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(71) Applicant: **Brøderna Rasch AB**
591 22 Motala (SE)

(72) Inventors:
• **Hermansson, Pär**
591 73 MOTALA (SE)
• **Thuresson, Mats**
591 97 MOTALA (SE)

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(74) Representative: **Awapatent AB**
Junkersgatan 1
582 35 Linköping (SE)

(54) **DAMPER FOR VENTILATION SYSTEM**

(57) The present disclosure relates to a damper (1) and a method (100) for a ventilations system. The damper comprises a plurality of rotatable damper blades (4), a rotatable torque transferring element (3) connected to a blade wherein each pair of adjacent blades are rotatable in opposite directions (R_1 , R_2), and a link (2) connecting at least two of the torque transferring elements, The method comprising the steps of applying a drive force causing a first blade to rotate in a first direction, causing, by means of interaction between torque transferring elements a second, adjacent blade, to rotate in an opposite direction, causing a third blade, adjacent the second blade, to rotate in the first blade's direction, and transferring torque from the first to the third blade by means of a link member. This arrangement reduces the effect of play between torque transferring elements and reduces the complexity in mounting and operation of a damper.

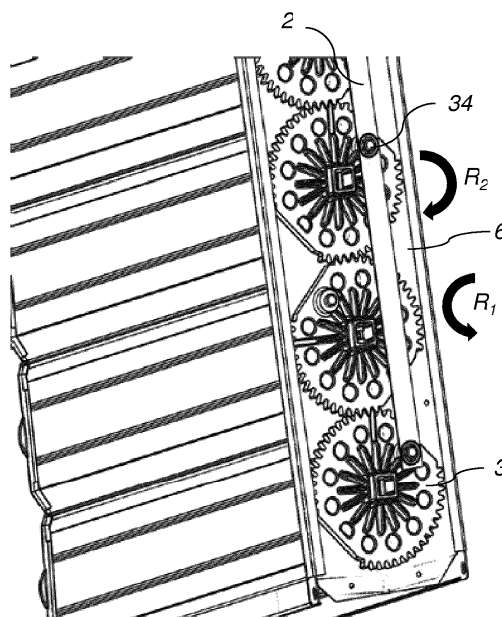


Figure 2

Description

Technical Field

[0001] The present disclosure relates to a damper for a ventilation system, and especially to a device and a method for controlling the rotation of the damper blades between an open position and a closed position.

Background

[0002] In ventilation systems for large structures, such as buildings and ships there is a need for valves that provide flow control. Such valves may be arranged, as non-limiting examples, at intakes or exhausts to/from the ventilation system, or between sections of the ventilation system.

[0003] A particular kind of valve is referred to as a damper, and comprises a plurality of damper blades, which are rotatable between an open position and a closed position.

[0004] A common way to control the rotation of damper blades is by using links or gears connected to the blades.

[0005] In this type of system for controlling the blade rotation, it is sometimes desirable to evenly distribute the power exerted on the gears while rotating adjacent blades in opposite directions. Prior art solutions, for example as described in EP0154089A2 or US3746042A, use a combination of geared links and gears to distribute the power exerted on the gears rotating the blades.

[0006] Hence, a particular problem with this type of damper is the amount of complex parts needed and the complex and time-consuming mounting of the blade controlling parts to the damper. Therefore, there is a need for a damper which provides fewer and less complex system parts and which enables time-effective and uncomplicated mounting and operation.

[0007] Yet another problem is the play which arises between components of the system, and which especially over a chain of components may become so large as to affect the operation of the system, e.g. with respect to its damper/shut off properties and/or its acoustic properties.

[0008] Hence, there is a need for an improved damper.

Summary

[0009] It is an object of the present invention to provide an improved solution that alleviates the mentioned drawbacks with present devices.

[0010] The invention is defined by the appended independent claims, with embodiments being set forth in the dependent claims, in the following description and in the attached drawings.

[0011] According to a first aspect, there is provided a damper for a ventilation system comprising a plurality of damper blades, each presenting a longitudinal direction and being rotatable about an axis parallel with the longi-

tudinal direction, a torque transferring element fixedly connected to each blade and rotatable about the axis associated with the respective blade, wherein the torque transferring elements associated with adjacent blades interact with each other, such that each pair of adjacent blades are rotatable in opposite directions, characterized by a link connecting at least two of the torque transferring elements with each other, said at least two torque transferring elements being arranged to rotate in the same direction.

[0012] With this arrangement, only a few parts, torque transferring elements and a link are needed for rotation of the damper blades and the torque transferring elements and the link are easily mounted to the blades and frame of the damper.

