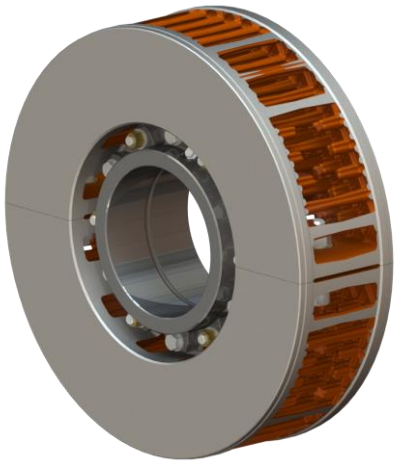
WORK PACKAGE 1 (WP1)

Optimization of DRFB disc crown

PROJECT DELIVERABLE 1.4

PATENT FILING



FUTUre RAil freight transport: cost-effective, safe, quiet and green! – FUTURA

The FUTURA project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No.700985

June 2017

TABLE OF CONTENTS

Document authors and reviewers

Lead Authors

Name	Organization
Ivan Smolej	KOVIS d.o.o
Uroš Grivc	KOVIS d.o.o

Reviewers

Name	Organization
Alen Šinko	KOVIS d.o.o
Mitja Črpič	KOVIS d.o.o
David Deržič	KOVIS d.o.o

LIST OF FIGURES

LIST OF TABLES

INDEX OF ABBREVIATIONS

DRFB Divided rail freight brake

IP Intellectual property

URSIL Intellectual Property Office of the Republic of Slovenia

1 INTRODUCTION

The scope of the document is to present intellectual property (IP) protection, precise patent parameters, patent application process, as well as registering the patent for DRFB disc.

2 REFERENCE STANDARDS

Table 1: Reference standards

Document Nr.	Revision	Title
UIC 541-3	2010-07	Brakes – Disc brakes and their application – General conditions for the approval of brake pads
EN 14535-1	2005-12	Railway applications – Brake discs for railway rolling stock– Part 1

3 PATENTING PARAMETERS

As final design of DRFB disc and fulfilment of specific objectives were finished, the precise parameters for patenting optimized DRFB disc were set. These parameters are:

1. Optimal form of projection of cooling ribs between the plates (improved shape of cooling ribs), ensuring high intensity of cooling.
2. Method of attaching both parts of DRFB disc crown.
3. Method of attaching DRFB disc crown to hub
4. Method of assembly/disassembly of DRFB disc to/from the axle of freight wagon

3.1 Optimal form of projection of cooling ribs between the plates

On DRFB (divided rail freight brake) disc, an optimal form of projection of cooling ribs between the plates was introduced. As it can be seen from the Figure 1, the cooling system is designed from both high and low ribs. High ribs form a solid structure of the disc, which serves to transfer and withstand the stresses caused by braking. On the other hand, low ribs are designed for even heat distribution on all surfaces of the brake discs. Evenly distributed heat prevents occurrence of non-allowable stresses. This cooling system improves thermal performance of the DRFB disc.

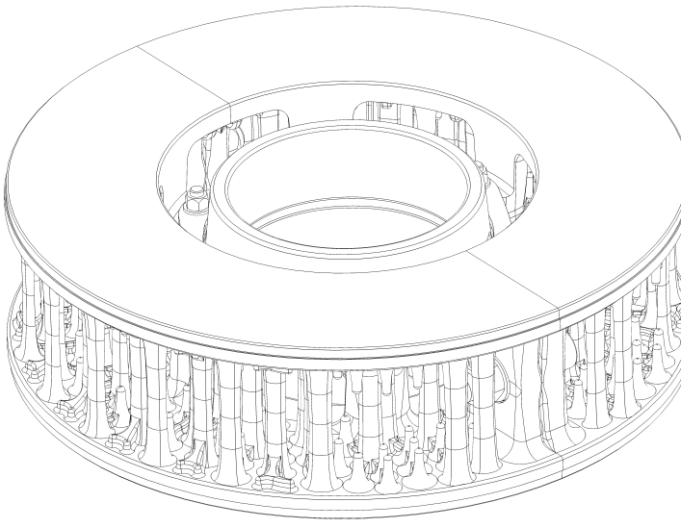


Figure 1: Execution of cooling

The height, shape and base radius of low ribs was carefully designed, just enough to dissipate the heat energy. Since the heat dissipates only up to the end of low ribs, there is no need for these ribs to be connected.

High ribs starts with radius from inner surface of brake plate and connect both brake surfaces. Their role is to form the solid structure of the brake disc, and transfer all braking load.

On the other hand, low ribs serve to dissipate the heat. Low round ribs start with big radius from inner surface of the brake plate, and go into height approximately 35mm. On the top, diameter of the round rib is approximately 8mm.

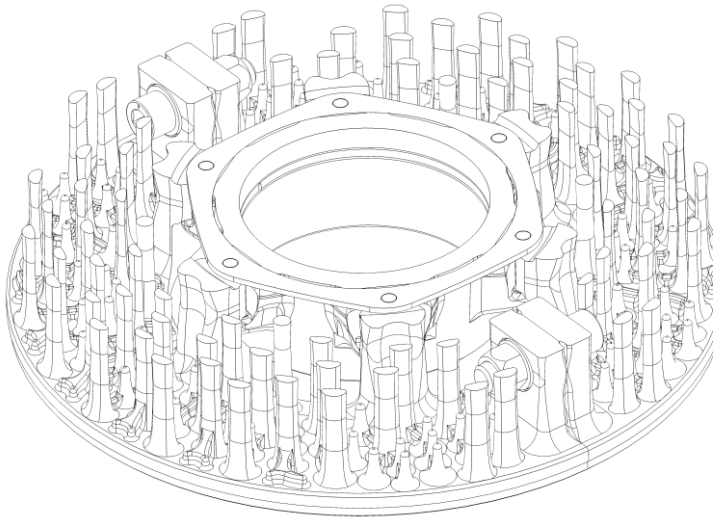


Figure 2: Section of DRFB disc

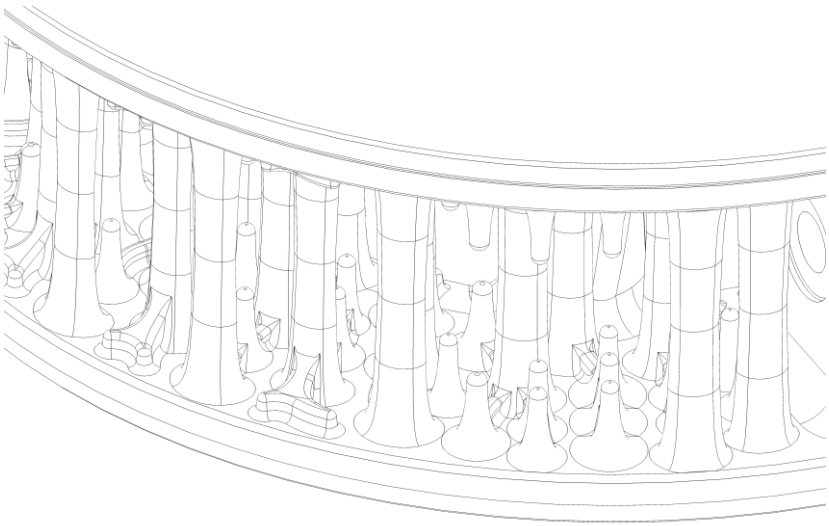


Figure 3: High and low ribs

As it can be seen from Figure 4, the cooling system has a portion of low ribs, which are radially connecting high and low ribs at the bottom of inner side of friction surfaces. These ribs have approximate height of 7mm.

Also, the both disc halves have unique pattern of cooling shape.

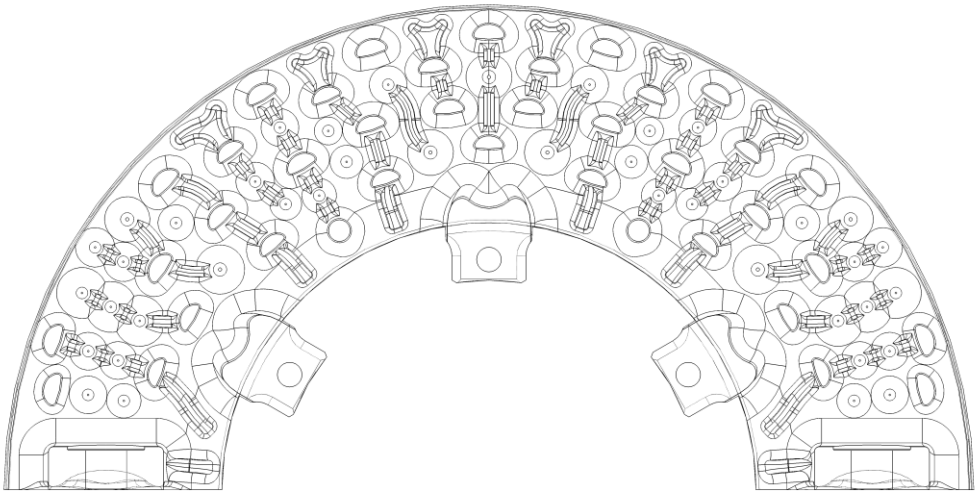


Figure 4: Unique shape of cooling ribs

This execution of cooling has lowered the mass of the disc for 21%, while keeping the same performance, in comparison with the state-of-the-art non-divided brake discs, which is currently used in freight transport.

3.2 Method of attaching both parts of DRFB disc crown

DRFB disc is made from two halves. This enables easy replacement of worn DRB disc crowns without removing the wheels and axle boxes from the axle.

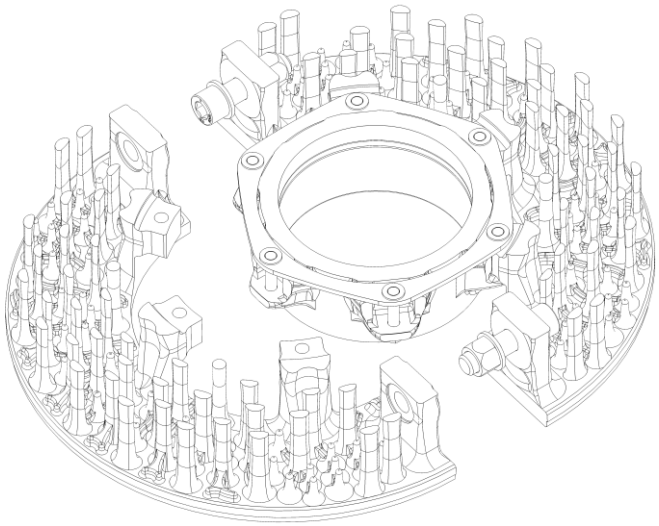


Figure 5: Two halves of DRFB disc

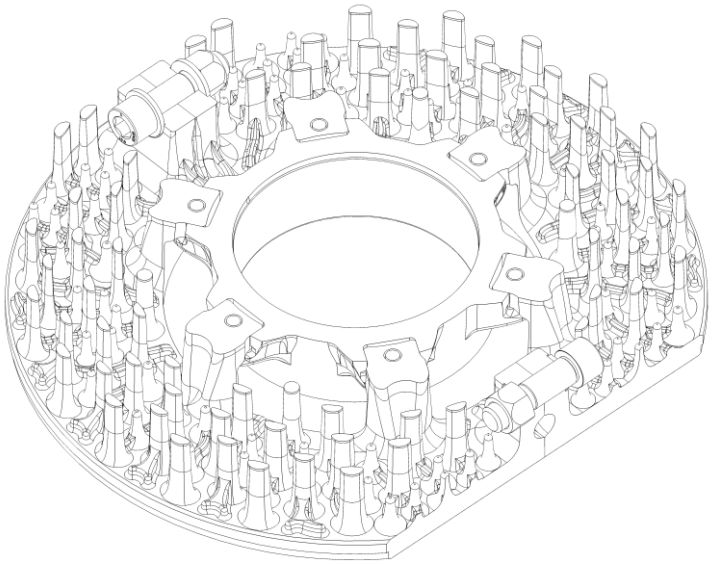


Figure 6: Connected DRFB disc halves

DRFB disc crown halves are connected with special bolts M24x90 (Figure 7). On both crowns there are two holes which are made in tight tolerance field (Ø25 H8). The connecting bolts M24x90 are also made on tight tolerance field (Ø25 f6). The length of tight connection is 50mm. When connected together and tightened to proper tightening torque, this connection provides firm structure of brake disc.

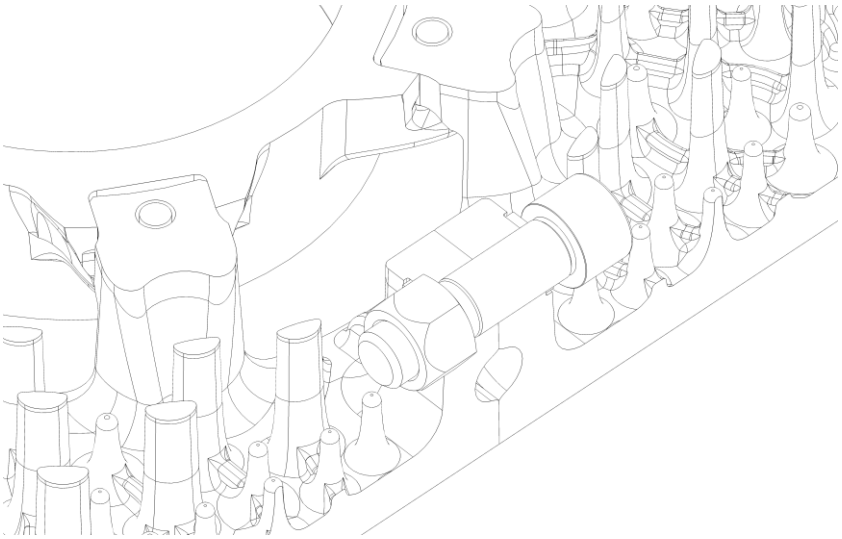


Figure 7: Special bolts M24x90

3.3 Method of attaching DRFB disc crowns to hub

DRFB disc crown and hub are connected through six connecting ears with special shape, which serve to transmit braking torque. This connection is machined on tight tolerance, providing high safety while transferring the braking torque, and enabling perfect centering of crown and the hub.

