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(54) Title: DEVICE FOR BRAKING A SHAFT

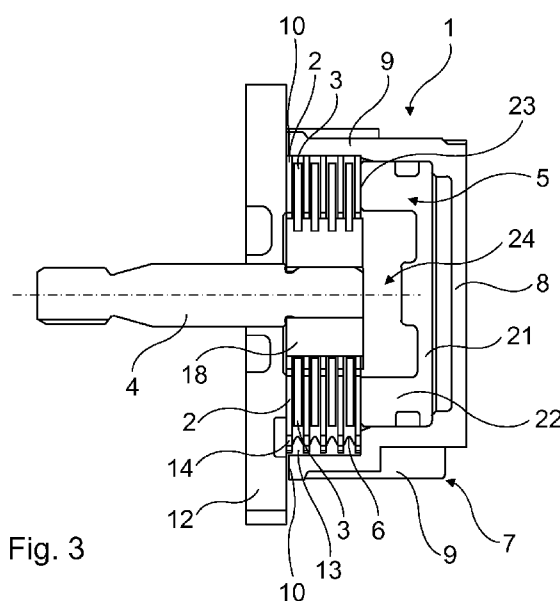


Fig. 3

(57) Abstract: The invention relates to a device for braking a shaft of a motor vehicle, comprising at least one brake disc and at least one plate, which at least one plate is detachably fastened to said shaft in such a way that said at least one plate is arranged for rotation with, and linear movement on, said shaft, and which at least one brake disc is arranged for linear movement in the longitudinal direction of the shaft and is so arranged as to be prevented from rotating, said at least one brake disc and said at least one plate being arranged alternately after one another, which device further comprises a pushing means adapted to pressing said at least one plate and said at least one brake disc together in order to exert a braking action on said shaft. According to the invention the device further comprises a spring element detachably fastened to said at least one brake disc.

DEVICE FOR BRAKING A SHAFT

Technical field

- 5 The present invention relates to a device for braking a shaft in accordance with the preamble of claim 1. The invention relates also to a motor vehicle according to claim 11.

Background to the invention

- 10 Stepped gearboxes for motor vehicles usually comprise a mainshaft with a number of freely supported shift gearwheels which are in engagement with a corresponding number of fixed gearwheels arranged on a countershaft. During a gearchange operation, before one of the freely supported shift gearwheels can be engaged with the mainshaft, the rotation speed of the shift gearwheel is synchronised, i.e. matched, with the rotation speed of the mainshaft, usually by means of a shaft brake which reduces the speed of the countershaft so that the rotation speed of the shift gearwheel which is to be engaged is synchronised with the rotation speed of the mainshaft. A countershaft brake is usually to some extent filled with oil and
- 15 comprises a piston, a number of brake discs and a number of planar, smooth or grooved discs or plates which are arranged between these brake discs. The plates are connected to the countershaft in such a way that they are rotatable with the shaft and capable of linear movement on the shaft in its axial direction, and the brake discs are likewise movable in the axial direction
- 20 of the shaft but are supported in a surrounding brake housing and thereby prevented from rotating. When the shaft is to be braked, the piston presses the brake discs and the plates together, thus slowing the rotation of the plates. As the plates are connected to the countershaft, the countershaft will thus also be braked. When the speed of the countershaft has been reduced
- 25 to a desired level, the piston is discharged and the piston, the brake discs and the plates revert to their original no-load positions so that the braking action on the shaft ceases completely. The problem with today's shaft
- 30

brakes is that when the force from the piston ceases and the piston reverts to its original position, there is in oil-filled disc brakes a time lag before the plates are released from the brake discs and hence also a time lag of the braking force on the shaft. The time lag is caused by the suction effect
5 exerted by the oil between the brake discs and the plates after the pressing-together force from the piston has ceased. When the suction effect ceases, the plates are released from the brake discs, allowing the plates and the brake discs to revert to a no-load state and thus making it possible for the gearchange process to commence. The disadvantage with this type of shaft
10 brake is thus that gearchange operations of the gearbox are delayed owing to the time lag which occurs when the plates have to release themselves from the brake discs at the end of a braking process. Braking process in this context means the period of time during which the countershaft is braked by the countershaft brake, i.e. the time from when the piston presses the brake
15 discs and the plates together and the rotation of the plates, and hence also of the countershaft, is slowed to when the piston is discharged and the piston, the brake discs and the plates revert to their original no-load positions so that the braking action on the shaft ceases completely. Where such a shaft brake is used, it is desirable that the braking process can take place as quickly as
20 possible and thereby allow as rapid a gearchange operation in the gearbox as possible.

