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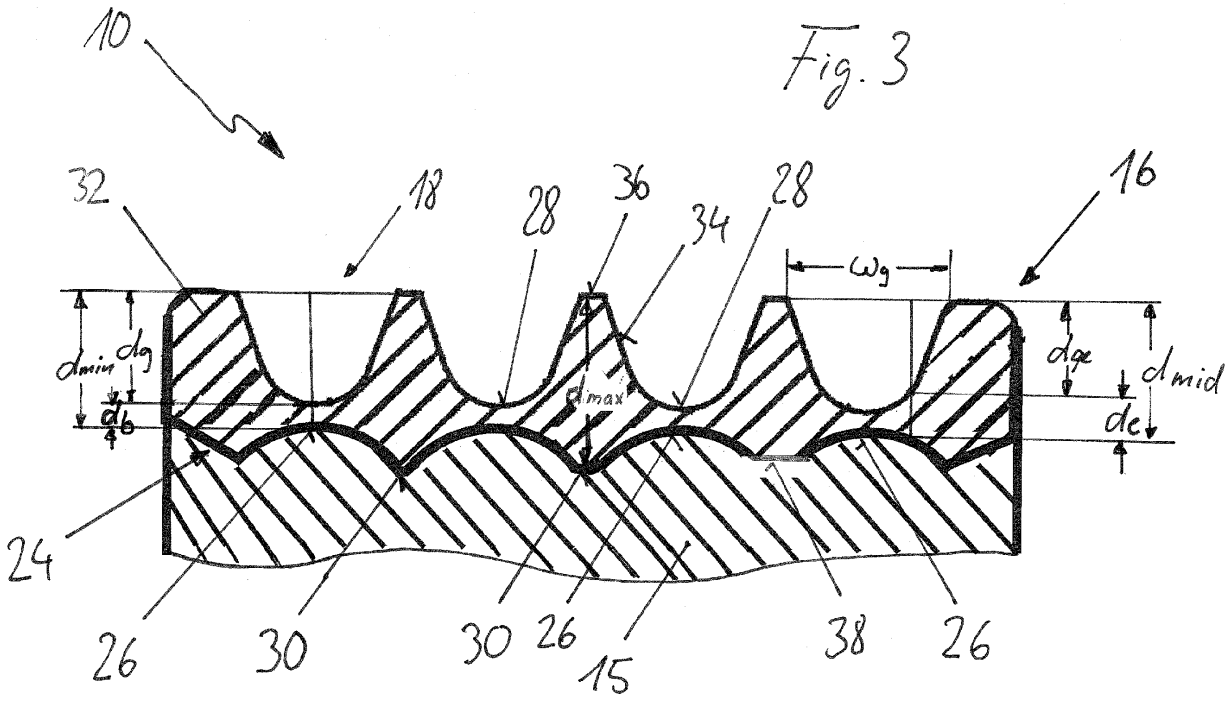
(54) **Elevator rope pulley**

(57) The invention refers to an elevator rope pulley comprising a rotation center, a hub (12), a pulley body (15) surrounding the hub and a rim (16) surrounding the pulley body and containing rope grooves (18) along its circumference, each groove having groove edges (34) and a groove bottom (28), whereby the material of the pulley body is harder than the material of the rim, and wherein the outer surface (24) of the pulley body is corrugated along its circumference, which outer surface builds the boundary surface to the rim, whereby the corrugation profile (24a-d) of the corrugated outer surface comprises in radial direction positive sections (26) or elevations and negative sections (30) or recesses, characterized in that the positive sections are radially aligned with the groove bottom (28) of the grooves. This pulley generates less noise in operation.

Fig. 3



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Description

[0001] The present invention relates to an elevator rope pulley. Elevator rope pulleys commonly have a central hub rotating about a rotation axis of the pulley, a pulley body surrounding the hub as well as a rim surrounding the pulley body containing rope grooves along its circumference. This kind of elevator rope pulleys are used as a traction sheave or as diverting pulleys in elevators. Several attempts have been made to increase the friction between the mostly metal elevator rope and the grooves, particularly in connection with traction sheaves, which resulted in a rim being made from a material having a lower hardness than the material of the pulley body. Usually the pulley body is made from metal, particularly cast-iron or cast-aluminum. The metal pulley body is surrounded by a rim made from softer material as e. g. plastics or rubber, particularly polyurethane, which rim contains the grooves for the ropes along its circumference. Each groove comprises a central groove bottom and bottom edges on both sides thereof for taking up the elevator ropes having commonly a circular cross section. The outer surface of the pulley body forms the boundary surface between the pulley body and the rim. The outer surface of the pulley body is corrugated along its circumference. The corrugation comprises positive sections extending in a positive direction, i.e. radially away from the rotation center of the pulley and negative sections extending in a negative direction, i.e. radially in direction to the rotation center and thus building a kind of recess in the outer surface of the pulley body. The invention refers to this type of pulley. Such an elevator rope pulley according to the preamble of claim 1 is known from EP 1 339 629.