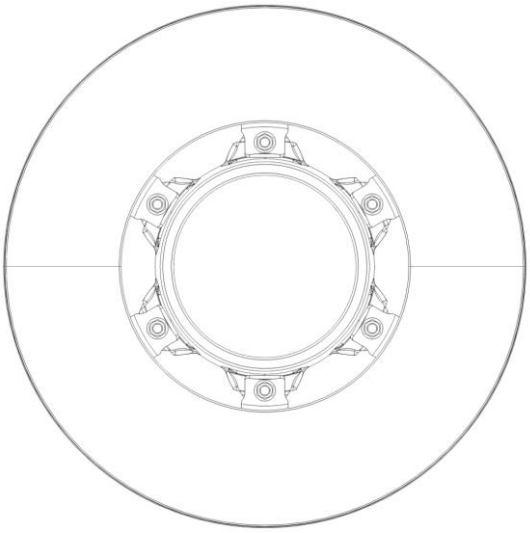


Figure 8: Arrangement of DRFB disc crown to hub connection

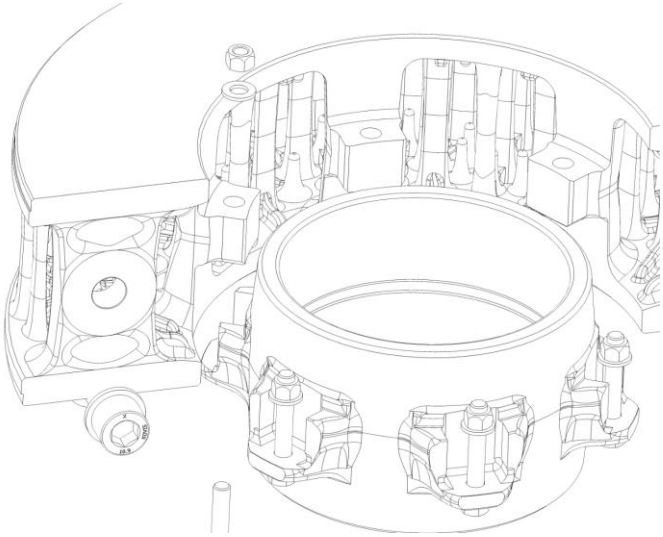


Figure 9: Exploded view of DRFB disc crown to hub connection

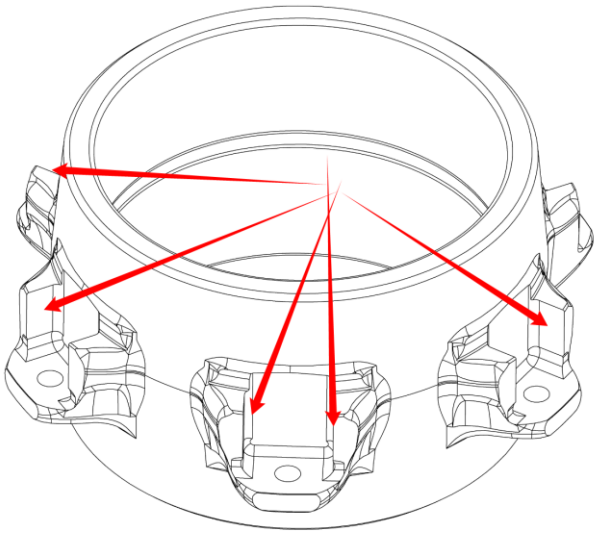


Figure 10: Torque transmitting faces on the hub

This connection is 3,7 times safer then connection with only pretension of bolts, which was used in first two prototypes.

3.4 Method of assembly/disassembly of DRFB disc onto the axle

Brake discs are mounted on the axle together with wheels and axle boxes (Figure 11).

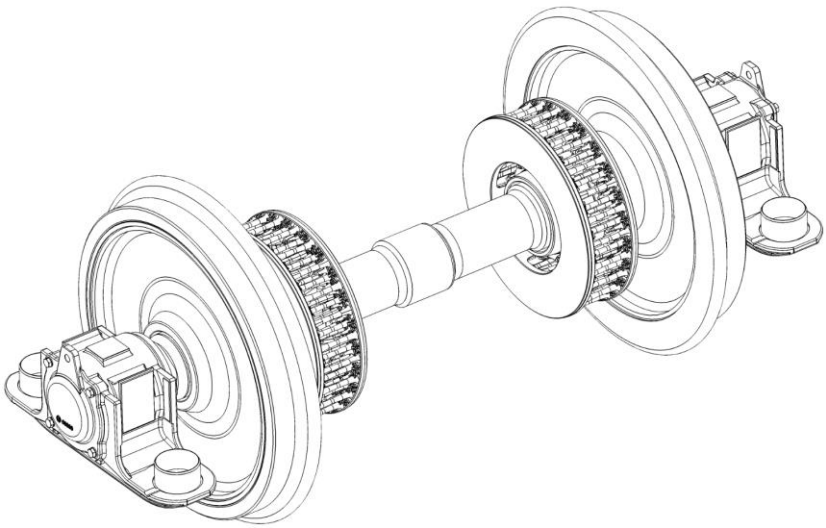


Figure 11: Arrangement of discs on the axle

As already mentioned in chapter 2, for replacement of non-divided brake disc, there is a need for dismounting axle boxes and wheels (Figure 12).

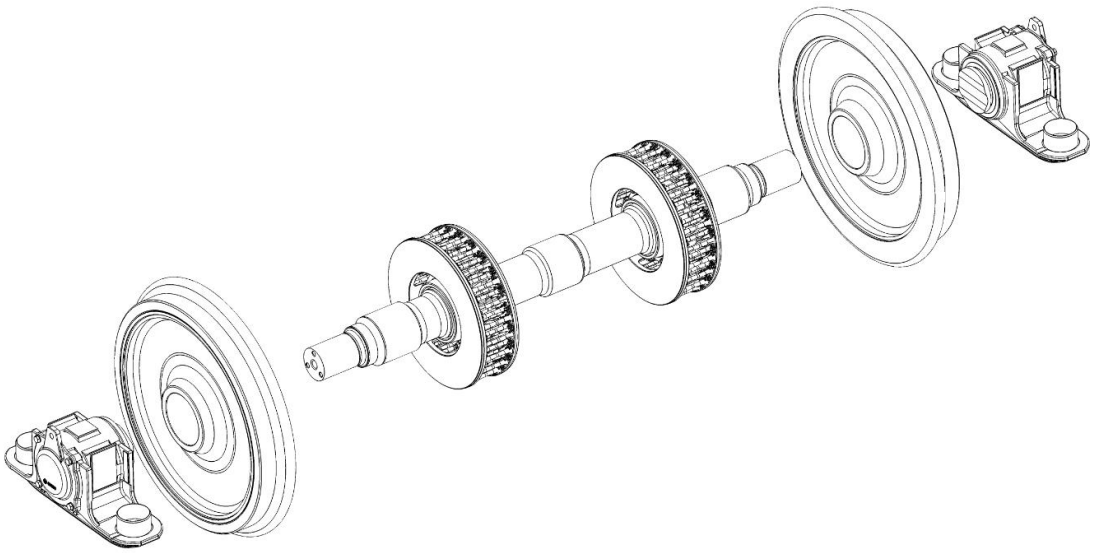


Figure 12: Dismounting of non-divided brake disc

With divided DRFB disc, the replacement of disc can be executed without removal of these components. The novelty is that DRFB disc crowns, due to connection with bolts M24x90, can be exchanged by rotation of only one half, without separating them. The process is following:

1. Completely remove one M24x90 connecting bolt from the disc.
2. Slightly loosen the second M24x90 connecting bolt, so that both halves of DRFB disc crown are movable.
3. Rotate one half of crown around connecting bolt body for minimum 90°.

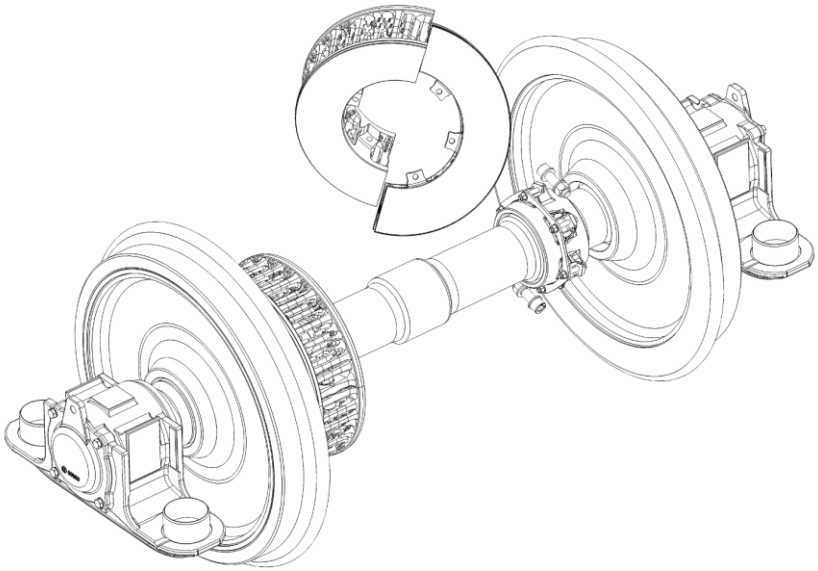


Figure 13: Rotating two halves around connecting bolts

4. Lower the entire disc on the axle.
5. Rotate back one half of crown until the bolt holes Ø25 of both halves are in the center. Now the disc is positioned around the axle.

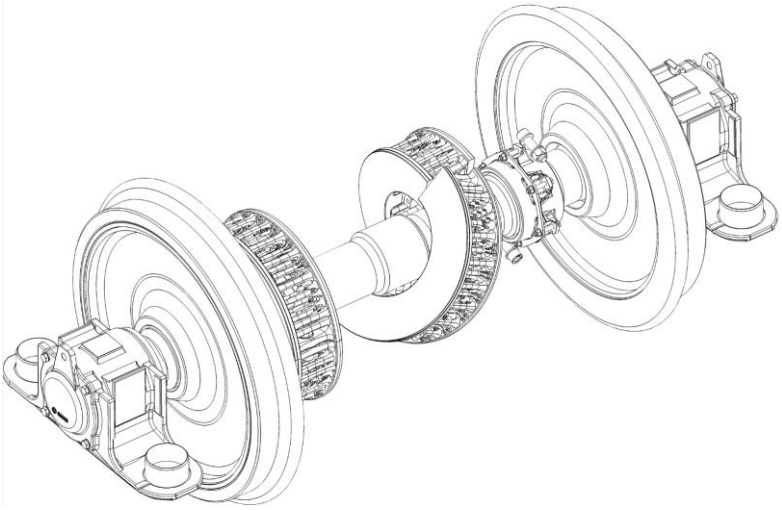


Figure 14: Lowering and rotating DRFB disc onto the axle

6. Insert previously removed bolt M24x90.
7. Tighten the both M24x90 bolts with prescribed torque.

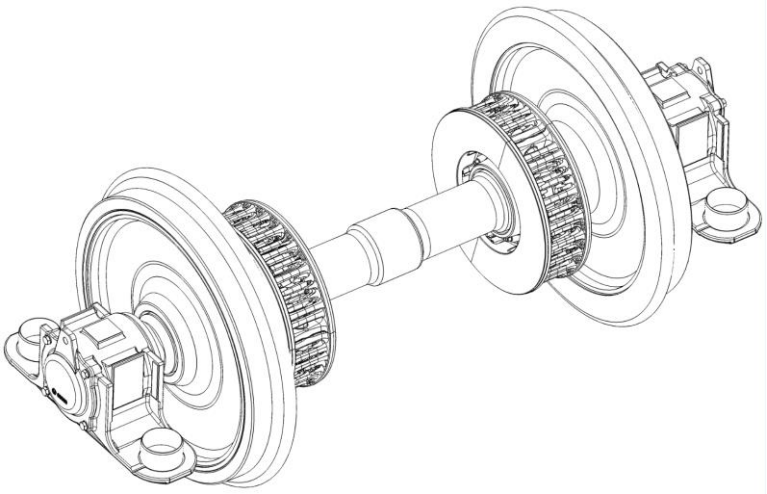


Figure 15: Mounted DRFB disc

4 PATENT APPLICATION PROCESS

Patent application parameters were set for four innovations: protection of optimal form of projection of cooling ribs between the plates of DRFB disc (improved shape of cooling ribs), ensuring high intensity of cooling, method of attaching both parts of DRFB disc crown, method of attaching DRFB disc crown to hub, and type of assembly/disassembly of DRFB disc to/from the axle of freight wagon.

Patent parameters were sent to patent office in the form of records, animation videos, and pictures. Followed by careful examination of patent parameters, patent office concluded that it is impossible to put them in one application (since they represent different solutions). Therefore, the patent application offers were divided into two patent applications. Method of high intensity cooling solves the problem of thermal performance, while on the other hand; the latter three are solving the construction improvements of DRFB disc.

