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(54) **Infinitely variable door check**

(57) The invention relates to an infinitely variable door check, especially for a vehicle door, with a hinge 1 comprising a first hinge part 2 and a second hinge part 3 which are pivotal relative to each other about a pivot axis 4, 24. According to a first aspect of the invention, a compression unit is provided that comprises an elastically deformable material 12 which is elastically compressed during movement of the first hinge part 2 relative to the

second hinge part 3. Further, according to a second aspect of the invention, a braking unit 28 is provided that applies a braking load for the pivot movement of the first hinge part 22 relative to the second hinge part 23, wherein a gear 27, 31 is provided that interacts with the hinge shaft 25 and the movement of which is controlled by the braking unit 28. These designs allow for a very compact design for an infinitely variable check for an automotive door.

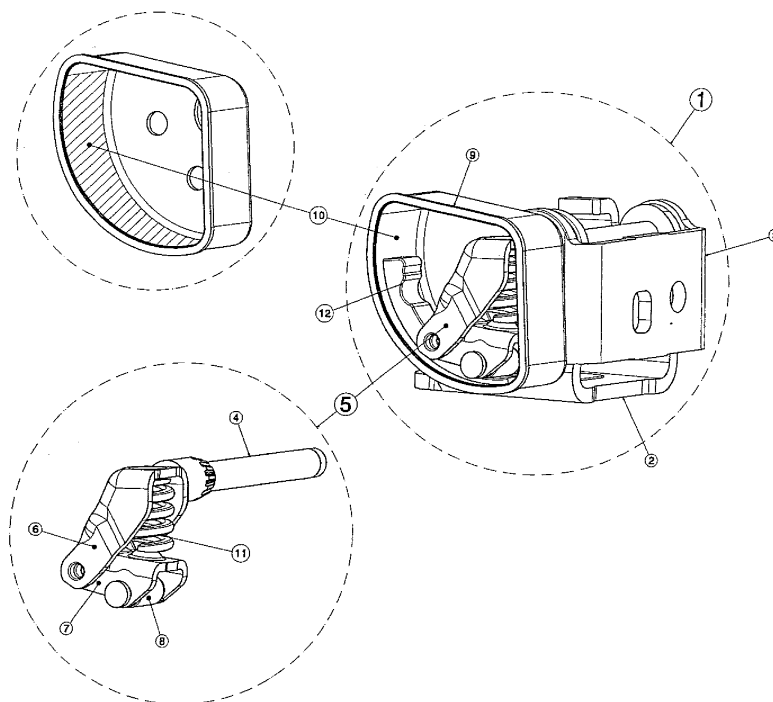


Fig. 1

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Description

[0001] The invention relates to an infinitely variable door check, especially for a vehicle door, with the features of the introductory part of claim 1, and further with the features of the introductory part of claim 10.

[0002] For automotive doors it is well known to check the movement of the door in one, two or three predefined positions in order to avoid a situation in which the door swings open in an uncontrolled way. Since it has been found to be inconvenient to be restricted to only one, two or three predefined positions of the door in which uncontrolled swinging of the door can be avoided, infinitely variable door checks have been developed which allow the door to be checked in essentially any opening position.

[0003] With respect to such an infinitely variable door check, in EP 0 705 951 B1 a continuous power assisted car door check is described. This door check allows to secure the door in practically any position without any risk that the car door swings open in an uncontrolled manner. However, for checking the car door in practically any opening position, according to this technique, auxiliary power is necessary. This auxiliary power is used for braking or fastening means in order to check the movement of the car door at any opening angle. Of course, the use of auxiliary power makes this design of an infinitely variable door check complicated and costly.

[0004] It is the object of the invention to address this problem and to provide such an infinitely variable door check which has a compact design and which can be manufactured at reasonable costs.

[0005] According to a first aspect of the invention, this object is met by an infinitely variable door check with the features of the subject matter of claim 1.

[0006] Accordingly, an infinitely variable door check, especially for a vehicle door, is provided that comprises a hinge with a first hinge part and a second hinge part which are pivotal relative to each other about a pivot axis, characterised in that a compression unit is provided that comprises an elastically deformable material which is elastically compressed during movement of the first hinge part relative to the second hinge part. This means that, according to the first aspect of the invention, the compression of the elastically deformable material is used in order to provide a resistance for the movement of the first hinge part relative to the second hinge part when the door is opened or closed.