Object of the invention

The object of the present invention is thus to provide an improved
25 device for braking a shaft which makes possible a quick braking process on the shaft by the shaft brake and hence also a rapid gearchange operation in the gearbox.

Summary of the invention

30 These and other objects indicated by the description set out below are achieved by means of a device for braking a shaft and a motor vehicle as above which further exhibit the features indicated in the characterising parts

of the attached independent claims 1 and 11 respectively. Preferred embodiments of the device are defined in the attached dependent claims 2-10.

The present invention thus defines a device for braking a shaft of a
5 motor vehicle, comprising at least one brake disc and at least one plate,
which at least one plate is detachably fastened to said shaft in such a way
that said at least one plate is arranged for rotation with, and linear movement
on, said shaft, and which at least one brake disc is arranged for linear
10 movement in the longitudinal direction of the shaft and is so arranged that it
is prevented from rotating, said at least one brake disc and said at least one
plate being arranged alternately after one another, which device further
comprises a pushing means adapted to pressing said at least one plate and
said at least one brake disc together in order to exert a braking action on said
15 shaft, the device further comprising a spring element detachably fastened to
at least said brake disc.

The invention affords the advantage that said at least one spring
element fastened to said at least one brake disc in an on-load state during
the overcoming of a suction effect releases said at least one brake disc from
said at least one plate and urges both said at least one brake disc and said at
20 least one plate back to their no-load state. The result is a quicker braking
process than in prior art, making possible a more rapid gearchange process
in the motor vehicle's gearbox than in prior art.

Furthermore, the device comprises a box element with a bottom, a
surrounding sidewall which is firmly connected to said bottom substantially
25 perpendicularly and which has a free edge constituting an aperture in the box
element, and a cover unit adapted to closing said aperture, with a portion of
said shaft extending through said cover unit and into the box element, which
box element is adapted to accommodating said at least one brake disc, said
at least one plate, said pushing means and the portion of the shaft which
30 extends through said cover unit. The result is a shaft brake which is simple
and functional and hence also inexpensive to manufacture.

Moreover, said sidewall of the box element comprise on the inside at least one groove which extends down from said edge towards the bottom of the box element, and said at least one brake disc may each comprise said at least one guide portion extending radially outwards from the periphery of the
5 respective brake disc, each which said at least one guide portion extends in the fitted state of said at least one brake disc into one of said at least one groove. The result is a shaft brake in which said at least one brake disc is prevented from rotating with the shaft and in which said at least one brake disc can at the same time move in a linear manner along the axial direction of
10 the shaft, and said spring element is fastened detachably to said guide portion, making it possible for the spring element to be changed if, for example, it becomes worn out or the spring force needs adjusting.

According to a further embodiment, said cover unit may take the form of the casing of the vehicle's gearbox, resulting in the countershaft brake
15 occupying little space. Alternatively, said cover unit may be a unit arranged separately for the box element.

According to a further embodiment, said at least one plate and said at least one brake disc may be adapted to being pressed together between said pushing means and said cover unit in order to exert a braking action on
20 said shaft. The result is a shaft brake of simple configuration.

