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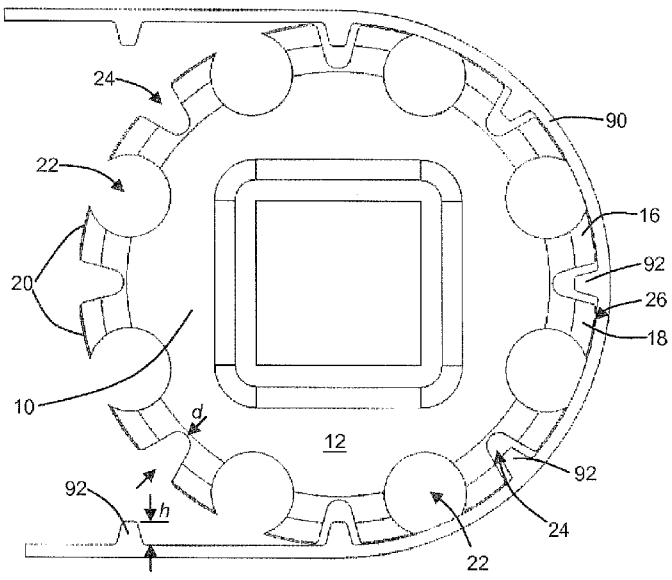

Fig. 2

(57) Abstract: A sprocket (10) is provided, which has a body (12) with a central opening for engaging a shaft and rotating about an axis. The sprocket (10) has a plurality of teeth (16, 18) disposed around the periphery of the body (12). The teeth (16, 18) are angularly spaced about the axis such that each tooth (16, 18) is spaced from the adjacent teeth (16, 18) by a first opening (22). Each tooth (16, 18) has a belt-contacting surface (26) which is convex in shape such that the outer-most periphery of the sprocket (10) is generally circular. The belt-contacting surfaces (26) of the teeth (16, 18) guide the belt (90) around the periphery of the sprocket (10) in order to minimize the ability of the belt (90) to buckle.

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SPROCKETS FOR A FLEXIBLE CONVEYOR BELT AND CONVEYOR BELT SYSTEM

Field of the Invention

[0001] The present invention relates generally to conveyor belts, and more specifically to sprockets used to propel conveyor belts in environments where cleaning systems must be used to maintain hygiene.

Background of the Invention

[0002] Traditional light conveyor belts are generally constructed from fabrics coated by plastics or rubber, or plastic sheets. In applications where hygiene and cleanliness are important, such as food processing plants, these conveyor belts are preferably made from monolithic plastics or otherwise sealed such that no contaminants can enter into the body of the belt, in order to prevent bacterial growth and other hygienic issues. Additionally, cleaning systems, which spray cleaning fluid on the sprockets and belts of such conveyors, are used to prevent the spread of contaminants.

[0003] Such conveyor belts are generally provided with transverse ribs on the underside of the belt in order to allow drive sprocket(s) to engage the ribs and better propel the belt. Fig. 9 shows the current art of drive sprocket used to engage the ribs of a belt and drive the belt (*see, e.g.*, U.S. Patent Application Publication No. 2006/0144676). As can be seen in Fig. 9, current sprockets a generally cylindrical in shape and have grooves which engage the ribs of the belt.

[0004] However, a sprocket as described above suffers from several disadvantages in environments where cleaning systems are used to maintain hygiene. First, the belt sits tightly on the sprocket, leaving little to no gap between the sprocket

and the underside of the belt. In this case, debris and contaminants are squeezed into the small gaps causing great difficulty in cleaning the affected areas. Additionally, in many cases, two or more sprockets are used to engage a belt, and the above-described sprockets offer few options for passing cleaning fluid to the area between sprockets.

[0005] These disadvantages have been overcome for modular belts by the sprocket depicted in Fig. 7A in conjunction with the cleaning-in-place system pictured in Fig. 8 (see, e.g., U.S. Patent Application Publication Nos. 2008/0190462 and 2990/0050185). However, the sprocket of Fig. 7A is not ideally suited for use with flexible (non-modular) belts. For example, as depicted in Fig. 7B, the shape of the teeth, and lack of support between adjacent pairs of teeth, allow a flexible belt to buckle as it is forced around the periphery of the sprocket while the belt is under tension. Over time, this buckling causes damage to the belt including cracks on the surface of the belt.

[0006] Accordingly, there is a need for an improved sprocket for use with flexible belts and that avoids the above-described shortcomings.

Brief Summary of the Invention

[0007] The present invention meets the above described need by providing a sprocket according to independent claims 1 and 10 and a conveyor belt system according to independent claim 17. Preferred embodiments will emerge from the dependent claims.

[0008] The present invention provides a sprocket having a body with a central opening for engaging a shaft and rotating about an axis. The sprocket has a plurality of teeth disposed

around the periphery of the body. The teeth are angularly spaced about the axis such that each tooth is spaced from the adjacent teeth by a first opening. Each tooth has a belt-contacting surface which is convex in shape such that the outer-most periphery of the sprocket is generally circular. The belt-contacting surfaces of the teeth guide the belt around the periphery of the sprocket in order to minimize the ability of the belt to buckle.

[0009] The first opening may be circular, trapezoidal, or any other shape. The first opening is configured expose the underside of the belt to cleaning fluid.

[0010] The teeth may each further comprise a second tooth such that pairs of teeth are disposed around the periphery of the body, the each pair being spaced from the adjacent pair by the first opening. Each tooth of a pair of teeth may be spaced from the other tooth of the pair by a second opening. The second opening is configured to engage a rib of the belt. The second openings may be configured to be larger than the corresponding ribs to allow cleaning fluid to pass between the sprocket and the ribs.

[0011] The longitudinal width of the body may be different at an inner portion of the body than at an outer portion of the body. The body may further have a transition portion where the width gradually increases from the inner portion to the outer portion.

[0012] The present invention may be embodied as a conveyor belt system comprising a belt which may have transverse ribs. The system further comprises a sprocket similar to that described above.

Description of the Drawings

[0013] For a fuller understanding of the nature and objects of the invention, reference should be made to the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1A is a perspective view of a sprocket according to an embodiment of the present invention;

Figure 1B is a side elevational view of the sprocket of Figure 1A;

Figure 1C is an end elevational view of the sprocket of Figure 1A and 1B;

Figure 2 is a side elevational view of the sprocket of Figures 1A-1C with a flexible belt engaged thereon;

Figure 3 is a prespective view of system according to an embodiment of the present invention;

Figure 4A is a perspective view of a sprocket according to another embodiment of the present invention;

Figure 4B is a side elevational view of the sprocket of Figure 4A;

Figure 4C is an end elevational view of the sprocket of Figure 4A and 4B;

Figure 5 is a side elevational view of the sprocket of Figures 4A-4C with a flexible belt engaged thereon;

Figure 6 is a prespective view of two sprockets according to another embodiment of the present invention with a flexible belt engaged thereon;

Figure 7A is a side elevational view of a prior art sprocket;

Figure 7B is a side elevational view of the prior art sprocket with a flexible belt engaged thereon;

Figure 8 is a perspective view of a cleaning-in-place system; and

Figure 9 is a side elevational view of another prior art sprocket with a flexible belt engaged thereon.

