11. For example, it may interrupt the flow of solid objects into the hopper 11. The flow control valve

10 is particularly suitable for a temporary interruption of the flow of capsules in case the discharge from the hopper 11 is interrupted for any reason.

In addition, sensors 300, 400 for monitoring the level of the solid objects contained in the hopper 11 are provided. Such sensor may send a signal
5 representative of the level of the solid objects contained in the hopper 11 to a control unit of the transportation system. Alternatively or in addition, sensors 300, 400 may send signals at the time the level of solid objects contained in the hopper reaches a first and second lower threshold level, respectively. This allows for an automatic control of the transportation system, which may initiate the transport of
10 solid objects to the hopper 11 upon receipt of a corresponding signal. Like sensors may be arranged in the reservoir 1 (not shown).

The Venturi nozzle 4 may be a separate component inserted into the transportation duct 2 or may be embodied as an integral portion of the transportation duct 2. The sucking portion 5 extends from the narrowest portion of
15 the Venturi nozzle 4, is connected to the outlet 6 of the reservoir 1 and is interrupted by valve 100. The outlet 6 for the discharge of the solid objects from the reservoir is arranged in a lower part of the reservoir 1, preferably at the bottom of the reservoir 1. The outlet 6 is preferably arranged such that the reservoir 1 can be emptied completely, preferably the reservoir can be emptied completely only by
20 gravitational forces acting on the solid objects. For that reason the outlet 6 is arranged in the bottom of the reservoir or in a side wall of and near the bottom of the reservoir. Outlet 6 and suction portion 5 are preferably arranged such that the solid objects are not supplied into the transportation duct 2 without a pressurized gas stream flowing through the transportation duct 2. This may be achieved, for
25 example, by an essentially horizontally arranged or only slightly downwardly inclined connection of the outlet 6 of the reservoir 1 to the sucking portion 5 of the Venturi nozzle 4.

In order to further assist in the complete emptying of the reservoir 1, the bottom of the reservoir 1 may be sloped downwardly towards the outlet 6 of the
30 reservoir 1. Alternatively, the outlet 6 may also be arranged such that a remaining bottom layer remains in the reservoir. For example, it may be beneficial not to

entirely empty the reservoir 1 as the remaining bottom layer may comprise dust, crumbs or other particles that are not intended for being transported.

Transportation duct 2 further comprises a first branch tube 12 branching off upstream of the Venturi nozzle 4. The first branch tube 12 extends from the transportation duct 2 to the reservoir 1. A branched-off part of the gas stream is guided through the first branch tube 12 into the reservoir 1. An inlet 13 for the branched-off part of the gas stream into the reservoir 1 is preferably located in an upper part of the reservoir 1, for example in the top or in a side wall near the top. The branched-off part of the gas stream keeps the solid objects in the reservoir 1 in motion thus facilitating the discharge and feeding of solid objects to the suction portion 5 of the Venturi nozzle 4. This prevents the jamming or sticking together of solid objects in the reservoir 1 and at the outlet 6. A second branch tube 14 branches off of the first branch tube and extends from the first branch tube 12 to the sucking portion 5 of Venturi nozzle 4. The second branch tube directs a part of the branched-off gas stream to the sucking portion 5 of Venturi nozzle 4 thereby supporting the flow of solid objects to the Venturi nozzle 4.

Underneath the Venturi nozzle 4 a bin 200 is arranged that is connected to the transportation duct 2. In the event that the gas supply is ramped down or stopped, solid objects that are in the rising portion 7 of the transportation duct 2 will drop back under the influence of gravity through the Venturi nozzle 4 and will be collected in bin 200 for reuse.

An embodiment of the Venturi nozzle is illustrated in more detail in a perspective view in **Fig. 2**, and in a sectional view in **Fig. 3**. Fig. 2 and Fig. 3 show a Venturi nozzle 4 with the flow directions being indicated by arrows 20, 21. The Venturi nozzle 4 comprises a narrow tube portion 15 in which the speed of the gas flow is increased. This generates a negative pressure in the narrow tube portion and in sucking portion 5 when gas passes through the Venturi nozzle 4. The sucking portion 5 extends perpendicular from the narrow tube portion 15.

