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Description:

The invention relates to an electromagnetically actuatable braking arrangement and to
5 an electric motor.

It is generally known that in an electromagnetically actuatable braking arrangement of
an electric motor an armature disc is accelerated in the direction of a magnet body.

10 A brake, on the armature disc of which a damping plate is fastened and thus forms a
unit, is known from DE 196 22 983 C1.

An assembly kit for producing different electric motors of a series of electric motors is
known from DE 10 2010 049747 A1.

15

An electromagnetically actuatable brake is known from US 5 274 290 A.

An electromagnetic brake is known from DE 89 13 767 U1.

20 A spring-operated brake is known from EP 0 222 312 A1.

It is therefore the object of the invention to refine an electromagnetically actuatable
braking arrangement, with environmental protection during operation and operational
reliability being improved.

25

According to the invention, this object is achieved in the case of the electromagnetically
actuatable braking arrangement in accordance with the features set forth in Claim 1, and
in the case of the electric motor in accordance with the features set forth in Claim 15.

30 What is advantageous in this case is that noise emission can be reduced and thus
environmental protection is improved. For the environment is impacted with less noise
when the brake is actuated. The damping plate lies on the elevation of the armature disc
and is thus deformable radially outside. Thus when moving the armature disc towards

the magnet body in this region located radially outside contacting of the damping plate by the magnet body can be carried out, and hence damping, i.e. braking, of the armature disc. Due to the elastic mounting of the damping plate on the armature disc, the noise generated upon impact is reduced or prevented.

5

By means of the damping, it is made possible to arrange an angle sensor directly on the magnet body, although the braking of the armature disc triggers a structure-borne noise wave which for the most part also passes in the axial direction through the magnet body.

10 According to Claim 1, an angle sensor is arranged on the axial side of the magnet body remote from the armature disc,

wherein the angle sensor has a sensor housing which is connected to the magnet body directly or by means of an adapter plate, and wherein a sensor rotor part is arranged,

15 surrounded by the sensor housing, which is connected non-rotatably to the shaft,

and wherein the adapter plate is manufactured from an amagnetic, diamagnetic or paramagnetic material, in particular aluminium or plastics material.

20 The material of the adapter plate has a greater absorption for structure-borne noise with a frequency of between 1 Hz and 100 kHz than the material of the magnet body.

What is advantageous in this case is that the shockwave which is caused by the armature disc and not completely damped by the damping disc can be damped further by the adapter plate and thus reinforcement of the damping towards the angle sensor can be

25 brought about. Owing to the suitable choice of material, protection from magnetic fields and shockwaves, therefore structure-borne noise, can be achieved.

In one advantageous configuration, the radial clearance region is a partial region of the radial clearance region covered by the brake coil. What is advantageous in this case is

30 that the elevation is arranged radially in the radial clearance region covered by the brake coil. Thus. Thus in this region the magnet body plus brake coil and associated coil holder and also potting compound can be embodied in axially recessed manner, so that an air space towards the damping plate is produced. In this manner, contacting of the

damping plate is prevented, so that it lies undisturbed on the axial elevation of the armature disc.

5 In one advantageous configuration, the brake coil and/or a coil holder of the brake coil is held in the magnet body by means of potting compound. What is advantageous in this case is that a simple connection technique, in particular a connection technique using a material-formed bond, can be used.

10 In one advantageous configuration, spring elements supported on the magnet body press on the armature disc, in particular in the axial direction. What is advantageous in this case is that when the brake coil is non-energised, for example in the event of a power failure, the brake engages and release is prevented. Thus safety is increased.

15 In one advantageous configuration, the damping plate lies on the elevation and/or contacts the elevation. What is advantageous in this case is that the force braking the armature disc can be introduced across the bearing surface, this force being able to be generated upon contacting of the damping plate by the magnet body by means of deformation of the damping plate.

20 In one advantageous configuration, there is an air space between the damping plate and potting compound. What is advantageous in this case is that the contacting of the damping plate by the magnet body takes place in a defined region, i.e. radially outside the radial clearance region covered by the elevation.