Detailed Description of the Invention

[0014] Initially, it should be noted that the terms "belt", "conveyor", "conveyor belt", and "flexible belt" are used interchangeably herein to refer to any non-modular belt as is known in the art. Such a belt may be constructed from fabrics coated by plastics or rubber, coated plastic sheets, monolithic plastic sheets, or other non-modular belt configurations. The terms may be used herein to refer to belts for any application, such as, for example, conveyor belts and process belts.

[0015] Figs. 1A-1C depict a sprocket **10** according to an embodiment of the present invention. The sprocket **10** comprises a body **12** which may be constructed from stainless steel, plastic, or other suitable materials generally known to be food compatible and easily cleanable. The sprocket **10** includes a central opening **14** for engaging a shaft (not shown). The shaft may be a drive shaft. The central opening **14** may be shaped to cause the sprocket **10** to rotate as the shaft is rotated; for example, the central opening **14** may be formed in the shape of a square. In this manner, the sprocket **10** may rotate about an axis **15** that is coincident with the shaft in order to drive a belt **90** (see, e.g., Fig. 2). The sprocket **10** may be an idling sprocket which is rotated about the axis **15** by movement of the belt **90** around the sprocket **10**. The central opening **14** may be formed in other shapes to accommodate different shaft geometries as will be evident to those of ordinary skill in the art based on this disclosure.

[0016] The sprocket **10** has a plurality of teeth **16, 18** disposed in pairs **20** around the periphery of the body **12.** Each tooth **16, 18** has a belt-contacting surface **26.** The belt-contacting surface **26** is convex in shape such that the outer-most periphery of the sprocket **10,** as defined by the belt-contacting surfaces **26** of the teeth **16, 18,** is generally circular. The discontinuous circle formed by the belt-contacting surfaces **26** of the teeth **16, 18** is centered on the axis **15** and guides the belt **90** around the periphery of the sprocket **10** in order to minimize the ability of the belt **90** to buckle.

[0017] The pairs **16** of teeth are angularly spaced about the axis **15** such that each pair **16** of teeth is spaced from the adjacent pairs **16** of teeth by a first opening **22.** The first opening **22** is configured to align with the underside of the belt **90** when the belt **90** is engaged with the sprocket **10** as best shown in Figs. 2 and 3. In this way, the first opening **22** allows for cleaning fluid sprayed generally toward the sprocket **10** and belt **90** to reach the underside of the belt **90.** The first opening **22** may be shaped to allow access of cleaning fluid to the belt **90** while maintaining a necessary amount of belt-contacting surface **26** of the teeth **16, 18** to prevent buckling of the belt **90.**

[0018] In the non-limiting example best depicted in Figs. 1B and 2, the first opening **22** is circular in shape where a chord of the circle intersects with the periphery of the sprocket **10** thus forming edges **28, 30.** As such, the wide circular formation of first opening **22** allows ample cleaning fluid to circulate, while the smaller peripheral gap created by edges **28, 30** allows the appropriate belt-contacting surfaces **26** to remain on the teeth **16, 18.** The appropriate

size of the gap created by edges **28, 30** will depend on the specific application. For example, the stiffness of the belt and/or the number and spacing of ribs in the belt will necessitate more or less support by the belt-contacting surfaces of the teeth of the sprocket. The edges **28, 30** or any edges formed by the elements of the disclosed sprockets may be beveled, rounded, or the like. The gap formed by edges **28, 30** may be considered a belt interface portion **38** of the first opening **22**. Such belt interface portion **38** may be narrower than a largest diameter (or dimension) of the first opening.

[0019] Another embodiment of a sprocket **50** is depicted in Figs. 4A-6, wherein the first opening **52** is trapezoidal. Other shapes and sizes suitable for the first opening **22** will be evident to those of ordinary skill in the art based on this disclosure. The first opening **22** may also comprise multiple openings. As such, a belt may be exposed to cleaning fluid at more than one position between the ribs of the belt.

[0020] The belt-contacting surfaces **26** of the sprocket **10** may make up approximately 50 percent of the circumference of the sprocket **10** (the first openings **22** and second openings **24** making up the other 50 percent of the circumference). The belt-contacting surfaces **26** may make up more or less then 50 percent of the circumference of the sprocket **10** depending on the application (*e.g.*, belt stiffness, number and spacing of ribs, etc.).

[0021] Each tooth **16, 18** of a pair **20** of teeth may be spaced from the other tooth **18, 16** of the pair **20** by a second opening **24**. The second opening **24** is configured to engage a rib **92** of the belt **90**. The second opening **24** may be, for example but not limited to, tapered in shape to engage a

tapered rib **92**. The second opening **24** may be configured to be larger than the corresponding rib **92**. For example, a depth *d* of the second opening **24** may be greater in length than a height *h* of the corresponding rib **92**. In this manner, cleaning fluid may pass between the sprocket **10** and the rib **92** while the belt **90** is engaged by the sprocket **10** in order to flush contaminants from the rib **92** area of the belt **90**.

[0022] The body **12** of the sprocket **10** may have a longitudinal width which varies. For example, as best shown in Fig. 1A, an inner portion **32** of the body **12** may have a width W_i which is less than a width W_o of an outer portion **34** of the body **12**. In this manner, the volume of material necessary for the body **12** and the mass of the body **12** may be minimized (due to the relatively narrow width W_i of the inner portion **32**) while still providing a large belt-contacting surface **26** (due to the relatively large width W_o of the outer portion **34**). The body **12** may further have a transition portion **36** where the width gradually increases from W_i to W_o.

[0023] The reduced width W_i of the inner portion **32** also has the benefit of improving access of cleaning fluid to the underside of belt **90**, especially to a portion of the belt 90 which is located between two sprockets (*see, e.g.*, Fig. 8, which shows where a V-shaped spray of cleaning fluid may be less hindered by a reduced width W_i).

[0024] The figures depict embodiments of sprockets **10, 50** where the first openings **22, 62** reach the inner portion **30, 64** of the sprocket **10, 50**, and the second openings **24, 66** reach the transition portion **34, 68** of the sprocket **10, 50**; however, other configurations are possible and contemplated within the scope of this disclosure.