The Venturi nozzle 4 further comprises a first port 16 to which an end of a first branch tube 12 can be connected. The other end of the first branch tube 12 is connected to the reservoir 1, as this has been described above. Venturi nozzle 4 further comprises a second port 17 arranged at the sucking portion 5 of the Venturi

nozzle 4. A second branch tube 14 branches off of first branch tube 12. The free end of the second branch tube is connected to the second port 17. The first branch tube 12 and the second branch tube 14 are indicated in Fig. 2 by dashed lines.

In this embodiment, preferably the transportation duct is made of a metallic or plastic material. Preferably, the transportation duct 2 has an inner diameter in the range of between about 25 mm and about 60 mm, preferably in the range of between about 30 mm and about 50 mm, and may for example be about 40 mm. Preferably, the inner diameter of the Venturi nozzle is in the range of between about 10 mm and about 25 mm. Preferably, the flow rates in the transportation duct are between about 10 liters per minute and about 50 liters per minute at a flow speed of less than about 25 m/s. However, the flow rate will depend on the type and weight of the solid objects and on the length of the transportation duct and the height of the rising portion. Preferably, the length of the rising portion of the transportation duct is in the range of between about 2 m and about 5 m, for example it may be about 3 m. The pressure 22 of the gas stream in the transportation duct upstream and downstream of the Venturi nozzle (also of the branched off gas streams) is less than 2 bar, preferably between about 1.2 and about 2 bar. This reduces the likelihood of causing damage to the solid objects during the transportation. Preferably, the pressure 24 in the Venturi tube is smaller than the pressure in the transportation duct and below ambient pressure and may be about 0.5 bar. Preferably, the pressurized gas (preferably air) used for the transport of solid objects in the transportation duct has a laminar flow profile with a Reynolds number smaller than 2000. Preferably, the sizes of the holes of the release mechanism are in the range of between about 0.1 mm and about 1 mm.

Claims

1. A transportation system for solid objects, comprising:
a reservoir (1) for holding a plurality of solid objects (31), the reservoir having
an outlet (6) for the discharge of the solid objects from the reservoir (1);
5 a transportation duct (2) for transporting the solid objects discharged from the
reservoir (1) to an object receiving unit; a gas supply for providing a gas
stream through the transportation duct (2); a Venturi nozzle (4) arranged in the
transportation duct; a release mechanism (9) arranged downstream of the
Venturi nozzle(4), wherein the Venturi nozzle (4) is in communication with the
10 outlet (6) of the reservoir (1), such that upon provision of a gas stream from
the gas supply solid objects are drawn from the outlet (6) of the reservoir (1)
through the Venturi nozzle (4) into the transportation duct (2), and wherein the
release mechanism (9) is provided for releasing pressure from the
transportation duct (2),
- 15 2. A transportation system according to claim 1, wherein the outlet (6) for the
discharge of the solid objects (31) is arranged at the bottom of the reservoir
(1).
3. A transportation system according to any one of the preceding claims, wherein
the release mechanism (9) comprises at least one hole in a wall of the
20 transportation duct (2).
4. A transportation system according to any one of the preceding claims, wherein
the release mechanism (9) comprises a tube portion having a diameter larger
than the diameter of the transportation duct (2).
5. A transportation system according to any one of the preceding claims, wherein
25 the transportation duct (2) comprises a rising portion (7) and a deflection
portion (8) which is arranged at an upper end of the rising portion (7), and
wherein the release mechanism (9) is arranged downstream of the deflection

portion (8).

6. A transportation system according to claim 5, wherein the transportation duct (2) comprises a descending portion which is arranged downstream of the deflection portion (8) and downstream of the release mechanism (9).

5 7. A transportation system according to any one of the preceding claims, wherein the object receiving unit is arranged at a level which is higher than the level where the outlet (6) of the reservoir (1) is arranged.

