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(73) Patenthaver: **Stromag GmbH, Hansastrasse 120, 59425 Unna, Tyskland**

(72) Opfinder: **SPINK, Daniela, Paul-Verhoeven-Straße 6, 59423 Unna, Tyskland**
Mikolajczyk, Olaf, Weimarer Straße 4, 59425 Unna, Tyskland
FAUST, Friedrich, Lange Wand 40, 59229 Ahlen, Tyskland
BÖHM, Peter, Körnerstraße 17, 59423 Unna, Tyskland

(74) Fuldmægtig i Danmark: **Chas. Hude A/S, H.C. Andersens Boulevard 33, 1780 København V, Danmark**

(54) Benævnelse: **SKIVEBREMSE TIL EN BREMSESKIVE-RING FOR ET AZIMUT-DREV I ET VINDKRAFTANLÆG**

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Description

Disk brake for a brake disk ring of an azimuth drive of a wind power installation

The invention relates to a disk brake for a brake disk ring of an azimuth drive of a wind power installation having a brake housing which comprises two housing halves which flank on opposite sides a receiving jaw for the brake disk ring, wherein in each housing half at least two brake pistons are mounted, which hydraulically pressurize friction lining carriers associated with the receiving jaw, wherein at least one housing half includes a cleansing channel which extends from a housing rear side to a housing front area, where the receiving jaw and the friction lining carriers are provided.

In KR 101 464 598 B1 is disclosed a disk brake for a brake disk ring of an azimuth drive of a wind power installation which has a brake housing which is provided with two housing halves which flank a receiving jaw for the brake disk ring on opposite sides. As is apparent in Fig. 3 and Fig. 5 of D6, one housing half includes a channel which extends from a housing rear side to a housing front area, where the receiving jaw of the brake housing begins.

Another disk brake is known from DE 10 2009 049 906 A1. The wind power installation has a horizontally rotatable nacelle which is turned by means of an azimuth drive. In order to block the nacelle in a desired wind direction, a horizontally arranged brake disk ring is provided which is hydraulically actuated by a plurality of identical disk brakes. Each disk brake has a brake housing which forms a receiving jaw for the brake disk ring. The brake housing includes two housing halves which, in the assembled state of the disk brake, flank the brake disk ring on the upper and lower sides. In each housing half two brake pistons are disposed, which pistons are movable orthogonal to a respective surface of the brake disk ring. The brake pistons apply force on friction lining carriers which interact with surfaces of the brake disk ring acting as friction surfaces via appropriate friction linings, in order to decelerate or release the brake disk ring.

It is an object of the invention to provide a disk brake of the type which is mentioned in the introduction, which can reduce noise generation during operation.

This object is achieved by the features of claim 1. The solution according to the invention uses the findings that squeaking noises during displacement of a nacelle of a wind power installation arise from brake dust in the vicinity of the brake disk ring, caused by frictional wear of the friction linings of the disk brake. The solution according to the invention allows access to the region of the receiving jaw and consequently to the region of the friction lining carriers from the housing rear side with appropriate cleaning elements, in order to remove brake dust there using the cleaning elements. The possibility of removing brake dust in a gap region of the receiving jaw of the brake housing itself allows to keep the surfaces of the brake disk ring clean and, thus, to reduce noise generation during operation of the disk brake. The cleansing channel may either be

