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(54) DAMPER FOR DAMPING VIBRATIONS OF A TUBE IN A HOLLOW STRUT OF A GAS TURBINE ENGINE AND HUB STRUT CASE WITH SUCH A DAMPER

(57) The present invention relates to a damper (1) for damping vibrations of a tube (2) in a strut (3) of a gas turbine engine, characterised in that it comprises:
a fixing part (4) for fixing the damper (1) to the tube (2), the fixing part being shaped substantially in a form of a portion of a cylinder surface,
a contact part (5) for contacting the strut inner wall, the contact part (5) being in a form of a curved surface, and
a middle part (6) connecting the fixing part (4) and the contact part (5), the middle part (6) being substantially in a form of a cone surface portion.

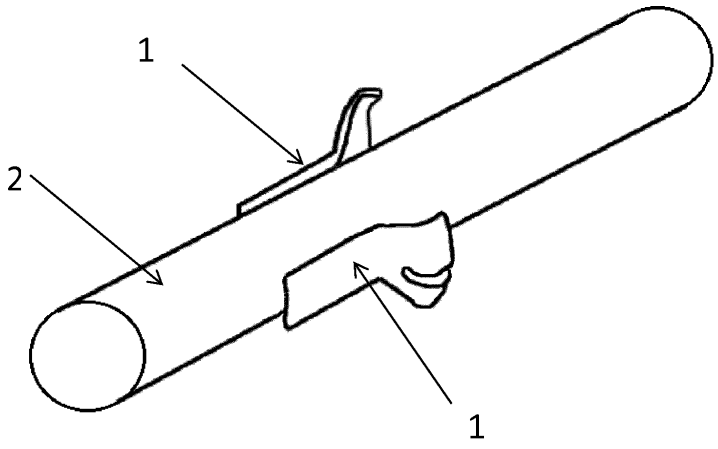

FIG. 5

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Description

Field of the invention

[0001] The present invention relates to a damper for damping vibrations of a tube, especially an oil tube, in a hollow strut of a gas turbine engine and the use thereof.

Technical background

[0002] The turbine center frame (TCF) for large aircraft engines plays a key role in every turbofan. The TCF is situated between the high-pressure turbine and the low-pressure turbine, where it performs two important functions. It connects the high-pressure shaft's rear bearing with the housing and forms an aerodynamic transition duct between the high-pressure and low-pressure turbine. This area is subject to very high stresses, because bearing loads are conducted to the outer casing through the TCF structure. In the event of faults, such as a broken fan blade, the turbine center frame must be able to withstand the resulting loads in terms of mechanical integrity. In addition, the component has to permanently withstand temperatures in excess of 1,000 degrees Celsius.

[0003] TCFs essentially consist of two main component groups. The first group includes a hub strut case (HCS), which is a load-bearing structure and takes form of a casing with several struts assembled around the hub with an integrated bearing. The second group includes the struts' panels and fairings - also known as flowpath hardware - which form a channel for hot gas flowing from the high-pressure turbine. In addition, there are various seals, and finally, oil lines and cooling air channels, through which oil and air are conveyed through the TCF to the turbines and the bearing.

[0004] During engine operation, its parts may be excited to vibrate at their natural frequencies. For example an oil tube passing through a hollow strut may start to vibrate causing the strut or tube damage. It is therefore desirable to eliminate or reduce such vibrations.

[0005] Currently, so called "hurricane" damper design is used, which comprises two dampers spirally formed and fixed to the tube (fig. 1). These dampers have to be manually bent to a conical shape (fig. 2) to enable installation of the tubes through a limited cross section of the HSC. Due to this pre-bending necessity and their geometry per design, contact conditions of current dampers to adjacent strut are almost undefined. In the best case, line contact can be achieved, which is effective in one direction only (circumferential, see fig. 2). For the other direction (axial) such a damper design is inappropriate.

[0006] Therefore an object of the present invention is to provide a new damper design with improved contact conditions between the damper and the hollow strut.

Summary of the invention

[0007] According to the present invention a damper for damping vibrations of a tube in a hollow strut of a gas turbine engine, comprises:

a fixing part for fixing the damper to the tube, the fixing part being shaped substantially in a form of a portion of a cylinder surface,
a contact part for contacting the strut inner wall, the contact part being in a form of a curved surface, and
a middle part connecting the fixing part and the contact part, the middle part being substantially in a form of a portion of a cone surface.