[0007] Further, according to a preferred embodiment of the invention, a pivoted arm is provided which is fixed to the first hinge part with its one end, wherein the other end of the pivoted arm runs, at least during part of its pivot movement, along a counter part, wherein the compression unit with the elastically deformable material is provided between the end of the pivoted arm and the counter part such that the elastically deformable material is elastically compressed during movement of the pivoted arm along the counter part.

[0008] In general, the end of the pivoted arm that runs

along the counter part during the pivoted movement can be provided with the compressible material. However, according to a preferred embodiment of the invention, the counter part is provided with the elastically deformable material. With respect to this, according to a preferred embodiment of the invention, it is further preferred that the pivoted arm comprises a roller wheel that is pressed against the elastically deformable material of the counter part. This means that during movement of the pivoted arm along the counter part, the roller wheel presses with a certain force against the elastically deformable material, which means that this material is crushed during the pivot movement leading to a resistance in the movement of opening or closing the door.

[0009] Further, there is not only a movement resistance due to the roller wheel crushing the elastically deformable material. When the door stands open in some opening angle, according to a preferred embodiment of the invention, an even higher resistance can be provided in order to start the movement of the roller wheel crushing the elastically deformable material as a result. This technique allows for a compact design at reasonable costs since no auxiliary power is necessary in order to generate braking forces.

[0010] The load acting on the roller wheel and therefore on the pivot movement is controlled by the compression ratio of the elastically deformable material. However, further control of the load can be achieved according to a preferred embodiment of the invention with the use of a tappet which is provided by an articulated part of the pivoted arm, wherein a compressed spring is provided in order to press the roller wheel at the end of the articulated part of the pivoted arm against the elastically deformable material.

[0011] In general, it is possible, that the elastically deformable material shows a constant compression ratio along the whole way of the moving pivoted arm. In this case, the necessary force in order to move the door is the same in any opening angle. However, according to a preferred embodiment of the invention, the elastically deformable material has a tailored geometry and/or a tailored composition in order to achieve different resistances for the roller wheel during movement along the elastically deformable material. This means that free areas of movement can be provided, especially at the beginning and the end of the vehicle door opening sequence, respectively.

[0012] In general, the pivoted arm, the counter part and the compression unit can be located at different positions relative to the hinge parts. However, according to a preferred embodiment of the invention, the pivoted arm with the roller wheel is comprised in a casing, one inner side of which provides the counter part and to which the second hinge part is fixed to. Accordingly, the function which is responsible for the infinitely variable door check can be housed in a preferably enclosed unit above or below the hinge parts which provides for the main hinge function. This leads to a very compact design.

[0013] Further, according to a second aspect of the invention, above mentioned object is addressed with an infinitely variable door check, especially for a vehicle door, with the features of the subject matter of claim 10.

[0014] Accordingly, an infinitely variable door check, especially for a vehicle door, is provided that comprises a braking unit that applies a braking load for the pivot movement of the first hinge part relative to the second hinge part, wherein a gear is provided that interacts with the hinge shaft and the movement of which is controlled by the braking unit.

[0015] In general, there are two preferred alternatives for this second aspect of the invention:

[0016] According to a first preferred alternative of this second aspect of the invention the braking unit comprises a braking gear which is directly fixed to the hinge shaft. This means that the braking unit directly acts on the hinge shaft via the braking gear. Accordingly, any braking load due to the braking unit is directly transferred to the hinge shaft.

[0017] According to a second preferred alternative, a first gear is fixed to the hinge shaft and the first gear interacts with a second gear the movement of which is controlled by a braking unit. This means that, the movement of the door is controlled by the braking unit via the two gears one of which is subjected to braking forces due to the braking unit. Hence, the movement of the first gear which is directly fixed to the hinge shaft and which is directly related to the movement of the two hinge parts relative to each other when the door is opened or closed, respectively, is indirectly controlled by the braking unit which acts on the second gear.