[0002] It is object of the invention to provide an elevator rope pulley which produces less noise in operation.

[0003] The object of the invention is solved with an elevator rope pulley according to claim 1 as well as with an elevator according to claim 13. Preferred embodiments are subject matter of the dependent claims.

[0004] The outer surface or circumference of the pulley body has corrugations along its circumference. The cross sectional profile of the corrugations in radial and axial direction has positive sections or elevations in the outer surface of the pulley and negative sections or recesses in the outer surface of the pulley body. According to the invention the positive sections, i.e. elevations are radially aligned with the groove bottom of the grooves. Via this measure the radial thickness of the rim material under the groove bottom is reduced compared to the material thickness of the rim in the area of the groove edges.

[0005] Of course, already with a flat outer surface of the pulley body the thickness of the rim material in the pulley bottom is thinnest. But the material thickness between the groove bottom and the pulley body is still further decreased by the inventive mutual arrangement of the corrugations with respect to the rope grooves. By placing the positive sections of the corrugations below the groove bottom the material thickness of the rim in this area is reduced with respect to the groove edges, which keeps them softer due to the enlarged material thickness of the rim material between the groove edge and the outer surface of the pulley body. By this measure the contact area of the ropes is softer at the groove edges, which keeps the operation of the pulley silent and reduces the noise when the elevator rope runs onto or from the rim. Furthermore the contact of the rope on both sides with the softer groove edges seals the harder contact area of the groove bottom with the rope and thus further reduces noise. Accordingly, the inventive elevator rope pulley is a rope pulley which reduces noise essentially.

[0006] In other words: The invention keeps the resulting rim thickness from the outer surface of the pulley body to the outer most circumferential area of the rim minimal at the groove bottom. This is another possibility of characterizing the invention based on a rope pulley according to the preamble of claim 1.

[0007] Preferably the groove bottom is aligned in radial direction with the center of the positive sections so that the transition from harder to softer rim area is symmetrical from the groove bottom in the direction of both groove edges.

[0008] Preferably, the rim is made of plastics or rubber, particularly from polyurethane. This material is well adapted to bear the load and stress applied by the ropes and is on the other hand soft enough to reduce the noise, particularly in combination with the mutual arrangement of the corrugations with respect to the rope grooves.

[0009] The corrugations may have an anticlinal, triangular , sinusoidal or square profile. In each case the positive sections of the profile are located below the groove bottom, which means the center of the groove. In case of the first three profiles there is a clear peak under the groove bottom, which has the advantage that the change in the material thickness from the groove bottom to the edges takes place gradually.

[0010] In case of a square profile the positive section below the groove bottom is flat. The width of the positive sections should be preferably half of the groove width at the most, preferably between a quarter and a half of the groove width. In this case it is ensured that the outer groove edges are radially aligned with the negative sections of the corrugations, thus leaving a large material thickness of the rim material between the outer groove edge portion and the outer surface of the pulley body, which is essential for the noise reduction.

[0011] A square profile has the advantage of a good mutual adhesion of the rim material on the outer surface of the pulley body. Thus a displacement of the rim on the pulley body, particularly in axial direction of the pulley, is efficiently avoided. In case of a square profile of the corrugations the vertical flanks of the profile could be preferably slightly tilted, which facilitates the forming or working of the profile during manufacture.

[0012] In case of an anticlinal profile the arc of the profile is preferably located exactly under the groove bottom whereas the edge regions of the anticlinal are in the area

between the rope grooves. This leads to the fact that on one hand the groove bottom is quite hard which reduces material wear and deformations on the groove bottom. On the other hand the anticlinal profile of the corrugations leads to an increase of the radial thickness of the elastic rim material in the area of the groove edges which leads to a higher elastic play when the elevator rope meets the groove edges. This however reduces the noise when the rope hits the groove.

[0013] The noise reduction ability of the invention has become important as nowadays elevator with a high suspension ratio of 3:1, 4:1, 5:1, 6:1 or more are uses wherein a lot of diverting pulleys have to be used. Accordingly, the noise generated by each rope pulley sums up to a level where the noise generated by the pulleys becomes essential. With the new inventive pulley it is possible to keep the total noise level generated by the elevator rope pulleys at an acceptable level.

[0014] Furthermore, the corrugated outer surface of the pulley body and correspondingly also the corrugated boundary and contact surface between the pulley body and the rim leads to a better connection of the rim material to the pulley body.