[0008] Preferably the contact part is in the form of a portion of a hollow sphere or of a hollow torus.

[0009] Preferably the contact part is curved towards the axis of the cylinder defined by fixing part.

[0010] Preferably the damper comprises a longitudinal crevice extending through the contact part and at least partially through the middle part, which enables pre-tensioning of a damper during tube assembly into the strut. Preferably the crevice is ended with a substantially circular orifice in the middle part. In a preferred embodiment the damper according to the invention is formed from a sheet of metal.

[0011] The present invention also relates to a hub strut case (HCS) comprising a damper arrangement comprising at least two dampers described above, fixed to an oil tube passing through the hollow strut on the opposite sides of the oil tube surface, such that contact parts of the dampers bear against the inner surface of the hollow strut walls.

[0012] The present invention also relates to the use of the damper defined above for damping vibrations of a tube in the hollow strut of a gas turbine engine.

[0013] The dampers according to the present invention, when fixed to an oil tube, form a tulip-shape damper assembly. Providing two dampers on the opposite sides of the tube, enables to achieve at least the two-point contact per side resulting in a kind of a self-locking assembly. Resulting friction between the contact parts of the damper and the hollow strut side walls has been found to be sufficient to keep the tube in place.

[0014] Pre-bending during installation no longer affects the damper shape itself, but its diameter only. Thus, the conditions of contacting the hollow strut remain unchanged and defined per design, which provides simplified requirements for those who install the tubes inside the hollow struts.

Brief description of drawings

[0015] Exemplary embodiments of the invention are described with reference to the following figures, which are provided for the purpose of illustration only, the full scope of the invention being set forth in the claims that follow:

Figure 1 shows "hurricane" damper prior art design;

Figure 2 shows a top view of two "hurricane" prior art dampers installed in the hollow strut;
Figure 3 is a perspective view of the exemplary damper according to the invention;
Figure 4 is another perspective view of the exemplary damper according to the invention;
Figure 5 shows two exemplary dampers according to the invention fixed to an oil tube;
Figure 6 shows a simplified image of a hollow strut;
Figure 7 is a cross section of a hollow strut comprising an oil tube with two exemplary dampers according to the invention.

Detailed description of preferred embodiment

[0016] A damper (1) for damping vibrations of a tube (2) in a hollow strut (3) in a gas turbine engine as shown in fig. 3 and 4 comprises a fixing part (4), a contact part (5) and a middle part (6). The fixing (4) part is in the form of a portion of a cylinder surface to adjoin the cylindrical exterior surface of an oil tube (2). The contact part (6) is in the form of a portion of a hollow torus, curved towards the axis of the cylinder defined by fixing part (4). Between the fixing (4) part and a contact part (5) extends a middle part (6) in form of a cone surface portion.

[0017] The damper (1) comprises a longitudinal crevice (7) extending through the contact part (5) and through the middle part (6), which is ended with a circular orifice (8) in the middle part (6). Longitudinal crevice (7) is parallel to the axis of a cylinder defined by a fixing part (4) and a tube (2), when the damper (1) is fixed on said tube (2).

[0018] Figure 5 shows the dampers (1) fixed to an oil tube (2). The dampers (1) are placed on the opposite sides of the tube (2) surface and form a tulip-like shape.

[0019] Figure 7 is a cross section of a hollow strut (3) comprising an oil tube (2) with two dampers (1) fixed on the opposite sides of the tube (2). The hollow strut (3) is hollow through the center, with an axially (with regard to HCS shape) elongated cross-section. The fixing parts of a dampers (1), not visible on the figure, are brazed to the oil tube (2). The contact parts (5) bear against the inner surface of the hollow strut (3) walls providing 4-point contact. The middle part (6) extends between the surface of the oil tube and the contact part.

[0020] During tube assembly into the hollow strut (3), the damper (1) is pre-tensioned as damper (1) arrangement width (diameter) is greater than inner hollow strut (3) cross-section.

