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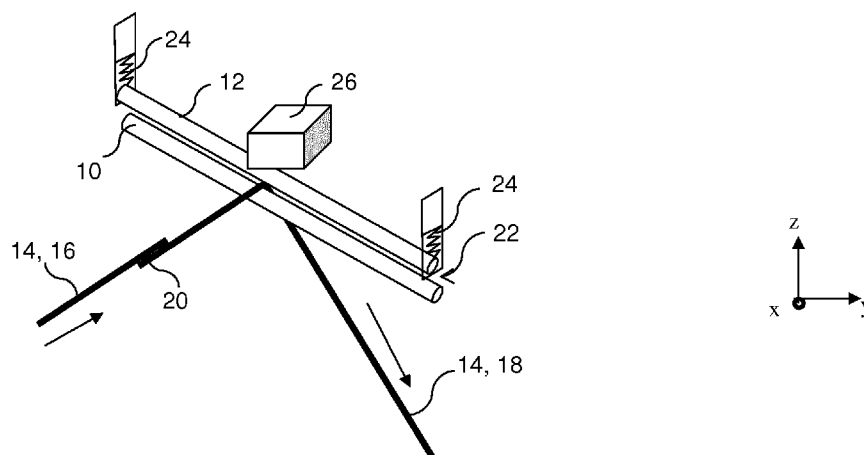
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(54) Title: A DETECTION SYSTEM FOR DETECTING A THREAD JUNCTION

Fig. 1



(57) Abstract: The invention relates to a detection system for detecting a thread junction, comprising a guiding element (10) for guiding a thread (14) and a displaceable element (12). The displaceable element (12) is arranged distanced from the guiding element (10). The system further comprises a sensor (26). The distance between the guiding element (10) and the displaceable element (12) is at least partly larger than the thread diameter and smaller than the junction diameter. The sensor (26) is configured to detect a movement of the displaceable element (12). The displaceable element (12) has a recess (28) with essentially corresponds to the diameter of the thread (14).

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A DETECTION SYSTEM FOR DETECTING A THREAD JUNCTION

The present invention relates to a detection system for detecting a thread junction and a method for detecting a thread junction.

5 In the production of aerosol-generating articles for generating an aromatized aerosol, aromatic thread is sometimes utilized for adding flavor to the aerosol. These threads may be incorporated in components of the article, typically the filter. Air or an aerosol flowing through the filter contacts the thread such that the air is aromatized, for example with menthol. In the production process, these aromatic threads are provided on bobbins. During production, 10 threads from subsequent bobbins are attached together by connecting the thread ends. During production, the thread of a second bobbin is then automatically used, when the thread from a first bobbin is depleted.

Often for attaching the subsequent threads to each other, a junction between the threads is created by overlapping and gluing two thread ends together. As a result, a thicker 15 junction is created. Junctions are unwanted in filters, since they may change the shape or characteristics of the filter.

Accordingly, there is a need for detecting junctions, such that these can subsequently be discarded. The mere optical detection of a junction is prone to errors due to different possible configurations of the junction. The thickness or orientation of the junction as well as 20 the color of the threads could vary. Also, high processing speeds are used. Hence, a fast and robust detection system is required.

It would be desirable to have a detection system for detecting a thread junction with accuracy, while the detection system can be employed in a production process with high production speeds.

25 According to a first aspect of the invention there is provided a detection system for detecting a thread junction, comprising a guiding element for guiding a thread and a displaceable element. The displaceable element is arranged distanced from the guiding element. The system further comprises a sensor. The distance between the guiding element and the displaceable element is at least partly larger than the thread diameter and smaller 30 than the junction diameter. The sensor is configured to detect a movement of the displaceable element. The displaceable element may have a recess with essentially corresponds to the diameter of the thread.

By detecting the movement of the displaceable element, a thread junction or thicker portion of the thread can be securely detected. A movement can be any change in shape or 35 spatial position of the displaceable element such as a spatial displacement or elastic deformation. Preferably, the movement is a linear translation of the displaceable element

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away from the guiding element. The movement may also be a rotative movement of the displaceable element.