[0015] It shall be clear for the skilled person that also multiple profiles of the contact surface between the pulley body and the rim are possible to obtain the inventive result, e. g. by using a sinus profile or a triangular profile etc. where always the positive section of the profile is below the groove bottom and the negative section of the profile is below the groove edges. Also a combination of the above mentioned profiles anticlinal, triangular, square and sinusoidal are possible.

[0016] The inventive elevator pulley is preferably used as a traction sheave or as a diverting pulley in an elevator.

[0017] It has to be emphasized that only the corrugation profile of the outer surface of the pulley body below the grooves is relevant for the invention. The corrugation profile in the area between the grooves is not relevant. The corrugation profile could be formed in these regions as to increase the connection between the pulley body and the rim material, e.g. a square or triangular profile.

[0018] It is further obvious for the skilled person that the pulley body may consist of several layers in radial succession. In this case only the outer surface of the outermost layer which builds the boundary surface to the rim layer is relevant and to be regarded as outer surface of the pulley body.

[0019] The invention further relates to an elevator comprising at least one of the above mentioned inventive elevator rope pulleys.

[0020] Of course, the pulley body and/or the hub of the elevator pulley may be manufactured from other materials than metal, e.g. plastics, particularly hard-PU.

[0021] The invention is now described with the aid of the enclosed drawings in a schematic way.

Figure 1 shows a partly sectioned view of an elevator rope pulley with a corrugated outer surface of the pulley body,

Figure 2 shows an enlarged detail of the rope pulley of figure 1 in the rim area,

Figure 3 shows a further enlarged detail of the rim area of the pulley of figure 1,

Figures 4 to 6 show different profiles of the corrugations, and

Figure 7 a corrugation with a connection profile in the area between the grooves.

[0022] Figure 1 shows an elevator rope pulley 10 comprising a hub 12 with a bearing 14 for mounting the pulley 10 to an axle of an elevator component or of a structure in the elevator shaft. The bearing is not necessary when the pulley is mounted to the shaft of a drive machine as traction sheave. The pulley has two end faces 20, 22 in axial direction. In radial direction the hub 12 is surrounded by a pulley body 15 which is again surrounded by the rim 16 having on its outer circumference the rope grooves 18.

[0023] The embodiment of the rim 16 surrounding the pullet body 15 can be seen in more detail in figure 2. The outer surface 24 of the pullet body 15 which builds the boundary surface between the pulley body 15 and the rim 16 is anticlinal (Fig. 3) or sinusoidal (Fig. 2). The sinusoidal outer surface 24 comprises arcs 26 as positive sections extending radially away from the rotation axis of the pulley, which are located radially under the bottom 28 of the groove 18. On the other hand the connection areas 30 between two arcs 26 build negative sections or recesses which are located below the groove edges.

[0024] Compared with a flat outer circumference of the pulley body this inventive embodiment of the border surface has the effect that the thickness of the rim material 32 between the border surface 24 at the center of the groove bottom is less than if the border surface 24 would be plain or flat and on the other hand in the area of the groove edges 34 the thickness of the rim material 32 is increased compared with a flat outer border surface 24 between the pulley body 15 and the rim material 32.

[0025] Accordingly, the resulting elasticity from the thickness of the material is decreased in the center of the rope grooves but decreased in the edge area of the grooves which leads to a much better noise reduction than a rope pulley having a flat border surface between the pulley body and the rim 16.

[0026] The geometrical relationships can better be seen from the highly enlarged portion of the elevator rope pulley 10 shown in figure 3.

[0027] Figure 3 shows clearly an anticlinal border surface 24 between the pulley body 15 and the rim 16. The anticlinal profile of the border surface 24 is arranged such that the arcs 26, i. e. the positive sections or elevations of the corrugation profile are exactly below the groove bottom 28. As the arcs 26, i. e. the elevations in the outer

surface or circumference of the pulley body 15 coincide radially with the groove bottom 28 of the grooves the material thickness between the outer surface 24 of the pulley body and the groove bottom 28 is reduced to a value d_b. The total thickness of the rim 16 at the groove bottom 28 adds up to the value d_{min} from the reduced thickness d_b of the rim material 32 in groove bottom and the groove depth dg. This resulting rim thickness is minimal at the groove bottom. On the right side of figure 3 the relation of the rim thickness is shown in an edge part of the groove. The total thickness d_{mid} results here from the thickness d_e of the rim material 32 in an edge part 34 of the rope groove 18 as well as the corresponding groove depths d_{ge} in said edge area. This value of the resulting rim thickness d_{mid} of the rim in the area of the groove edges is higher than the resulting rim thickness d_{min} at the groove bottom. Anyway, this value is lower than the total rim thickness d_{max} from the outer surface 24 to the outer most circumferential area 36 of the rim in the area between the grooves. This shows - generally and independent of the current embodiment - that the resulting rim thickness from the outer surface of the pulley body to the outermost circumferential area 36 of the rim is according to the invention smallest at the groove bottom. This is a relevant aspect of the invention.