[0018] In dependence of the gear ratios, the resulting force in order to open or close the door can be controlled. According to a preferred embodiment of the invention, the size of the first gear is different from the size of the second gear. The first gear can directly be linked to the second gear, which is subjected to the forces of the braking unit. With respect to this, further, according to a preferred embodiment of the invention, the second gear can be combined with one or more gears in order to further control the rotation resistance by the gear factors.

[0019] In general, the forces according to the braking unit can be generated and applied in different ways. However, according to a preferred embodiment of the invention, the braking unit applies a rotation resistance, preferably a friction rotation resistance, onto the braking gear or the second gear, respectively. With respect to this, it is especially preferred that at least one, preferably two, braking plates are provided in the braking unit which act on the braking gear or the second gear, respectively. Further, according to a preferred embodiment of the invention, the friction force due to the braking plate is controlled by a spring that presses at least one of the braking plates onto this gear.

[0020] In general, the gears used for the door check according to the second aspect of the invention can be conventional gears with a symmetrical design. However,

according to a preferred embodiment of the invention, the first gear and/or the second gear have a tailored geometry with at least one toothless area in order to allow for free movement of the hinge in this area. This means that similar to the preferred embodiment described with respect to the first aspect of the invention, areas of free movement can be defined where the two gears do not interact with each other, and thus, no braking force is generated when moving the door in these areas.

[0021] In the following, the two aspects of the invention will be described in more detail with reference to the drawings.

[0022] In the drawings:

15 Fig. 1 shows a perspective view of a preferred embodiment of a door check according to the first aspect of the invention;

20 Fig. 2a and b show a top view onto the door check according to the preferred embodiment according to the first aspect of the invention while the door is closing or opening, respectively,

25 Fig. 3 shows a perspective view of a preferred embodiment of a door check according to the second aspect of the invention, and

30 Fig. 4 shows a side view, partly as a cross sectional view, of another preferred embodiment of a door check according to the second aspect of the invention.

35 **[0023]** In Fig. 1 an example of an infinitely variable door check according to a first aspect of the invention is shown that comprises a hinge 1 with a first hinge part 2 and a second hinge part 3. The first hinge part 2 is designed as a male hinge and the second hinge part 3 is designed as a female hinge. The hinge parts 2, 3 are pivotally fixed to each other. They are pivotal about a pivot axis 4. The pivot axis 4 is fixed to the male hinge, i.e. to the first hinge part 2.

40 **[0024]** Further, a pivoted arm 5 is provided which is also fixed to the pivot axis 4. Accordingly, the movement of the pivoted arm 5 is directly related to the movement of the first hinge part 2 relative to the second hinge part 3. Further, since the first hinge part 2 and the second hinge part 3 are fixed to a door and a door post, respectively, the movement of the door while closing and opening leads to a respective movement of the pivoted arm 5.

50 **[0025]** This design of the pivoted arm 5 is comprised in a casing 9 which is fixed to the female hinge, i.e. the second hinge part 3. Accordingly, a movement of the door leads to a movement of the pivoted arm 5 in the inner of the casing 9. Pivoted arm 5 comprises a base part 6 which is fixed to the pivot axis 4 and an articulated part 7 as a tappet with a roller wheel 8. The articulated

part 7 of the pivoted arm 5 is hinged to the other end of the base part 6. Further, a compressed spring 11 is provided in order to press the tappet with the roller wheel 8 away from the pivot axis 4.

[0026] The casing 9 comprises a wall 10, the inner side of which acts as a counter part for the tappet with the roller wheel 8. The inner side of the wall 10 of the casing 9 is provided with an elastically deformable material 12, e.g. rubber or plastic material. A strip of this elastically deformable material 12 is fixed to the inner side of the wall 10 of the casing 9, e.g. by gluing.

[0027] The strip of the elastically deformable material 12 is dynamically compressed and decompressed during movement of the pivoted arm 5 since the roller wheel 8 on the tappet is pressed onto to the strip. This provides for a braking force when the door is moved to which the door check is fixed to.