4.1 1st patent application P-201700188

First patent application P-201700188 protects optimal form of projection of cooling ribs between the plates (improved shape of cooling ribs), ensuring high intensity of cooling. Method of high intensity cooling solves the problem of thermal performance of DRFB disc.

Patent application was issued on 22nd of June by Intellectual Property Office of the Republic of Slovenia (URSIL), under number P-201700188. The patent is valid for one year in the whole world and ten years in Slovenia, from this date. The URSIL will publish the information on granted patent within eighteen months of the application date. Until then, temporary protection is valid, and patent is invisible to general public.

In this period of eighteen months, there is a possibility to have insight into patent applications only by certain request, and approval of Kovis.

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA GOSPODARSTVO

URAD REPUBLIKE SLOVENIJE
ZA INTELEKTUALNO LASTNINO
1000 LJUBLJANA, KOTNIKOVA 6

ZAHTEVA ZA PODELITEV PATENTA

1. **Naslov za obveščanje:**
ITEM d.o.o.
Resljeva cesta 16
1000 Ljubljana
Tel.: (01) 432 01 67
Faks: (01) 431 53 31 Šifra: 2173-P149/17

Potrdilo o prejemu prijave
(izpolni urad)
Datum vložitve prijave: 22-06-2017
Številka prijave: P-201700188
Žig urada in podpis:

2. **Prijavitelj** (priimek, ime in naslov; za pravne osebe firma in sedež):
Kovis d.o.o.
Brezina 102
SI-8250 Brežice

3. **Zastopnik:** ITEM d.o.o. Registrska številka: 134

4. **Izumitelj** (priimek, ime in naslov):
Uroš Grivc, Lončarjev dol 17A, 8290 Sevnica
David Deržič, Ponikve 20A, 8261 Jesenice na Dolenjskem

5. **Naziv izuma:** A low mass brake disc with improved shape of cooling ribs

6. **Podatki o zahtevani prednostni pravici in podlagi zanjo:**

7. **Dodatne zahteve:**
☐ prijava je za patent s skrajšanim trajanjem
☐ predhodna objava patenta po preteku____ mesecev
☐ prijava je izločena iz prijave številka:_____

8. **Izjava:**
☐ izjava o skupnem predstavniku

9. **Priloge**
☒ opis izuma, ki ima 7 strani
☒ patentni zahtevek (zahtevki), ki ima(jo) 2 strani; število zahtevkov: 9
☒ skice (če so zaradi opisa izuma potrebne); število listov: 5
☒ povzetek
☐ potrdilo o plačilu prijavne pristojbine _____
☐ potrdilo o deponiranju biološkega materiala, če gre za izum, ki ga ni mogoče drugače opisati
☐ pooblastilo zastopniku
☐ generalno pooblastilo zastopniku je deponirano pri uradu pod št.: ____
☐ potrdilo o razstavni prednostni pravici
☐ podatki o drugih prijaviteljih
☒ podatki o drugih izumiteljih
☐ prikaz zaporedja nukleotidov ali aminokislin v opisu
☐ prijava je bila predhodno posredovana po faksu ali v elektronski obliki
☐ ____

ITEM d.o.o., Tatjana Jeršan
Priimek in ime ter podpis prijavitelja (zastopnika)

Obrazec SIPO P-1

Figure 16: Patent application P-201700188

4.1.1 Content of patent application P-201700188

1

A low mass brake disc with improved shape of cooling ribs

The present invention relates to brake discs, i.e. to an improved construction of a brake disk for disc brakes especially for railway vehicles. Disc brakes are formed from two parts, a brake disc and a hub. Hub is mounted on the axle by pressing with the pressing machine, while brake disc is mounted on the hub by a connecting element, which is preferably bolt, or by other type of connection. On the inner periphery of the brake disc and on the outer periphery of the hub mounting brackets are formed, which are positioned at even intervals. When joined together, they form a solid connection, which then serves to transmit braking torque and forces.

A brake disc is formed of two coaxial annular plates which are interconnected by radial ribs or a helical portion. A brake disc of a disc brake must dissipate a very large amount of thermal energy, for example when braking a heavy vehicle, i.e. railway vehicle, or a vehicle which travels at high speed. In the course of such braking the high kinetic energy of the vehicle is transformed into heat energy which heats a brake disc and consequently influences the efficiency of the disc brake. Due to the temperature rise, the efficiency of the disc brake is reduced, i.e. the friction coefficient decreases and thus the friction force decreases. High temperatures and local differences in temperature can cause mechanical damage to the surface of the brake disc which results in cracks and plastic deformation of the brake disc.

It is known to improve the capability of the disc to dissipate heat energy by forming therein passages for the passage of air so as to increase the surfaces of contact of the disc and the cooling air. However said passages can result in the formation of cracks which can ultimately result in breakage of the disc.

In document GB 1449512 a disc for a disc brake is disclosed which comprises two coaxial annular plates interconnected by cross members defining between them passages for the flow of cooling air, wherein a plurality of bands of cross members are

provided, the cross members of each band being disposed along a respective circular path and being substantially evenly spaced apart. The cooling is improved with respect to that obtained with discs having radial ribs, since, on one hand, the cylindrical cross members produce a whirling flow of the air and, on the other hand, the surface of exchange is greater.

In document SI23474 a disc for a disc brake is disclosed which comprises two coaxial annular plates (discs) interconnected by cross members defining between them passages for the flow of cooling air and which comprises on the inner sides of discs additional cooling elements in a form of protrusions which are situated linear around cross members in a raster form. With said protrusions the heat exchange area of the disc is increased which results in better heat transfer into the surrounding during braking. The cooling intensity is also increased due to the increased air turbulence between the discs.

However if the amount of heat to be dissipated is great and the surfaces of contact between the air and the discs is still insufficient for adequate and fast heat dissipation, there was a need for further improvement of cooling of a brake disc.

In brake discs especially for railway vehicles, adequate and fast heat dissipation is predominantly limited by heat conduction properties of brake disc material which is still relatively high for grey cast iron from which brake discs are made for railway vehicles and also by the dimensions of the disc. Heat dissipation towards the center of the brake disc is too slow which can be problematic especially when the train composition already stops or for emergency and service stops.

So it is desirable to dissipate heat from the friction surfaces even faster, so the temperatures would be lower and brake disc would be exposed to less thermal strain, which would benefit in further reduction of the mass of the brake disc, in less deformation of the brake disc, friction properties would remain better, and less wear

would be caused on the braking elements during braking.

This is achieved with the improved construction of a brake disk according to the invention. With the proposed construction, higher heat conduction away from the friction plates is achieved by increasing the heat flux behind the friction plates where cooling ribs are located.

This is done by including additional small hyperbolically shaped cooling ribs and low profile ribs to the load carrying cooling ribs, which interconnect two coaxial annular plates, wherein low profile ribs connect load carrying cooling ribs and/or small hyperbolically shaped cooling ribs. Low profile ribs also connect some of the load carrying cooling ribs which are positioned along the outer and the inner end of the annular plates with the outer and the inner edge of said annular plates.

Said small hyperbolically shaped cooling ribs and low profile ribs act as thermal heat absorbers or capacitors and because they are distributed more uniformly and close to the heat source, i.e. the friction surface, temperature of friction surfaces is decreased. Also because these ribs are close to the heat source they heat up faster so larger area of the brake discs' cooling area gets hotter which improves heat convection. Additionally the cross sectional area at the base of the cooling ribs, i.e. load carrying cooling ribs, small hyperbolically shaped cooling ribs and low profile ribs, is increased. With this design the heat dissipation during braking is improved, as forced heat convection is not fast enough and has negligible effect on heat dissipation while short and powerful braking occurs. Namely ribs aren't heated up yet to dissipate heat which is dependent on temperature of the cooling ribs' surfaces and air flowing through the brake discs center. When cooling ribs start to heat up the train has already stopped or moving really slowly which negatively effects thermal convection even further. With this construction the mass from the centre of the brake disc is moved more towards the disc plates, the number of load carrying cooling ribs is reduced and consequently the mass of the brake disc is reduced.

4

The invention will be further described below and presented on figures:
Fig. 1 presents a brake disc according to the invention
Fig. 2 presents a sectional of a brake disc according to the invention
Fig. 3 presents a cross-section of a brake disc according to the invention
Fig. 4 presents a graph which shows ventilation losses for different designs of brake discs
Fig. 5 presents a graph which shows drag brake characteristics for different designs of brake discs
Fig. 6 presents a graph which shows emergency stop characteristics for different designs of brake discs.

A brake disc 1 which is shown on Fig. 1 to 3 is formed of two coaxial annular plates 2, i.e. friction plates, which are interconnected by load carrying cooling ribs 3. Load carrying cooling ribs 3 are parallel to the rotational axis of the brake disc 1 and are essentially evenly distributed they are positioned in a circular pattern, on the surface of the plates 2 and connect both inner surfaces of both plates 2. Load carrying cooling ribs 3 form the solid structure of the brake disc 1, which serves to transfer and withstand the stresses caused by braking. At least six mounting brackets 10 are positioned at even intervals on the inner periphery of the brake disc 1 for mounting the brake disc 1 on the hub.

Between load carrying cooling ribs 3 small hyperbolically shaped cooling ribs 4 are positioned at certain locations on the inner surface of both plates 2 and are designed in such a way to enable even heat distribution on all surfaces of the brake discs. Evenly distributed heat prevents occurrence of non-allowable stresses. Small hyperbolically shaped cooling ribs 4 are parallel to the rotational axis of the brake disc 1 and protrude from the inner surfaces into the space between the plates 2 and have the height between 10 to 30% of the width of the brake disc 1 preferably their height is 20% of the width of the brake disc 1.

5

Additionally low profile ribs 5 are positioned on the inner surface of both plates 2. Said low profile ribs 5 connect, essentially in the radial direction, at least two adjacent load carrying cooling ribs 3 or two adjacent small hyperbolically shaped cooling ribs 4 or at least one adjacent load carrying cooling rib 3 and one small hyperbolically shaped cooling rib 4. Low profile ribs 5 also connect some of the load carrying cooling ribs 3 which are positioned along the outer and the inner end of the annular plates 2 with the outer and the inner edge of said annular plates 2. Low profile ribs 5 have the height between 1 to 5% of the width of the brake disc 1, preferably 4 %. Low profile ribs are placed on most critical places for heat dissipation and structural stability which is determined by simulation. Numerous simulations showed that the optimal percentage of connected load carrying cooling ribs 3 and small hyperbolically shaped cooling ribs 4 with low profile ribs 5 should be between 60-80%, i.e. between 60 to 80 % of load carrying cooling ribs 3 and small hyperbolically shaped cooling ribs 4 should be connected by low profile ribs 5.

Load carrying cooling ribs 3 have circular cross-section, preferably ellipsoidal cross-section, small hyperbolically shaped cooling ribs 4 have preferably circular cross section with rounded top. Ellipsoidal cross-section of load carrying cooling ribs 3 is similar to an airfoil, except that it is symmetric, as brake discs are used in both directions of rotation, so the performance of the brake disc should be the same in both directions. Low profile ribs 5 have cross-section selected from various forms such as quadrangle, triangle, semicircle, ellipse segment, trapezoid, whereby the edges are rounded. Low profile ribs 5 have preferably trapezoidal cross-section. Low profile ribs 5 which connect some of the load carrying cooling ribs 3 which are positioned along the outer end of the annular plates 2 with the outer edge of said annular plates 2 have preferably cross section of any shape with variable radius to even more enlarge the area needed for better heat dissipation. For better structural stability, preferably twelve low profile ribs 5 connect load carrying cooling ribs 3 which are positioned along the outer end of the annular plates 2 with the outer edge of said annular plates 2.

6

All cooling ribs, i.e. load carrying cooling ribs 3, small hyperbolically shaped cooling ribs 4 and low profile ribs 5 have an enlarged cross-section of their base area 6, 7, 8, i.e. at the contact area of the individual rib 3, 4, 5 with the inner surface of the plates 2. The total enlarged cross-section of the base areas 6, 7, 8 is up to 7,5 times higher with regard to the total cross-section area of the cooling ribs 3, 4 and 5. For optimal cooling of the disc, cross-section of the base area 6, 7 and 8 should be enlarged to cover at least 60 % of the inner surface of the plates 2 preferably the base area 6, 7 and 8 should be enlarged to cover between 60 to 67% of the inner surface of the plates 2.
With careful selection of the height and the shape of small hyperbolically shaped cooling ribs 4 and low profile ribs 5 and with careful selection of the position of load carrying cooling ribs 3, small hyperbolically shaped cooling ribs 4 and low profile ribs 5 and with careful selection of the cross-section of the base areas 6, 7 and 8 we can optimize the brake disc according to braking application.

In tables 1 and 2 and in Fig. 4, 5 and 6 different characteristics measured for different designs of brake discs are shown.
Type “Initial” refers to the disc brake with load carrying cooling ribs which are placed in a circular pattern and with a circular cross section which are connected with a net system in the form of 6mm high cooling ribs.
Type “Futura 1” refers to the disc brake with load carrying cooling ribs which are placed in a circular pattern and with an ellipsoidal cross section similar to an airfoil except that it is symmetric as brake discs are used in both directions of rotation. The design also includes a net system in the form of 6mm high cooling ribs connecting load carrying ribs together.
Type “Futura 2” refers to the disc brake with load carrying cooling ribs which are placed in a circular pattern and with a circular cross section. The design includes small hyperbolically shaped cooling ribs and a net system in the form of 6mm high cooling ribs connecting only load carrying ribs. Less load carrying cooling ribs were used as some of them were replaced by small hyperbolically shaped cooling ribs.