According to a further embodiment, each said at least one guide portion may be provided with a groove and said spring element may be inserted into said groove. The spring element can thus be fastened securely to said at least one brake disc.
25

Brief description of the drawings

The invention is described in more detail below on the basis of non-limitative embodiment examples and with reference to the attached drawings, in which:

30 Figure 1 depicts a partly exploded perspective view of a device for braking a shaft according to the present invention, in which the box element

and the piston of the device are separated from the other parts of the device, which other parts are mounted on the shaft,

Figure 2 depicts a perspective view of an embodiment of the device for braking a shaft according to the present invention,

5 Figure 3 depicts a cross-sectional view of the device for braking a shaft according to the present invention,

Figure 4 depicts an embodiment of the device in which the box element is provided with protruding portions on its inside and the brake disc is provided with recesses in which the protruding portions can engage,

10 Figure 5 depicts a side view of an embodiment of the spring element in a fitted state on the brake discs,

Figure 6 depicts an embodiment of the spring element in the form of a band spring, and

15 Figure 7 depicts schematically a motor vehicle comprising a device according to the present invention.

Detailed description of the invention

Figures 1-5 depict an embodiment of the present invention applied to a device for braking a countershaft in a motor vehicle. It should however
20 immediately be emphasised that the invention is in no way limited to this type of device for braking of shafts, since it is applicable to all kinds of devices for braking of shafts.

Figure 1 depicts a countershaft brake 1 in a perspective view in which the parts of the countershaft brake 1 are partly separated from one
25 another. The countershaft brake 1 comprises a box element 7 with a bottom 8 which is connected to a sidewall 9 substantially perpendicularly, brake discs 2, in this case numbering five, although the number may of course range from one brake disc upwards, plates 3, in this case numbering four, although the number may of course range from one plate upwards, a pushing
30 means 5, in this case a piston, adapted to pressing the plates 3 and the brake discs 2 together in order to exert a braking action on the countershaft 4, and a cover unit 12. Said piston 5 is preferably operated pneumatically,

although it is of course possible for the piston to be operated in some other way, e.g. hydraulically. The sidewall 9 of the box element 7 comprises an edge 10 which defines an aperture 11 on the box element 7. The aperture 11 is situated centrally to the bottom 8 of the box 7 and is intended to be a fitting space for the piston 5, the brake discs 2, the plates 3 and the portion of the countershaft 4 which goes through the cover unit 12 and into the fitting space of the box 7. The inside of the sidewall 9 is also provided with elongate grooves 13 which extend down towards the bottom 8 of the box element 7 from the edge 10 on the sidewall 9. The number of elongate side grooves in this embodiment is three, although it is of course possible to conceive of the sidewall 9 of the box element 7 being provided with one or two grooves or more than the three grooves indicated in the embodiment depicted.

In this embodiment, the plates 3 and the brake discs 2 are pressed together between the piston 5 and the cover unit 12, although it is of course also conceivable for the pushing means 5 to comprise two pistons 5 which press the plates 3 and the brake discs 2 together from their respective directions. A portion of the countershaft 4 of the gearbox goes through the cover unit 12 and has the plates 3 mounted on it in such a way that they rotate with it but are capable of linear movement on it. The plates 3 in Figure 1 are provided with internal splines, although it is of course also conceivable for the plates 3 to be provided with internal teeth, and the shaft 4 is provided correspondingly with external splines, or external gearwheels, to enable the plates 3 to be able to rotate with, and transmit a braking force to, the shaft 4. In Figure 1, an adaptor 18 with both internal and external splines is provided in addition between the plates 3 and the shaft 4. The brake discs 2, however, are not fastened to the shaft 4 but each comprise in Figure 1 three guide portions 14 which extend out from the periphery of the brake discs 2. In the fitted state of the brake discs 2, each of these guide portions 14 extends into its respective groove in the sidewall 9 of the box element 7, thereby preventing the brake discs 2 from moving to any great extent in the

radial direction. Each brake disc 2 is nevertheless capable of linear movement in the axial direction of the shaft 4.