When a thicker part of the thread, due to a junction or a defect, passes between the guiding element and the displaceable element, the displaceable element is contacted by the thread, because even if the junction lies on the side of the thread, its diameter is typically larger than a single thread. The junction lies on the side of the thread if both of the threads constituting the junction have essentially the same distance with respect to the guiding element. The diameter of the junction may increase due to the added material of two thread portions compared to a single thread. Also, adhesive or other material such as stitching material may be present in the area of the junction, which increases the diameter of the junction. Because of the contact between the junction and the displaceable element, the displaceable element then moves from its original position, and this movement is detected by the sensor.

The displaceable element may be arranged or adapted such that the movement of the displaceable element caused by the thread junction is multiplied, thereby facilitating the save detection of the movement by the sensor. In this embodiment, the displaceable element may be arranged as a lever or cantilever.

The movement of the displaceable element may also be a result of the stiffness of the junction compared to the stiffness of a single thread. The stiffness of the junction can be higher due to the added material of two thread portions. Also, adhesive increases the stiffness of the junction. The movement of the displaceable element may be a result of the thickness as well as the stiffness of the junction. Apart from these causes, the junction is indirectly detected by detecting the movement of the displaceable element by means of the sensor.

In case the junction has an asymmetrical profile, the junction diameter denotes the largest diameter of the thread junction. For example, if the junction is constituted by two overlapping thread ends next to each other, the diameter of the junction is typically substantially two times the diameter of a single thread in a direction through the center of the two threads. Perpendicular to this direction, the diameter of the thread junction is less than two times the diameter of a single thread but still larger than the diameter of a single thread. For securely detecting a junction and avoiding a wrong junction detection, the distance between the guiding element and the displaceable element preferably is between one and two times the diameter of a single thread. The diameter of a thread, particularly a multi filament thread, and of a junction may be affected by parameters such as pressure, thread tension and humidity causing swelling. Also, the thread diameter may slightly fluctuate due to material variations of the threads. The thread diameter may vary in a horizontal and vertical

direction of the thread with respect to the cross-section of the thread. However, the diameter of a thread junction is always larger than the diameter of a single thread in all directions with respect to the junction cross-section compared with the cross-section of a single thread. Under given conditions, the thread and junction diameters are determined such that the distance between the guiding element and the displaceable element can be adjusted to be larger than the diameter of a single thread and smaller than a junction diameter.

In some embodiments, the thread junction comprises overlapping thread ends, and the thread junction preferably comprises an adhesive.

Thus, the diameter of the junction is larger than the diameter of a single thread. Due to the fact that the distance between the guiding part and the displaceable element is larger than the diameter of a single thread but smaller than the diameter of a junction, the displaceable element is moved every time a junction passes between the guiding element and the displaceable element.

Since a thread junction is provided for connecting two threads with each other, two thread ends are present adjacent to a thread junction. For further improving the detection of the junction, at least one of the thread ends could be modified in that the diameter of the thread end is enlarged for example by melting the thread end such that thread material accumulates at the thread end. Preferably, the thread end is treated this way before the junction is formed and before the two threads are connected with each other. The enlarged thread end may then be part of the junction or arranged next to the junction such that the junction is safely detected by the detection system even if the diameter of the junction without the enlarged thread end has a diameter which is only slightly larger than the diameter of a single thread.

In some embodiments, the system comprises a control unit. The control unit is configured to control an ejecting mechanism for ejecting the thread junction in a subsequent processing step based upon the detection of a movement of the sensor.

The detection of a junction can be utilized for ejecting an unwanted subsequent product such as a filter which contains the thread junction. In that way, all subsequent products containing a thread junction can securely be ejected. The ejecting mechanism can be any known mechanism.

In some embodiments, the system comprises a control unit, and the control unit is configured such that a further movement of the displaceable element does not result in a detection of a further junction in a time period after a junction is detected, and wherein the time period is 5 minutes, preferably 3 minutes, and more preferably 1 minute.

In this regard, it is possible that a first contact with a junction creates vibrations and bouncing movements in the displaceable element and triggers afterwards, during a short

time, a series of false signals, erroneously indicating the presence of thread junctions. In other words, signals of a movement of the displaceable element may be detected after the contact of the displaceable element with a junction, while the thread has no further junctions. By not taking into account signals immediately following the initial signal, false signals can be prevented.