[0013] Moreover, the use of both torque transferring elements and the link reduce the effect of play between torque transferring elements.

[0014] Further, the torque transferring elements may be engaged to the blades via a blade gable. The blade gable may be configured to engage with the short sides of the blades and comprise a protruding part extending along the axis along which the blade and torque transferring element rotate and by this part engage with the center of the torque transferring element whereby the blade, blade gable, and torque transferring element all rotate around the same axis. The protruding part of the gable may extend through a damper frame into the torque transferring element such that the blades and blade gable are located on different sides of the frame in relation to the torque transferring elements and link.

[0015] The link may be connected to every third, every second or all torque transferring elements arranged to rotate in the same direction. Interconnecting the torque transferring elements via the link may allow the gears to rotate simultaneously, at the same speed, and to the same distance which may give an even rotation of the blades and an evenly distributed force on the torque transferring elements.

[0016] A second link may be connected to all torque transferring elements arranged to rotate in an opposite direction. A second link may be located on the opposite sides of the blades along the longitudinal extension in relation to the first link.

[0017] The damper may comprise at least four blades and at least four torque transferring elements. The blades, extending along a longitudinal direction may be arranged such that the blades are in parallel to each other with respect to this direction and the axis around which they rotate. Further, the blades may be arranged inside a damper frame which may constitute a quadrangular shape where the inner dimensions of the frame correspond to the outer dimensions of the closed position of the blades such that, in the closed position, essentially no air penetrates through the damper. The blades may comprise torque transferring elements on both short sides of the blades. Torque transferring elements may be located on a first and/or second short side of the

blades. Torque transferring elements on both sides may further facilitate the even rotation of the blades while torque transferring elements on one side may further reduce the complexity in mounting and the amount of parts required. The first and the second link may be engaged with the torque transferring elements on the first and second side respectively.

[0018] The torque transferring elements may comprise gear wheels or the like. The gear wheels may comprise teeth around part or whole of the circumference. The torque transferring elements may alternatively comprise a sun and planet gear, a partial gear, rack and pinion, non-circular gear, or other gears or wheels or the like comprising a friction circumference, which allow for torque transfer through opposite rotation of adjacent elements. In such cases, biasing may be applied, e.g. through elasticity of the elements.

[0019] Further, each blade may be rotatable between an open position and a closed position. In the open position the blades may be rotated such that air is allowed to pass through the damper. In the closed position the blades may be rotated such that air cannot pass through the damper. In the closed position the damper blades may touch or overlap as not to allow any air penetration there between. As the torque transferring elements are fixedly connected to the blades, the rotation of the torque transferring elements occurs simultaneously with the rotation of the blades and the open and closed positions of the blades correspond to a first and second position of the torque transferring elements.

[0020] The damper may further comprise an actuator connected to one of the torque elements, to an additional torque element which directly or indirectly interacts with said torque element, or to a link. The actuator may serve to activate the rotation of the gears and thereby rotating the blades between the open and closed positions.

[0021] According to a second aspect, there is provided a method for operating a damper for a ventilation system is presented. The method comprising the steps of applying a drive force to cause a first damper blade to rotate in a first direction about a longitudinal axis thereof, causing a second, adjacent damper blade to rotate in a direction opposite said first direction by means of interaction between torque transferring elements associated with the first and second damper blades, respectively, causing a third damper blade, arranged adjacent the second damper blade, to rotate in the same direction as the first damper blade by means of interaction between torque transferring elements associated with the second and third damper blades, respectively, and also transferring torque from the first to the third blade by means of a link member connected to the first and third blades.

[0022] With this arrangement, the operation of the damper is easily performed by the drive force evenly spreading the power over the torque transferring elements via their interconnecting link. This also reduces the effect of play between torque transferring elements.

[0023] As all torque transferring elements rotating in

the same direction may be interconnected via a link, the power and rotation is evenly distributed. Further, since all torque transferring elements interact with at least one other torque transferring element, applying drive force to one wheel consequently may cause simultaneous rotation of all torque transferring elements and thereby also simultaneous rotation of the blades fixedly attached to the torque transferring elements.

[0024] The link member may be connected at a radial distance from a center of the respective torque transferring element. The link member being connected at a radial distance from the center or respective torque transferring element facilitates the simultaneous rotation of the torque transfer elements interconnected by the link. As the drive force causes the first damper blade to rotate, the rotation of the respective torque transferring element also causes a movement of the link. The link interconnecting to other torque transfer elements in turn facilitates simultaneous rotation of the interconnected torque transfer elements.