[0025] Turning to Fig. 2, the sprocket **10** is shown engaged with the belt **90**. The belt-contacting surfaces **26** of the teeth **16, 18** engage with and ease the belt around the periphery of the sprocket **10** and the second openings **24** engage with the transverse ribs **92** of the belt **90**. Also, the first openings **22** provide large openings and improved access to the underside of the belt **90** for cleaning when the belt **90** passes over the sprocket **10**, while still maintaining sufficient belt-contacting surface **26** to minimize the risk of buckling of the belt **90**. The relation of the first openings **22** and the inner portion **30**, transition portion **34**, and outer portion **32** of the sprocket may allow improved access of the cleaning fluid to the belt **90**. Similarly, the varying width of the body **12** at the second openings **24** may allow improve access of the cleaning fluid to the ribs **92**.

[0026] The present invention may be embodied as a conveyor belt system **100** comprising a belt **110** which may have transverse ribs **112** (*see, e.g.*, Fig. 3). The system further comprises a sprocket **120**, similar to that described above, having a body **122** with a central opening **124** for engaging a shaft. A system **100** may comprise more than one sprocket **120**. The shaft may be a drive shaft and, in this case, will cause the sprocket **120** to rotate around an axis **123**. The sprocket **120** has a plurality of teeth **126, 128** disposed in pairs **130** around the periphery of the body **122**. Each tooth **126, 128** has a belt-contacting surface **132** configured to engage the underside **114** of the belt **110**. The belt-contacting surfaces **132** are convex in shape such that the outer-most periphery of the sprocket **120**, as defined by the belt-contacting surfaces **132** of the teeth **126, 128**, is generally circular. The discontinuous circle formed by the belt-contacting surfaces **132** of the teeth **126, 128** is centered on the axis **123** and

guides the belt **110** around the periphery of the sprocket **120** in order to minimize the ability of the belt **110** to buckle.

[0027] The pairs **130** of teeth are angularly spaced about the axis **123** such that each pair **130** of teeth is spaced from the adjacent pairs **130** of teeth by a first opening **140**. The first opening **140** is configured to align with the underside **114** of the belt **110** when the belt **110** is engaged with the sprocket **120** as shown. In this way, the first opening **140** allows for cleaning fluid sprayed generally toward the sprocket **120** and belt **110** to reach the underside of the belt **110**. The first opening **140** may be shaped to allow access of cleaning fluid to the belt **110** while maintaining a necessary amount of belt-contacting surface **132** of the teeth **126, 128** in order to prevent buckling of the belt **110**.

[0028] In the case where the belt **110** has ribs **112**, each tooth **126, 128** of a pair **130** of teeth may be spaced from the other tooth **128, 126** of the pair **130** by a second opening **144**. The second opening **144** is configured to engage a rib **112** of the belt **110** in order to increase the ability of the sprocket **120** to move the belt **110** (when the sprocket is a drive sprocket). The second opening **144** may be, for example but not limited to, tapered in shape to engage a tapered rib **112**. The second opening **144** may be configured to be larger than the corresponding rib **112**. For example, a depth of the second opening **144** may be greater in length than a height of the corresponding rib **112**. In this manner, cleaning fluid may pass between the sprocket **120** and the rib **112** while the belt **110** is engaged by the sprocket **120** in order to flush contaminants from the rib **112** area of the belt **110**.

[0029] Although the present invention has been described with respect to one or more particular embodiments, it will be

understood that other embodiments of the present invention may be made without departing from the scope of the present invention. Hence, the present invention is deemed limited only by the appended claims and the reasonable interpretation thereof.

Claims

1. Sprocket (10; 120) for a flexible belt (90; 110) having transverse ribs (92; 112), the sprocket (10; 120) being disposed on a shaft and configured to rotate about an axis (15; 123) coincident with the shaft, the sprocket (10; 120) comprising:

a body (12; 122) comprising:

a central opening (14; 124) for receiving the shaft;

a plurality of teeth (16, 18; 126, 128) disposed in pairs (20; 130), the pairs (20; 130) being angularly spaced about the axis (15; 123), wherein each pair (20; 130) of teeth being spaced from adjacent pairs (20; 130) of teeth by a first opening (22; 140), and wherein each tooth (16, 18; 126, 128) in each pair (20; 130) of teeth being spaced from the other tooth (16, 18; 126, 128) in the pair (20; 130) by a second opening (24; 144); and

wherein a belt-contacting surface (26; 132) of each tooth (16, 18; 126, 128) is convex such that the outer-most periphery of the body (12; 122), as defined by the belt-contacting surfaces (26; 132) of the teeth (16, 18; 126, 128), is generally circular.

2. Sprocket according to claim 1, wherein the first opening (22; 140) is circular in shape.

3. Sprocket according to claim 1, wherein the first opening (22; 140) is trapezoidal in shape.

4. Sprocket according to any one of claims 1 to 3, wherein a belt interface portion (38) of the first opening (22; 140) is narrower than a largest diameter of the first opening (22; 140).

5. Sprocket according to any one of claims 1 to 4, wherein a width in a longitudinal direction of an outer portion (34) of the body (12; 122) is greater than a width of an inner portion (32) of the body (12; 122).

6. Sprocket according to any one of claims 1 to 5, wherein a depth of the second opening (24; 144) is greater than a height of a rib (92; 112) of the belt (90; 110).

7. Sprocket according to any one of claims 1 to 6, wherein the first opening (22; 140) further comprises at least one additional opening.

8. Sprocket according to any one of claims 1 to 7, wherein the sprocket (10; 120) is a drive sprocket.

9. Sprocket according to any one of claims 1 to 7, wherein the sprocket (10; 120) is an idling sprocket.

10. Sprocket for a flexible belt, the sprocket being disposed on a shaft and configured to rotate about an axis coincident with the shaft, the sprocket comprising:

a body comprising:

a central opening for receiving the shaft;

a plurality of teeth, the teeth being angularly spaced about the axis, wherein each tooth is spaced from adjacent teeth by a first opening; and

wherein a belt-contacting surface of each tooth is convex such that the outer-most periphery of the body, as defined by the belt-contacting surfaces of the teeth, is generally circular.

11. Sprocket according to claim 10, wherein each of the plurality of teeth further comprises a pair of teeth wherein each tooth in each pair of teeth is spaced from the other tooth in the pair by a second opening.

12. Sprocket according to claim 10 or 11, wherein the first opening is circular in shape.

13. Sprocket according to claim 10 or 11, wherein the first opening is trapezoidal in shape.

14. Sprocket according to any one of claims 10 to 13, wherein a belt interface portion of the first opening is narrower than a largest diameter of the first opening.

15. Sprocket according to any one of claims 10 to 14, wherein a width in a longitudinal direction of an outer portion of the body is greater than a width of an inner portion of the body.