In some embodiments, the system is configured such that more than one thread can be advanced through the detection system at the same time. In this embodiment, the guiding element as well as the displaceable element may have an elongate shape such that multiple threads can be advanced next to each other. Downstream of the system, multiple ejection systems could be provided for ejecting junctions of the respective threads. In this embodiment, a displaceable element could be provided for each of the threads such that a detected thread junction can be correctly allocated to a specific thread.

In some embodiments, the system comprises a marking unit for applying a mark to the junction.

A mark aids a save subsequent ejection of a product containing the thread junction. For example, an optical detection system can be employed for confirming the presence of a thread junction, wherein the security of the optical detection is improved by the mark on the junction. In this regard, the mark may comprise a color. The mark may also comprise information such as thread speed and junction detection time. This information may be utilized downstream of the system to precisely determine the position of the junction ejection. The mark may also be provided as a virtual mark, wherein the sensor is configured to send information such as thread speed, junction detection time or other information characterizing the thread junction to a control unit. This information constitutes a virtual mark regarding a specific thread junction. The virtual mark could also be employed to facilitate a subsequent ejection process.

In some embodiments, the thread after passing the guiding element may be arranged with an angle with respect to the thread before the guiding element, such that the thread is redirected by the guiding element.

By redirecting the thread by means of the guiding element, a junction may be detected with higher accuracy. In this regard, a junction has a higher stiffness than a single thread. When a junction of the thread passes the guiding element and is redirected in a different direction, the relatively stiff junction may bulge in the direction of the displaceable element such that the displaceable element is moved away from the guiding element. Thus, the thickness of the junction and the relative stiffness of the junction may both be utilized for moving the displaceable element. A redirection of the thread may be optimized without

damaging the thread by providing the contact surface of the guiding element regarding the thread with a curved shape to aid the redirection of the thread.

In some embodiments, the guiding element is configured as a flat element such as a bar, and wherein the displaceable element is preferably configured as a flat element such as a bar. In this embodiment, the flat element has a relatively large contact surface with respect to the thread. Strong forces acting upon the thread and wear of the thread in the detection element can thereby be prevented. The surface may be smooth to optimize guiding of the thread. Also, multiple threads could be advanced simultaneously through the detection system.

In some embodiments, the guiding element is configured as a concave element.

In that way, a secure positioning of the thread running over the guiding element can be achieved, since the thread is hereby defined to run in the lowest part of the guiding element formed by the U-shape of the guiding element. The concave shape of the guiding element provides a guide or duct to secure the pathway of the thread running through the guiding element.

The displaceable element preferably has a recess with essentially corresponds to the diameter of the thread. Next to the recess, wing elements could be provided. Wing elements could be provided as flaps or similar shaped elements, which protrude further in the direction of the guiding element from the displaceable element. In this way, the path of a single thread that is advanced through the detection system is confined in the system by the guiding element, the recess and the wing elements.

This embodiment enables a detection of a thread junction, even if the junction passes the guiding element in a lying position. In this position, the two threads constituting the junction are arranged side by side in contact with the surface of the guiding element. The thread junction may then have, at its thinnest part, a similar height as the diameter of a single thread. Since the recess of the displaceable element corresponds, in this embodiment, to the shape of a single thread, the thread junction contacts the wing elements of the displaceable element next to the recess, even if the junction is in a lying position.

In some embodiments, the guiding element is arranged below the displaceable element. The term below is to be understood with reference to a horizontal plane. The thread is preferably advanced in this horizontal plane. If the thread is redirected in the detection system, the thread has an angle relative to this horizontal plane. The thread is preferably sandwiched between the guiding element and the displaceable element in the sense that the guiding element is arranged below the horizontal plane, and the displaceable element is arranged above the horizontal plane.

In this embodiment, gravity acts on the displaceable element. Thus, no means must be provided for biasing the displaceable element towards the guiding element. If a thread passes between the guiding element and the displaceable element, the displaceable element is displaced by the junction against the direction of gravitational force acting upon the displaceable element. After the junction has been detected by the sensor and passed the system, the movable element is automatically moved into the original position by gravity. A guide rail or similar means may be provided for guiding the movement of the movable element.

In some embodiments, the guiding element is made from a low-friction material such as a ceramic or a material with a low-friction coating.

In this embodiment, the thread is less likely to be damaged by the guiding element. Also, the pulling force for advancing the thread through the detection system can be advantageously reduced.