provided merely in one housing half or else in both housing halves. The cleansing channel is open both towards the housing rear side and towards the housing front area, i.e. towards the receiving jaw, such that a suitable cleaning element can be positioned or passed through from a rear side, in order to allow cleaning in the housing front area, i e. in the vicinity of the friction lining carriers and the receiving jaw. Thus, the cleansing channel provides a passageway traversing the part of the housing halves of the brake housing located on top of each other. With particular advantage, at least an upper housing half of the brake housing – in relation to an assembled operating state of the disk brake - is provided with the cleansing channel. Due to the horizontal orientation of the brake disk ring powdery friction wear debris remains, in particular on the upper side of the brake disk ring, which debris can be removed using the cleaning element. The cleansing channel in the vicinity of the upper housing half is sufficient to allow access to the upper side of the brake disk ring for the cleaning element. The cleaning element provided is preferably a blower, a vacuum cleaner or a mechanical cleaning brush, in particular a bottle brush. Relevant wear debris accumulated between friction linings and respective surfaces of the brake disk ring is deposited preferably between the adjacent friction lining carriers of one housing half in each case. During turning of the brake disk ring, said wear debris is pressed between the respective friction lining and the brake disk ring, whereby as a result, vitrification of the friction lining may occur. A corresponding vitrification of the friction lining causes undesirable squeaking noises. Moreover, such vitrified friction linings lose their friction properties and consequently their braking properties, as a result, there is need for replacement. Owing to the solution according to the invention, via the cleansing channel, wear debris in the vicinity of the receiving jaw and, in particular, between the adjacent friction lining carriers can be removed, whereby vitrification of the friction linings may be prevented. Advantageously, the cleansing channel is dimensioned such that the receiving jaw of the brake housing is accessible from the housing rear side in the region of the upper and the lower friction lining carriers for an appropriate cleaning element. According to the invention, the cleansing channel, in the vicinity of the receiving jaw, is continued in a cleansing groove which is open towards a housing front side. Thus, it is possible from the housing rear side by means of an appropriate cleaning brush to move out, in particular to push out, the wear debris, which has accumulated between the friction linings in the vicinity of the centre bar and with it in the vicinity of the receiving jaw, towards the housing front side. Thereby the cleaning brush is passed from the rear through the cleansing channel and then moved back and forth in the vicinity of the receiving jaw. As an alternative or in addition, using a pressure blower or suction fan, which is positioned on the rear side to an open end face of the cleansing channel, a suction or pressurized air flow is generated to cause the desired dust removal.

In an embodiment of the invention, the cleansing channel is provided in alignment with at least one centre bar between each two adjacent friction lining carriers. In case of merely two adjacent friction lining carriers, a single cleansing channel is provided in the region of the respective housing half. In case of more than two friction lining carriers in the region of each housing half, an

accordingly greater number of cleansing channels is provided in the region of the centre bar between respectively two adjacent friction lining carriers.

In another embodiment of the invention, the cleansing groove has an inclination relative to a horizontal plane in the direction of the housing front side, where the friction lining carriers are disposed, wherein a bottom of the cleansing groove is more remote from the horizontal plane towards the housing front side. As a result, a slope in the type of a chute is formed, which allows further improved removal of brake dust, i.e. of wear debris, from the vicinity of the centre bar between each two adjacent friction lining carriers.

In another embodiment of the invention, a cross-sectional area of the cleansing groove is increasing continuously towards the housing front side. An increase of the cross-sectional area of the cleansing groove is in particular achieved by a continuous increase of the width of a bottom of the cleansing groove towards the housing front side, whereby a chute functionality for wear debris swept into the cleansing groove is further improved.

In another embodiment of the invention, the cleansing groove is trough shaped. Accordingly, using a cleaning brush, the wear debris accumulating between the friction lining carriers can be swept into the cleansing groove and be swept out towards the housing front side in a simple manner.

In another embodiment of the invention, both housing halves together form the cleansing channel, and in the vicinity of the receiving jaw, in each of the two housing halves, a respective cleansing groove is provided. In each case, the cleansing channel transitions in alignment into the respective cleansing groove.

In another embodiment of the invention, both cleansing grooves are designed with mirror symmetry to a horizontal separating plane of the housing halves, and each is provided with a

respective inclination. The cleansing grooves as well as the at least one cleansing channel are integrally formed in the brake housing, in particular on both housing halves.

Further advantages and features of the invention result from the claims and from the following description of one preferred exemplary embodiment of the invention, which exemplary embodiment is shown with reference to the drawings.

Figure 1 shows schematically a detail of a wind power installation in the vicinity of a rotatable nacelle including embodiments of disk brakes according to the invention;

Figure 2 shows schematically in a plan view one half of a brake disk ring with multiple disk brakes according to an embodiment of the invention;

Figure 3 shows in enlarged perspective view an embodiment of a disk brake according to the invention of Figs. 1 and 2;

Figure 4 shows a lower half of the disk brake according to Fig. 3; and

Figure 5 shows in a perspective view in longitudinal section the lower brake half according to Fig. 4.