Claims

1. A damper (1) for damping vibrations of a tube (2) in a hollow strut (3) of a gas turbine engine, **characterised in that** it comprises:

   a fixing part (4) for fixing the damper (1) to the tube (2), the fixing part being shaped substantially in a form of a portion of a cylinder surface,
   a contact part (5) for contacting the hollow strut inner wall, the contact part (5) being in a form of a curved surface, and
   a middle part (6) connecting the fixing part (4) and the contact part (5), the middle part (6) being substantially in a form of a cone surface portion.

2. The damper (1) according to claim 1, **characterised in that** the contact part (5) is in the form of a portion of a hollow sphere or of a hollow torus.

3. The damper (1) according to claim 1 or 2, **characterised in that** the contact part (5) is curved towards the axis of the cylinder defined by the fixing part (4).

4. The damper (1) according to claim 1 or 2 or 3, **characterised in that** it comprises a longitudinal crevice (7) extending through the contact part (5) and at least partially through the middle part (6).

5. The damper (1) according to claim 3, **characterized in that** the crevice (7) is ended with a substantially circular orifice (8) in the middle part (6).

6. The damper (1) according to one of the preceding claims, **characterized in that** the damper (1) is formed from a sheet of metal.

7. A hub strut case (HCS) comprising a damper arrangement comprising at least two dampers (1) according to any of the preceding claims, fixed to an oil tube (2) passing through a hollow strut (3) on the opposite sides of the oil tube (2) surface, such that a contact parts (5) of the dampers (1) bear against the inner surface of the hollow strut (3) walls.

8. Use of the damper (1) according to any of claims 1-6 for damping vibrations of a tube (2) in a hollow strut (3) of a gas turbine engine.

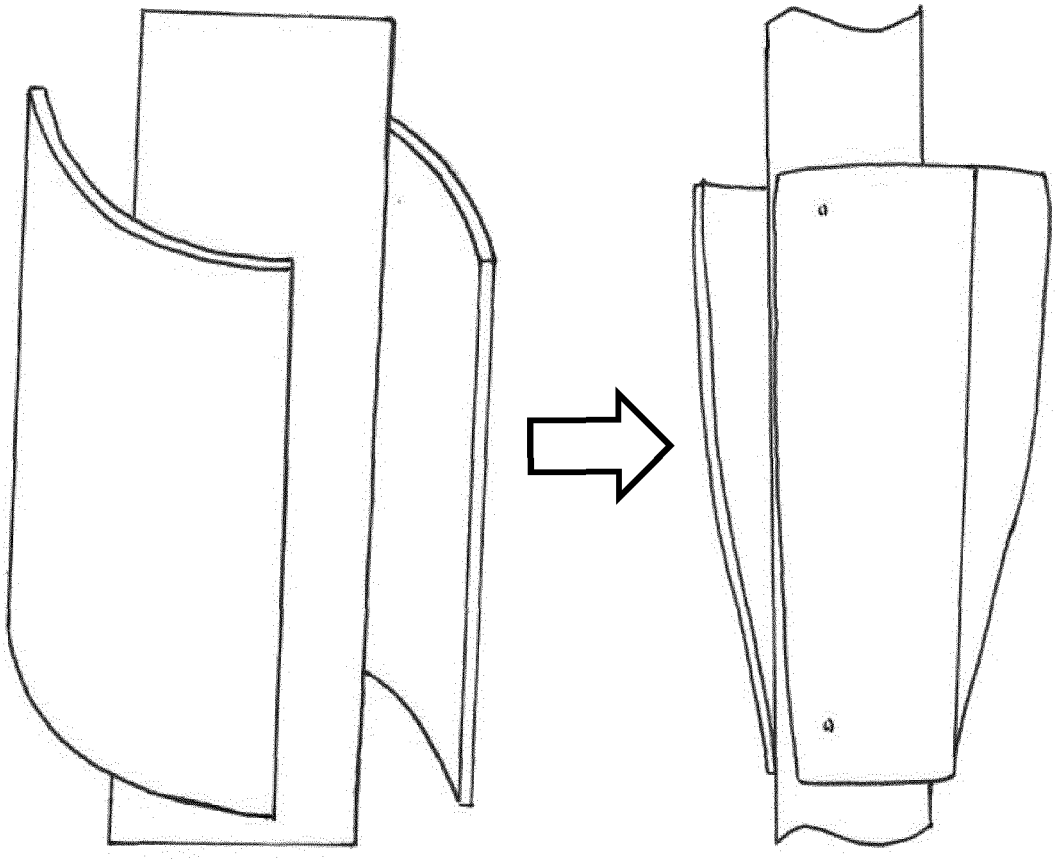

FIG. 1 (PRIOR ART)