When the countershaft 4 is to be braked, the piston 5 presses the plates 3 and the brake discs 2 together against the cover unit 12, thereby
5 slowing the rotation of the plates 3 and hence also of the countershaft 4. When the speed of the countershaft 4 has been reduced to a desired level, the piston 5 is discharged, whereupon the piston 5, the plates 3 and the brake discs 2 will tend to revert to their no-load position. In the oil-filled countershaft brake 1, a delay then occurs before the plates 3 are released
10 from the brake discs 2. The delay is caused by the suction effect exerted by the oil between the brake discs 2 and the plates 3 after the pressing-together force from the piston 5 has ceased. To counteract this suction effect and thus shorten this delay, a spring element 6 is detachably fastened to each of the guide portions 14 of the brake discs 2. It is of course possible to
15 conceive of the spring element being detachably fastened also to the cover unit and/or to the piston, or the pistons in the case of an embodiment with two pistons as above. Like the brake discs 2 and the plates 3, each of the three spring elements 6 fastened to the guide portions 14 of the plates 3 will be pressed together during the braking process on the shaft 4. When the
20 force from the piston 5 is discharged, the spring elements 6 will tend to revert to a no-load state. If the spring force of the spring elements 6 is greater than said suction effect, the brake discs 2 will release themselves from the plates 3 more quickly than without spring elements 6 and the braking process on the shaft 4 will therefore be more rapid with the spring element 6 than in prior art. A more rapid braking process on the shaft 4 also means that the
25 gearchange process in the gearbox of the motor vehicle 20 will be quicker than gearchange processes according to prior art.

Figure 2 depicts a perspective view of the countershaft brake 1 in a fitted state in which the piston 5, the plates 3, the brake discs 2 and a portion
30 of the countershaft 4 are accommodated in the box element 7.

Figure 3 depicts a cross-sectional view of the countershaft brake 1, in which the shaft brake 1 does not exert any braking action on the countershaft

4. The drawing also shows the configuration of the piston 5. The piston 5 comprises a piston body with a bottom 21 and an enclosing sidewall 22 which is firmly connected to said bottom 21 substantially perpendicularly and which has a free edge 23 constituting an aperture 24 in the piston body.

- 5 When the piston 5 presses the brake discs 2 and the plates 3 together, the free edge 23 of the piston 5 thus abuts against the first brake disc 2, and the more the piston presses the brake discs 2 and the plates 3 together the more the piston 5 will enclose the shaft 4 and the adaptor means 18.

Figure 4 depicts the box element 7 in a perspective view and the
10 brake disc 2 in a view from in front. In this embodiment, the box element 7 comprises three protruding portions 15 which extend down along the sidewall 9 of the box element 7 from the edge 10 of the box element 7 towards the bottom, and radially in towards the middle, of the box element 7. The brake disc 2 comprises three recesses 16 in its periphery, and in its fitted state
15 accommodates in these recesses 16 the protruding portions 15 in the box element 7 in order thus to simultaneously prevent the brake disc 2 from rotating and make it possible for the brake disc 2 to move in a linear manner along the protruding portions 15.

Figure 5 depicts a spring element 6 fitted on each of the brake discs
20 2, with the countershaft brake 1 in a non-braking state.

Figure 6 depicts an embodiment of the spring element 6 in a non-fitted state.

Figure 7 depicts schematically a motor vehicle 20 comprising a device 1 according to the present invention.

CLAIMS

1. A device for braking a shaft (4) of a motor vehicle (20), comprising at least one brake disc (2) and at least one plate (3), which at least one plate (3) is
5 detachably fastened to said shaft (4) in such a way that said at least one plate (3) is arranged for rotation with, and linear movement on, said shaft (4), and which at least one brake disc (2) is arranged for linear movement in the longitudinal direction of the shaft (4) and is so arranged as to be prevented from rotating, said at least one brake disc (2) and said at least one plate (3)
10 being arranged alternately after one another, which device (1) further comprises a pushing means (5) adapted to pressing said at least one plate (3) and said at least one brake disc (2) together in order to exert a braking action on said shaft (4), wherein the device (1) further comprises at least one spring element (6) detachably fastened to said at least one brake disc (2), a
15 box element (7) with a bottom (8), a surrounding sidewall (9) which is firmly connected to said bottom (8) substantially perpendicularly and which has a free edge (10) constituting an aperture (11) in the box element (7), and a cover unit (12) adapted to closing said aperture (11), with a portion of said shaft (4) extending through said cover unit (12) and into the box element (7),
20 said box element (7) being arranged to accommodate said at least one brake disc (2), said at least one plate (3), said pushing means (5) and the portion of the shaft (4) which extends through said cover unit (12), wherein said sidewall (9) of the box element (7) comprises on the inside at least one groove (13) which extends down from said edge (10) towards the bottom (8)
25 of the box element (7), and that said at least one brake disc (2) comprises at least one guide portion (14) which extends radially out from the periphery of the respective brake disc (2), with each said at least one guide portion (14) in the fitted state of said at least one brake disc (2) extending into one of said at least one groove (13), **characterised** in that said spring elements (6) are
30 fastened detachably to said guide portions (14), and arranged for bridging each one of the brake discs (2) being part of the device (1).