A wind power installation according to Fig. 1 has a stationary tower 1 which is fastened to a ground and rises vertically upwards from said ground. On an upper end region of the tower 1, a nacelle 2 is mounted to be rotatable about a vertical central longitudinal axis of the tower 1. The nacelle 2 bears a rotor 3 which actuates an electric generator via a gearing within the nacelle 2.

Turning of the nacelle 2 is obtained using an azimuth drive, not illustrated in more detail. In the process, the nacelle 2 is oriented in relation to the respective wind direction such that the rotor 3 is always directed to the wind. For securing the relevant adjusted turning position, the nacelle has a horizontally oriented brake disk ring 4 associated, which is rotationally fixed with the nacelle 2. A plurality of disk brakes 5 engage on the brake disk ring 4 (Fig. 2), which disk brakes are distributed around the circumference of the brake disk ring 4 and fixed stationarily to the tower 1. Each disk brake 5 is hydraulically actuatable and has a brake housing, according to Figs. 3 to 5, which is composed of two housing halves 6 and 7. The two housing halves 6 and 7 are designed with mirror symmetry to a central horizontal plane, however, otherwise identical to each other. Both housing halves 6 and 7 have a housing rear area in which the housing halves 6 and 7 are located one on top of the other and are firmly attached to each other by screw connections, not illustrated. Also, both housing halves 6 and 7 are mutually spaced in a housing front area with formation of a receiving jaw 8. The receiving jaw 8 provides an open gap extending across the entire width of the brake housing into the housing front area and open towards three sides, through which gap

the brake disk ring 4 is passed. Consequently, the two housing halves 6 and 7 flank the brake disk ring 4 in the vicinity of its upper side and in the vicinity of its lower side in parallel.

In each of the two housing halves 6 and 7 two brake pistons are mounted for lifting motion, which pistons act in the vicinity of the receiving jaw 8 on a respective one of the friction lining carriers 9 which is clamped in a corresponding receiving region of the respective housing half 6, 7. Upon pressurization by an associated brake piston, the respective friction lining carriers 9 are urged against the corresponding surface of the brake disk ring. Each friction lining carrier 9 carries a respective friction lining in a manner not illustrated in more detail. The two friction lining carriers 9 of a respective housing half 6, 7 are in pairs actuated in synchronism by the respective pair of brake pistons. The brake pistons positioned mutually opposite in pairs in the two housing halves 6 and 7 are movable in synchronism and opposite to each other such that simultaneous pressing of the friction linings against the upper side and the lower side of the brake disk ring 4 occurs upon according hydraulic pressurizing of the disk brake. Between the two friction lining carriers 9 of one housing half 6, 7, the respective housing half 6, 7 has a centre bar 12 which separates the two receiving chambers for the two friction lining carriers 9 of the respective housing half 6, 7.

In the region of a horizontal separating plane of the two housing halves 6, 7, which also constitutes a horizontal central plane of the receiving jaw 8, the two housing halves 6, 7 rest against each other in their housing rear area. Said housing rear area is provided with a cleansing channel 10 located centred and in alignment with the centre bar 12 of the housing front area, which channel is open both to the front towards the receiving jaw 8 and to the rear towards a housing rear side. The cleansing channel 10 is formed by a respective open channel portion in the respective housing half 6, 7, wherein the open channel portions are in mirror symmetry to the separating plane, however, otherwise identical to each other. Due to the two housing halves 6 and 7 located on top of each other in the housing rear area, the closed cleansing channel 10 is formed, which channel has a rectangular free cross section.

In the region of the centre bar 12 between the two friction lining carriers 9 in the housing front area, moreover a cleansing groove 11 is provided in each of the housing halves 6, 7, which groove is in alignment with the cleansing channel 10 and inclined towards a housing front side, i.e. away from the cleansing channel 10. In that context, the cleansing groove 11 is designed, in the vicinity of the lower housing half 7, with a constant decline towards the housing front side, whereby the functionality of a chute results. The complementary cleansing groove is designed, in the vicinity of the upper housing half 6, with an ascend relative to the horizontal separating plane towards the housing front side, and namely with mirror symmetry to the inclination of the cleansing groove 11 in the lower housing half 7. Moreover, the cleansing groove 11 widens towards the housing front side on both sides in the type of a funnel, whereby also the free cross section of the cleansing groove 11 necessarily increases towards the housing front side. With reference to Figs. 4 and 5, it is apparent that the cleansing groove 11 is configured with a trough shape having a bottom and two lateral walls in the vicinity of the centre bar 12. The bottom is continuously declining to the front towards the housing front side, whereby necessarily the two lateral walls are increasingly

higher towards the housing front side. Indeed, the centre bar 12 has a border area which remains in parallel to the horizontal separating plane.