25 In one advantageous configuration, when the brake coil is non-energised the spring elements press the armature disc towards the lining carrier, which is thus pressed onto a braking surface,

30 in particular wherein the braking surface is arranged on a housing part and/or bearing bracket which is connected to the magnet body,

in particular wherein the shaft is mounted in the part having the braking surface by means of at least one bearing. What is advantageous in this case is that safety is

increased, since application of the brake is provided in the event of a power failure or the like.

5 In one advantageous configuration, when the brake coil is energised the armature disc is attracted towards the magnet body counter to the spring force generated by the spring elements. What is advantageous in this case is that the brake lining carrier gains axial clearance and thus moves away from the braking surface.

10 In one advantageous configuration, the brake coil is a toroidal coil which is accommodated in an annular cutout in the magnet body,

15 in particular wherein the axis of the toroid is the shaft axis. What is advantageous in this case is that simple production is made possible, in particular in that the magnet body is formed in a pot-shape, with a centrally arranged central limb opening on to the pot base.

20 In one advantageous configuration, the magnet body radially outside the radial clearance region covered by the elevation projects axially further towards the armature disc than in this radial clearance region or radially further to the inside. What is advantageous in this case is that the contacting of the damping plate by the magnet body takes place in a defined manner, i.e. only radially outside the radial clearance region covered by the elevation.

25 In one advantageous configuration, the damping plate is manufactured from steel sheet and/or embodied as a perforated disc. What is advantageous in this case is that effective noise damping can be achieved without an excessively large air gap being necessary. To this end, it is important on one hand for the steel sheet to have great stability, and on the other hand for the steel sheet to be ferromagnetic.

30 In one advantageous configuration, the armature disc is formed from a ferromagnetic material, such as steel or iron, and/or the magnet body is formed from cast steel. What is advantageous in this case is that rapid release is made possible with a low coil current, although the spring elements produce high spring forces.

In one advantageous configuration, the lining carrier has internal toothing which is engaged with external toothing connected to the shaft or arranged on the shaft, in particular wherein the toothing extends axially. What is advantageous in this case is that a high torque can be transmitted, with a low Hertzian stress occurring. Preferably involute toothing can be used.

Important features in the case of the electric motor with a braking arrangement, in particular with an aforementioned braking arrangement, are that the shaft is a rotor shaft of the electric motor. What is advantageous in this case is that the drive comprising the electric motor with braking arrangement, for example converter-fed geared motor, is low-noise and thus can be operated in an environmentally compatible manner.

Further advantages will become apparent from the dependent claims.

The invention will now be discussed in greater detail with reference to illustrations:

Figure 1 shows a schematic cross-section through a braking arrangement according to the invention of a drive.

Figure 2 shows an enlarged detail.

As shown in the figures, the shaft 1 is mounted by means of a bearing 2 accommodated in the bearing bracket 3 of an electric motor.

The shaft 1 in such case is the rotor shaft of the electric motor, and is embodied with toothing or non-rotatably connected to a toothed part which has toothing, the toothing being the input toothing of a gear mechanism driven by the motor.

The bearing bracket 3 is connected to the stator housing and/or further housing parts of the electric motor.

To the bearing bracket 3 there is connected, in particular screw-connected with interposed spacing bolts, on the axial side of the bearing bracket 3 remote from the

stator, a magnet body 11, preferably made of cast steel, in particular nodular cast iron.
The magnet body 11 can also be referred to as a coil form.

5 Additionally, sealing can be produced with a housing part 5 interposed between the magnet body 11 and bearing bracket 3 which is connected to the bearing bracket 3 and to the magnet body 11 in sealed manner.

On the outer periphery of the shaft 1 or on a ring part 15 connected non-rotatably thereto, there is attached toothing, the teeth of which extend in the axial direction.
10 Preferably the toothing is involute toothing.