[0028] In Fig. 2a and 2b it is shown how the strip of the elastically deformable material 12 is compressed when the door is closing (Fig. 2a) and when the door is opening (Fig. 2b), respectively. The load which is achieved with this design is controlled by the compression ratio of the elastically deformable material 12 and by the force due to the compressed spring 11. The spring 11 could be omitted since the compression ratio of the elastically deformable material 12 itself could be sufficient for the braking effect of the door check.

[0029] Since the elastically deformable material 12 which is used for the door check according to the first aspect of the invention, immediately decompresses when the roller wheel 8 moves on, the function of the door check is always guaranteed even if an opening sequence of the door is directly continued by a closing sequence.

[0030] As a result compact and less costly solution is provided for an infinitely variable door check which does not need any external power.

[0031] From Fig. 3, a perspective view of an example of an infinitely variable door check according to the second aspect of the invention is shown. This door check comprises a hinge 21 with a first hinge part 22 and a second hinge part 23. The first hinge part 22 which is a male hinge and the second hinge part 23 which is a female hinge are pivotal relative to each other about a pivot axis 24 defined by a hinge shaft 25. The hinge shaft 25 is fixed to the first hinge part 22, thus, no movement is allowed between the first hinge part 22 and the hinge shaft 25.

[0032] A first gear 26 is fixed to the hinge shaft 25. This first gear 26 interacts with a second gear 27. This means that due to a movement of the door which moves the first hinge part 22 relative to the second hinge part 23, a movement of the first, smaller gear 26 and, hence, the second gear 27 is achieved.

[0033] The movement of the second gear 27 is controlled by a braking unit 28. This braking unit 28 is comprised of two braking plates 29 which act on the two sides of the second gear 27. Thus, a rotation resistance, i.e. a

friction rotation resistance, is achieved the load of which is controlled with the help of a compressed spring 30 which acts on the upper one of the two braking plates 29.

[0034] As can be seen from Fig. 3, the first gear 26 and the second gear 27 have a symmetrical design. However, according to another preferred embodiment of the invention, such a shape of the gears 26, 27 can be provided, respectively, that allows for a "free movement" area. This means that for determined opening angles of the door no or at least a smaller braking force is applied.

[0035] Finally, from Fig. 4 a side view, partly as a cross sectional view, of another preferred embodiment of a door check according to the second aspect of the invention can be seen. The design of this door check is very similar to the one described above. However, in contrast to the preferred embodiment described with reference to Fig. 3, only one braking gear 31 is provided which is directly fixed to the hinge shaft 25 via the braking gear 31. Further, the braking unit 28 with its two braking plates 29 and the compressed spring 29 acts directly on the hinge shaft 25 which means that no second gear is necessary. Accordingly, this is an example of the first alternative of the second aspect of the invention mentioned further above.

[0036] As a result, according to the second aspect of the invention, such an infinitely variable door check is provided which can be integrated with the hinge which leads to a very compact design.

Claims

1. Infinitely variable door check, especially for a vehicle door, with a hinge (1) comprising a first hinge part (2) and a second hinge part (3) which are pivotal relative to each other about a pivot axis (4), **characterised in that** a compression unit is provided that comprises an elastically deformable material (12) which is elastically compressed during movement of the first hinge part (2) relative to the second hinge part (3).
2. Door check according to claim 1, **characterised in that** a pivoted arm (5) is provided which is fixed to the first hinge part (2) with its one end, wherein the other end of the pivoted arm (5) runs, at least during part of its pivot movement, along a counter part, wherein the compression unit with the elastically deformable material (12) is provided between the end of the pivoted arm (5) and the counter part such that the elastically deformable material (12) is elastically compressed during movement of the pivoted arm (5) along the counter part.
3. Door check according to claim 1 or 2, **characterised in that** the compressible material (12) is dynamically compressed and decompressed during movement of the pivoted arm (5).