[0025] The torque transferring element may comprise a gear member, such as a gear wheel. The gear wheels may comprise teeth around part or whole of the circumference. The torque transferring elements may alternatively comprise wheels comprising a high friction circumference.

[0026] The method may comprise a step of causing a fourth damper blade, arranged adjacent the third damper blade, to rotate in the same direction as the second damper blade by means of interaction between torque transferring elements associated with the third and fourth damper blades, respectively. As the torque transferring elements interact, for example by meshing of gear wheel teeth, rotation of one element also causes rotation of the elements with which it interacts.

[0027] The method may further comprise the step of transferring torque from the second to the fourth damper blade by means of a second link member connected to the second and fourth blades. The second link member may be located on the opposite side of the blades, with respect to their direction of extension, to the first link member. Links on both sides of the blades may further facilitate the simultaneous rotation of the blades and the power distribution between the torque transfer elements.

[0028] The method may further comprise the step of causing the first and fifth blades to rotate in the same direction and interconnecting the first and a fifth torque transfer elements by a link member. The force from the drive force causing the first wheel to rotate may be transferred to the fifth wheel by the interconnecting link also facilitating rotation of the interconnected torque transfer elements.

[0029] The method may further comprise the step of causing the second and sixth blade to rotate in the same direction and interconnecting the second and sixth torque transferring elements by a link member. The force from the drive force causing the first torque transferring element to rotate also causes rotation of the second, adja-

cent torque transferring element with which it interacts. The link interconnecting the second torque transferring element with the sixth torque transferring element may facilitate simultaneous rotation of these in the same direction.

Brief Description of the Drawings

[0030]

Figure 1 shows a perspective view of a damper.

Figure 2 shows an angled view of a damper.

Figure 3 shows a perspective view of a link.

Figure 4 shows a detailed view of a torque transfer element.

Figure 5 shows a perspective view of a blade gable at a short side of the blade.

Figure 6 shows a perspective view of a damper.

Detailed Description

[0031] The present invention will be described more fully hereinafter with reference to the accompanying drawings. In the drawings, like numbers refer to like elements.

[0032] A damper 1 according to the invention is illustrated in figure 1. The damper 1 comprises blades 4, a link 2, and gear wheels 3. The link 2 is connected to gear wheels 3 at a radial distance from the center of the connected gear wheel. The radial distance may be on the order of 50-100 % of a radius of the respective element. The blades are rotatable about an axis parallel to a longitudinal direction B along which they extend. The link 2 and gear wheels are separated from the blades 4 by the damper frame 6. The blades 4 are illustrated in an open position.

[0033] Damper blades 4 may be on the order of 200-2000 mm long and 50-200 mm wide. The sides of the damper frame 6 may thus be on the order of 200-2000 mm.

[0034] Figure 2 show a more detailed view of part of the damper 1. The blades 4 are illustrated in the closed position. The link 2 is rotatably connected to at least two gear wheels 3 by a connecting part 34, rotatably connecting the link 2 to the protruding part of the gear wheel 3. The gear wheels 3 interact with each other by meshing of gear teeth such that the rotation of adjacent gear wheels occurs in opposite directions, R_1 and R_2 . The connecting part may be a nut, a pin, a shaft or similar device which is capable of rotatably fastening the link 2 to the gear wheel 3.

[0035] In figure 3, a link 2 is illustrated. The link 2 extends along a longitudinal axis A and comprises engagement holes 21 which connect to the protruding part 32 of the gear wheel (illustrated in fig. 4).

[0036] A gear wheel 3 is illustrated in figure 4. The gear wheel comprises teeth 31 configured to interact with teeth 31 of adjacent gear wheels 3. Further, the gear comprises

a protruding part 32 configured to be connected to the engagement holes 21 of the link 2. Multiple gear wheels may thereby be interconnected via the link engaging with other gear wheels. The gear wheel 3 further comprises a locking part 32 configured to engage with the protruding part 51 of the blade gable 5.

[0037] The protruding part 51 may comprise a snap arrangement for interaction with the gear wheels.

[0038] Such a snap arrangement may comprise one or more axially extending flexible tongues, which each carry a locking element at a distal portion thereof. The locking element may taper towards the distal end of the tongue, so as to form a ramp surface.

[0039] The gear wheels may present a central recess for interaction with the snap arrangement. This central recess may provide a locking surface for interaction with the locking element.

[0040] The locking element and the locking surface may thus be adapted to interact so as to provide axial locking of the blade 4 relative to the gear wheel 3.