During operation of the disk brake 5, once brake dust, i.e. wear debris, is deposited in the region of the receiving jaw 8 between the friction lining carriers 9, i.e. in the region of the centre bar 12, said brake dust can be pushed out or swept out using a cleaning brush which has been inserted from a housing rear side into the cleansing channel 10 and advanced to the front towards the centre bar 12. In the process, the brake dust is pushed into the cleansing groove 11. Since the cleansing groove 11 is widened towards the housing front side, a most simple removal of the brake dust towards the housing front side is facilitated.

The appropriate cleaning brush is dimensioned such that it can be pushed manually by a respective operator towards the respective centre bar 12 of the upper housing half 6 or the lower housing half 7, both above and below the brake disk ring. This ensures that relevant wear debris can be removed both in the region of the upper housing half 6 and in the region of the lower housing half 7.

Both the cleansing channel 10 and the cleansing grooves 11 are each respectively formed integrally in the two housing halves 6, 7 during production of the housing halves. Preferably, the corresponding channel portions of the cleansing channel 10 and the cleansing grooves 11 are provided already in a casting tool for the production of the housing halves 6, 7 so that the channel portions for the cleansing channel 10 and the cleansing grooves 11 are placed in together, without additional machining, directly following completion of the housing halves 6, 7 in the form of metal cast parts.

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PATENTKRAV

1. Skivebremse til en bremseskive-ring (4) for et azimut-drev i et vindkraftanlæg med et bremsehus, som omfatter to hushalvdele (6, 7), der på modsat beliggende sider flankerer en modtagekæbe (8) for bremseskive-ringen (4), hvorved der i hver hushalvdel (6, 7) er monteret mindst to bremsestempler, som hydraulisk påvirker friktionsbelægningsbærere (9), der er tilordnet til modtagekæben (8), hvorved mindst en hushalvdel (7) omfatter en rensningskanal (10), som strækker sig fra en husbagside til et husfrontområde, i hvilket modtagekæben (8) og friktionsbelægningsbærerne (9) er tilvejebragt,
kendetegnet ved, at rensningskanalen (10) i området ved modtagekæben (8) fortsætter i en rensningsnot (11), der er åben mod en husfrontside.

2. Skivebremse ifølge krav 1, **kendetegnet ved, at** rensningskanalen (10) er tilvejebragt som flugtende med mindst et midterstykke (12) mellem respektive to til hinanden grænsende friktionsbelægningsbærere (9).

3. Skivebremse ifølge krav 1, **kendetegnet ved, at** rensningsnoten (11) i retning mod husfrontsiden besidder en hældning i forhold til et horisontalplan, i hvilket friktionsbelægningsbærere (9) er arrangeret, hvorved en bund i rensningsnoten (11) er længere fjernet fra horisontalplanet hen imod husfrontsiden.

4. Skivebremse ifølge krav 1 eller 3, **kendetegnet ved, at** et tværsnitsareal for rensningsnoten (11) kontinuerligt forøges hen imod husfrontsiden.

5. Skivebremse ifølge et af kravene 1, 3 eller 4, **kendetegnet ved, at** rensningsnoten (11) er udført som trugformet.

6. Skivebremse ifølge et af de foregående krav, **kendetegnet ved, at** begge hushalvdele (6, 7) tilsammen danner rensningskanalen (10), og at der i området ved modtagekæben (8) i begge hushalvdele (6, 7) er tilvejebragt en respektiv rensningsnot.

7. Skivebremse ifølge krav 6, **kendetegnet ved, at** begge rensningsnoter (11) er udført som spejlsymmetriske i forhold til et horisontalt skilleplan for hushalvdelene (6, 7) og hver er udstyret med en respektiv hældning.