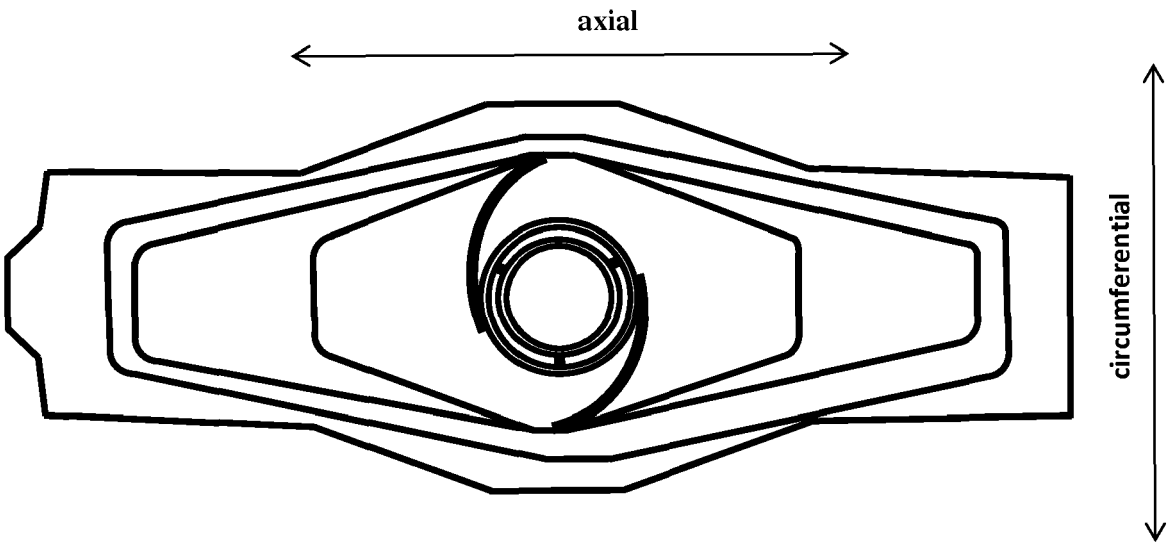

FIG. 2 (PRIOR ART)