[0041] In figure 5 a blade gable 5 connected to a short side 41 of a blade 4 is illustrated. The blade gable 5 comprises a protruding part 51 extending along the axis C around which the blade rotates. The protruding part 51 may extend through the damper frame 6 such that the blade 4 and blade gable 5 are separated from the gear wheels 3 by the frame 6, further illustrated in fig. 1.

[0042] Figure 6 illustrates the damper according to the invention comprising an transmission cover 7 fixed to the side of the damper 1 and covering the gear wheel 3 and link 2.

[0043] This transmission cover 7 may, together with the frame 6, form a housing for the gears 3 and the link 2. The cover 7 may provide a mounting device for mounting the actuator (not shown) and/or for mounting e.g. a lever, in case manual operation is desired.

[0044] The actuator may be connected to one of the gears, e.g. by means of an extension of the gear's rotational axis through a hole in the cover 7.

[0045] The operation of the damper is as follows. A drive power may be applied to one of the gears, either by hand, if the damper is to be manually operated, or by means of an actuator.

[0046] The drive power may thus be applied as a torque to one of the gears, or as a linear force to one of the links.

[0047] The application of the drive power causes the gear to rotate along with its associated damper blade.

[0048] The rotation of this gear will cause at least one adjacent gear to rotate in the opposite direction, and thus the associated adjacent blade to rotate in this opposite direction.

[0049] Hence, every pair of adjacent blades will rotate in opposite directions.

[0050] By arranging a plurality of adjacent and meshing gears with associated adjacent damper blades, there is provided a chain of meshing gears.

[0051] With at least two, preferably all, or every second or every third, gears which rotate in the same direction

being interconnected by a link, this link will also transmit a force to those gears with which it is connected, thus reducing the effect of play between gears.

[0052] Alternatively to the above description, the gear wheels as described may be replaced by for example circular, non-circular gear wheels or partial gear wheels. Wheels comprising a high friction circumference such as to allow rotation of two adjacent wheels without slipping may also be considered.

[0053] It may be considered to connect the link to the gear wheel not by an engaging hole but by for example a part engaging with a hole, protrusion or recess in the gear wheel or other connection elements that allow the link to be rotatably connected to the gear wheel. Yet another alternative may be an additional gear on the gear wheel interacting with yet an additional gear wheel on the link, such as the commonly known sun and planet solution.

[0054] In one alternative solution, gears may be located on both sides of the damper frame. In this solution two links may be used, one on each side of the damper frame wherein a first link is connected to the gears rotating in a first direction and the second link is connected to the gears rotating to a second direction, opposite to that of the first direction.

[0055] In another alternative solution gears may be located on one side of the damper frame and wheels without gear teeth may be located on the other side of the frame. In this solution, the link may be connected to the wheels on the one side and no link need be used on the gear side of the frame.

[0056] The link may be connected to at least two of the gears rotating in the same direction but is not required to be connected to all gears with the same direction of rotation.

[0057] For example, the link may be connected to the two outermost gear wheels having the same direction of rotation.

[0058] The gear wheels may be produced from plastic, metal, or other suitable material. The gear wheels, or similar element used to transfer torque, may present an effective radius corresponding to about $\frac{1}{2}$ of a width of the blades 4. For example, the radius may be $\frac{1}{2}$ of the blade width $\pm 10\%$, preferably $\pm 5\%$ or $\pm 1\%$.

[0059] The link and blades may be produced from plastic, metal, or other suitable material.

Claims

1. A damper (1) for a ventilation system comprising:

a plurality of damper blades (4), each presenting a longitudinal direction (B) and being rotatable about an axis parallel with the longitudinal direction,

a torque transferring element (3) fixedly connected to each blade and rotatable about the

axis associated with the respective blade, wherein the torque transferring elements associated with adjacent blades interact with each other, such that each pair of adjacent blades are rotatable in opposite directions (R_1 , R_2),

characterized by

a link (2) connecting at least two of the torque transferring elements with each other, said at least two torque transferring elements being arranged to rotate in the same direction.

2. The damper (1) according to claim 1, wherein the link (2) is connected to every third, every second or all torque transferring elements (3) arranged to rotate in the same direction.
3. The damper (1) according to claim 1 or 2, wherein a second link (2) connected to all torque transferring elements (3) arranged to rotate in an opposite direction.
4. The damper (1) according to any of the previous claims comprising at least four blades (4) and at least four torque transferring elements (3).
5. The damper (1) according to any of the previous claims, wherein the blades (4) comprise torque transferring elements (3) at both short sides (41) of the blades.
6. The damper (1) according to any one of the preceding claims, wherein the torque transferring elements (3) comprise gear wheels or the like.
7. The damper (1) according to any of the previous claims, wherein each blade (4) is rotatable between an open position and a closed position.
8. The damper (1) according to any of the previous claims, further comprising an actuator connected to one of the torque elements (3), to an additional torque element which directly or indirectly interacts with said torque element, or to a link (2).
9. A method of operating a damper (1) for a ventilation system, comprising:

applying a drive force to cause a first damper blade (4) to rotate in a first direction about a longitudinal axis thereof, causing a second, adjacent damper blade to rotate in a direction opposite said first direction by means of interaction between torque transferring elements (3) associated with the first and second damper blades, respectively, causing a third damper blade, arranged adjacent the second damper blade, to rotate in the same direction as the first damper blade by

means of interaction between torque transferring elements associated with the second and third damper blades, respectively, and also transferring torque from the first to the third blade by means of a link member (2) connected to the first and third blades. 5

10. The method according to claim 9, wherein the link member (2) is connected at a radial distance from a center of the respective torque transferring element (3). 10
11. The method according to claim 9 or 10, wherein the torque transferring element (3) comprises a gear member, such as a gear wheel. 15
12. The method according to any one of claims 9-11, further comprising causing a fourth damper blade (4), arranged adjacent the third damper blade, to rotate in the same direction as the second damper blade by means of interaction between torque transferring elements (3) associated with the third and fourth damper blades, respectively. 20
13. The method according to claim 12, further comprising transferring torque from the second to the fourth damper blade (4) by means of a second link member (2) connected to the second and fourth blades. 25
14. The method according to any one of claims 9-13, causing the first and a fifth blades (4) to rotate in the same direction and interconnecting the first and fifth torque transfer elements (3) by a link member (2). 30
15. A method according to any one of claims 9-14, causing the second and a sixth blades (4) to rotate in the same direction and interconnecting the second and sixth torque transferring elements (3) by a link member (2). 35

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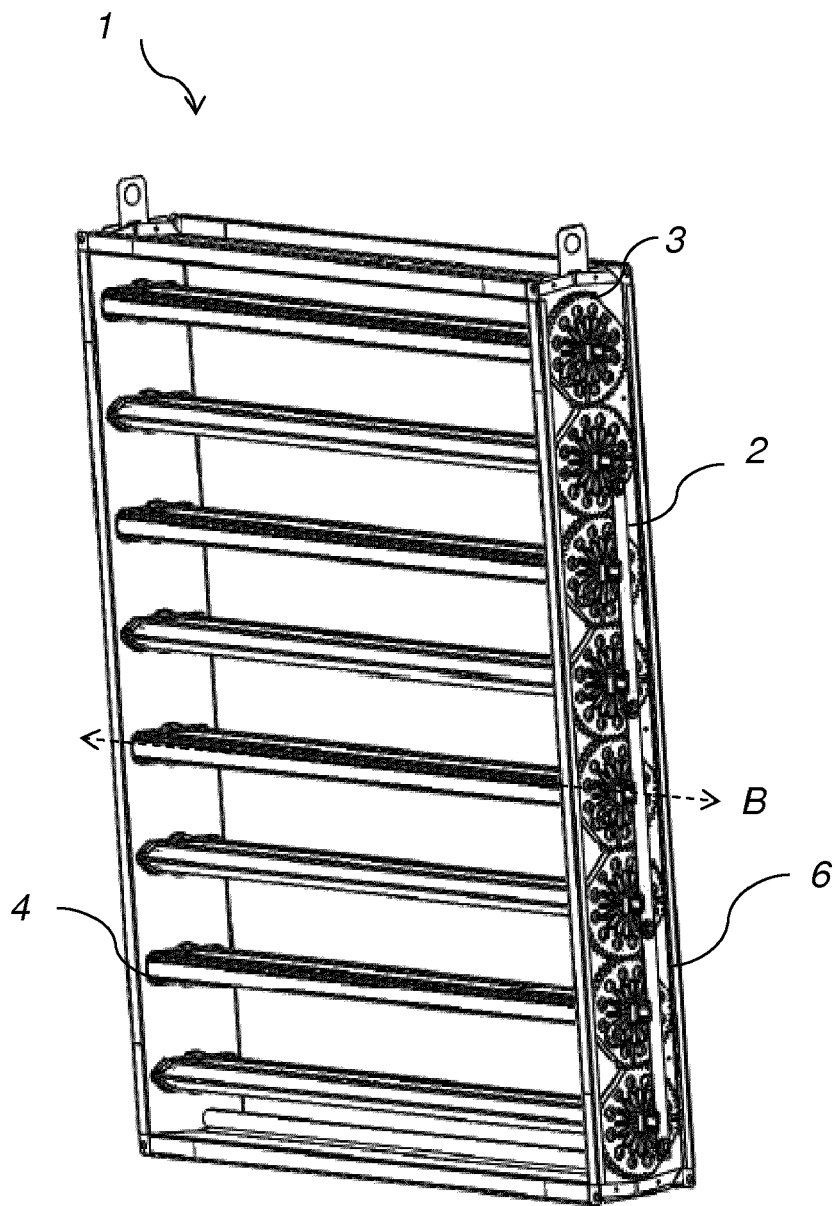