8. A transportation system according to any one of the preceding claims, wherein the object receiving unit comprises a hopper (11) which is smaller than the
10 reservoir (1) from which the solid objects (31) are discharged.

9. A transportation system according to any one of the preceding claims, wherein an object flow control valve (10) is arranged at the end of the transportation duct (2).

10. A transportation system according to any one of the preceding claims, further
15 comprising a first branch tube (12) branching off of the transportation duct (2) at a location upstream of the Venturi nozzle (4), the first branch tube (12) extending from the transportation duct (2) into the reservoir (1).

11. A transportation system according to claim 10, further comprising a second
20 branch tube (14) branching off of the first branch tube (12), the second branch tube (14) extending from the first branch tube (12) to an object sucking portion (5) of the Venturi nozzle (4).

12. A method for transporting solid objects from a reservoir (1) to an object receiving unit, the method comprising the steps of:
providing a reservoir (1) containing a plurality of solid objects (31);
25 drawing the solid objects from the reservoir (1) into a transportation duct (2)

with the aid of an negative pressure generated by a gas stream flowing through a Venturi nozzle (4) arranged in the transportation duct;

transporting the solid objects through the Venturi nozzle (4) into the transportation duct (2) and to an object receiving unit with the aid of the gas stream; and

releasing pressure from the transportation duct (2) at a location downstream of the Venturi nozzle (4) in order to slow down the transport speed of the solid objects (31).

13. A method according to claims 12, comprising the step of branching off of a part of the gas stream in the transportation duct (2) at a location upstream of the Venturi nozzle (4), and directing the branched off part of the gas stream into the reservoir (1) holding the solid objects (31).

14. A method according to claim 13, further comprising the step of branching off a portion of the branched off part of the gas stream, and directing the branched off portion of the branched off part of the gas stream to an object sucking portion (5) of the Venturi nozzle (4).

15. Use of the transportation system according to any one of claims 1 to 11 in a unit for making filters for smoking articles.

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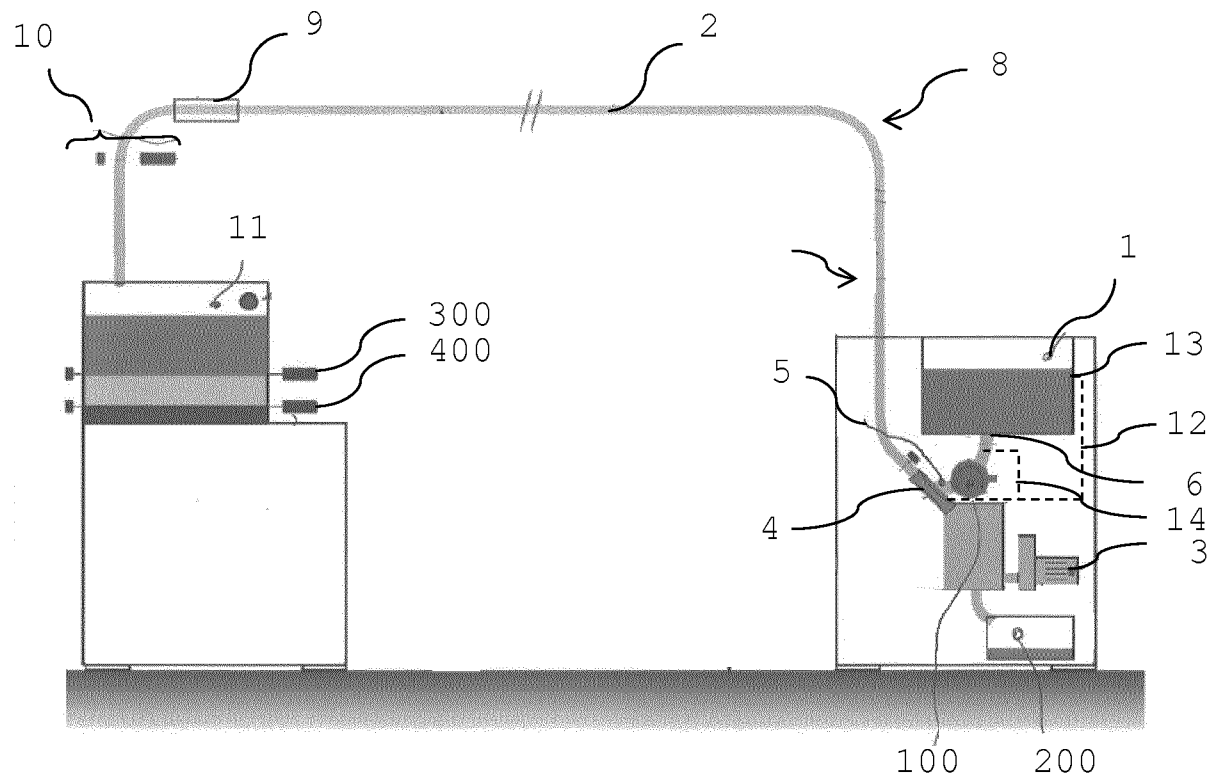