7

Type "Futura 3" is the same as "Futura 2" wherein the middle row of load carrying cooling ribs has an ellipsoidal cross section as in "Futura 1". Additionally only 6 mounting brackets instead of 12 were used for mounting the disc brake to the hub.
Type "Futura 4" refers to the preferred embodiment of the disc brake according to the invention.

Table 1

Type	Mass [kg]	Thermal dissipation efficiency [W/m^2 K kg]:	Emergency brake temperature [°C]	Heat dissipation temperatures at 40 kW drag brake [°C]	Ventilation losses [W]
Initial	145	1	354	439	475
Futura 1	132,8	0.859	357	486	230
Futura 2	125	1.157	359	483	356
Futura 3	118	1.35	355	437	346
Futura 4	114		352	445	373

Table 2

Prototype	Mass [%]	Thermal dissipation efficiency [%]	Ventilation losses [%]
Initial	100	100	100
Futura 1	-8.3	-14	-51
Futura 2	-13.7	+15.7	-25
Futura 3	-18.6	+35	-27
Futura 4	-21.37		-22

With this construction the area from which heat is dissipated is enlarged and thus heat dissipation towards the center of the brake disc 1 is faster. The average temperature drop, i.e. the average wall heat transfer coefficient of the brake discs cooling ribs area, has risen for about 10 to 15 %. With the proposed construction of the brake disc 1 the mass of the brake disc 1 is reduced for 20%, while keeping the same performance, in comparison with the state-of-the-art non-divided brake disc, which is currently used in freight transport. Said brake disc with improved cooling can be used for divided brake

8

discs and for drag brake.

9

Claims

1. A low mass brake disc (1) with improved shape of cooling ribs for disc brake for railway vehicles wherein said brake disc (1) is formed of two coaxial annular plates (2) which are interconnected by load carrying cooling ribs (3) parallel to the rotational axis of the brake disc (1) and essentially evenly distributed on the surface of the plates (2) and connect both inner surfaces of both plates (2) and mounting brackets (10) are positioned at even intervals on the inner periphery of the brake disc (1) for mounting the brake disc (1) on the hub, characterized in that between load carrying cooling ribs (3) small hyperbolically shaped cooling ribs (4) are positioned and are parallel to the rotational axis of the brake disc (1) and protrude from the inner surfaces into the space between the plates (2) and additionally low profile ribs (5) are positioned on the inner surface of both plates (2) and connect, essentially in the radial direction, at least two adjacent load carrying cooling ribs (3) or two adjacent small hyperbolically shaped cooling ribs (4) or at least one adjacent load carrying cooling rib (3) and one small hyperbolically shaped cooling rib (4) and wherein low profile ribs (5) also connect some of the load carrying cooling ribs (3) which are positioned along the outer and the inner end of the annular plates (2) with the outer and the inner edge of said annular plates (2).
2. A low mass brake disc (1) according to claim 1, characterized in that the height of the small hyperbolically shaped cooling ribs (4) is between 10 to 30% of the width of the brake disc (1) preferably their height is 20% of the width of the brake disc (1).
3. A low mass brake disc (1) according to claims 1 and 2, characterized in that the height of the low profile ribs (5) is between 1 to 5% of the width of the brake disc (1), preferably 4 %.
4. A low mass brake disc (1) according to previous claims, characterized in that between 60 to 80 % of load carrying cooling ribs 3 and small hyperbolically shaped cooling ribs 4 are connected by low profile ribs 5.

5. A low mass brake disc (1) according to previous claims, characterized in that load carrying cooling ribs (3) have circular cross-section, preferably ellipsoidal cross-section, small hyperbolically shaped cooling ribs (4) have preferably circular cross section with rounded top and low profile ribs (5) have cross-section selected from various forms such as quadrangle, triangle, semicircle, ellipse segment, trapezoid, whereby the edges are rounded, preferably trapezoidal cross-section.
6. A low mass brake disc (1) according to previous claims, characterized in that low profile ribs (5) which connect some of the load carrying cooling ribs (3) which are positioned along the outer end of the annular plates (2) with the outer edge of said annular plates (2) have preferably cross section of any shape with variable radius.
7. A low mass brake disc (1) according to previous claims, characterized in that load carrying cooling ribs (3), small hyperbolically shaped cooling ribs (4) and low profile ribs (5) have an enlarged cross-section of their base area (6, 7, 8) at the contact area of the individual rib (3, 4, 5) with the inner surface of the plates (2).
8. A low mass brake disc (1) according to previous claims, characterized in that the cross-section of the base area (6, 7 and 8) covers at least 60 % of the inner surface of the plates (2), preferably between 60 to 67% of the inner surface of the plates (2).
9. A low mass brake disc (1) according to previous claims, characterized in that the total enlarged cross-section of the base areas (6, 7, 8) is up to 7,5 times higher with regard to the total cross-section area of the cooling ribs (3, 4 and 5).

11

Abstract

A low mass brake disc with improved shape of cooling ribs

The present invention relates to brake discs, i.e. to an improved construction of a brake disk for disc brakes especially for railway vehicles. A brake disc (1) is formed of two coaxial annular plates (2) which are interconnected by load carrying cooling ribs (3). Between load carrying cooling ribs (3) small hyperbolically shaped cooling ribs (4) are positioned and are parallel to the rotational axis of the brake disc (1) and protrude from the inner surfaces into the space between the plates (2) and additionally low profile ribs (5) are positioned on the inner surface of both plates (2) and connect, essentially in the radial direction, at least two adjacent load carrying cooling ribs (3) or two adjacent small hyperbolically shaped cooling ribs (4) or at least one adjacent load carrying cooling rib (3) and one small hyperbolically shaped cooling rib (4). All ribs (3, 4, 5) have an enlarged cross-section of their base area (6, 7, 8) at the contact area of the individual rib (3, 4, 5) with the inner surface of the plates (2). With this construction the area from which heat is dissipated is enlarged and thus heat dissipation towards the center of the brake disc (1) is faster and the mass of the brake disc (1) is reduced for 20%.