A lining carrier 4, which has at least axially on both sides, i.e. facing towards the bearing bracket 3 and also the magnet body 11, a respective brake lining or is manufactured from a brake lining, has internal toothing by means of which the lining
15 carrier 4 is connected non-rotatably but axially displaceably to the toothing of the shaft 1 or of the ring part 15.

An armature disc 6 arranged axially between the lining carrier 4 and magnet body 11 and connected axially displaceably but non-rotatably to the magnet body is formed from
20 a ferromagnetic material, such as steel or the like.

The magnet body 11 has an annular cutout, into which a toroidal coil, which is also referred to as a brake coil 10, accommodated in a coil holder 12 made of plastics material is laid. The magnet body therefore has a pot-shaped appearance, with a
25 centrally arranged central limb being formed on the magnet body 11.

When the brake coil 10 is non-energised, spring elements 9 supported on the magnet body press the armature disc 6 onto the lining carrier 4, which is thus pressed onto the bearing bracket 3. The contact face of the corresponding brake lining portion of the
30 lining carrier 4 with the bearing bracket 3 is finish-machined, in particular ground, as a braking surface.

The brake coil 10 plus coil holder 12 is held in the annular cutout in the magnet body 11 by means of potting compound.

When the brake coil 10 is energised, the armature disc 6 is attracted in the direction
5 towards the magnet body counter to the spring force of the spring elements 9.

On the side of the magnet body 11 remote from the bearing bracket, there is arranged an adapter plate 13, on the axial side of which which is remote from the magnet body 11 a sensor housing 14 of an angle sensor is connected, in particular screw-connected. A
10 sensor rotor part of the angle sensor is non-rotatably connected to the shaft 1, so that the angular position of the sensor rotor part surrounded by the sensor housing 14 can be detected. In this case, the sensor housing 14 in Figure 1 is not illustrated in a cutaway view.

15 The adapter plate 13 is manufactured from a non-magnetic and/or diamagnetic material, such as for example aluminium or plastics material, so that magnetic decoupling can be achieved between the magnet body and angle sensor. The adapter plate 13 has a first interface for connection to the magnet body 11 and a second interface for connection to the sensor housing 14. Thus various sensor housings can be connected on the same
20 magnet body 11. Alternatively, an always identical angle sensor can be connected to different magnet bodies 11, in that a corresponding respective adapter is associated with the respective sensor housing 14, this adapter always having the same interface towards the magnet body 11, but always the same interface to the angle sensor [sic]. "Interface" in this case is understood to mean the geometric arrangement of steps and/or the drilling
25 pattern of bores in the region of connection of the respective component.

A damping system with a damping plate 21 is provided to protect the angle sensor. This plate is connected to the armature disc 4, in particular connected in positive manner and/or riveted.

30

The damping plate 21 is embodied as a flat sheet metal piece and has cutouts for the continuous spring elements 9.

The damping plate 21 lies on a collar 20, i.e. an annular elevation, on the armature disc 6. This elevation 20 faces towards the magnet body 11 and is arranged within the radial clearance region covered by the brake coil 10. To avoid contacting, an air space 7 is arranged between the damping plate 21 and the potting compound 8. To this end,
5 correspondingly little potting compound 8 is used when pouring into the annular cutout of the magnet body 11. The air space 7 covers the region covered by the elevation 20 in the radial direction.

10 In the radial clearance region which adjoins the radial clearance region covered by the elevation 20 and lies radially further to the outside, the damping plate 21 is axially spaced apart from the armature disc 6.

Thus the magnet body presses on the damping plate 21 when the brake is applied, i.e. when the brake coil 10 is energised. Since however the air space 7 is arranged between
15 the potting compound 8 and damping plate 21, the damping plate 21 is not contacted by potting compound 8 or by the magnet body 11 even when the brake is applied, i.e. when the brake coil 10 is energised.

20 Thus the energy of the armature disc 6 which is accelerated when the brake coil 10 is energised is dissipated at least partially by means of the damping plate 21 and thus the resulting impact noise is damped by means of the deformation of the damping plate 21.