[0028] The geometrical relationships in the rim area is apparent from figure 3 show that the inventive embodiment of the border surface 24 between the pullet body 15 and the rim 16 leads to a reduction of the resulting elasticity in the groove bottom center 28 and in an increase of the resulting elasticity because of the material thickness of the elastic material in the edge region 34 of the grooves 18.

[0029] Figure 3 shows on the right side a possible alternative embodiment of the outer surface 24 whereby the connection area 38 between two arcs 26 of the border surface 24 is flat.

[0030] Figures 4 to 6 show in a very schematically way alternative embodiments of the profile of the corrugations in the outer surface 24 of the pulley body 15 building the boundary surface between the pulley body and the rim 16.

[0031] In figure 4 the corrugation profile is triangular 24a with the upper peaks 45 being radially aligned with the groove bottom 28.

[0032] In figure 5 the corrugation profile is sinusoidal 24b with the upper peaks 47 being radially aligned with the groove bottom 28.

[0033] Finally, figure 6 shows a kind of square profile 24c of the corrugations where the positive sections 40 of the square profile 24c are centered below the groove bottom 28. Also in this case the thickness of the rim is reduced in the groove bottom center by the shape of the outer circumference of the rope pulley body. The width of the positive sections w_s is preferably in the range of on quarter to one half of the groove width w_g. By this measure it is obtained that additional to the minimization of the rim thickness below the groove bottom, the rim thickness below the groove edges is increased, which still improves the noise characteristics of the pulley in operation.

[0034] Finally, figure 7 shows an embodiment of a corrugation profile 24d consisting of an anticlinal part 48 comprising arcs centered below the groove bottom as well as square parts 51 located in the area between the grooves. The anticlinal part 48 is provided for keeping the groove bottom hard with respect to the groove edges whereas the square part 51 is provided for a good, particularly axial contact between the material of the rim 16 and the pulley body.

[0035] The different embodiments can be combined arbitrarily as long as this is technically feasible.

[0036] The invention can be realized within the scope of the appended patent claims.

Claims

1. Elevator rope pulley comprising a rotation center, a hub (12), a pulley body (15) surrounding the hub and a rim (16) surrounding the pulley body and containing rope grooves (18) along its circumference, each groove having groove edges (34) and a groove bottom (28), whereby the material of the pulley body is harder than the material of the rim, and wherein the outer surface (24) of the pulley body is corrugated along its circumference, which outer surface builds the boundary surface to the rim, whereby the corrugation profile (24 a-d) of the corrugated outer surface comprises in radial direction positive sections (26) or elevations and negative sections (30) or recesses, **characterized in that** the positive sections are radially aligned with the groove bottom (28) of the grooves.

2. Elevator rope pulley according to claim 1, wherein the center of the positive sections (26) are radially aligned with the groove bottom (28) of the grooves.

3. Elevator rope pulley according to claim 1 or 2, wherein the rim (16) is made of plastics or rubber.

4. Elevator rope pulley according to claim 3, wherein the rim (16) is made of Polyurethane.

5. Elevator rope pulley according to any of the preceding claims, wherein the corrugation profile of the outer surface is anticlinal (24).

6. Elevator rope pulley according to any of the preceding claims, wherein the corrugation profile of the outer surface is triangular (24a).

7. Elevator rope pulley according to any of the preceding claims, wherein the corrugation profile of the outer surface is sinusoidal (24b).

8. Elevator rope pulley according to any of the preceding claims, wherein the corrugation profile of the outer surface is square (24c).

9. Elevator rope pulley according to claim 8, wherein the square corrugation profile has tilted flanks (43).

10. Elevator rope pulley according to any of the preceding claims, wherein the corrugation profile (24d) of the outer surface has said positive sections (49) as well as a connection profile (51) located axially between the rope grooves to improve the connection of the rim and the rope pulley.