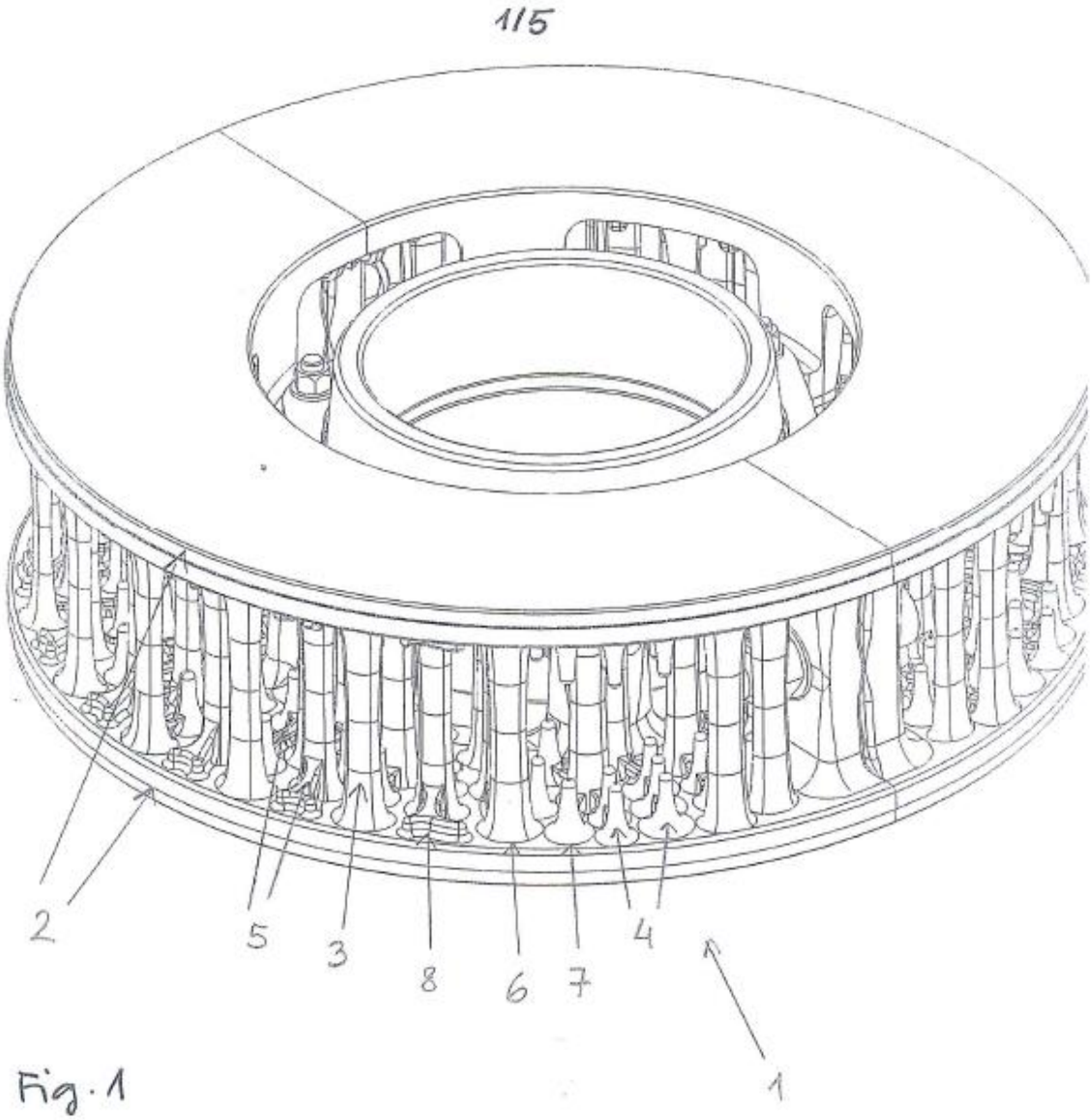


Fig. 1

2/5

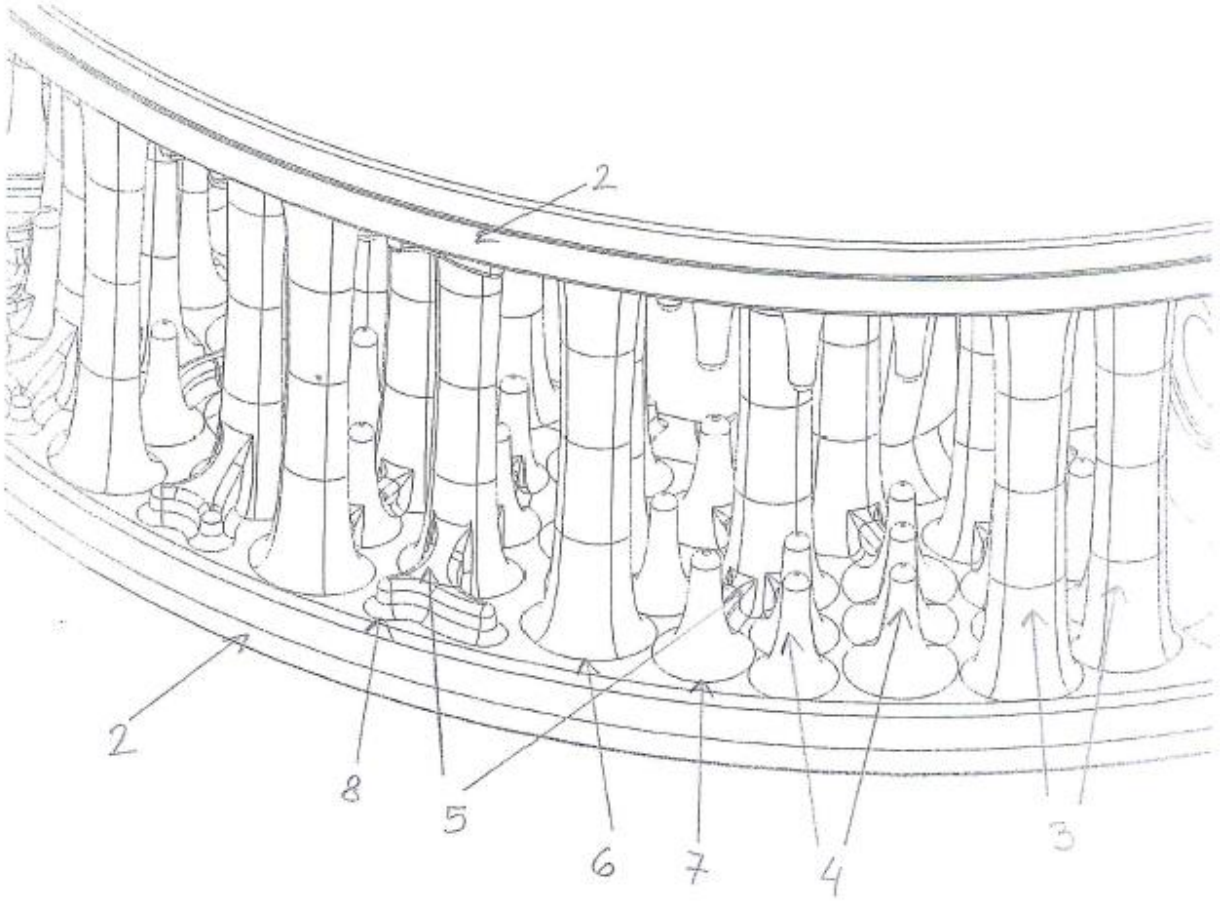


Fig. 2

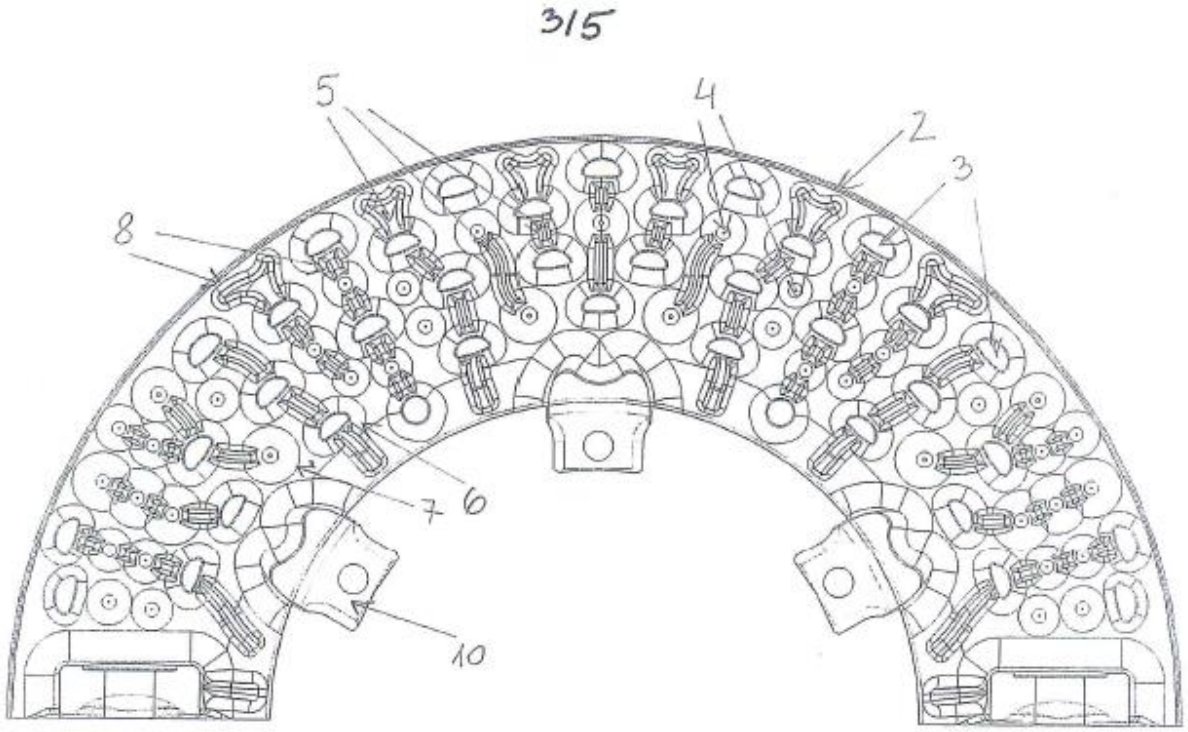


Fig. 3

415

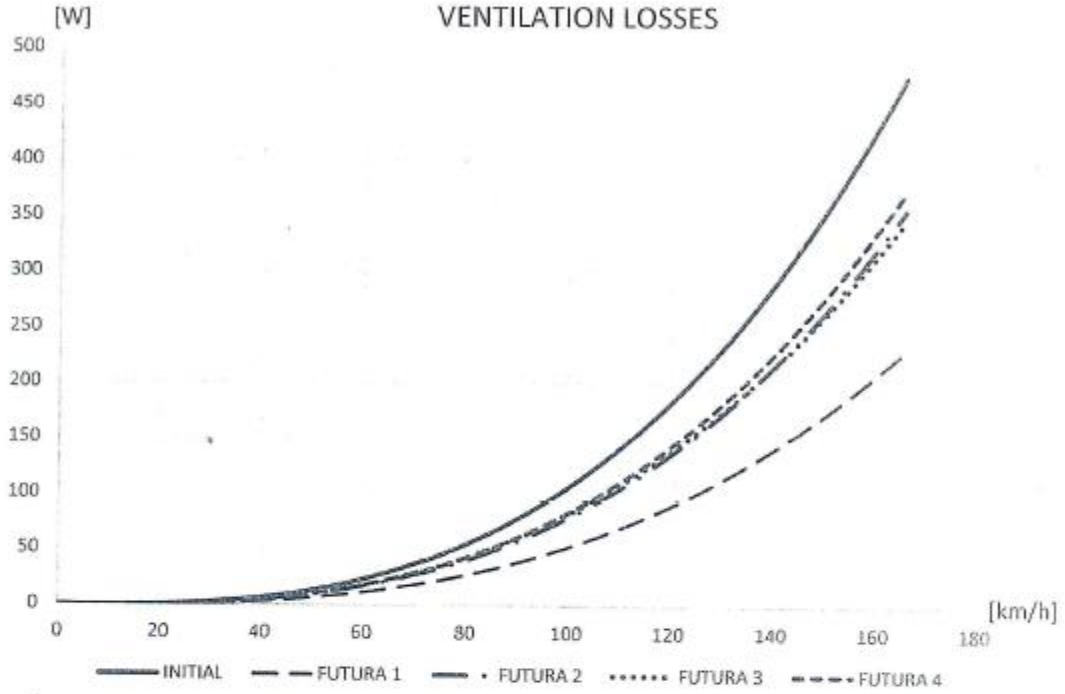


Fig.4

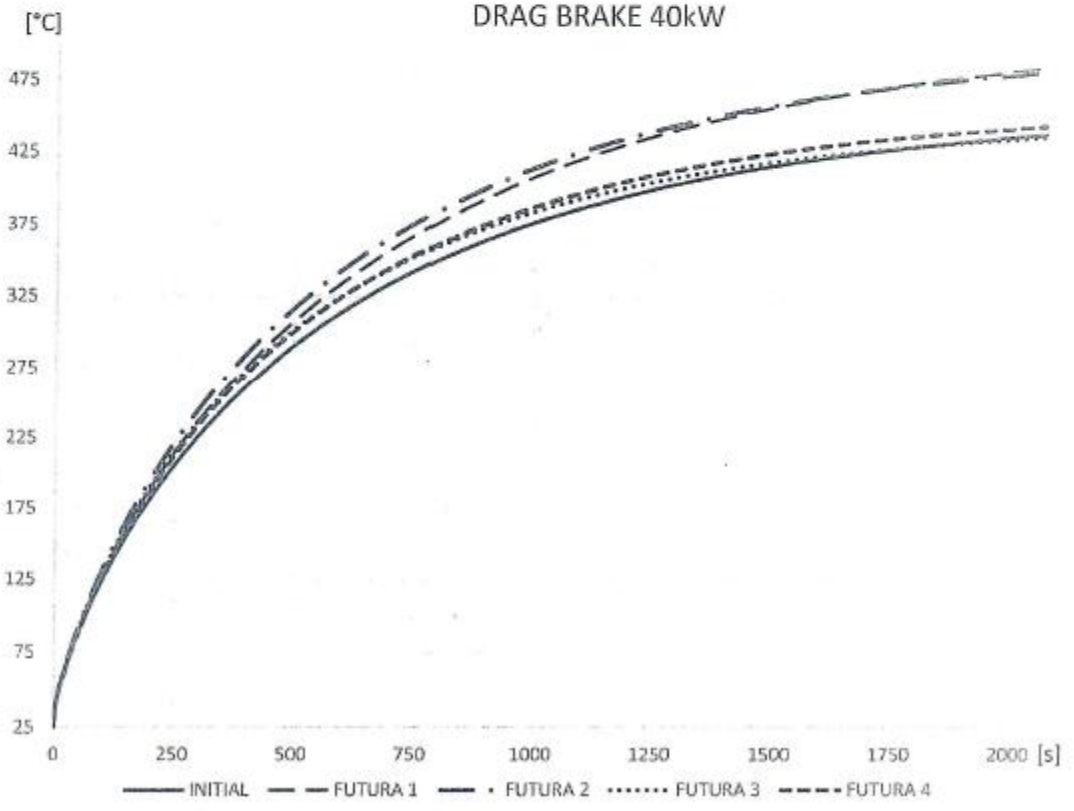


Fig. 5

5/5

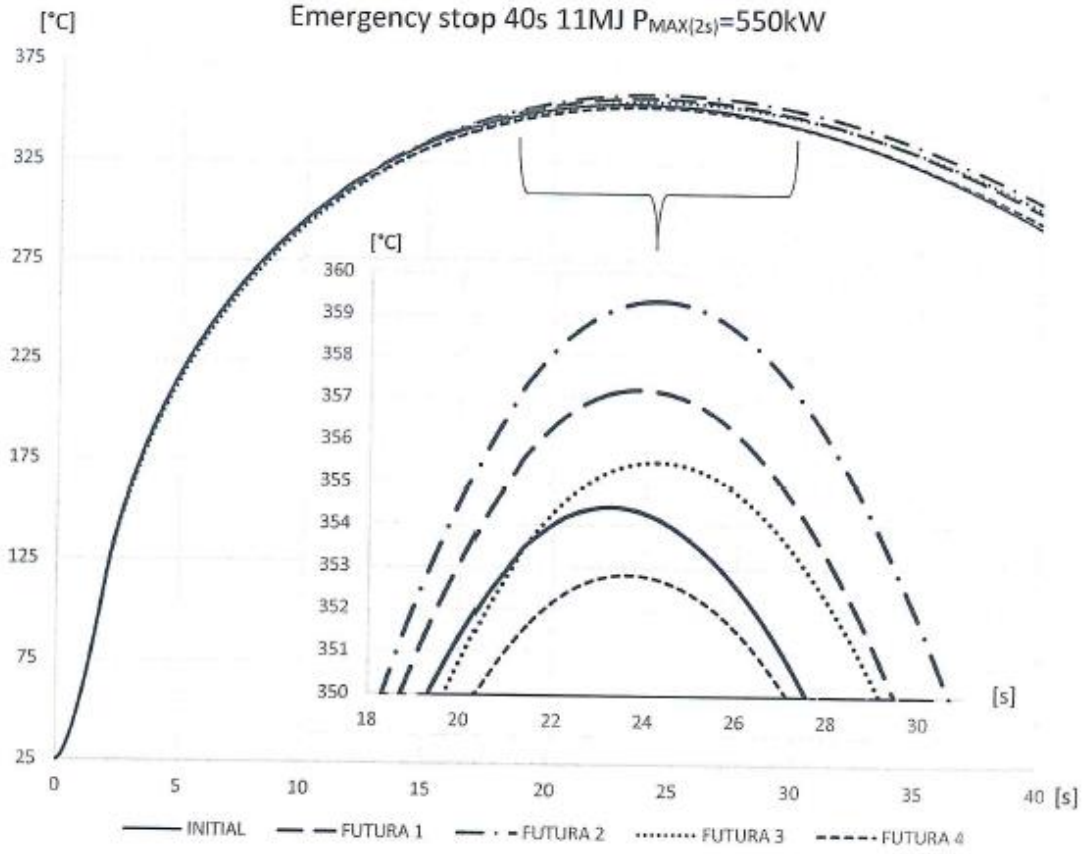

Emergency stop 40s 11MJ $P_{MAX(2s)}$=550kW
[°C]
375
325
275
225
175
125
75
25
0
5
10
15
20
25
30
35
40
[s]
[°C]
360
359
358
357
356
355
354
353
352
351
350
18
20
22
24
26
28
30
[s]
INITIAL
FUTURA 1
FUTURA 2
FUTURA 3
FUTURA 4

Fig. 6

4.2 2nd patent application P-201700189

Second patent application protects method of attaching both parts of DRFB disc crown, method of attaching DRFB disc crowns to hub, and method of assembly/disassembly of DRFB disc to/from the axle of freight wagon.

Patent application was issued on 22nd of June by Intellectual Property Office of the Republic of Slovenia (URSIL), under number P-201700189. The patent is valid for one year in the whole world and ten years in Slovenia, from this date. The URSIL will publish the information on granted patent within eighteen months of the application date. Until then, temporary protection is valid, and patent is invisible to general public.

In this period of eighteen months, there is a possibility to have insight into patent applications only by certain request, and approval of Kovis.