16. Sprocket according to any one of claims 11 to 15, wherein a depth of the second opening is greater than a height of a rib of the belt.

17. Conveyor belt system (100) comprising:
a sprocket (10; 120) comprising:
a body (12; 122) comprising:
a central opening (14; 124) for receiving a shaft, the shaft configured to rotate about a longitudinal axis (15; 123);
a plurality of teeth (16, 18; 126, 128) disposed in pairs (20; 130), the pairs (20; 130) being angularly spaced about the axis (15; 123), wherein each pair (20; 130) of teeth being spaced from adjacent pairs (20; 130) of

teeth by a first opening (22; 140), and wherein each tooth (16, 18; 126, 128) in each pair (20; 130) of teeth being spaced from the other tooth (16, 18; 126, 128) in the pair (20; 130) by a second opening (24; 144); and

wherein a belt-contacting surface (26; 132) of each tooth (16, 18; 126, 128) is convex such that the outer-most periphery of the body (12; 122), as defined by the belt-contacting surfaces (26; 132) of the teeth (16, 18; 126, 128), is generally circular;

a belt (90; 110) configured to contact the belt-contacting surfaces (26; 132) of the teeth (16, 18; 126, 128) of the sprocket (10; 120), a plurality of transverse ribs (92; 112) being disposed on the belt (90; 110) and configured to engage the second openings (24; 144) of the sprocket (10; 120) as the belt (90; 110) is conveyed around the sprocket (10; 120).