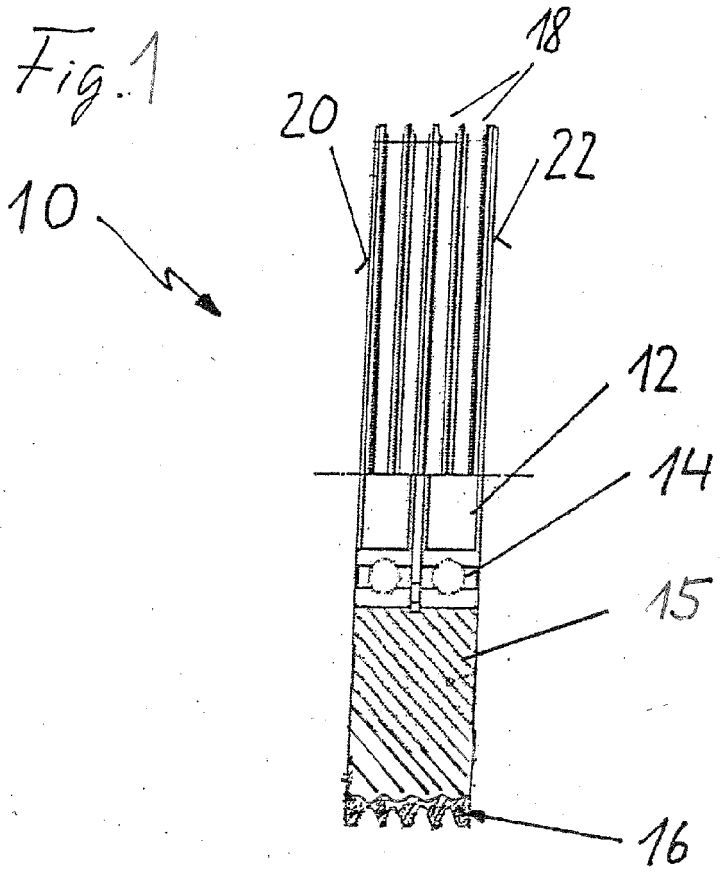
11. Elevator rope pulley according to any of the preceding claims, wherein the pulley body (15) is made from cast metal.

12. Elevator rope pulley according to any of the preceding claims, wherein the hub (12) comprises a bearing (14).

13. Elevator rope pulley according to any of the preceding claims, wherein the pulley is a traction sheave or diverting pulley.