Figure 1

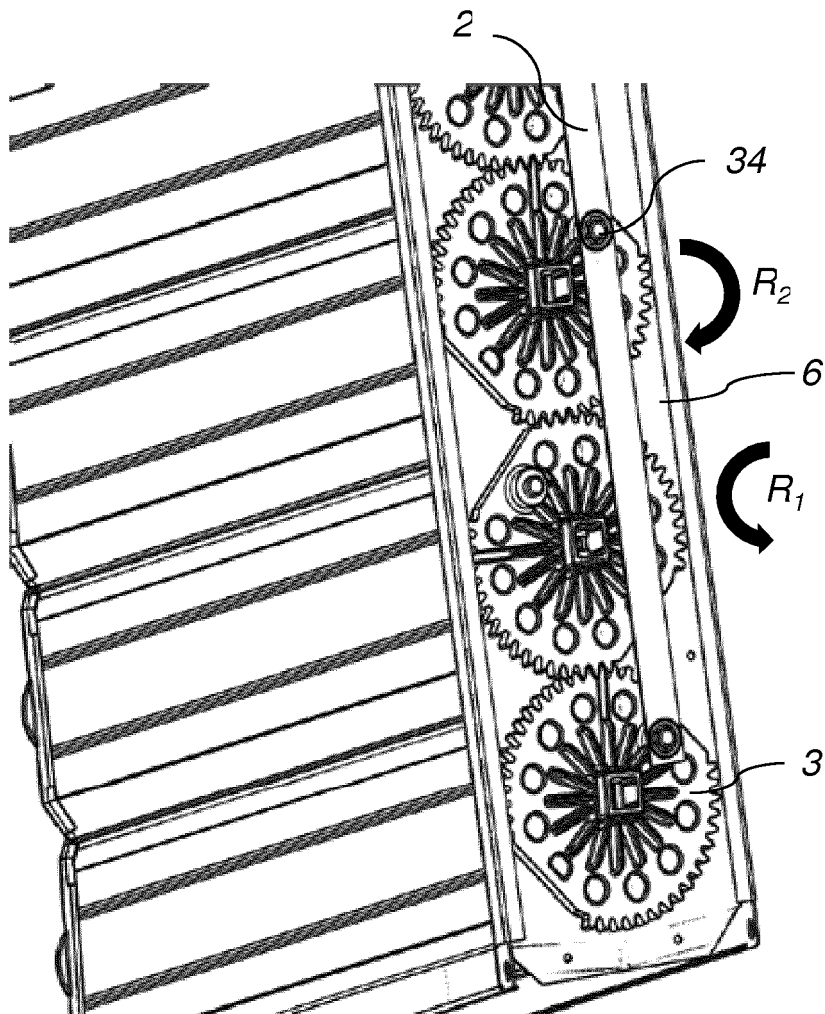


Figure 2

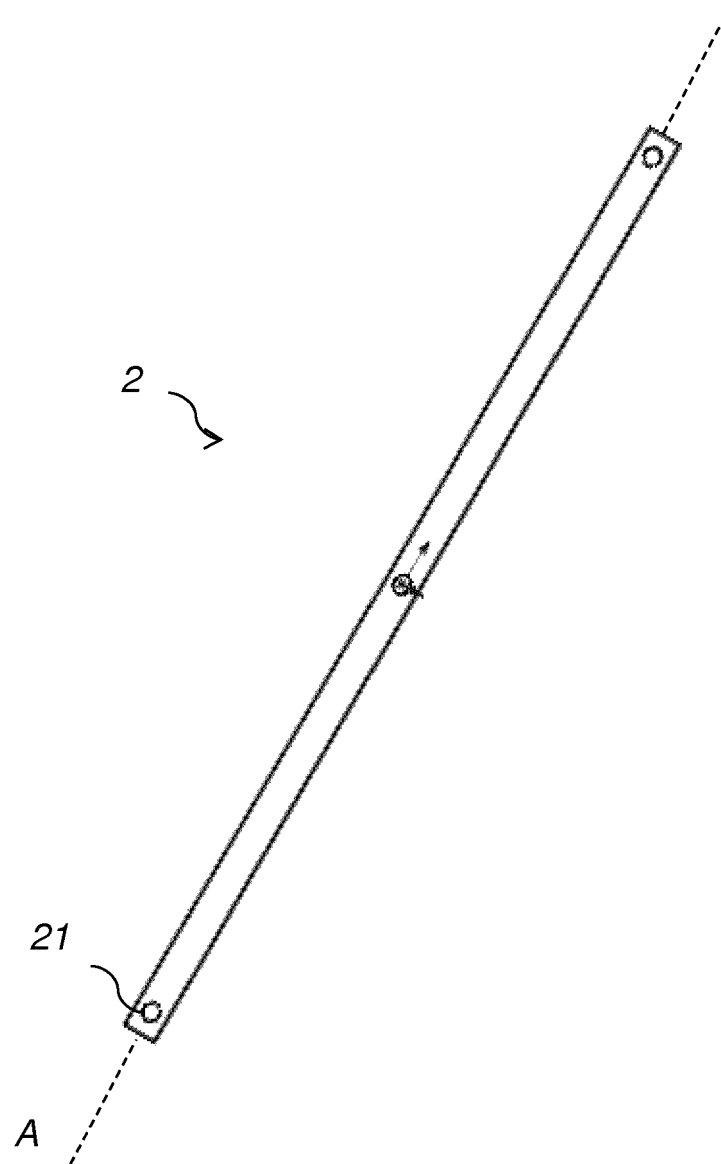


Figure 3