2. A device according to claim 1, **characterised** in that said sidewall (9) of the box element (7) comprises on the inside at least one protruding portion (15) which extends radially inwards from the sidewall (9) of the box element (7) towards the middle of the box element (7) and away from the edge (10) of the box element (7) and down towards the bottom (8) of the box element (7), and that each said at least one brake disc (2) comprises at least one recess (16) in its periphery, with said at least one protruding portion (15) in the fitted state of said at least one brake disc (2) extending into one of said recesses (16) of said at least one brake disc (2).

10

3. A device according to any one of claims 1-2, **characterised** in that said cover unit (12) is constituted by the casing for the gearbox of the motor vehicle (20).

4. A device according to any one of claims 1-2, **characterised** in that said cover unit (12) is a unit arranged separately for the box element (7).

5. A device according to any one of claims 1-4, **characterised** in that said pushing means (5) is adapted to being operated pneumatically.

20

6. A device according to any one of claims 1-5, **characterised** in that said at least one plate (3) and said at least one brake disc (2) are adapted to being able to be pressed together between said pushing means (5) and said cover unit (12) in order to exert a braking action on said shaft (4).

25

7. A device according to any one of claims 1-6, **characterised** in that each said at least one guide portion (14) is provided with a recess (19) and that said spring elements (6) can move into said recesses (19).

8. A device according to any one of claims 1-7, **characterised** in that said at least one plate (3) is fastened to the shaft (4) via an adapter means (18).

30

9. A device according to any one of the preceding claims 1-8, **characterised** in that said spring element (6) is a band spring.

10. A device according to any one of the preceding claims 1-9,
5 **characterised** in that the device (1) is a countershaft brake.

11. A motor vehicle comprising a device (1) according to any one of claims 1-10.

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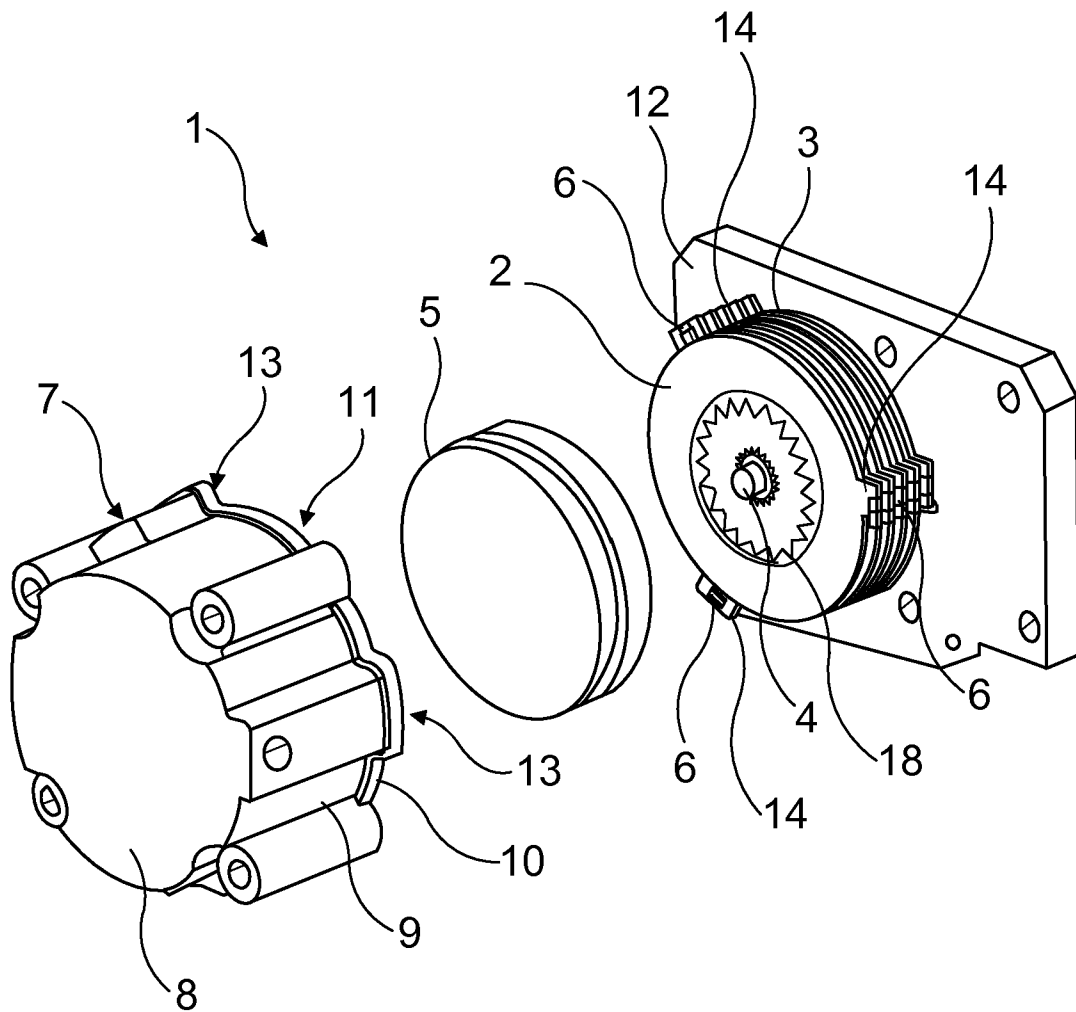