18. Conveyor belt system according to claim 17, further comprising a second sprocket (10; 120).

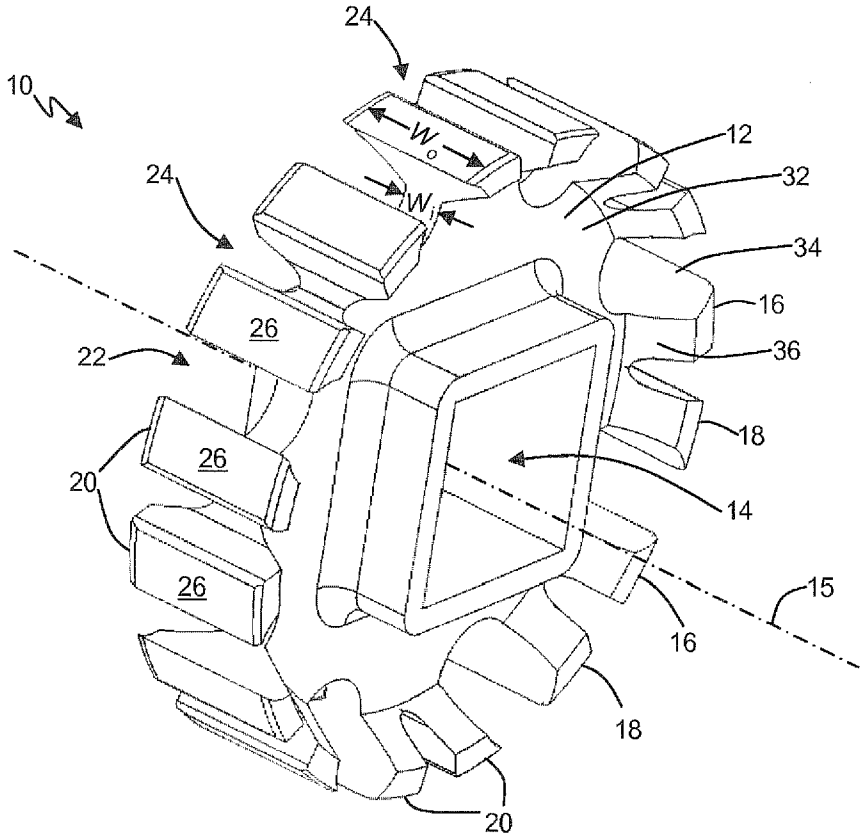

Fig. 1A

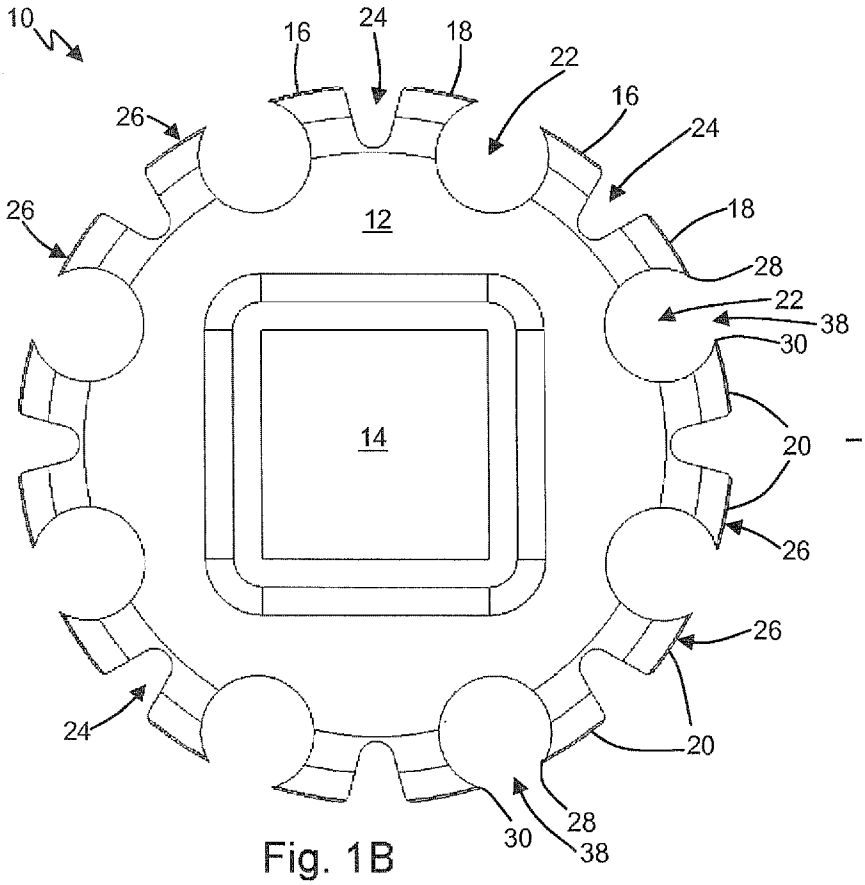

Fig. 1B

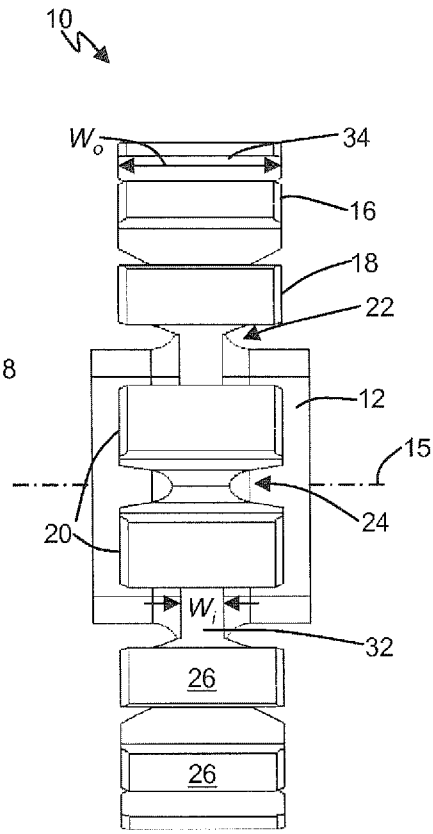

Fig. 1C

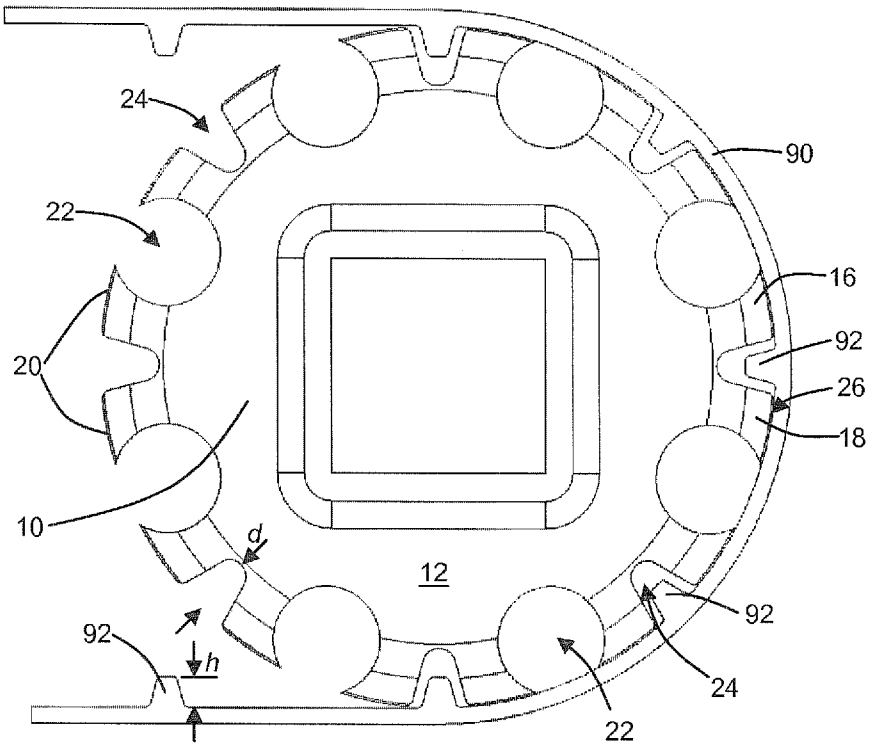
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Fig. 2

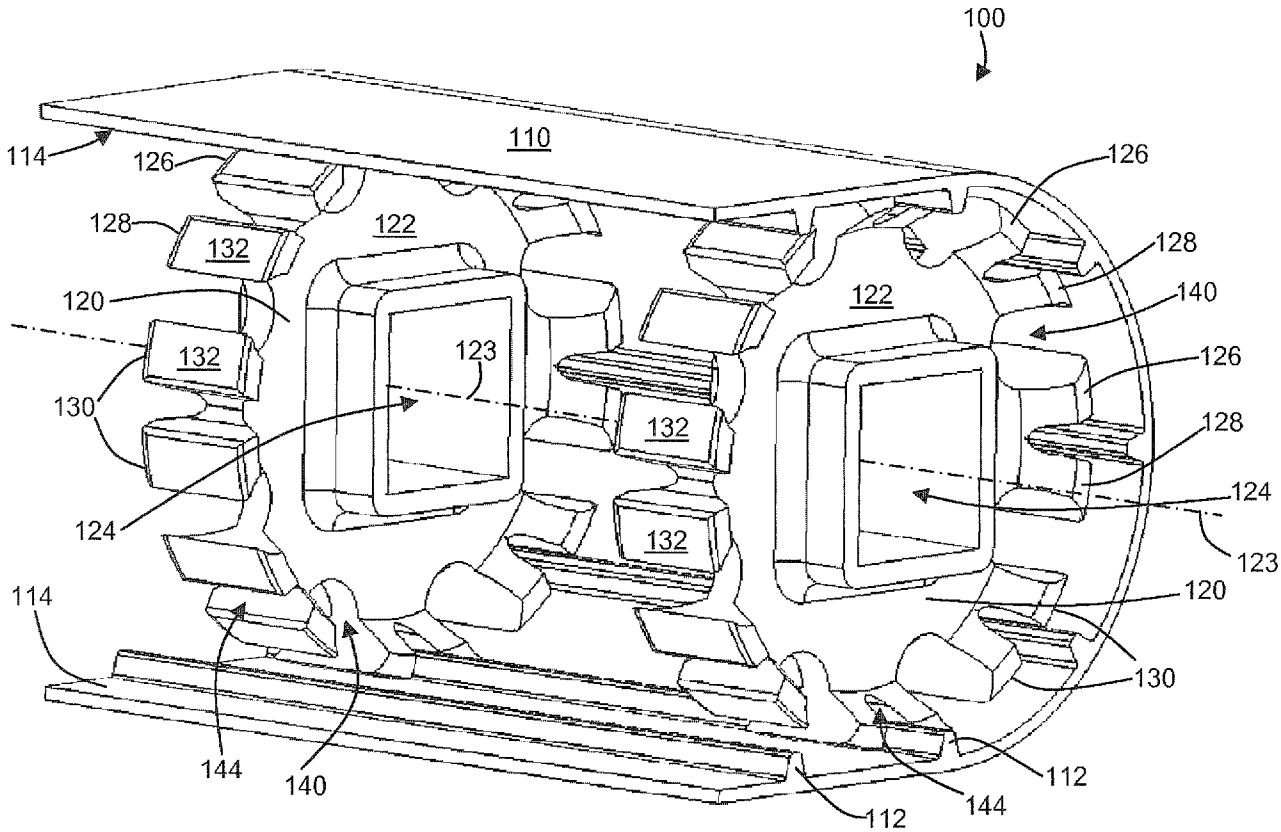
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Fig. 3