In some embodiments, the guiding element is made from a material with high thermal conductivity, preferably higher than 1 Watt/(meter*Kelvin) more preferably higher than 3 Watt/(meter*Kelvin). Advantageously, a high thermal conductivity of the guiding element material reduces the risk of overheating the guiding element.

In some embodiments, the guiding element is connected with the movable element by an elastic element such as a spring. In some embodiments, the movable element is mounted by means of an elastic element such as a spring.

By means of the elastic element, the force needed to move the movable element away from the guiding element can be adjusted. Also, the elastic element ensures that the movable element returns to its original position, after being displaced from the guiding element by a thread junction.

In some embodiments, the displaceable element comprises a rotating mechanism. According to this embodiment, the rotating mechanism is rotated, when the distance between the guiding element and the displaceable element changes. Preferably the sensor is configured for detecting a rotation of the rotating mechanism. A save detection of the movement of the movable element can be ensured in this embodiment, since a rotating movement can be detected with high accuracy.

In some embodiments, the sensor is provided as a switch, a proximity sensor, a contact sensor, or an optical sensor. In some embodiments, the sensor is provided as an inductive proximity sensor, in which case the displaceable element is made from a conductive material such as a metal. If the sensor is provided as an inductive proximity sensor, the inductive sensor detects the distance between the sensor and the displaceable element. The sensor could be arranged close to the displaceable element, so that when the

displaceable element is contacted and moved by the junction, the displaceable element gets closer to the proximity sensor and activates it.

There is also provided a method for detecting a thread junction, comprising the steps
5 of:

(a) providing a detection system for detecting a thread junction comprising a guiding element for guiding a thread, a displaceable element, wherein the displaceable element is arranged distanced from the guiding element, and a sensor, wherein the distance between the guiding element and the displaceable element is at least partly larger than the
10 thread diameter and smaller than the junction diameter,

(b) detecting, by the sensor, a movement of the displaceable element,

(c) detecting a thread junction, if a movement of the displaceable element is detected by the sensor.

In some embodiments, the thread is provided as an aromatic thread for an aerosol-
15 generating article such as a filter, and wherein the thread preferably contains menthol.

In some embodiments, the thread is advanced through the detection system with a speed of between 100 to 700 meters per minute, preferably 200 to 500 meters per minute.

According to the invention, the presence of a junction can be determined while a high processing speed can be maintained due to the fact that detection of the junction is realized
20 by the mechanical movement of the displaceable element. This mechanical movement can be detected with high accuracy with different kinds of sensors.

The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 shows a first embodiment of a detection system for detecting a thread junction;
25 and

Fig. 2 shows a second embodiment of a detection system for detecting a thread junction.

Fig. 1 shows a detection system comprising a guiding element 10 and a displaceable element 12. The guiding element 10 and the displaceable element 12 are configured as elongate elements and are arranged distanced to each other.

Between the guiding element 10 and the displaceable element 12, a thread 14 is
35 advanced. The thread 14 consists of a first thread 16 and a second thread 18. The two threads 16, 18 are connected with each other through a thread junction 20. Connecting two

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threads 16, 18 with each other is necessary to enable a continuous operation of the system. Downstream of the detection system, the thread 14 may be introduced into a filter rod of an aerosol-generating article to add flavor to the aerosol.

5 The thread junction 20 may be manufactured in different ways, for example by gluing the two threads 16, 18 together using an adhesive. The thread junction 20 has a larger diameter than the diameter of the single thread 14.

10 When the thread 14 is advanced between the guiding element 10 and the displaceable element 12 through gap 22, the thread 14 is only in contact with the guiding element 10. This is facilitated by the distance of the gap 22 between the guiding element 10 and the displaceable element 12 being larger than the diameter of the thread 14. The distance of the gap 22 is, however, smaller than the diameter of a thread junction 20. Consequently, if a thread junction 20 is advanced through the gap 22, the thread junction 20 contacts the guiding element 10 and the displaceable element 12.

15 The displaceable element 12 is mounted such that it can be displaced away from the thread 14 and the guiding element 10. In Fig. 1, the displaceable element 12 is exemplarily mounted by means of a spring 24. A guide rail or similar means may be provided to guide the displacement of the displaceable element 12. When a thread junction 20 passes the gap 22, the displaceable element 12 is moved away from the thread junction 20 and the guiding element 10. The guiding element 10 is mounted such that the passing thread junction 20
20 does not move the guiding element 10, but only the displaceable element 12.