Fig. 1

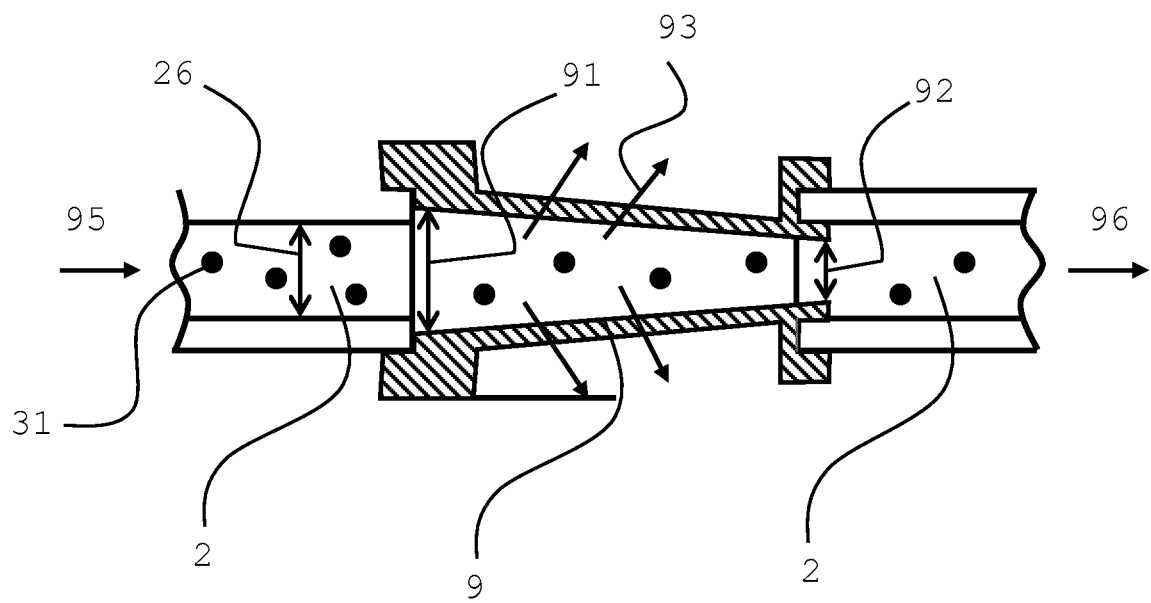


Fig. 4

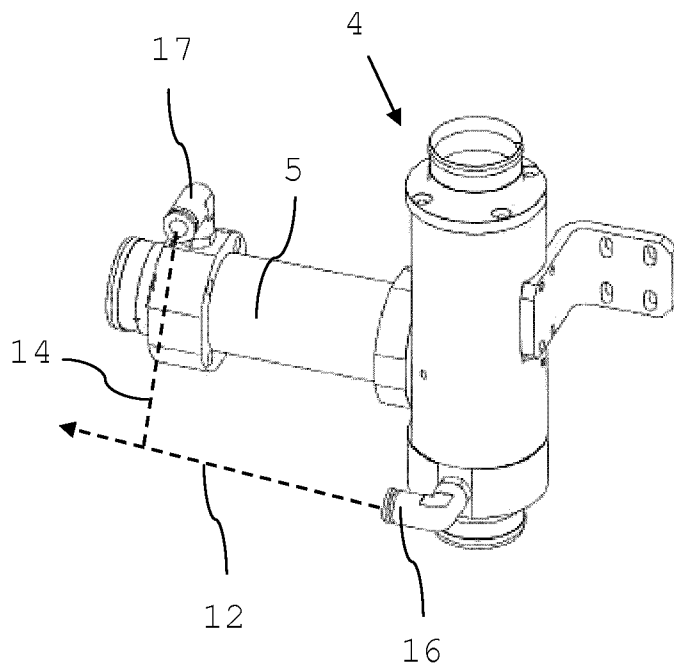


Fig. 2

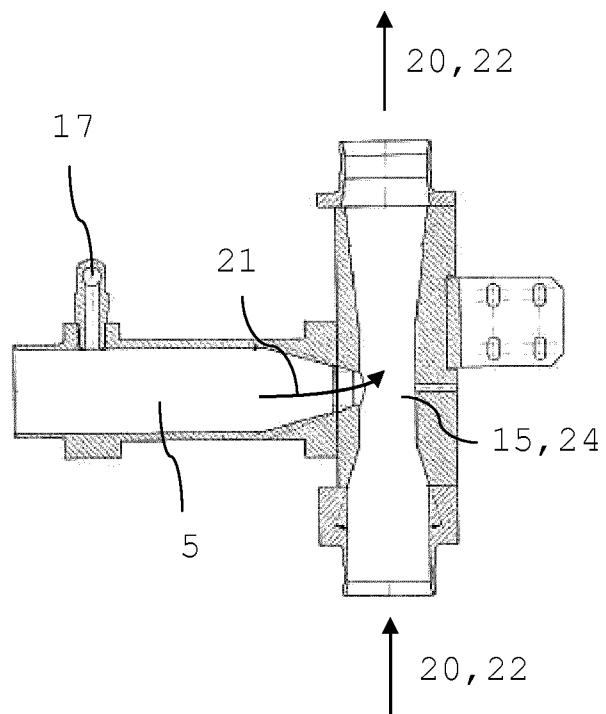


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/058831

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65G53/14 A24D3/02
ADD.

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)
B65G A24D

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 118 225 A (C. KOCH) 2 June 1992 (1992-06-02)	1,2,7,12
A	column 3, line 22 - column 4, line 62; figures	6
Y	US 5 899 641 A (J. PFEIFFER) 4 May 1999 (1999-05-04)	1,2,7,12
	column 2, line 31 - column 3, line 39; figures	
A	US 6 012 875 A (THE CONAIR GROUP) 11 January 2000 (2000-01-11)	1,2,12
	column 2, line 45 - column 3, line 51; figures	
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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Date of the actual completion of the international search

19 July 2013

Date of mailing of the international search report

01/08/2013

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/058831

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 071 289 A (P. SPIVAK) 10 December 1991 (1991-12-10) column 3, line 16 - column 5, line 46; figures -----	1,2,12
A	US 6 283 327 B1 (Y. RUBTSOV) 4 September 2001 (2001-09-04) column 7, line 13 - column 11, line 37; figures -----	1,12
A	EP 0 164 436 B1 (W. STEIN) 2 March 1988 (1988-03-02) column 4, line 20 - column 5, line 10; figures -----	1,12
A	US 6 974 279 B2 (TRINITY INDUSTRIAL CORP.) 13 December 2005 (2005-12-13) column 4, line 61 - column 5, line 58; figures -----	1,12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/058831

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US 6012875	A	11-01-2000	CA 2233811 A1 02-10-1998 US 6012875 A 11-01-2000
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US 6283327	B1	04-09-2001	NONE
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US 6974279	B2	13-12-2005	NONE