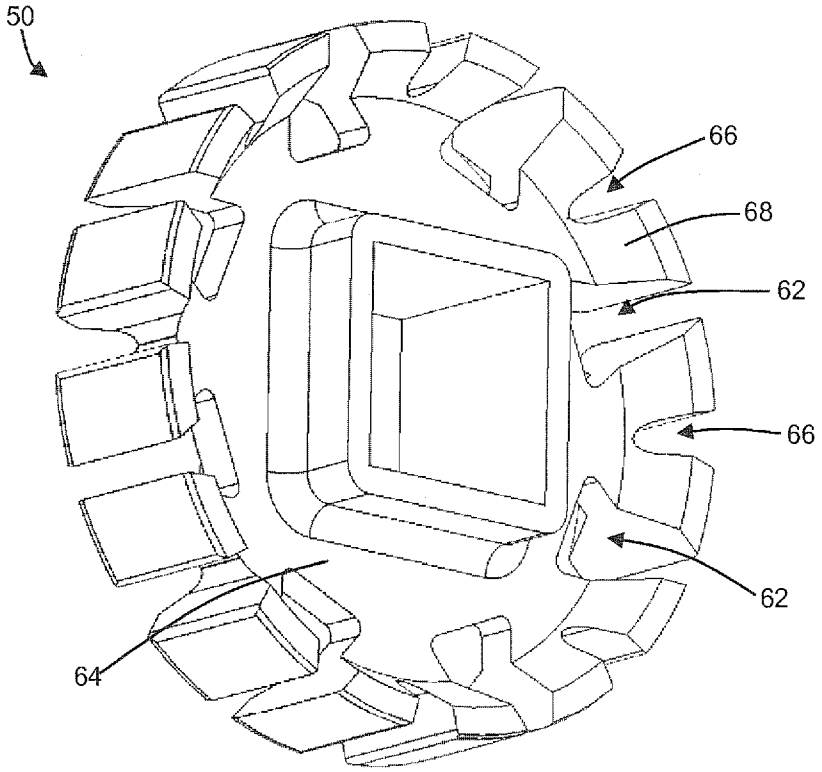

Fig. 4A

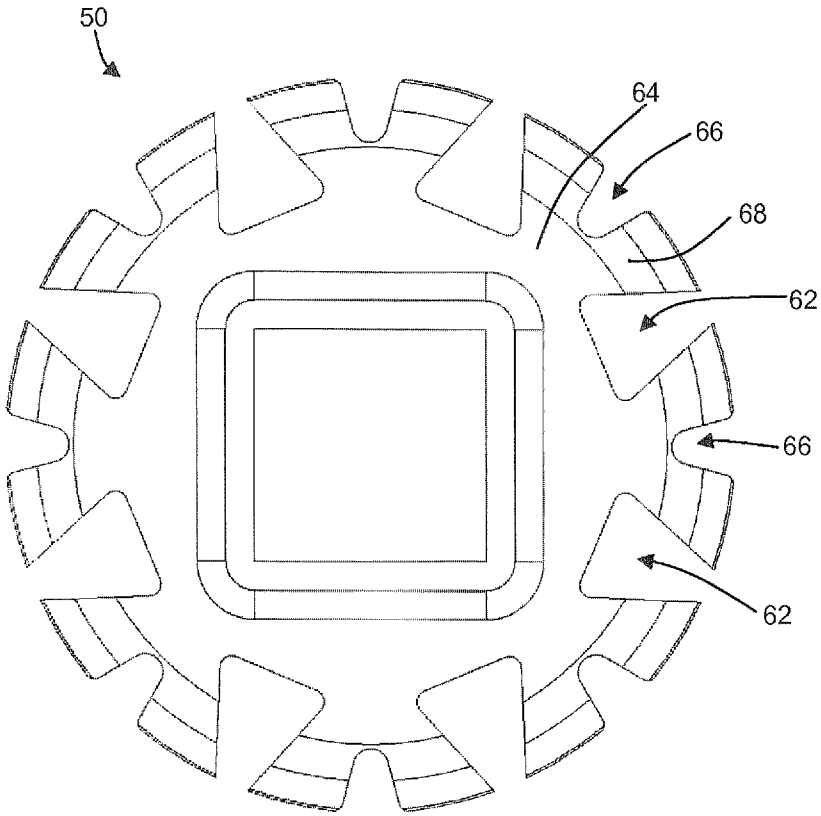

Fig. 4B

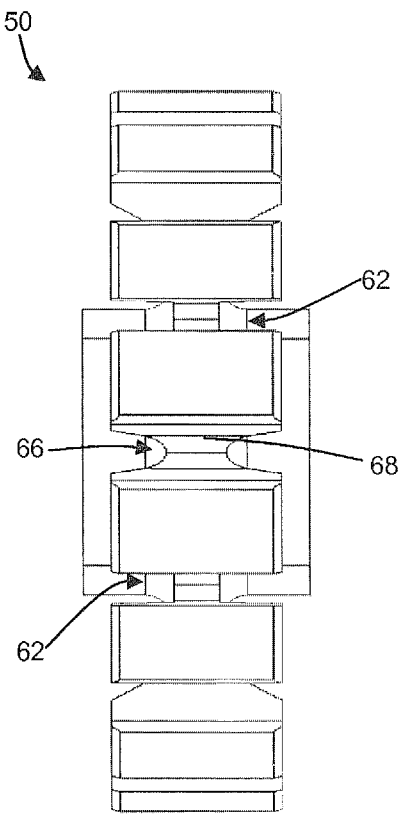

Fig. 4C

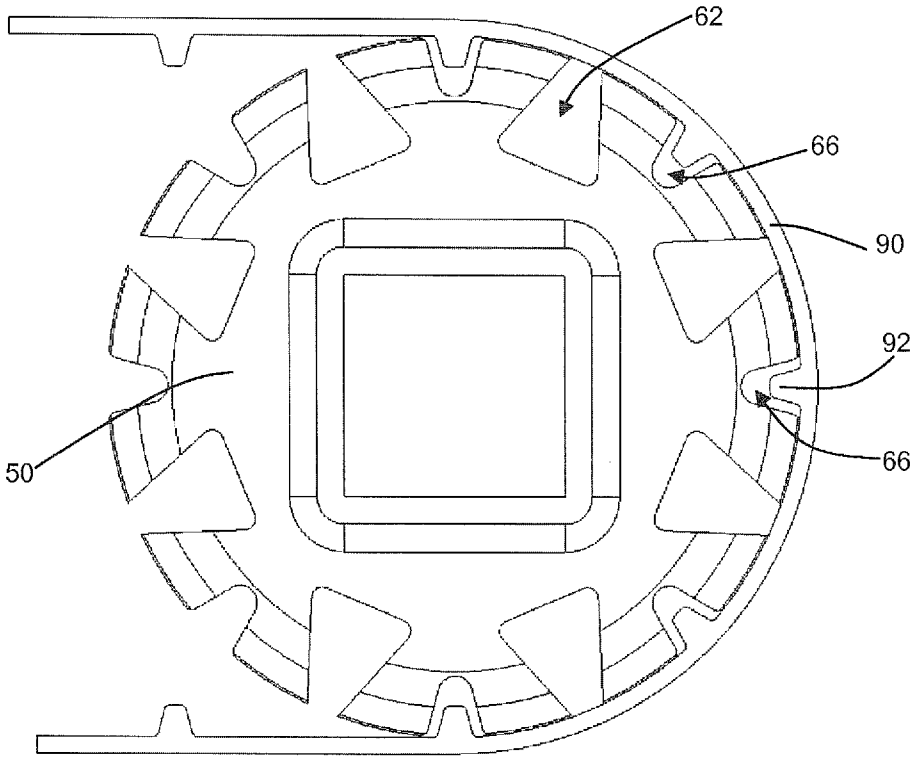

Fig. 5

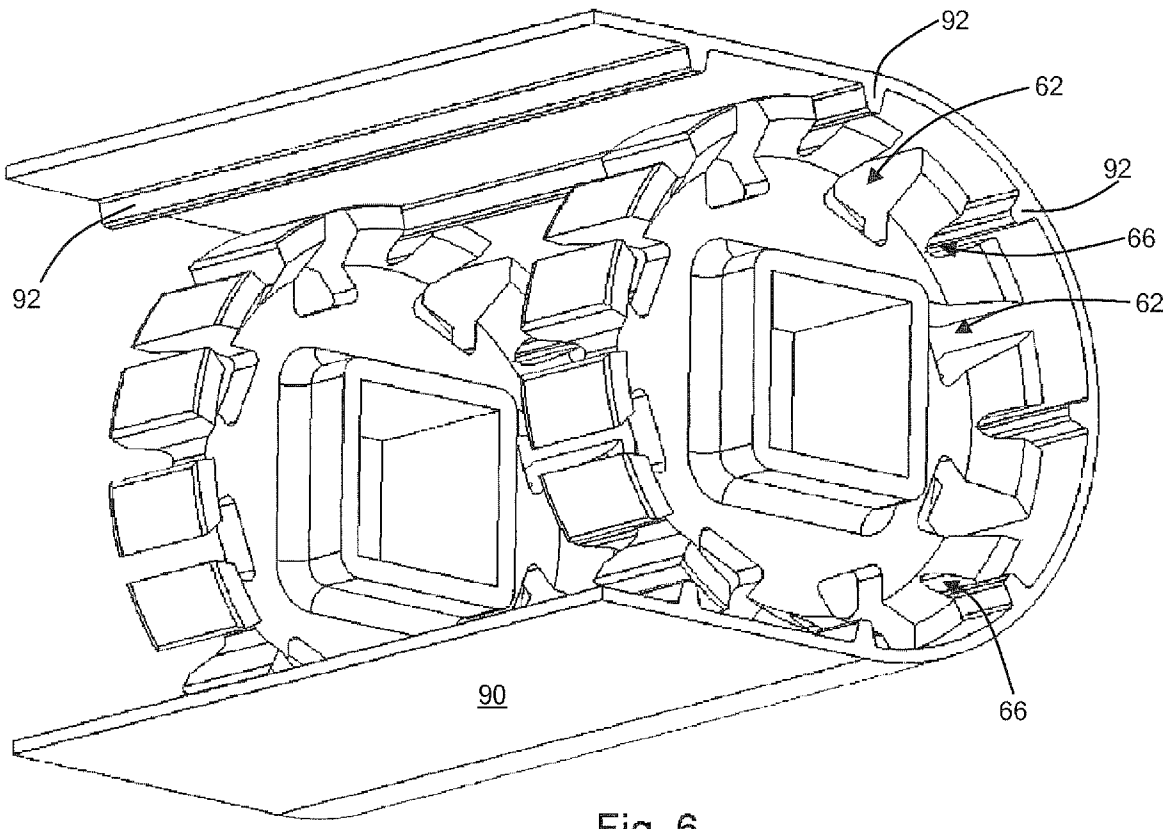

Fig. 6

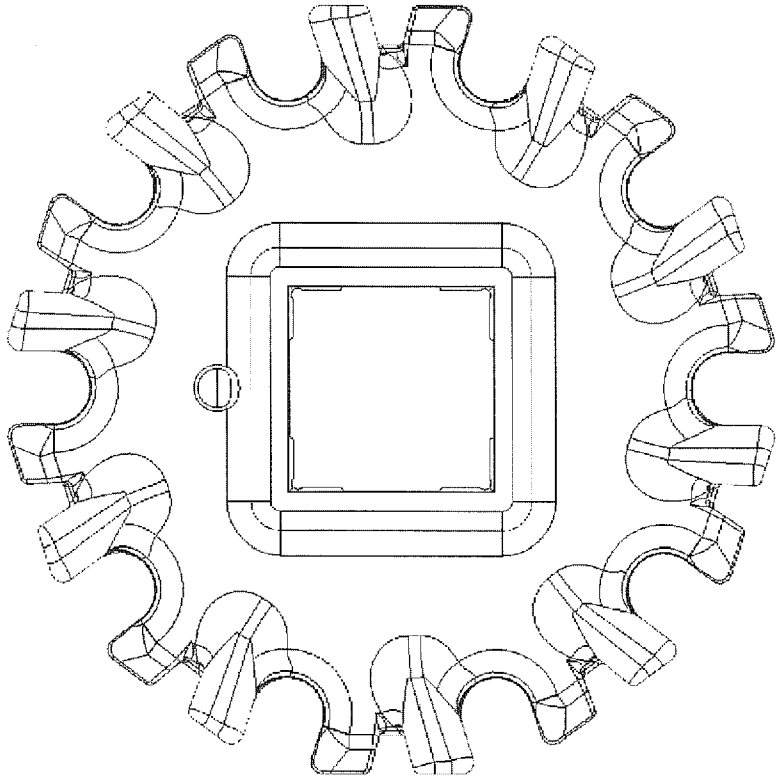

Fig. 7A
Prior Art

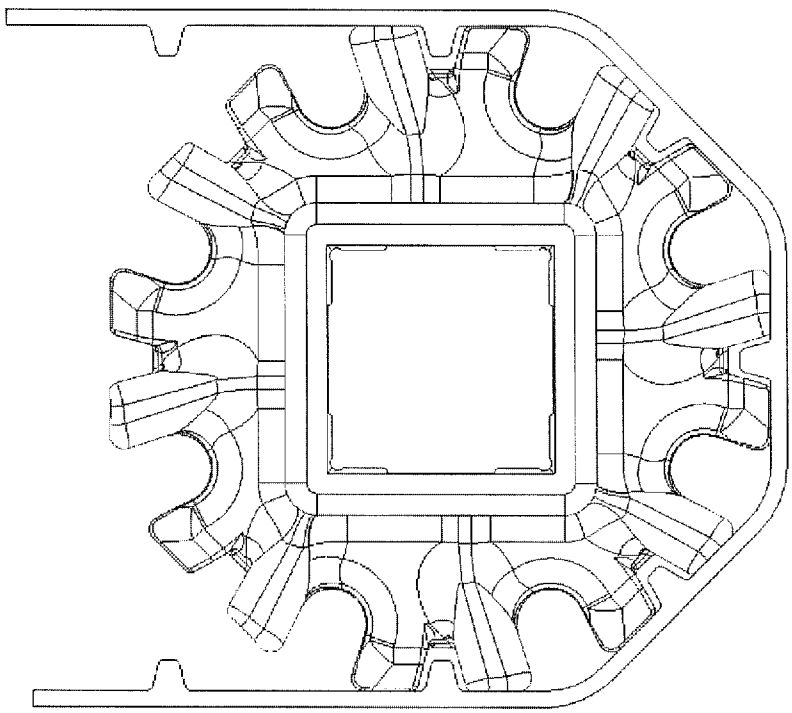

Fig. 7B
Prior Art

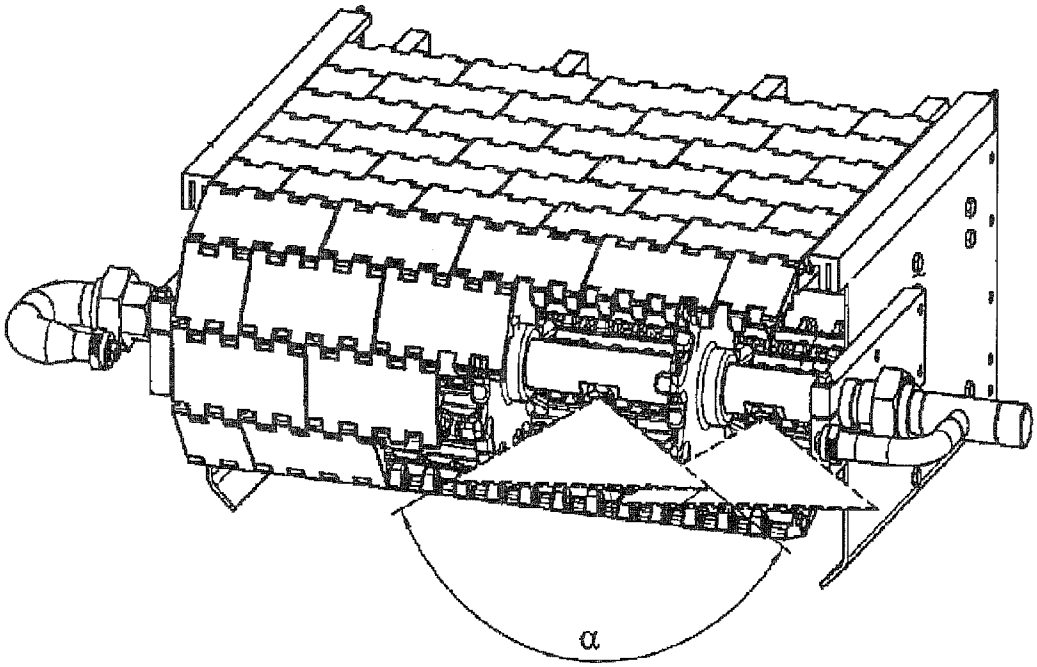

Fig. 8
Prior Art

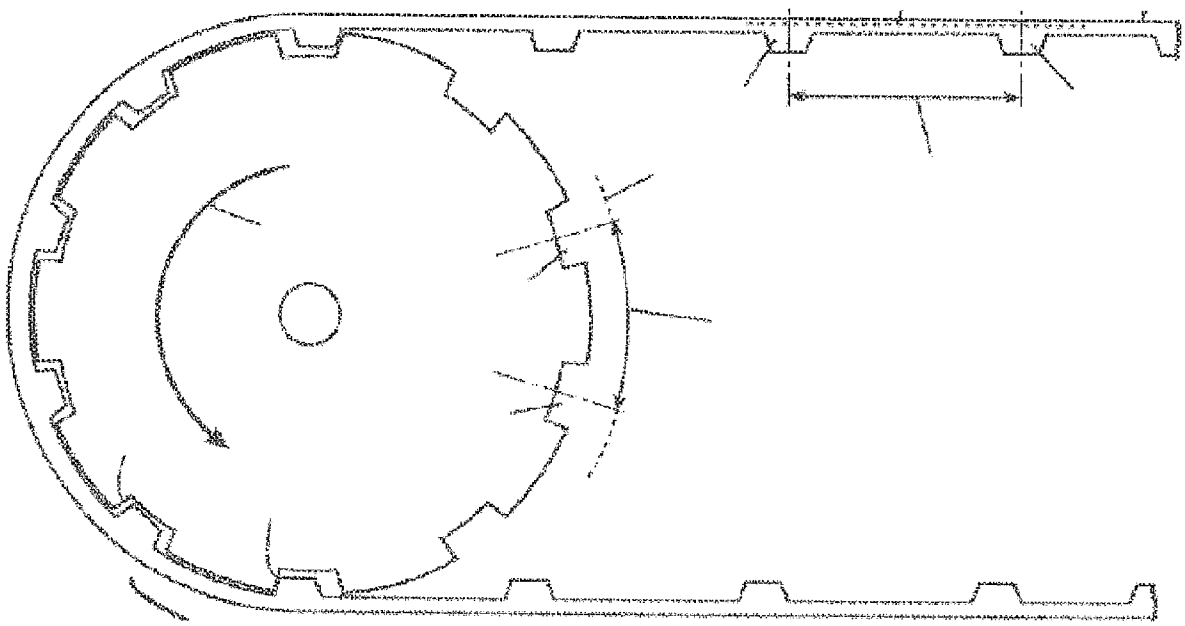

Fig. 9 - Prior Art

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/063990

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65G23/06 B65G45/22
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

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 practical, search terms used)
EPO-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.
X Y	US 6 367 613 B1 (MONTGOMERY PRESTON D [US]) 9 April 2002 (2002-04-09) columns 1-8; figures 1-7	1,6-11, 16-18 3-5, 13-15
X	US 7 134 545 B1 (SMITH CHRIS [US]) 14 November 2006 (2006-11-14) columns 1-8; figures 1-10	1
X	US 2009/050185 A1 (GULDENFELS DIETER [CH] ET AL) 26 February 2009 (2009-02-26) pages 1-4; figures 1-21	1,2,10, 12
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 October 2011	15/12/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Martin, Benoit

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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