4. Door check according to any of claims 1 to 3, **characterised in that** the counter part is provided with the elastically deformable material (12).
5. Door check according to claim 4, **characterised in that** the pivoted arm (5) comprises a roller wheel (8) that is pressed against the elastically deformable material (12). 5
6. Door check according to claim 5, **characterised in that** the roller wheel (8) is attached to a tappet which is provided by an articulated part (7) of the pivoted arm (5). 10
7. Door check according to claim 6, **characterised in that** a spring (11) is provided in order to press the roller wheel (8) at the end of the articulated part (7) of the pivoted arm (5) against the elastically deformable material (12) with a controlled load. 15
8. Door check according to any of claims 5 to 7, **characterised in that** the elastically deformable material (12) has a tailored geometry and/or a tailored composition in order to achieve different resistances for the roller wheel (8) during its movement along the elastically deformable material (12). 20
9. Door check according to any of claims 5 to 8, **characterised in that** the pivoted arm (5) with the roller wheel (8) is comprised in a casing (9), one inner side of which provides the counter part and to which the second hinge part (3) is fixed to. 25
10. Infinitely variable door check, especially for a vehicle door, with a hinge (21) comprising a first hinge part (22) and a second hinge part (23) which are pivotal relative to each other about a pivot axis (24) defined by a hinge shaft (25) which is fixed to the first hinge part (22), **characterised in that** a braking unit (28) is provided that applies a braking load for the pivot movement of the first hinge part (22) relative to the second hinge part (23), wherein a gear (27, 31) is provided that interacts with the hinge shaft (25) and the movement of which is controlled by the braking unit (28). 30
11. Door check according to claim 10, **characterised in that** the gear (31) which interacts with the hinge shaft (25) and the movement of which is controlled by the braking unit (28) is directly fixed to the hinge shaft (25). 35
12. Door check according to claim 10, **characterised in that** a first gear (26) is fixed to the hinge shaft (25) and the first gear (26) interacts with a second gear (27) the movement of which is controlled by the braking unit (28). 40
13. Door check according to claim 11 or 12, **characterised in that** the braking unit (28) applies a rotation resistance, preferably a friction rotation resistance, onto the braking gear (31) or the second gear (27), respectively. 45
14. Door check according to claim 13, **characterised in that** the braking unit (28) comprises at least one, preferably two, braking plates (29) which act on the braking gear (31) or the second gear (27), respectively. 50
15. Door check according to claim 14, **characterised in that** the friction force due to the braking plate (29) is controlled by a spring (30) that presses the braking plate (29) onto braking gear (31) or the second gear (27), respectively. 55
16. Door check according to any of claims 12 to 15, **characterised in that** the first gear (26) and/or the second gear (27) have a tailored geometry with at least one toothless area in order to allow for a free movement of the hinge (21) in this area.
17. Door check according to any of claims 12 to 16, **characterised in that** the second gear (27) is combined with at least one more gear in order to control the rotation resistance by the gear factors.