The displacement of the displaceable element 12 due to the thread junction 20 passing the gap 22 is detected by the sensor 26. The sensor 26 is provided as a proximity sensor and measures the distance between the sensor 26 and the displaceable element 12. If the distance between the sensor 26 and the displaceable element 12 decreases due to a
25 thread junction 20 passing the gap 22, the sensor 26 detects the presence of the thread junction 20. Thus, the presence of a thread junction 20 is not directly detected, but indirectly detected by detecting a movement of the displaceable element 12.

30 As depicted in Fig. 1, the thread 14 is advanced towards the detection system with an oblique angle. In the detection system, the thread 14 is redirected by means of the guiding element 10. This redirection further improves the detection of a thread junction 20, since a thread junction 20 typically has a higher stiffness than a single thread 14. Thus, when the relatively stiff thread junction 20 passes the gap 22 of the detection system, the stiff thread junction 20 will further displace the displaceable element 12 away from the guiding element 10.

35 In Fig. 2, a second embodiment of the invention is described. In the left part of Fig. 2, a situation is depicted in which a single thread 14 is advanced through the detection system.

The guiding element 10 has a concave shape to aid the positioning of the thread 14 in the center of the guiding element 10.

Adjacent to the guiding element 10, the displaceable element 12 has a recess 28. The gap 22 between the guiding element 10 and the displaceable element 12 is constituted by this recess 28 and wing elements 30 which are arranged next to the recess 28. The distance between the wing elements 30 and the guiding element 10 is smaller than the diameter of the thread 14. However, the distance between the recess 28 and the guiding element 10 is larger than the diameter of the thread 14. Thus, the thread 14 is guided through the detection system by means of the concave shaped guiding element 10 as well as the shape of the displaceable element 12. In this embodiment, the distance between the guiding element 10 and the displaceable element 12 is partly larger than the thread diameter and smaller than the junction diameter. In more detail, the distance is larger in the recess 28, while the distance between the guiding element 10 and the wing elements 30 of the displaceable element 12 is smaller than the thread diameter. In the first embodiment, depicted in Fig. 1, the distance between the guiding element 10 and the displaceable element 12 is always larger than the thread diameter.

The right part of Fig. 2 depicts the situation that a thread junction 20 passes the detection system. In the right part of Fig. 2, the thread junction 20 is depicted as lying horizontally. Thus, the threads 16, 18 constituting the thread junction 20 are arranged horizontally next to each other and contacting the guiding element 12. However, the detection system as depicted in Fig. 2 can be employed independently of the orientation of the thread junction 20, since the distance between the recess 28 and the guiding element 10 is chosen such that the displaceable element 12 would also be moved if the thread junction 20 would be oriented vertically. In more detail, the distance between the recess 28 and the guiding element 10 is larger than the diameter of the thread 14 but smaller than the diameter of at least a vertically oriented thread junction 20.

In the right part of Fig. 2, the lying thread junction 20 creates a displacement of the displaceable element 12 due to thread junction 20 contacting the wing elements 30. The diameter of the recess 28 is chosen to be smaller than the diameter of the lying thread junction 20, such that the thread junction 20 does not fit inside the recess 28.

Furthermore, Fig. 2 shows a specific embodiment of the displaceable element 12, in which the displaceable element 12 comprises a rotating mechanism 32. The rotating mechanism 32 is configured to rotated if the displaceable element 12 is displaced by a thread junction 20 passing the gap 22 and thereby pushing the displaceable element 12 in the direction of the rotating mechanism 32. A sensor is provided to detect the rotation of the rotating mechanism 32. The displaceable element 12 itself may constitute the rotating

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mechanism 32 in that the displaceable element 12 may be configured such that it may be able to roll up. In more detail, the displaceable element 12 may have a deformable shape such that the upwards movement of the displaceable element 12 creates a rotating movement of the displaceable element 12.