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA GOSPODARSTVO

URAD REPUBLIKE SLOVENIJE
ZA INTELEKTUALNO LASTNINO
1000 LJUBLJANA, KOTNIKOVA 6

ZAHTEVA ZA PODELITEV PATENTA

1. **Naslov za obveščanje:**
   ITEM d.o.o.
   Resljeva cesta 16
   1000 Ljubljana

   Tel.: (01) 432 01 67
   Faks: (01) 431 53 31 Šifra: 2173-P150/17

Potrdilo o prejemu prijave
(izpolni urad)

Datum vložitve prijave: 22-06-2017

Številka prijave: P-201700189

Žig urada in podpis:

2. **Prijavitelj** (priimek, ime in naslov; za pravne osebe firma in sedež):

   Kovis d.o.o.
   Brezina 102
   SI-8250 Brežice

3. **Zastopnik:** ITEM d.o.o. Registrska številka: 134

4. **Izumitelj** (priimek, ime in naslov):
   Uroš Grivc, Lončarjev dol 17A, 8290 Sevnica
   David Deržič, Ponikve 20A, 8261 Jesenice na Dolenjskem

5. **Naziv izuma:** Dvodelni zavorni disk kolutne zavore, njegovo vpetje na pesto in postopek montaže in demontaže

6. **Podatki o zahtevani prednostni pravici in podlagi zanjo:**

7. **Dodatne zahteve:**
   - ☐ prijava je za patent s skrajšanim trajanjem
   - ☐ predhodna objava patenta po preteku____ mesecev
   - ☐ prijava je izločena iz prijave številka:_____

8. **Izjava:**
   - ☐ izjava o skupnem predstavniku

9. **Priloge**
   - ☒ opis izuma, ki ima 6 strani
   - ☒ patentni zahtevek (zahtevki), ki ima(jo) 3 strani; število zahtevkov: 10
   - ☒ skice (če so zaradi opisa izuma potrebne); število listov: 5
   - ☒ povzetek
   - ☐ potrdilo o plačilu prijavne pristojbine _____
   - ☐ potrdilo o deponiranju biološkega materiala, če gre za izum, ki ga ni mogoče drugače opisati
   - ☐ pooblastilo zastopniku
   - ☐ generalno pooblastilo zastopniku je deponirano pri uradu pod št.: ____
   - ☐ potrdilo o razstavni prednostni pravici
   - ☐ podatki o drugih prijaviteljih
   - ☒ podatki o drugih izumiteljih
   - ☐ prikaz zaporedja nukleotidov ali aminokislin v opisu
   - ☐ prijava je bila predhodno posredovana po faksu ali v elektronski obliki
   - ☐ ____

ITEM d.o.o., Tatjana Jeršan
Priimek in ime ter podpis prijavitelja (zastopnika)

Figure 17: Patent application P-201700189

4.2.1 Content of patent application P-201700189

1

Dvodelni zavorni disk kolutne zavore, njegovo vpetje na pesto in postopek montaže in demontaže

Predmet izuma je dvodelni zavorni disk kolutne zavore, prednostno za tirnična vozila, vpetje dvodelnega zavornega diska na pesto, in postopek njegove montaže in demontaže z osi, pri čemer za zamenjavo izrabljenega zavornega diska ni potrebno odstraniti koles in ležajnega ohišja z osi. Na ta način je omogočena enostavna in hitra zamenjava zavornega diska. Vpetje dvodelnega zavornega diska na pesto preko šestih povezovalnih elementov zagotavlja prenašanje višjega zavornega momenta in vibracij, posledično pa višjo varnost in s tem krajšo zavorno pot vagona. Poleg tega pa vpetje zavornega diska na pesto ne zahteva posebnega orodja ali naprav.

Pri tirničnih vozilih je kolutna zavora običajno sestavljena iz zavornega diska in pesta. Pesto je na os pritrjeno s prešanjem, medtem ko je zavorni disk pritrjen oziroma vpet na pesto preko povezovalnih elementov, ki so v enakomernih razmikih radialno razporejeni tako na pestu, na njegovem zunanjem obodu, kot tudi na zavornem disku, na njegovem notranjem obodu, tako da nalegajo en v drugega in je pritrditev povezovalnih elementov izvedena prednostno s sorniki ali vijaki ali na druge znane načine. Na ta način se tvori trdna povezava zavornega diska in pesta, ki mora pri zaviranju prenašati velik zavorni navor in sile.

Zavorni disk je običajno izveden iz dveh soosnih kolobarjastih plošč, ki sta medsebojno povezani z radialnimi rebri, tako da se med ploščama tvorijo prehodi za zrak, ki izboljšajo hlajenje zavornega diska pri zaviranju. Med obema ploščama so lahko izvedeni še dodatni hladilni elementi prednostno v obliki štrlin, ki še dodatno izboljšajo odvajanje toplote iz plošč proti sredini zavornega diska.

Ko se zavorni disk izrabi, ga je potrebno zamenjati. Ker je zavorni disk enovit, je potrebno za njegovo zamenjavo odstraniti kolo in ležajno ohišje z osi. V izogib temu obstajajo tudi dvodelni diski, kjer je disk izveden iz dveh delov, ki sta med sabo

2

povezana običajno z dvema sornikoma. Pri povezavi dvodelnega diska je potrebno paziti na varnost, togost povezave (premikanje dvodelnih plošč), možnost prenosa zavornega momenta in centrifugalne sile. Vsaka polovica diska ima običajno na stičnem delu na obeh straneh izvedeni simetrični kontaktni plošči, v kateri je izvedena luknja oziroma jašek za sprejem sornika. Sornik povezuje obe polovici zavornega diska vendar pri znanih povezavah sornik ni s celo svojo površino v tesnem stiku s površino zavornega diska. Ko je potrebno izrabljeni disk zamenjati, je potrebno popolnoma odstaniti oba sornika, ki povezujeta obe polovici diska, in sornike oziroma vijake, ki povezujejo pesto in zavorni disk, in zavorni disk se lahko zamenja, ne da bi bilo potrebno odstraniti kolo in ležajno ohišje z osi. Če pa je sornik s celo površino v stiku, je omogočena večja togost, odpornost na vibracije in na pomike obeh delov zavornega diska, kot tudi hitrejša montaža in demontaža, saj je potrebno popolnoma odstraniti le enega od sornikov oziroma vijakov, ki povezujeta obe polovici diska.

Za vpetje dvodelnega zavornega diska na pesto je zaželeno, da je uporabljeno sodo število povezovalnih elementov, saj sta na ta način oba dela zavornega diska lahko izvedena simetrično. Običajno je povezava pesta in zavornega diska izvedena z dvanajstimi povezovalnimi elementi, kjer se ustrezno trdnost zveze doseže s prednapetjem vijakov, ki se uporabijo za pritrditev zavornega diska na pesto. Pomanjkljivost te povezave je nemožnost prenosa večjega zavornega momenta, in posledično manjša varnost (daljše zaviralne poti). Tovorni promet počasi gre na višje hitrosti in prevoz več tovora, kar pomeni da prenos zavornega momenta samo z vijačno zvezo ne bo več dovolj.

V GB patentni prijavi št. 1411734 je zavorni disk vpet na pesto le preko treh povezovalnih ementov. Ker zaradi zgoraj navedenih razlogov ni možna simetriča izvedba obeh delov diska, je ena od povezav obeh delov zavornega diska izvedena v območju stične površine obeh delov diska in je za dosego trdne povezave zavornega diska in pesta potrebno tesno naleganje in ujem povezovalnih elementov na pestu in zavornem disku, kar zahteva posebne in drage naprave za montažo. Navedeni postopek

je kljub temu, da je zavorni disk iz dveh delov, še vedno zamuden in zahteva specialna orodja za ustrezo demontažo in ponovno montažo novega diska na pesto.

Navedene pomankljivosti so odpravljene z dvodelnim diskom po izumu in z njegovim vpetjem na pesto. Izum bo opisan v nadaljevanju in predstavljen na slikah, ki prikazujejo:

Slika 1 prikazuje dvodelni zavorni disk s povezovalnimi elementi za vpetje na pesto;
Slika 2 prikazuje detajl povezave dveh delov zavornega diska med sabo;
Slika 3 prikazuje dvodelni zavorni disk s pestom in podložko, pri čemer je zgornja plošča odstranjena;
Slika 4 prikazuje vpetje zavornega diska na pesto;
Slika 5 prikazuje postopek montaže/demontaže dvodelnega zavornega diska.

Zavorni disk 1, ki je prikazan na slikah, je sestavljen iz dveh simetričnih delov 1a in 1b, pri čemer je vsak del 1a in 1b izveden iz dveh soosnih polkolobarjastih plošč 2, ki sta medsebojno povezani z radialnimi rebri 3. Vsak del 1a, 1b zavornega diska 1 ima na delu, ker se dela 1a, 1b stikata, na obeh straneh izvedeno kontaktno ploščo 4a, 4b, v kateri je izvedena luknja 5a, 5b oziroma jašek za sprejem sornika 6. Sornika 6 povezujeta oba dela 1a, 1b zavornega diska 1. Obe luknji 5a, 5b in ravna površina sornika 6 so izvedeni v ozkih tolerancah tako, da je dolžina ravnega dela sornika 6, to je del med glavo in navojem, enaka skupni dolžini obeh lukenj 5a, 5b, tako da je sornik 6 s svojo celotno ravno površino v tesnem kontaktu s celotno notranjo površino obeh lukenj 5a, 5b, ko sta oba dela 1a, 1b zavornega diska 1 v stiku. Ko sta oba dela 1a, 1b diska 1 povezana in sta sornika 6 privita z zahtevanim privijalnim navorom, je zagotovljena trdna struktura zavornega diska 1. V izvedbenem primeru je uporabljen sornik M24x90, luknji pa imata dimenzije Ø25 H8. Skupna dolžina tesnega stika je 50 mm. Prednosti takšne povezave so: večja togost dvodelnega zavornega diska, nemožnost premikanja deljenih plošč v vseh smereh in prenos večjih centrifugalnih sil.

Na svojem notranjem obodu 1c ima vsak del 1a, 1b zavornega diska 1 izvedene

4

povezovalne elemente v obliki štrlin 7 za vpetje zavornega diska 1 na pesto 8. Štrline 7 so v enakomernih razmikih radialno razporejene po notranjem obodu 1c, prednostno so pozicionirane na sredini višine zavornega diska 1 in imajo v preseku prednostno trapezoidno obliko. Vsak del 1a, 1b zavornega diska 1 ima prednostno po tri štrline 7, pri čemer so le-te pozicionirane tako, da sta sosednji štrlini 7, med katerima se oba dela 1a, 1b zavornega diska 1 stikata, izvedeni v enaki oddaljenosti od kontaktnih plošč 4a, 4b, to je od stične površine obeh delov 1a, 1b zavornega diska 1. Štrline 7 imajo izvedene luknje 10 za sprejem sornikov 11, s katerimi je zavorni disk 1 vpet na pesto 8.

Pesto 8 ima na svojem zunanjem obodu 8a izvedene povezovalne elemente v obliki ušes 9 za vpetje zavornega diska 1. Ušesa 9 so ravnotako v enakih in enakomernih razmikih radialno razporejena po zunanjem obodu 8a pesta 8, prednostno so pozicionirana na sredini višine pesta 8, tako da se njihova pozicija ujema s pozicijo štrlin 7. Zunanje dimenzije štrlin 7 se dimenzijsko ujemajo z notranjo površino ušes 9, tako da ob vpetju zavornega diska 1 na pesto 8 štrline 7 tesno nalegajo v ušesa 9. Ušesa 9 imajo izvedene luknje 12 za sprejem sornikov 11 oziroma vijakov, s katerimi je zavorni disk 1 vpet na pesto 8. Ob vpetju zavornega diska 1 na pesto 8, luknje 10 nalegajo na luknje 12. Pri vpetju zavornga diska 1 na pesto 8, štrline 7 naležejo v ušesa 9, tako da so luknjne 10 poravnane z luknjami 12. Sledi pozicioniranje podložke 13, ki ima v enakih in enakomernih razmikih radialno razporejene luknje 14 za sprejem sornikov 10, na pesto 8. Skozi poravnane luknje 10, 12 in 14 se vstavi sornike 10 in se jih ustrezno pritrdi. S takim načinom vpetja, se prenos zavornega momenta prenaša z bočnim pritiskom, in ni odvisen od vijakov. Takšen način vpetja je trikrat varnejši, manjše je tveganje za prelom ali slabljenja vijaka in vijačne zveze.

V prednostni izvedbi je zavorni disk 1 vpet na pesto 8 s šestimi povezovalnimi elementi, to je s šestimi štrlinami 7 in ušesi 9, pri čemer navedeni način vpetja zagotavlja zahtevan zavorni navor. Vpetje je izvedeno z ozkimi tolerancami kar dodatno zagotavlja visoko varnost pri prenosu zavornega navora in omogoča odlično centriranje zavornaga diska 1 in pesta 8. Navedeno vpetje je kar za 3.7 krat bolj varno od znanih vpetjih, ki so

izvedena s prednapetjem vijakov.

Postopek demontaže izrabljenega dvodelnega zavornega diska 1 z osi vključuje sledeče korake:

- odvitje sornikov 10 in odstanitev podložke 13 s pesta 8;
- sprostitev zavornega diska 1 s pesta 8;
- popolno odvitje in odstranitev enega od sornikov 6, ki povezujeta oba dela 1a, 1b zavornega diska 1 iz lukenj 5a, 5b;
- rahla sprostitev drugega sornika 6, tako da je omogočena rotacija obeh delov 1a, 1b zavornega diska 1 okoli drugega sornika 6;
- rotacija enega dela 1a, 1b zavornega diska 1 vsaj za 90° okoli drugega sornika 6, pri čemer se oba dela 1a, 1b zavornega diska 1 v enem delu razmakneta in je omogočeno snetje zavornega diska 1 z osi.

Postopek ponovne montaže zavornega diska 1 na os, oziroma na pesto 8 vključuje sledeče korake:

- popolno odvitje in odstranitev enega od sornikov 6, ki povezujeta oba dela 1a, 1b zavornega diska 1 iz lukenj 5a, 5b;
- rahla sprostitev drugega sornika 6, tako da je omogočena rotacija obeh delov 1a, 1b zavornega diska 1 okoli drugega sornika 6;
- rotacija enega dela 1a, 1b zavornega diska 1 vsaj za 90° okoli drugega sornika 6, pri čemer se oba dela 1a, 1b zavornega diska 1 v enem delu razmakneta in je omogočen natik zavornega diska 1 na os;
- rotacija obeh delov 1a, 1b zavornega diska 1 okoli drugega sornika 6 dokler oba dela 1a, 1b nista poravnana;
- vstavitev sornika 6 v luknji 5a, 5b in privitje obeh sornikov 6 z zahtevanim privijalnim navorom;
- namestitev zavornega diska 1 na pesto 8;
- pritrditev podložke 13 na pesto 8 s sorniki 10.