Fig. 1

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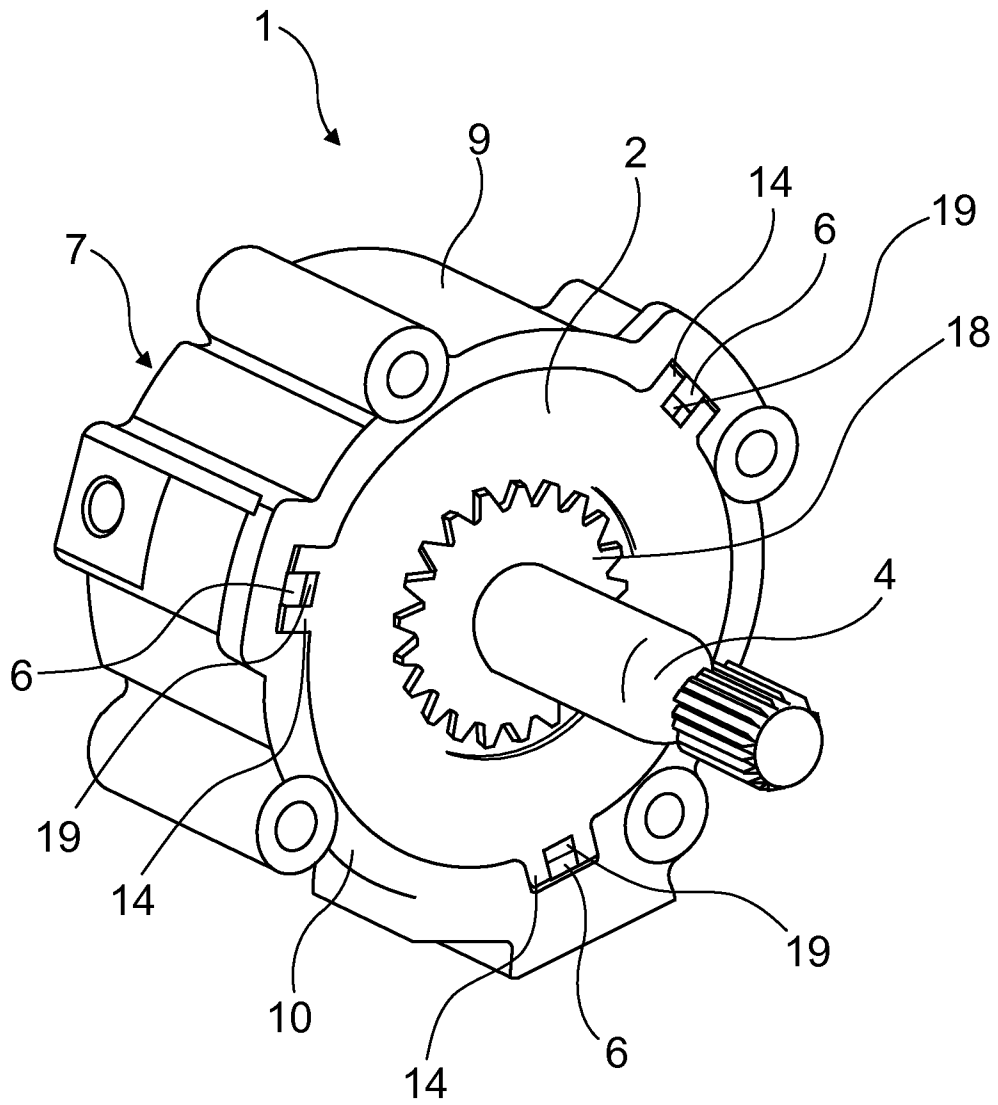