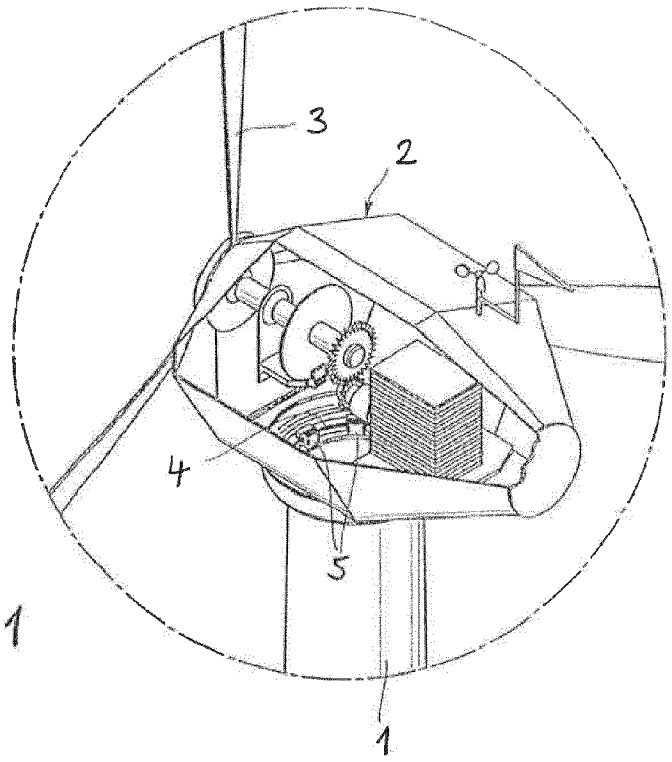

Fig. 1

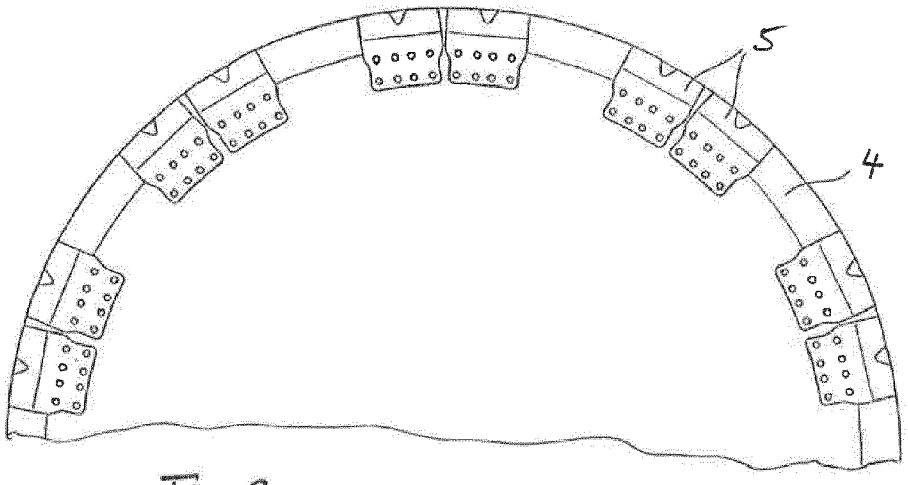

Fig. 2