6

Z navedeno konstrukcijo dvodelnega zavornega diska 1 in njegovega vpetja na pesto 8, ki je izvedeno s sodim številom povezovalnih elementov, to je štrlin 7 in ušes 9, je omogočena simetrična izvedba obeh delov 1a, 1b zavornega diska 1 in njegova enostavna montaža/demontaža. Ker je povezava obeh delov 1a, 1b zavornega diska 1 izvedena med dvema sosednjima štrlinama 7 in je sornik 8 s celo svojo površino v tesnem stiku s površino zavornega diska 1, je zagotovljena večja togost, odpornost na vibracije in na pomike obeh delov 1a, 1b zavornega diska 1.

7

Patentni zahtevki

1. Dvodelni zavorni disk (1) kolutne zavore prednostno za tirnična vozila, pri čemer je dvodelni zavorni disk (1) sestavljen iz dveh delov (1a) in (1b), ki sta izvedena iz dveh soosnih polkolobarjastih plošč (2) medsebojno povezanih z radialnimi rebri (3) in ima vsak del (1a, 1b) zavornega diska (1) na delu, ker se dela (1a, 1b) stikata, na obeh straneh izvedeno kontaktno ploščo (4a, 4b), v kateri je izvedena luknja (5a, 5b) za sprejem sornika (6) in ima vsak del (1a, 1b) na svojem notranjem obodu (1c) izvedene povezovalne elemente za vpetje zavornega diska (1) na pesto (8), označen s tem, da sta oba dela (1a) in (1b) izvedena simetrično in sta obe luknji (5a, 5b) in ravna površina sornika (6) izvedeni v ozkih tolerancah tako, da je dolžina ravnega dela sornika (6) enaka skupni dolžini obeh lukenj (5a, 5b), tako da je sornik (6) s svojo celotno ravno površino v tesnem kontaktu s celotno notranjo površino obeh lukenj (5a, 5b), ko sta oba dela (1a, 1b) zavornega diska (1) v stiku.
2. Dvodelni zavorni disk (1) po zahtevku 1, označen s tem, da je uporabljen sornik M24x90, luknji imata dimenzije Ø25 H8 in je skupna dolžina tesnega stika 50 mm.
3. Dvodelni zavorni disk (1) po zahtevkih 1 in 2, označen s tem, da so povezovalni elementi izvedeni v obliki štrlin (7), ki so v enakomernih razmikih radialno razporejene po notranjem obodu (1c) in so pozicionirane tako, da sta sosednji štrlini (7), med katerima se oba dela (1a, 1b) zavornega diska (1) stikata, izvedeni v enaki oddaljenosti od kontaktnih plošč (4a, 4b), to je od stične površine obeh delov (1a, 1b) zavornega diska (1).
4. Dvodelni zavorni disk (1) po predhodnih zahtevkih, označen s tem, da so štrline (7) prednostno pozicionirane na sredini višine zavornega diska (1) in imajo v preseku prednostno trapezoidno obliko in imajo izvedene luknje (10) za sprejem sornikov (11), s katerimi je zavorni disk (1) vpet na pesto (8).
5. Vpetje dvodelnega zavornega diska (1) kolutne zavore prednostno za tirnična vozila na pesto (8), pri čemer je vpetje izvedeno s povezovalnimi elementi, ki so v enakih in enakomernih razmikih radialno razporejeni po notranjem obodu (1c)

zavornega diska (1) in po zunanjem obodu (8a) pesta (8) in podložko (13) in so povezovalni elementi na zavornem disku (1) izvedeni v obliki štrlin (7), označeno s tem, da so povezovalni elementi na pestu (8) izvedeni v obliki ušes (9) in se notranja površina ušes (9) dimenzijsko ujema z zunanjo dimenzijo štrlin (7) in imajo ušesa (9) izvedene luknje (12) za sprejem sornikov (11), tako da ob vpetju zavornega diska (1) na pesto (8) štrline (7) tesno nalegajo v ušesa (9) in luknje (12) nalegajo na luknje (10).

6. Vpetje dvodelnega zavornega diska (1) po zahtevku 5, označeno s tem, da so ušesa (9) prednostno pozicionirana na sredini višine pesta (8), tako da se njihova pozicija ujema s pozicijo štrlin (7).
7. Vpetje dvodelnega zavornega diska (1) po zahtevkih 5 in 6, označeno s tem, da pri vpetju zavornga diska (1) na pesto (8) štrline (7) naležejo v ušesa (9), tako da so luknjne (10) poravnane z luknjami (12), sledi pozicioniranje podložke (13), ki ima v enakih in enakomernih razmikih radialno razporejene luknje (14) za sprejem sornikov (10), na pesto (8) in se skozi poravnane luknje (10, 12 in 14) vstavi sornike (10) in se jih ustrezno pritrdi.
8. Vpetje dvodelnega zavornega diska (1) po zahtevkih od 5 do 7, označeno s tem, da je vpetje izvedeno s šestimi štrlinami (7) in ušesi (9).
9. Postopek demontaže dvodelnega zavornega diska (1) po zahtevkih od 1 do 4 z vpetjem po zahtevkih od 5 do 8 z osi, označen s tem, da vključuje naslednje korake:

- odvitje sornikov (10) in odstanitev podložke (13) s pesta (8);
- sprostitev zavornega diska (1) s pesta (8);
- popolno odvitje in odstranitev enega od sornikov (6), ki povezujeta oba dela (1a, 1b) zavornega diska (1) iz lukenj (5a, 5b);
- rahla sprostitev drugega sornika (6), tako da je omogočena rotacija obeh delov (1a, 1b) zavornega diska (1) okoli drugega sornika (6);
- rotacija enega dela (1a, 1b) zavornega diska (1) vsaj za 90° okoli drugega sornika (6), pri čemer se oba dela (1a, 1b) zavornega diska (1) v enem delu razmakneta in je omogočeno snetje zavornega diska (1) z osi.

9

10. Postopek montaže dvodelnega zavornega diska (1) po zahtevkih od 1 do 4 z vpetjem po zahtevkih od 5 do 8 na os, označen s tem, da vključuje naslednje korake:

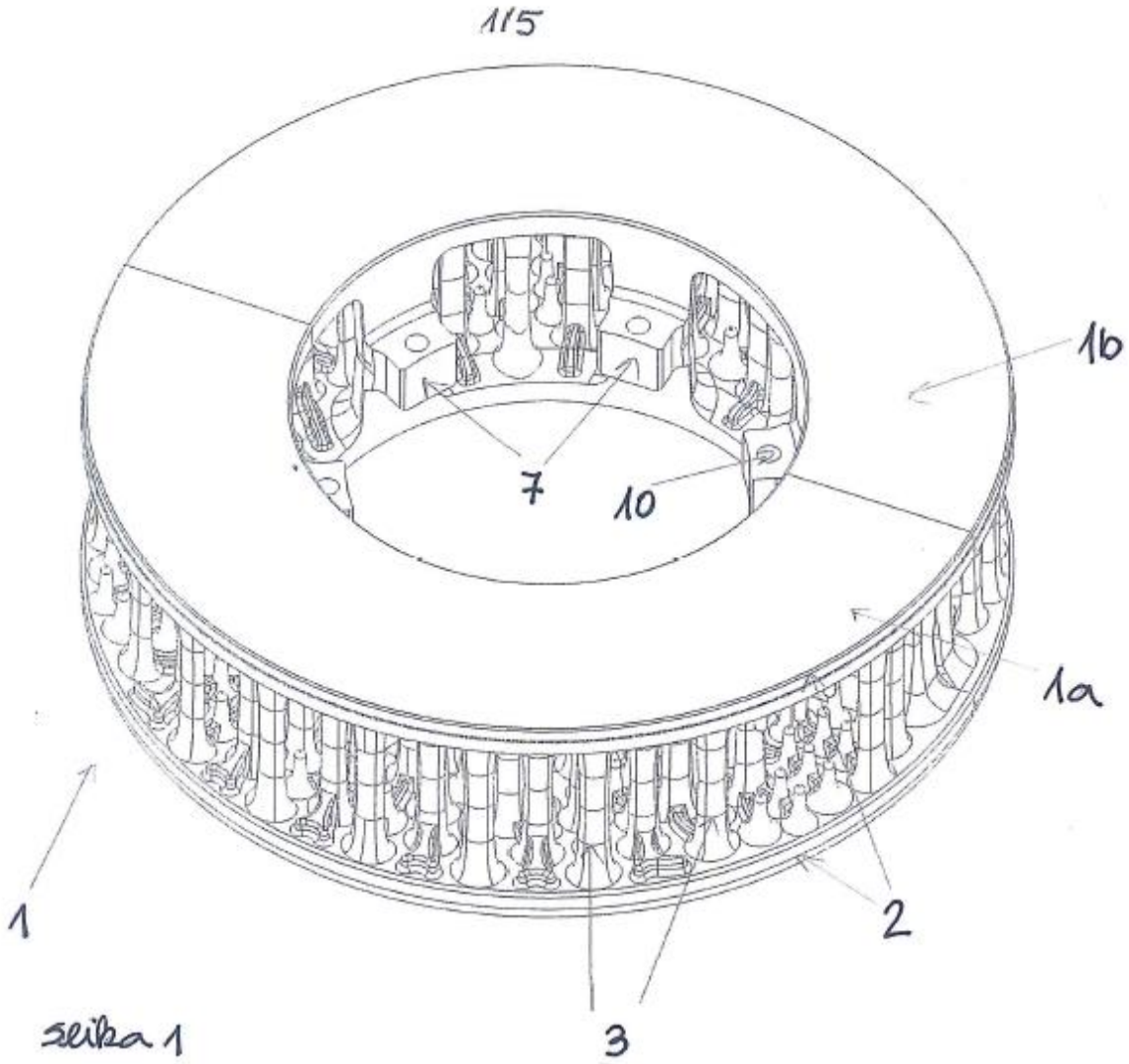
- popolno odvitje in odstranitev enega od sornikov (6), ki povezujeta oba dela (1a, 1b) zavornega diska (1) iz lukenj (5a, 5b);
- rahla sprostitev drugega sornika (6), tako da je omogočena rotacija obeh delov (1a, 1b) zavornega diska (1) okoli drugega sornika (6);
- rotacija enega dela (1a, 1b) zavornega diska (1) vsaj za 90° okoli drugega sornika (6), pri čemer se oba dela (1a, 1b) zavornega diska (1) v enem delu razmakneta in je omogočen natik zavornega diska (1) na os;
- rotacija obeh delov (1a, 1b) zavornega diska (1) okoli drugega sornika (6) dokler oba dela (1a, 1b) nista poravnana;
- vstavitev sornika (6) v luknji (5a, 5b) in privitje obeh sornikov (6) z zahtevanim privijalnim navorom;
- namestitev zavornega diska (1) na pesto (8);
- pritrditev podložke (13) na pesto (8) s sorniki (10).

10

Izvleček

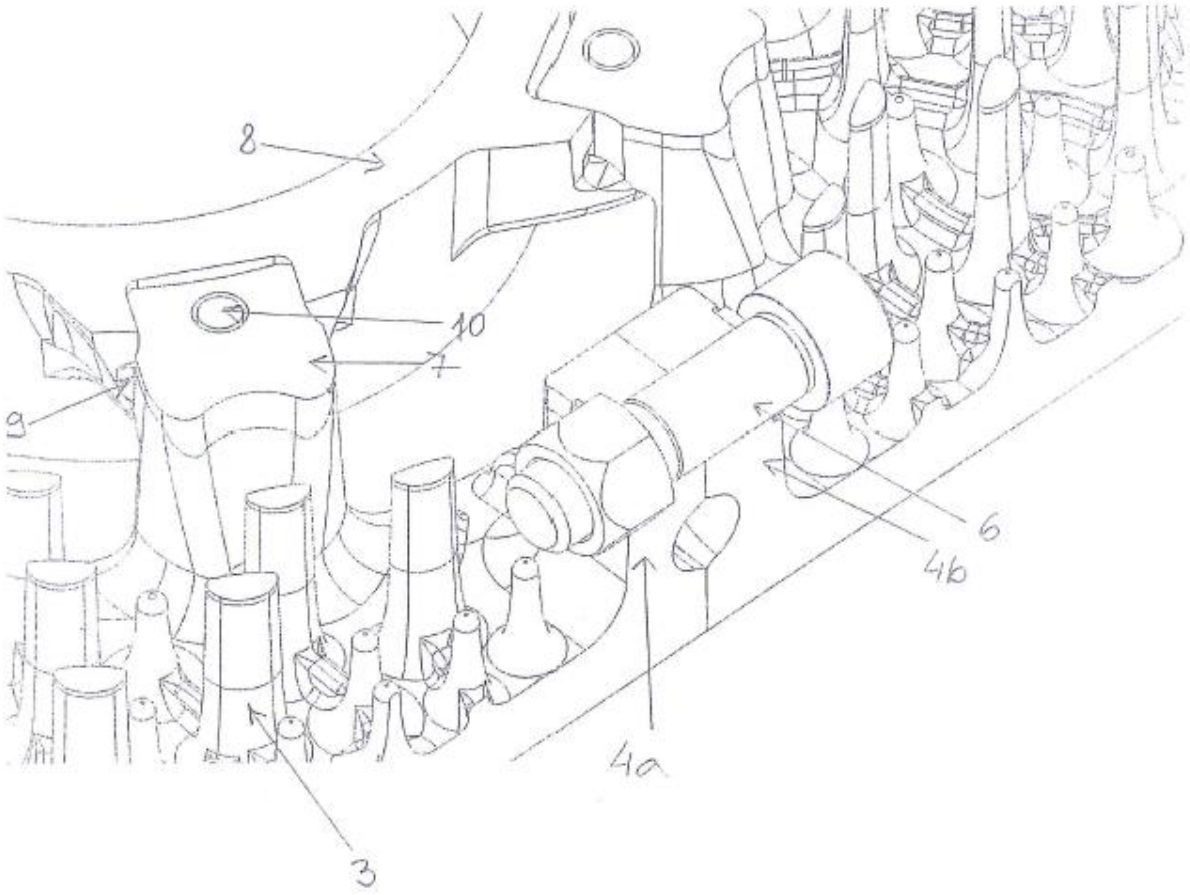
Dvodelni zavorni disk kolutne zavore, njegovo vpetje na pesto in postopek montaže in demontaže