Fig. 2

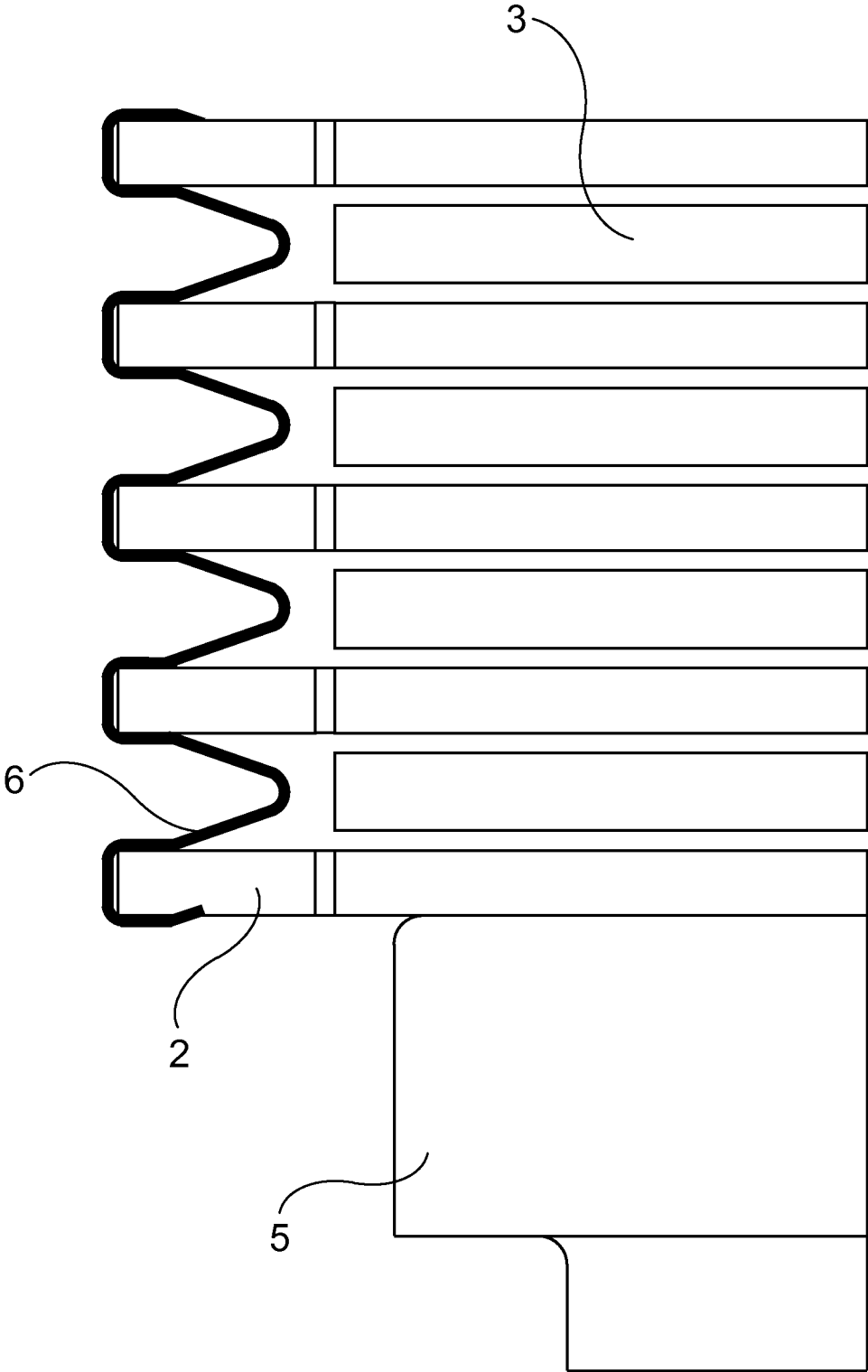


Fig.5

Fig. 6

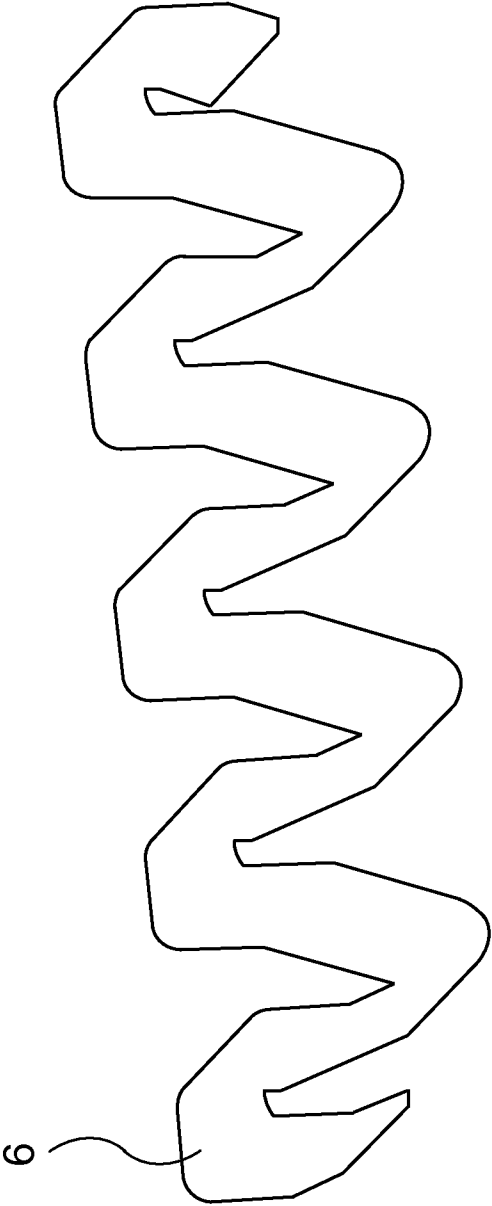
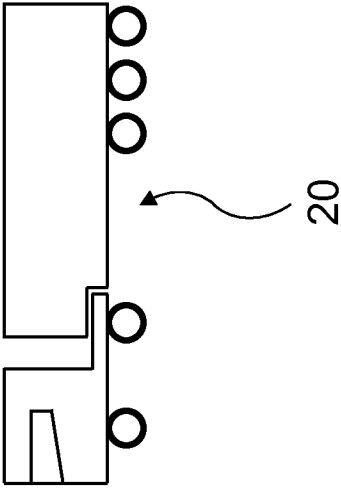


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/051207

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F16D, B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3994378 A (SCHWÄBE, JÜRGEN ET AL), 30 November 1976 (30.11.1976) --	1-11
A	US 20050252731 A1 (HEDMAN, ANDERS), 17 November 2005 (17.11.2005) --	1-11
A	JP 2003013996 A, FUJI HEAVY IND LTD, 2003-01-15: (abstract) Retrieved from: JP database --	1-11
A	DE 4408666 A1 (ZF FRIEDRICHSHAGEN AG), 21 Sept 1995 (21.09.1995) -- -----	1-11

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2009/051207

US	3994378	A	30/11/1976	NONE
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				WO	9525230	A	21/09/1995