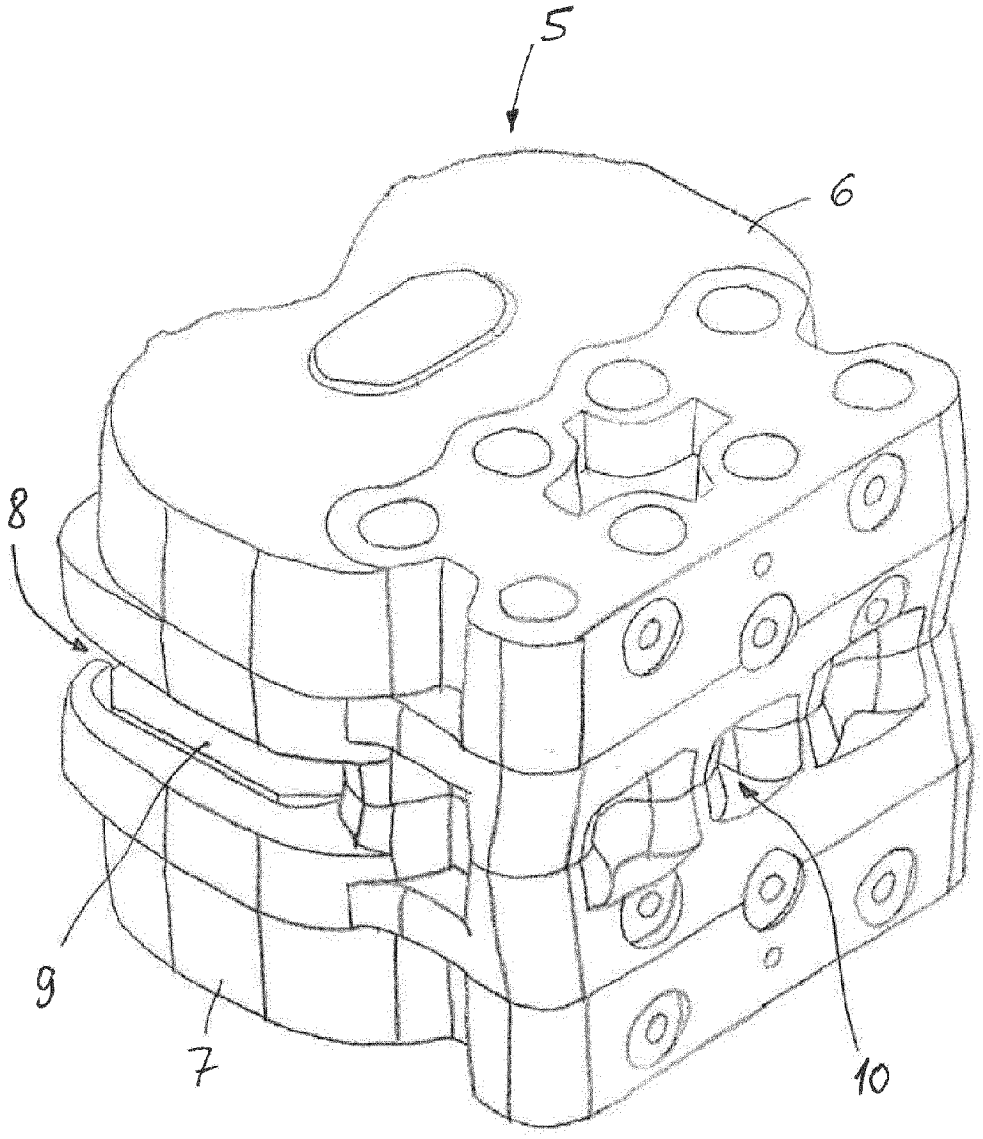

Fig. 3

Fig. 4

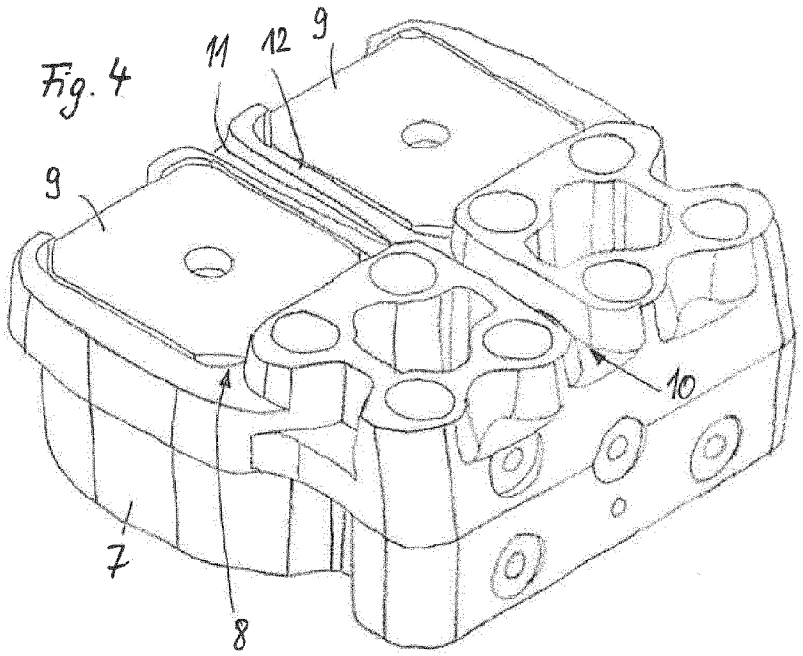

Fig. 5