The axial extent of the elevation 20 is smaller than, in particular at least five times as small as, the axial extent of the air space 7.

25

The elevation 20 is formed in annular manner. It is similar to a circumambient collar.

The damping plate 21 is again ferromagnetic, just like the armature disc.

30 In further examples of embodiment according to the invention, the ring part 15 is embodied in one piece with the shaft 3.

List of reference numerals

	1	shaft
5	2	bearing
	3	bearing bracket
	4	brake lining carrier
	5	housing part
	6	armature disc
10	7	air space
	8	potting compound
	9	spring element
	10	brake coil
	11	magnet body
15	12	coil holder
	13	adapter plate
	14	sensor housing
	20	collar, annular elevation
	21	damping plate
20		

P a t e n t k r a v

1. Elektromagnetisk aktiverbar bremseanordning til bremsning af en aksel, på hvilken der drejefast, men aksialt bevægeligt er anbragt en belægningsbærer, hvor der er optaget en bremsespole (10) i en magnetkrop (11), med hvilken en ankerskive (6) er drejefast forbundet, men er aksialt bevægeligt anbragt, hvor ankerskiven (6) har en forhøjning på sin side, der vender mod magnetkroppen, hvor en dæmpningsplade (21) er anbragt aksialt mellem ankerskiven og magnetkroppen, hvor dæmpningspladen uden for radialafstandsområdet, der er overdækket af forhøjningen (20), kan deformeres og/eller kan berøres af magnetkroppen, især af magnetkroppen, **kendetegnet ved, at** ankerskiven og dæmpningspladen er anbragt løst aksialt ved siden af hinanden, der på magnetkroppens aksiale side, der vender bort fra ankerskiven, er anbragt en vinkelsensor, hvor vinkelsensoren har et sensorhus (14), som direkte eller via en adapterplade (13) er forbundet med magnetkroppen, og hvor der omgivet af sensorhuset er anbragt en sensorrotordel, som er drejefast forbundet med akslen, hvor adapterpladen er fremstillet af et umagnetisk, diamagnetisk eller paramagnetisk materiale, især aluminium eller kunststof.
2. Bremseanordning ifølge krav 1, **kendetegnet ved, at** adapterpladens materiale har en større absorption for kropslyd med en frekvens mellem 1 Hz og 100 kHz end magnetkroppens materiale.
3. Bremseanordning ifølge mindst et af de foregående krav, **kendetegnet ved, at** ankerskiven (6) og dæmpningspladen (21) er respektivt drejefast, men aksialt bevægeligt anbragt ved hjælp af føringselementer, som er forbundet, især skrueforbundet, med magnetkroppen, hvor føringselementerne på en formluttende måde er forbundet med både ankerskiven og med dæmpningspladen i

omkredsretning, især hvor der er anvendt cylinderstifter som føringselementer.

4. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

5 radialafstandsområdet er et delområde af radialafstandsområdet, der er overdækket af bremsespole.

5. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

10 bremsespole og/eller en spolebærer af bremsespole holdes i magnetkroppen ved hjælp af støbemasse.

6. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

15 fjederelementer (9), der hviler på magnetkroppen, trykker på ankerskiven, især i aksial retning.

7. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

20 dæmpningspladen ligger på forhøjningen og/eller berører forhøjningen, og/eller at der mellem dæmpningsplade og støbemasse er et luftrum.

8. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

25 når bremsespole ikke får tilført strøm, trykker fjederelementerne ankerskiven hen mod belægningsbæreren, som således trykkes på en bremseflade, især hvor bremsefladen er anbragt på en husdel og/eller et lejeskjold, som er forbundet med magnetkroppen,
30 især hvor akslen er monteret i den del, som har bremsefladen, ved hjælp af mindst et leje.

9. Bremseanordning ifølge mindst et af de foregående krav,

kendetegnet ved, at

når bremsespole får tilført strøm, tiltrækkes ankerskiven hen imod magnetkroppen mod den fjederkraft, som frembringes af fjederelementerne.