14. Elevator having at least one elevator rope pulley according to one of the preceding claims.

Fig. 1



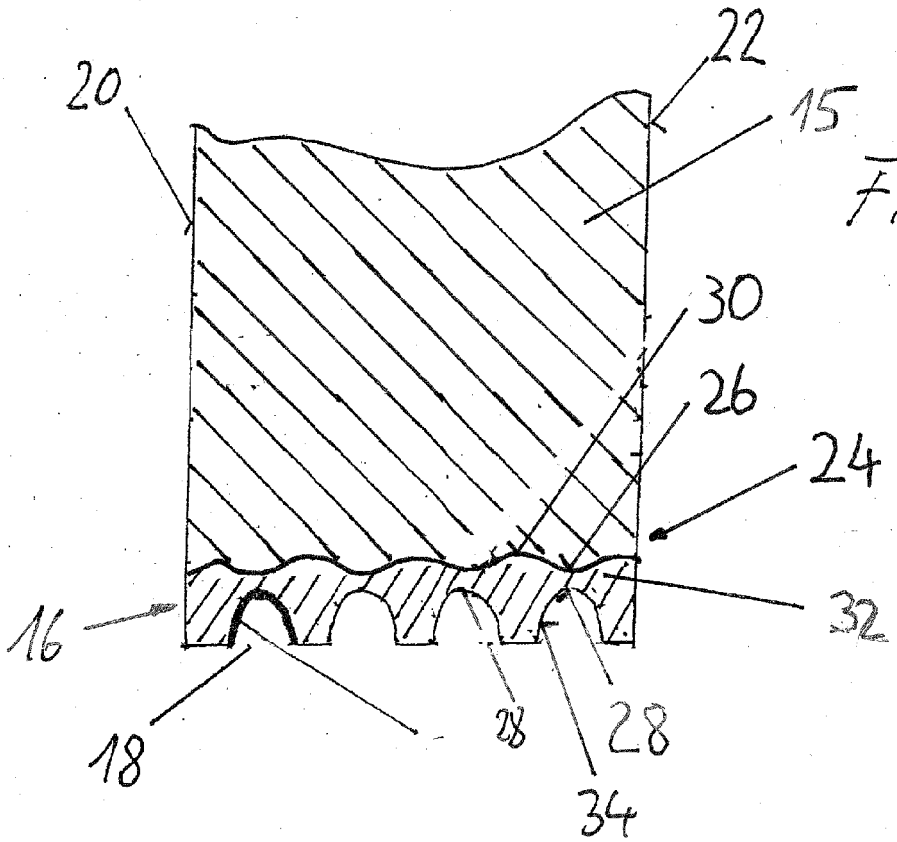
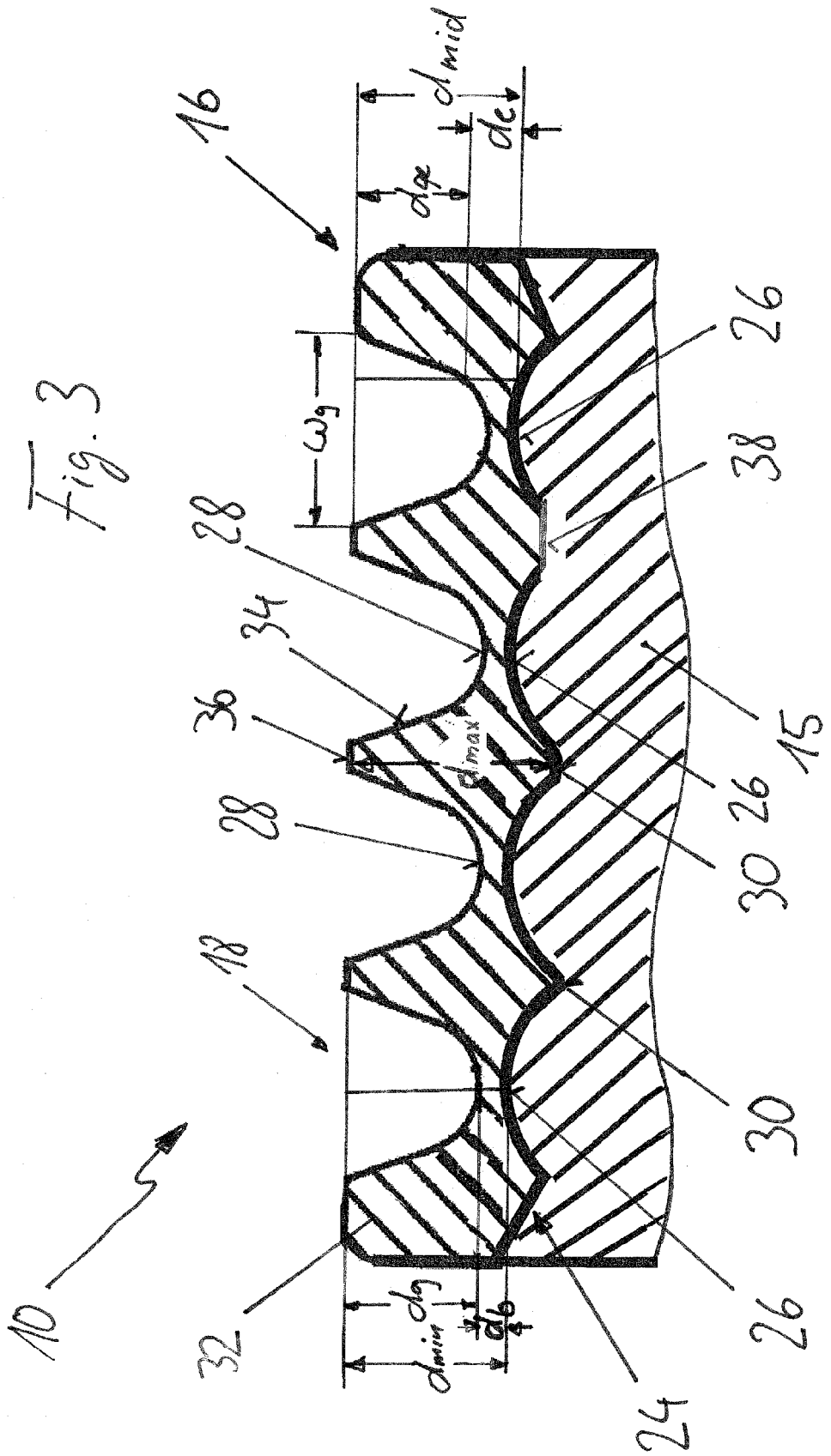


Fig. 2

Fig. 3


16
d_{mid}
d_c
d_g
w_g
26
38
28
34
36
d_{max}
15
28
30
26
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10
32
d_g
d_{min}
d_b
24
26