5 It is to be noted that the features which are described in the context of the first and second embodiments can be combined with each other within the scope of the invention. For example, the specific shape of the guiding element 10 and the displaceable element 12 as depicted in Fig. 2 can also be employed in the first embodiment depicted in Fig. 1. Also, the rotating mechanism described in the context of the second embodiment could be
10 employed in the first embodiment. The redirection of the thread 14 as described in the context of the first embodiment to exploit the stiffness of the thread junction 20 in order to enhance the detection accuracy of a thread junction 20 could also be employed in the second embodiment.

CLAIMS

1. A detection system for detecting a thread junction, comprising:

a guiding element for guiding a thread;

5 a displaceable element, wherein the displaceable element is arranged distanced from the guiding element; and

a sensor,

wherein the distance between the guiding element and the displaceable element is at least partly larger than the thread diameter and smaller than the junction diameter, wherein
10 the sensor is configured to detect a movement of the displaceable element, and wherein the displaceable element has a recess with essentially corresponds to the diameter of the thread.

2. A detection system according to claim 1, wherein the thread junction
15 comprises overlapping thread ends, and wherein the thread junction preferably comprises an adhesive.

3. A detection system according to one of the previous claims, wherein the system comprises a control unit, and wherein the control unit is configured to control an
20 ejecting mechanism for ejecting the thread junction in a subsequent processing step based upon the detection of a movement of the displaceable element by the sensor.

4. A detection system according to one of the previous claims, wherein the system comprises a control unit, wherein the control unit is configured such that a further
25 movement of the displaceable element does not result in a detection of a further junction in a time period after a junction is detected, and wherein the time period is preferably 5 minutes, more preferably 3 minutes, and even more preferably 1 minute.

5. A detection system according to one of the previous claims, wherein the
30 system comprises a marking unit which is configured for applying a mark to the junction, wherein the mark preferably comprises at least one of color, thread speed information or junction detection time information, or wherein the mark is a virtual mark.

6. A detection system according to one of the previous claims, wherein the
35 guiding element is configured as a flat element such as a bar, and wherein the displaceable element is preferably configured as a flat element such as a bar.

7. A detection system according to one of the previous claims, wherein the thread after passing the guiding element may be arranged with an angle with respect to the thread before the guiding element.

5

8. A detection system according to one of the previous claims, wherein the guiding element is configured as a concave element.

9. A detection system according to one of the previous claims, wherein the guiding element is connected with the movable element by an elastic element such as a spring or wherein the movable element is mounted by means of an elastic element such as a spring.

10. A detection system according to one of the previous claims, wherein the displaceable element comprises a rotating mechanism, and wherein the rotating mechanism is rotated, when the distance between the guiding element and the displaceable element changes, and wherein preferably the sensor is configured for detecting a rotation of the rotating mechanism.

11. A detection system according to one of the previous claims, wherein the sensor is provided as a switch, a proximity sensor, a contact sensor, an optical sensor or an inductive proximity sensor.

12. A method for detecting a thread junction, comprising the steps of:

(a) providing a detection system for detecting a thread junction comprising a guiding element for guiding a thread, a displaceable element, wherein the displaceable element is arranged distanced from the guiding element, and a sensor, wherein the distance between the guiding element and the displaceable element is at least partly larger than the thread diameter and smaller than the junction diameter, and wherein the displaceable element has a recess with essentially corresponds to the diameter of the thread,

(b) detecting, by the sensor, a movement of the displaceable element,

(c) detecting a thread junction, if a movement of the displaceable element is detected by the sensor.

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13. A method for detecting a thread junction according to claim 12, wherein, in step a), the thread is provided as an aromatic thread for an aerosol-generating article such as a filter, and wherein the thread preferably contains menthol.

5 14. A method for detecting a thread junction according to claim 12 or 13, wherein the thread is advanced through the detection system with a speed of between 100 to 700 meters per minute, preferably 200 to 500 meters per minute.