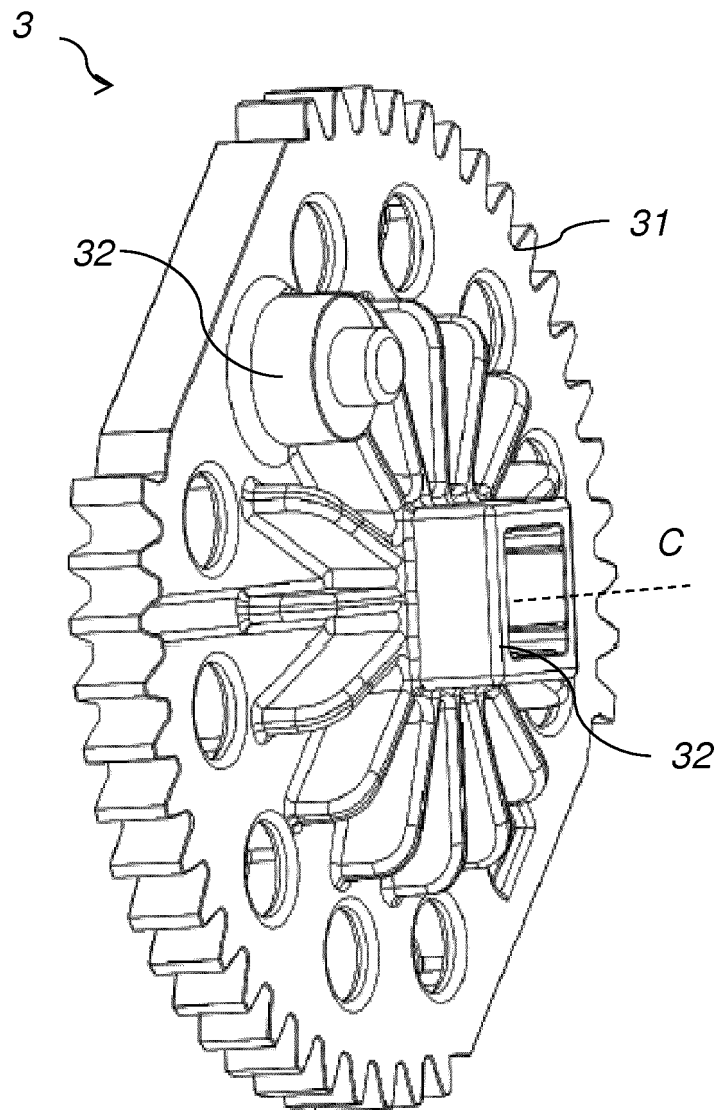


Figure 4

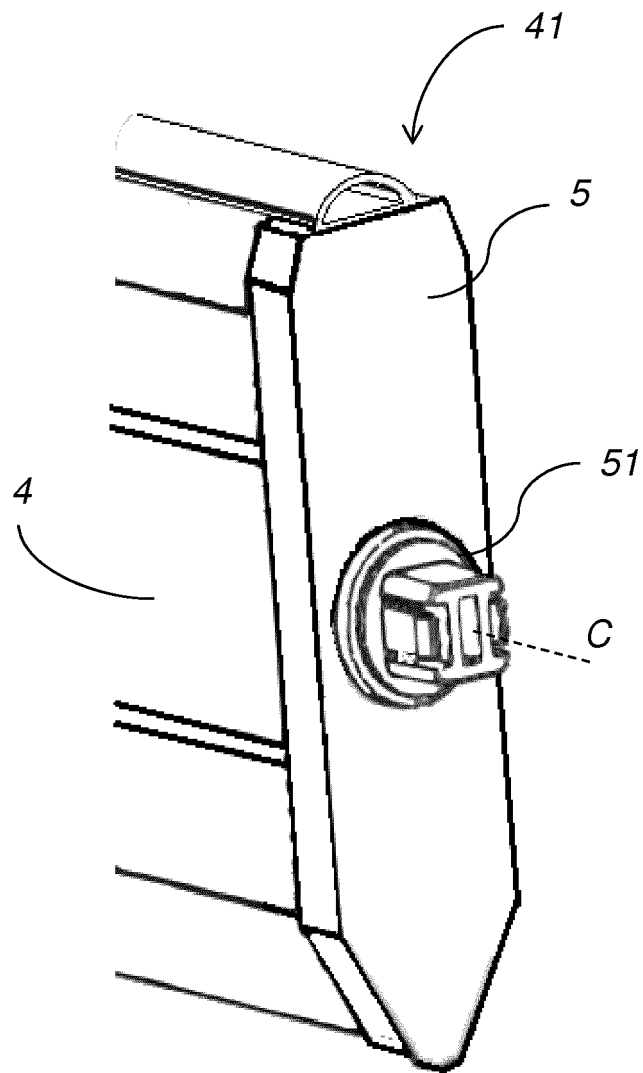


Figure 5

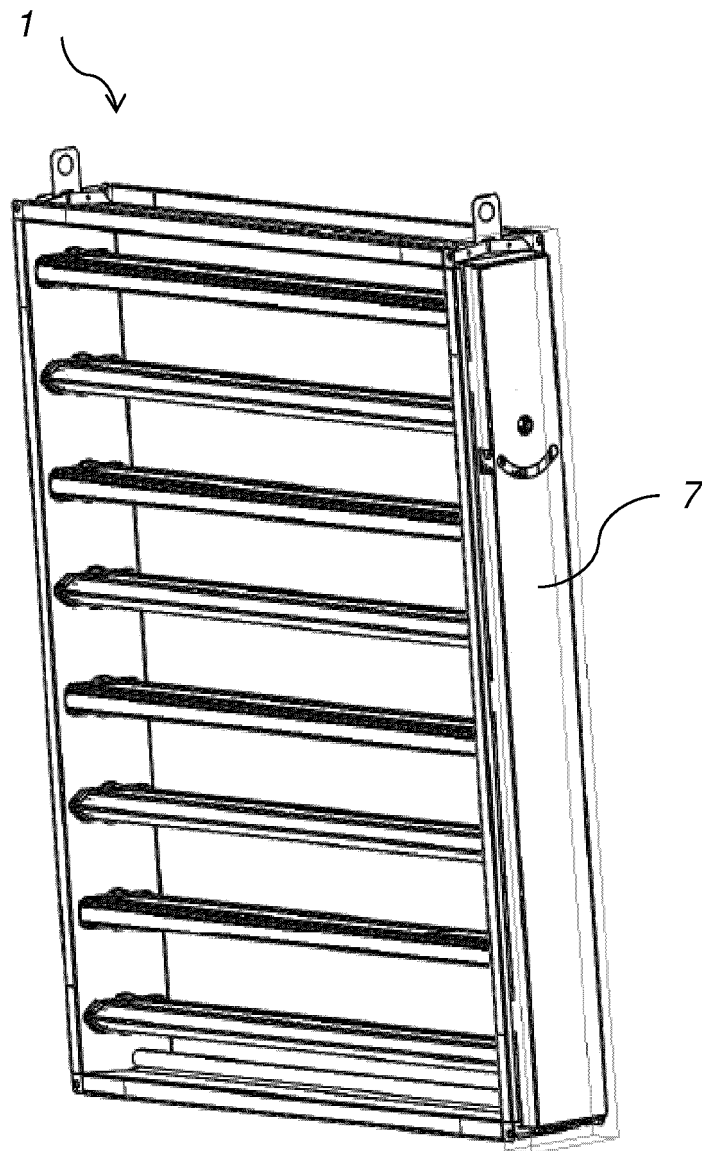


Figure 6



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 16 3463

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