Fig. 4

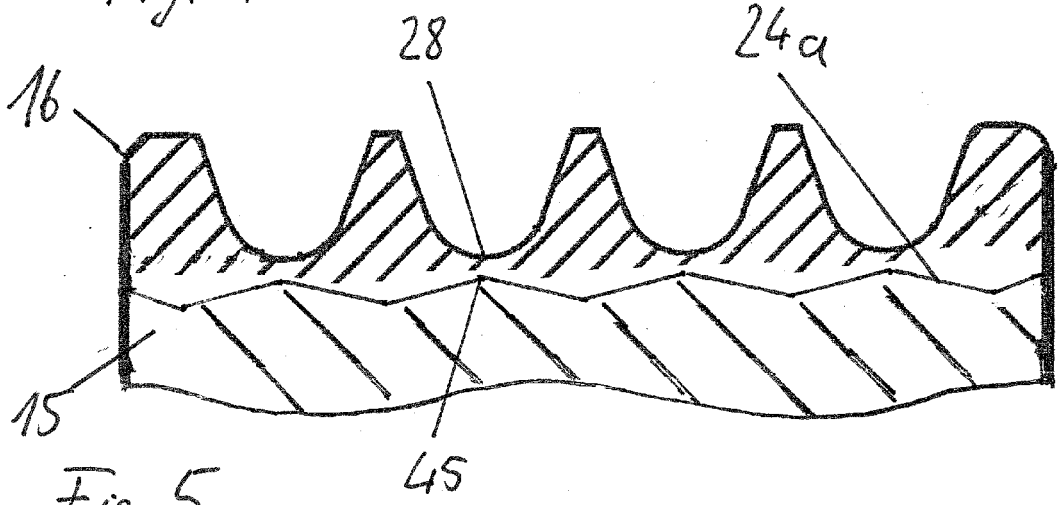


Fig. 5

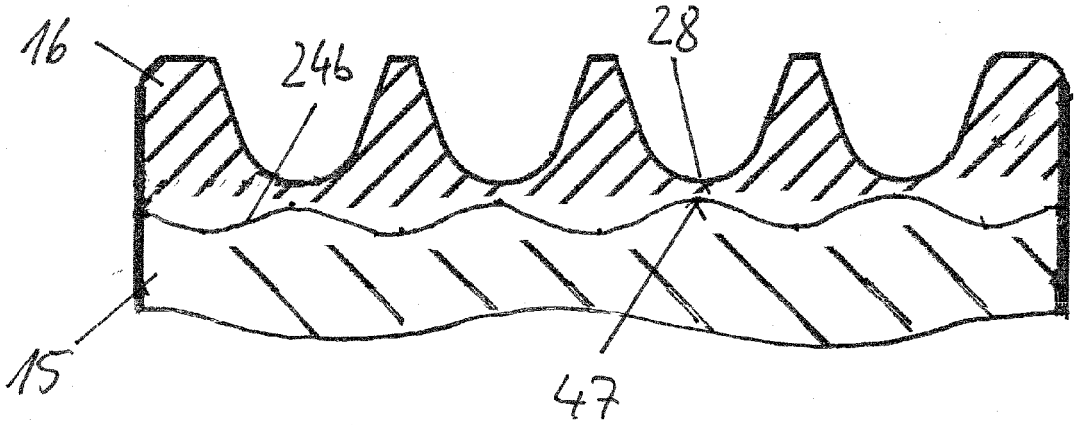


Fig. 6

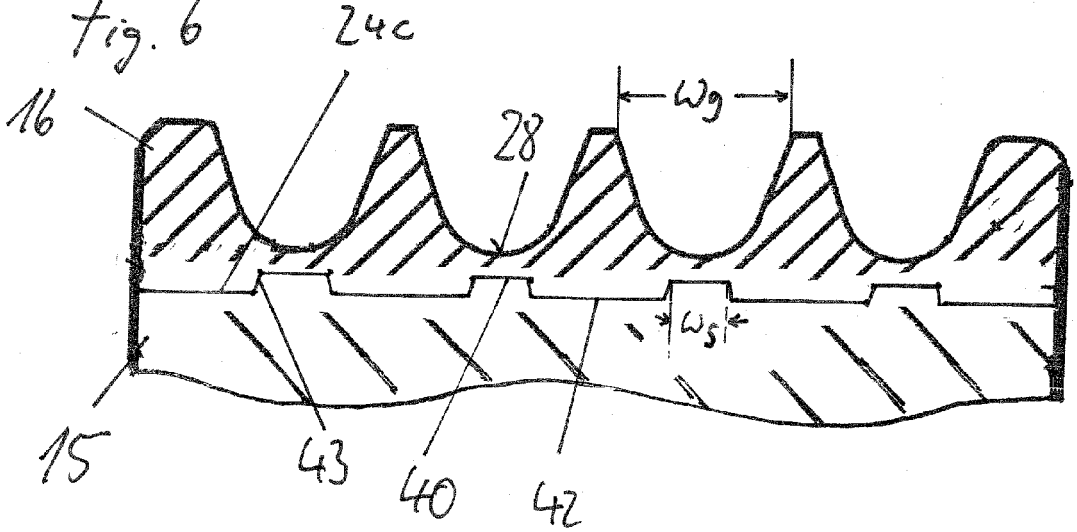
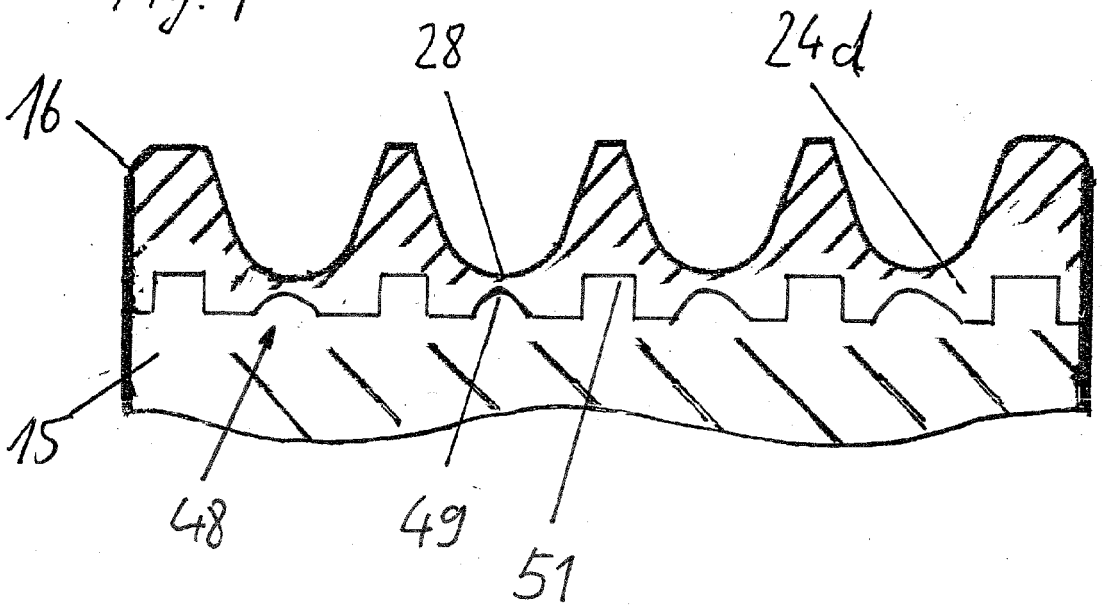


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 6349

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 465 161 A (OHTA KAZUTOSHI [JP] ET AL) 14 August 1984 (1984-08-14) * abstract; figures 1-7 * * column 1, line 1 - column 2, line 64 * * column 4, lines 44-49 * * claim 1 * -----	1-11,13, 14	INV. B66B15/02 B66B15/04
A,D	EP 1 339 629 A1 (KONE OYJ KONE CORP [FI]) 3 September 2003 (2003-09-03) * the whole document * -----	1-14	
A	JP 59 195248 U (-) 25 December 1984 (1984-12-25) * figures 1-4 * -----	1-14	

TECHNICAL FIELDS SEARCHED (IPC)
B66B B66D F16H

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 December 2012	Bleys, Philip

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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17-12-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4465161 A	14-08-1984	CA 1186676 A1	07-05-1985