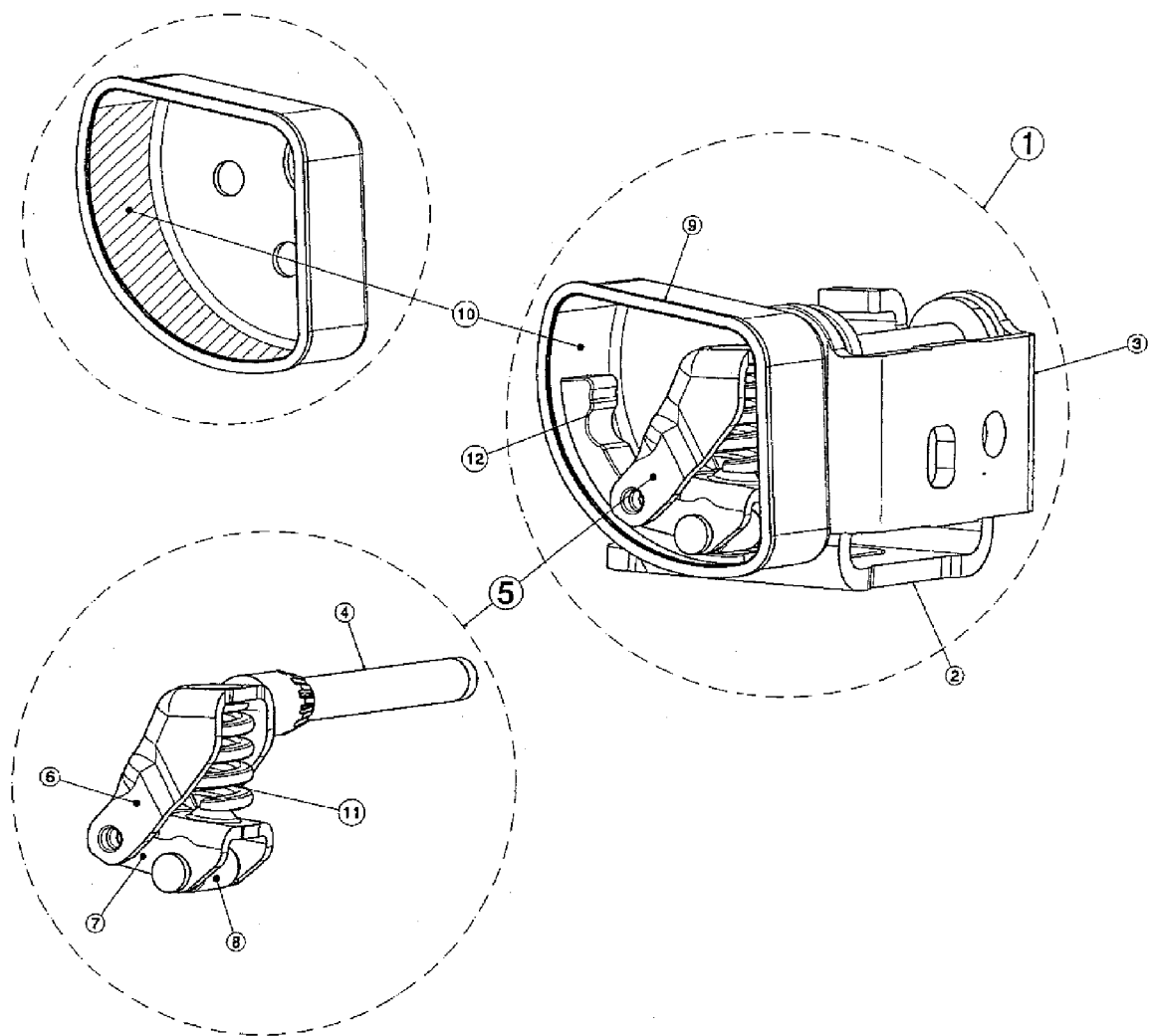


Fig. 1

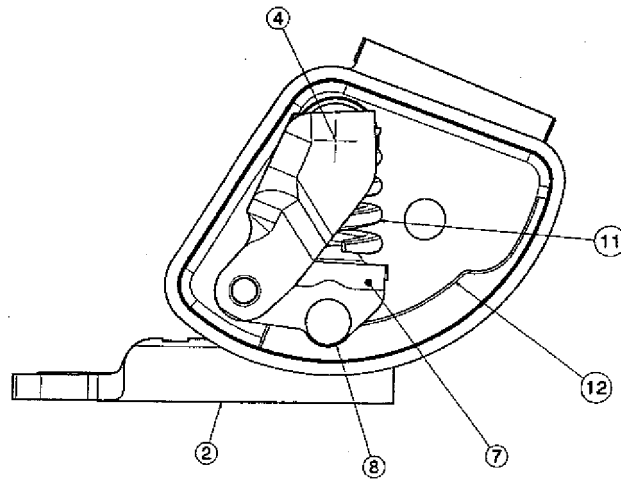


Fig. 2a

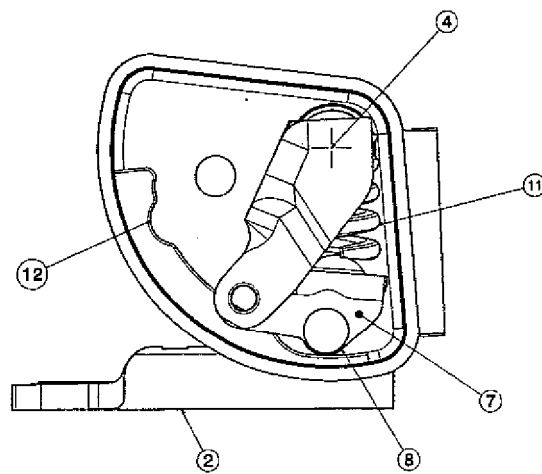


Fig. 2b

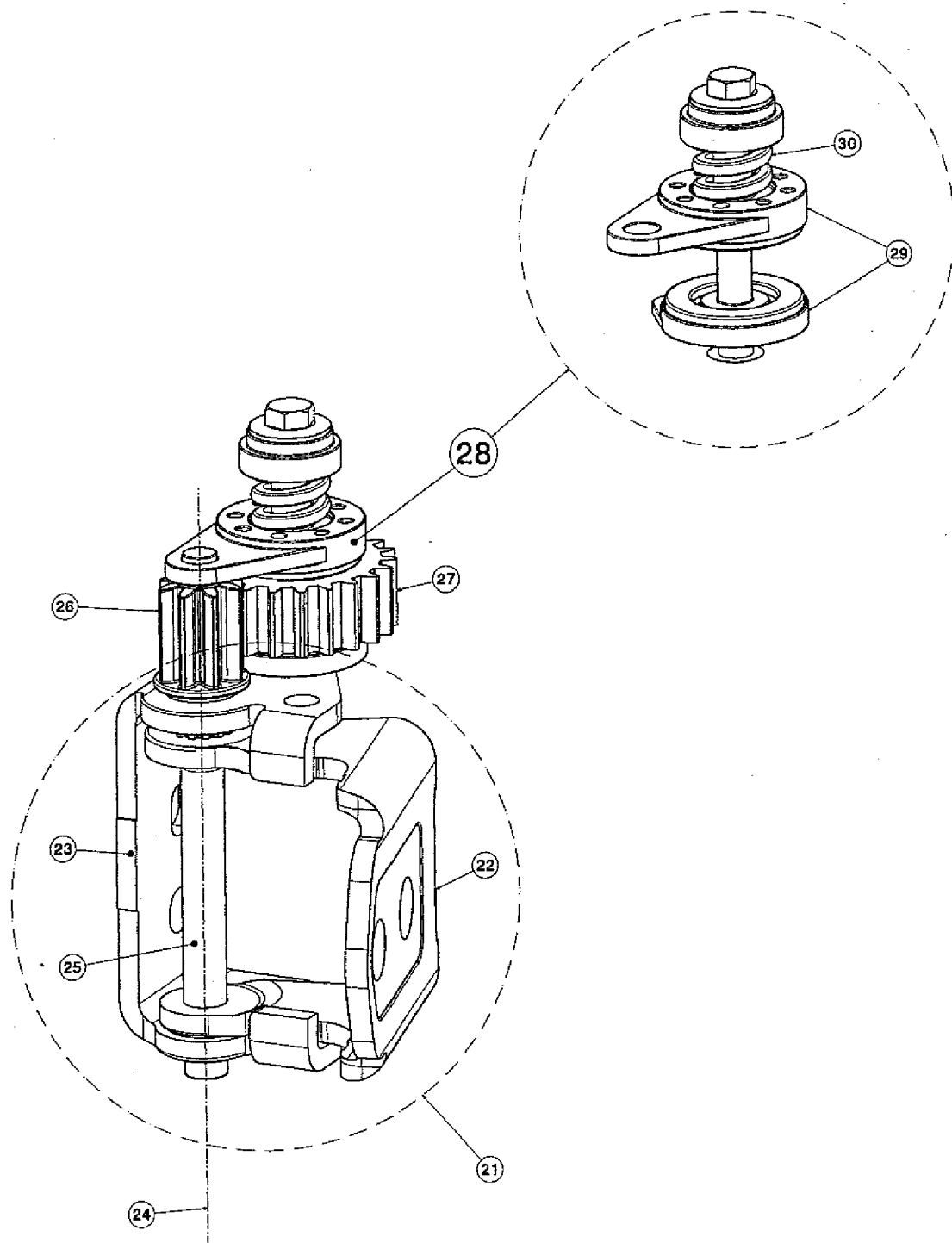


Fig. 3

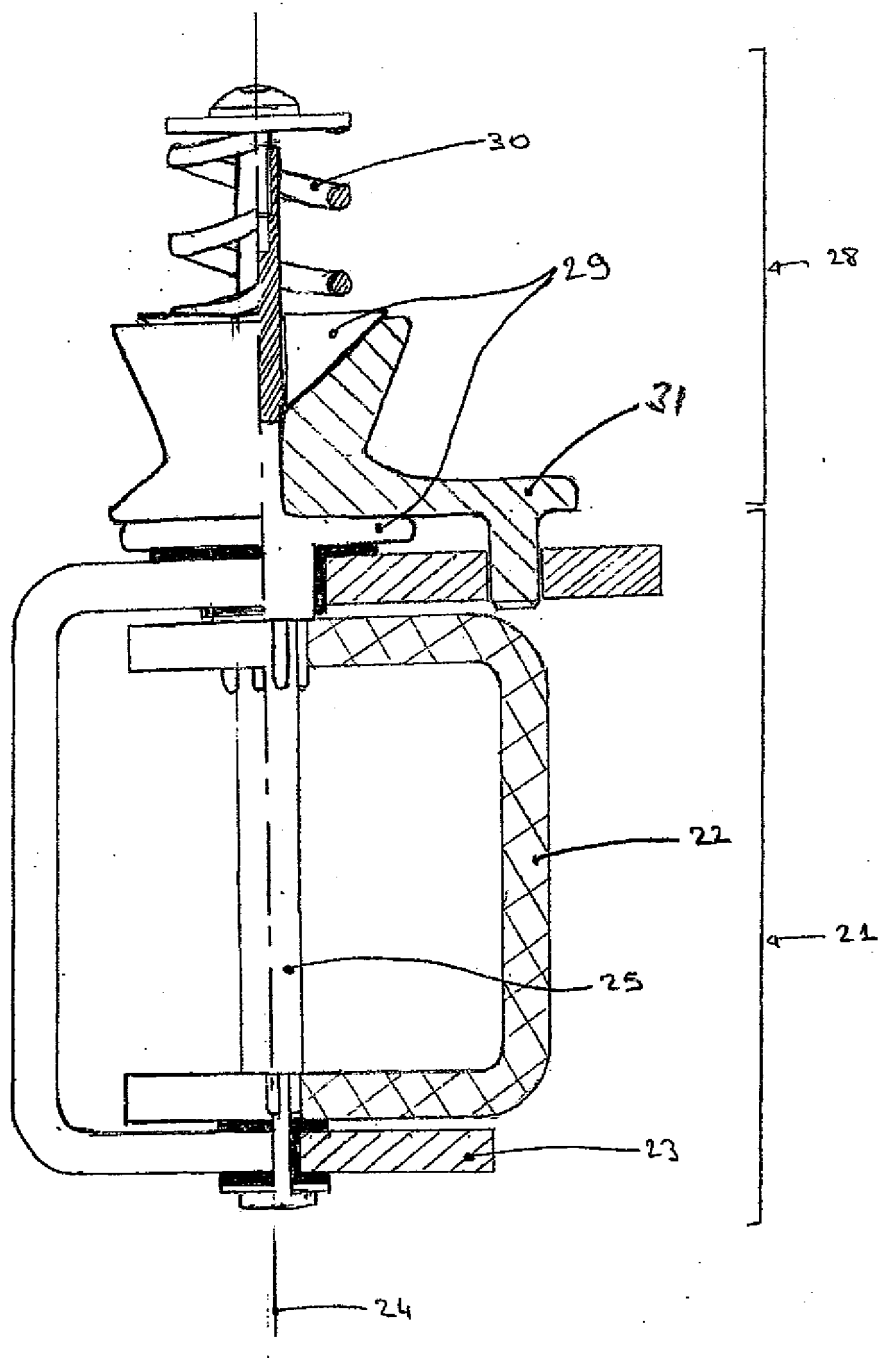


Fig. 4



European Patent
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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 January 2008	Examiner WAGNER, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)



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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
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EPO FORM 1503 03.82 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9

Infinitely variable door check having a compression unit with elastically deformable material which is elastically compressed during movement of the first hinge part (2) relative to the second hinge part.

2. claims: 10-17

Infinitely variable door checkhaving a braking unit, wherein a gear is provided that interacts with the hinge shaft and the movement of which is controlled by the braking unit.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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