Fig. 1

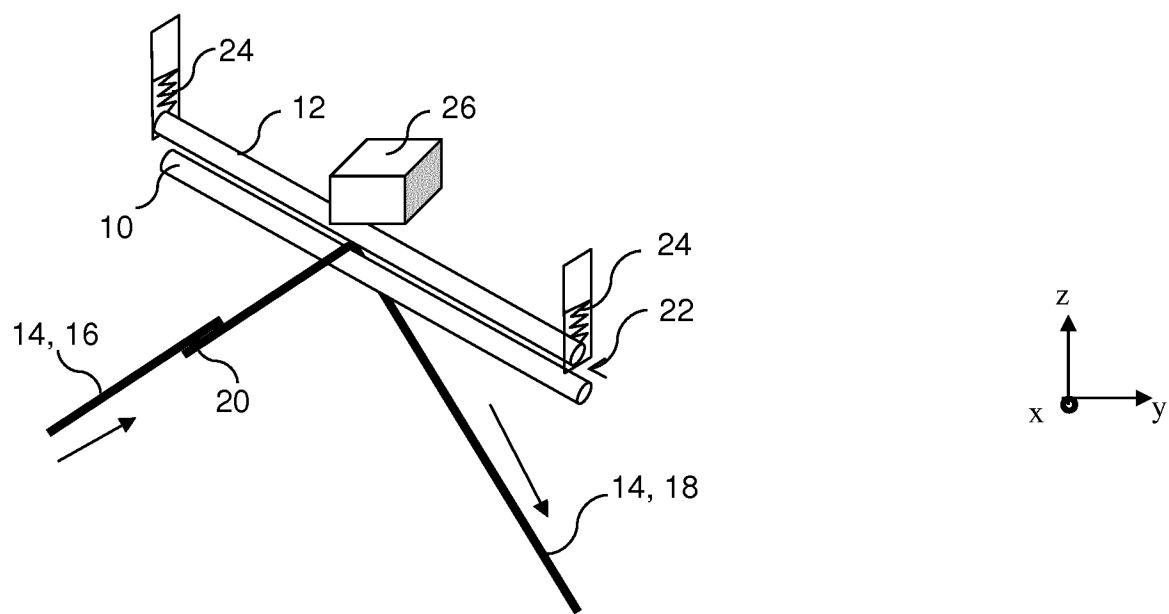
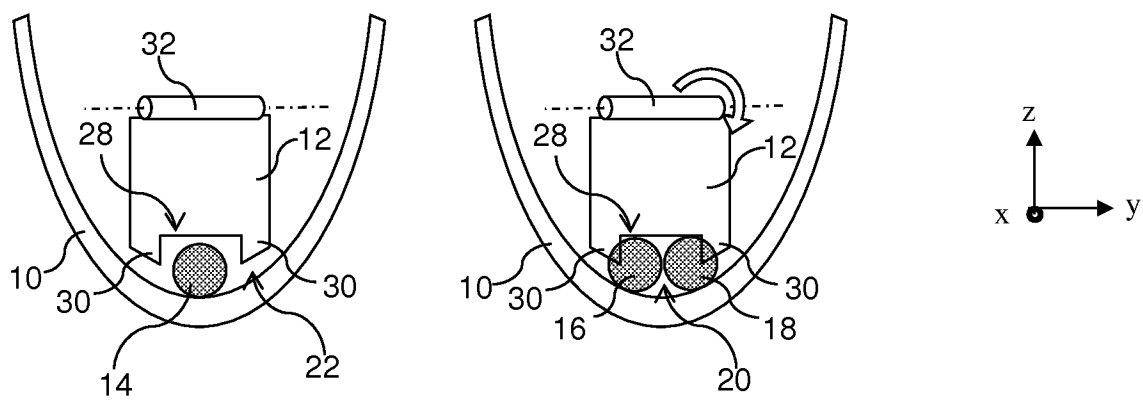


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067217

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65H63/06
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)
B65H

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 233 421 A1 (IRO AB [SE]) 29 September 2010 (2010-09-29) paragraphs [0009], [0010], [0018] -----	1-14
A	GB 1 069 166 A (FLIGHT REFUELING LTD) 17 May 1967 (1967-05-17) page 2, lines 69-130; figures 3,4 -----	1,6, 11-13
A	US 2003/121246 A1 (WEICHEL ANDREAS [DE] ET AL) 3 July 2003 (2003-07-03) paragraphs [0001], [0011], [0015]; claim 1; figures 1,2 -----	1-3,6,8, 10-13
A	CN 103 303 744 B (CHONGQING POLYCOMP INT CO LTD) 29 June 2016 (2016-06-29) figures 1,2 ----- -/--	1-3,6,8, 10-13



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

24 August 2018

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067217

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