		JP 57137285 A	24-08-1982
		MX 156333 A	09-08-1988
		US 4465161 A	14-08-1984
EP 1339629 A1	03-09-2003	AT 327960 T	15-06-2006
		AT 474806 T	15-08-2010
		AU 1717802 A	18-06-2002
		BR 0116040 A	14-10-2003
		CA 2427361 A1	13-06-2002
		CN 1476409 A	18-02-2004
		CZ 20031583 A3	13-10-2004
		DE 60120212 T2	21-09-2006
		DK 1339629 T3	25-09-2006
		EP 1339629 A1	03-09-2003
		EP 1688384 A2	09-08-2006
		ES 2260340 T3	01-11-2006
		ES 2347061 T3	25-10-2010
		FI 20002701 A	09-06-2002
		HK 1059073 A1	26-08-2005
		HU 0302652 A2	28-11-2003
		JP 2004515430 A	27-05-2004
		MX PA03004800 A	10-09-2003
		NO 20032530 A	04-06-2003
		PL 365519 A1	10-01-2005
		PT 1339629 E	29-09-2006
		RU 2302368 C2	10-07-2007
		SK 6932003 A3	04-11-2003
		UA 75096 C2	15-08-2003
		US 2003192743 A1	16-10-2003
		US 2008041667 A1	21-02-2008
		WO 0246086 A1	13-06-2002
		ZA 200303741 A	16-08-2004
JP 59195248 U	25-12-1984	JP 2005151 Y2	07-02-1990
		JP 59195248 U	25-12-1984

EPO FORM P0459

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Patent documents cited in the description

- EP 1339629 A **[0001]**