Predmet izuma je dvodelni zavorni disk kolutne zavore, prednostno za tirnična vozila, vpetje dvodelnega zavornega diska na pesto, in postopek njegove montaže in demontaže z osi, pri čemer za zamenjavo izrabljenega zavornega diska ni potrebno odstraniti koles in ležajnega ohišja z osi. Na ta način je omogočena enostavna in hitra zamenjava zavornega diska. Vsak del (1a, 1b) zavornega diska (1) ima na delu, ker se dela (1a, 1b) stikata, na obeh straneh izvedeno kontaktno ploščo (4a, 4b), v kateri je izvedena luknja (5a, 5b) za sprejem sornika (6). Obe luknji (5a, 5b) in ravna površina sornika (6) so izvedeni v ozkih tolerancah tako, da je sornik (6) s svojo celotno ravno površino v tesnem kontaktu s celotno notranjo površino obeh lukenj (5a, 5b). Vpetje dvodelnega zavornega diska (1) na pesto (8) je izvedeno s štrlinami (7) in ušesi (9), ki so v enakih in enakomernih razmikih radialno razporejeni po notranjem obodu (1c) zavornega diska (1) in po zunanjem obodu (8a) pesta (8) in podložko (13), pri čemer sta sosednji štrlini (7), med katerima se oba dela (1a, 1b) zavornega diska (1) stikata, izvedeni v enaki oddaljenosti od kontaktnih plošč (4a, 4b), to je od stične površine obeh delov (1a, 1b) zavornega diska (1).

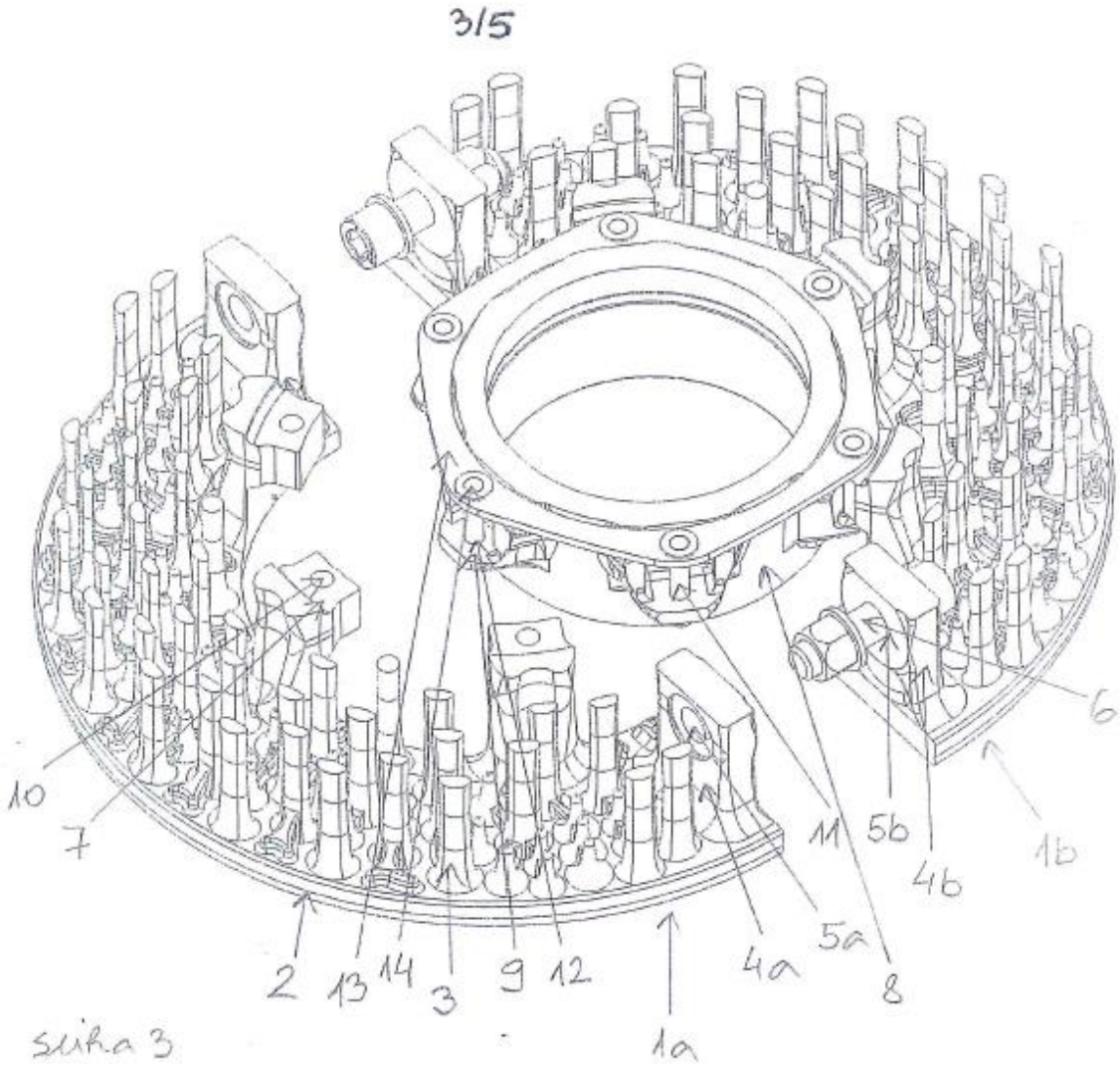


Slika 1

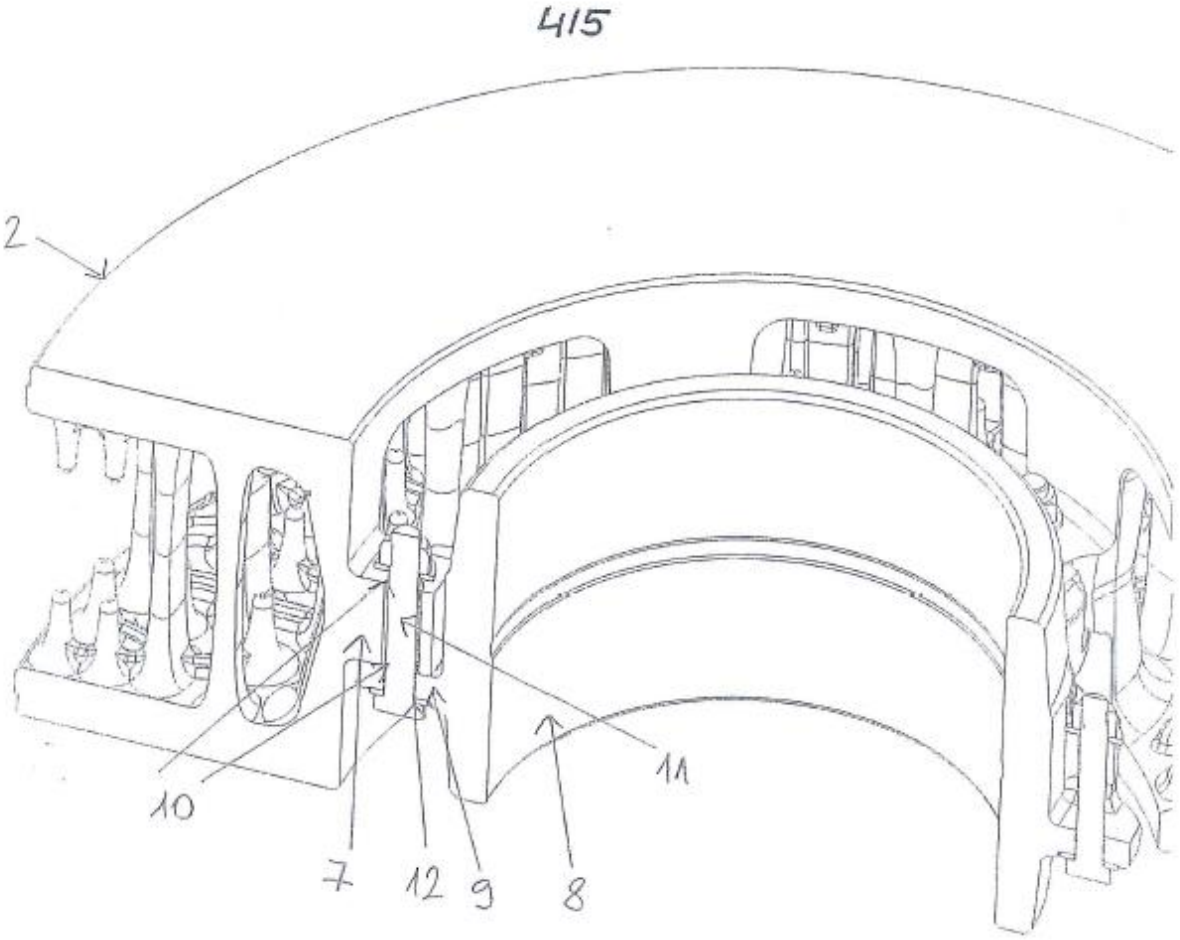
2/5



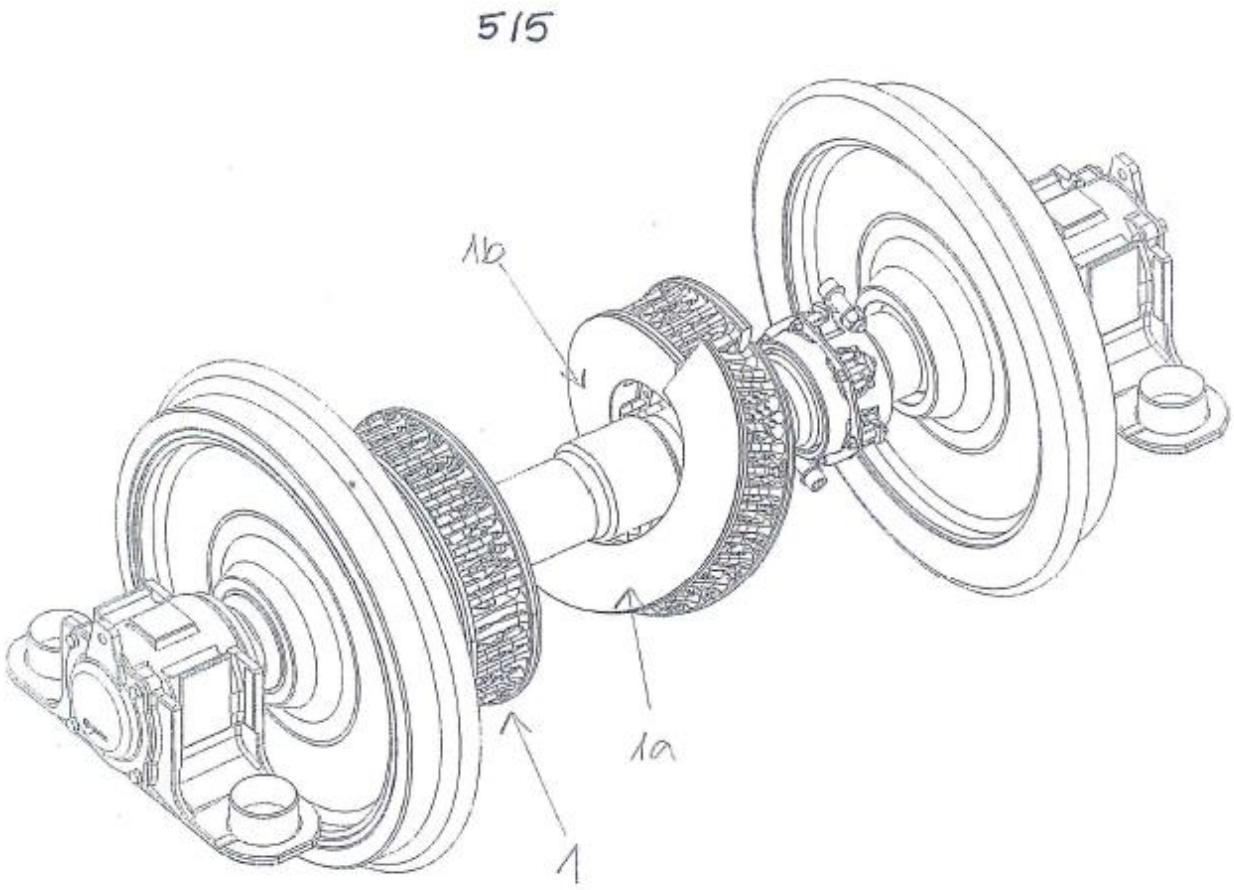
Sliha 2



slika 3



Slika 4



Slika 5

5 REFERENCES

[1] KOVIS d.o.o.: Internal company documents