- 5 **10. Bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
bremsespole er en ringspole, som er optaget i en ringformet udsparing af magnetkroppen,
især hvor ringaksen er akselaksen.
- 10 **11. Bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
magnetkroppen radialt uden for radialafstandsområdet, som er overdækket af forhøjningen, rager aksialt længere udad mod ankerskiven end i dette radialafstandsområde eller radialt længere indad.
- 15 **12. Bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
dæmpningspladen er fremstillet af en stålplade og/eller er udført som hulskive.
- 20 **13. Bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
ankerskiven er udført af et ferromagnetisk materiale såsom stål eller jern, og/eller at magnetkroppen er udført af støbestål.
- 25 **14. Bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
belægningsbæreren har en indvendig fortanding, som er i indgreb med en udvendig fortanding, som er forbundet med akslen eller anbragt på akslen, især hvor fortandingen strækker sig aksialt.
- 30 **15. Elektromotor med en bremseanordning ifølge mindst et af de foregående krav,
kendetegnet ved, at**
akslen er en rotoraksel af elektromotoren.
- 35

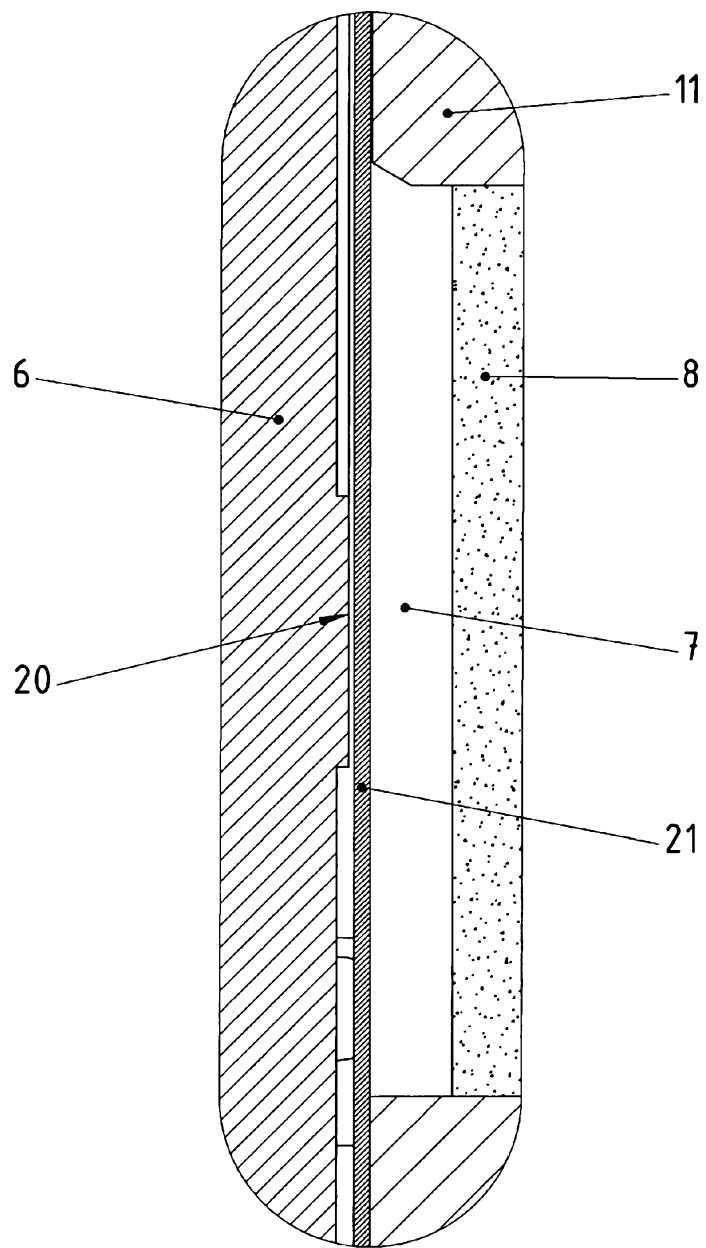


Fig. 2