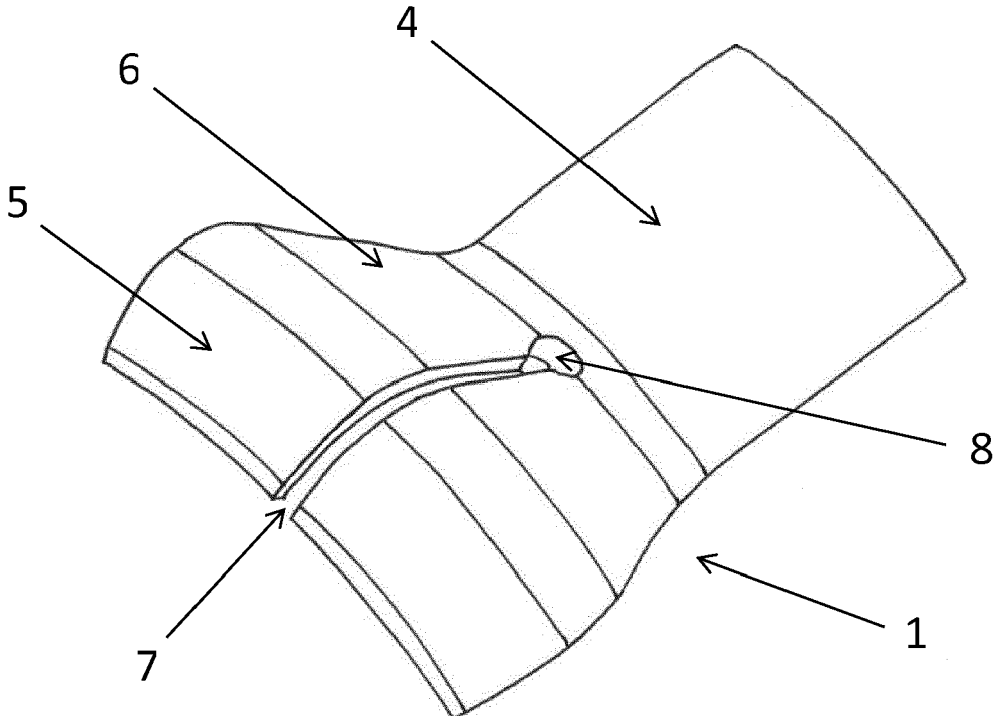

FIG. 3

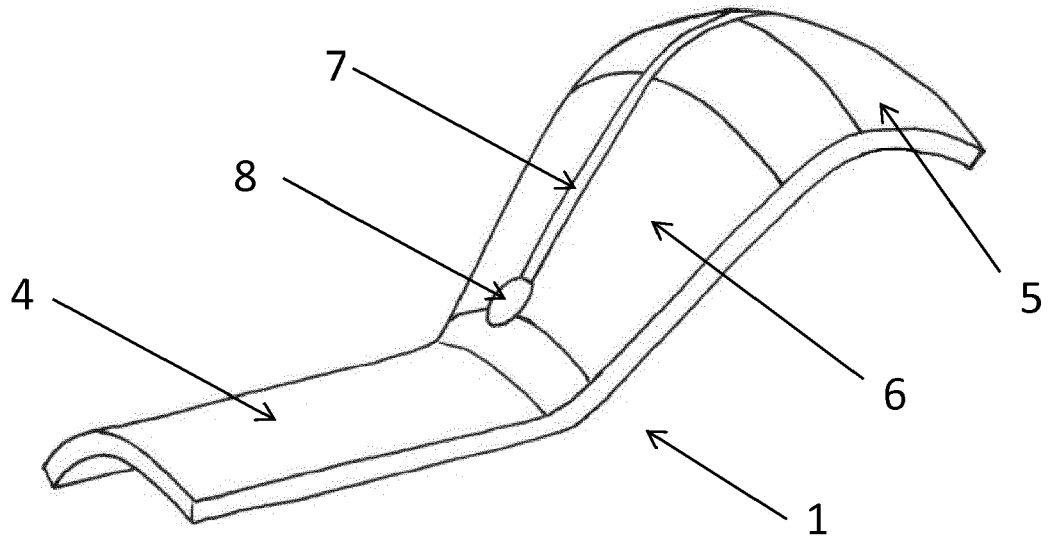

FIG. 4

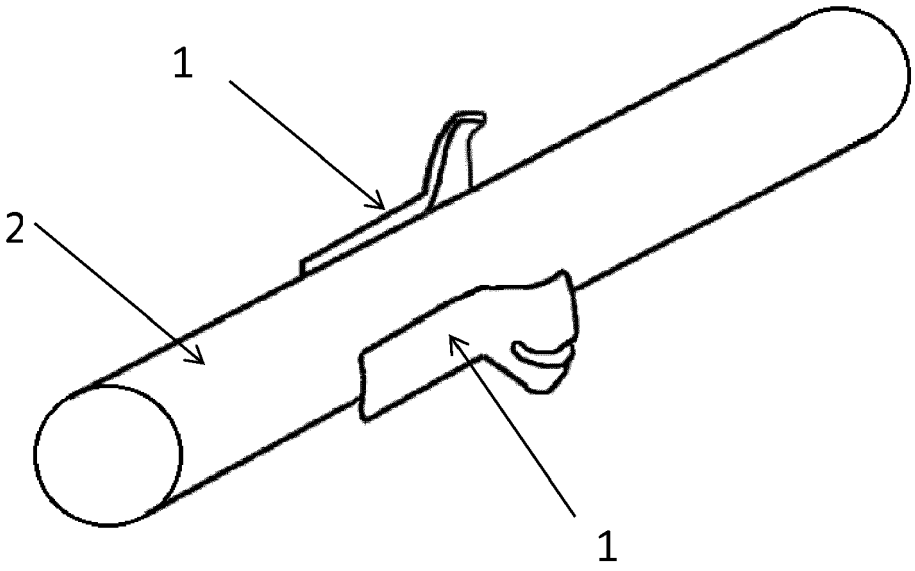

FIG. 5

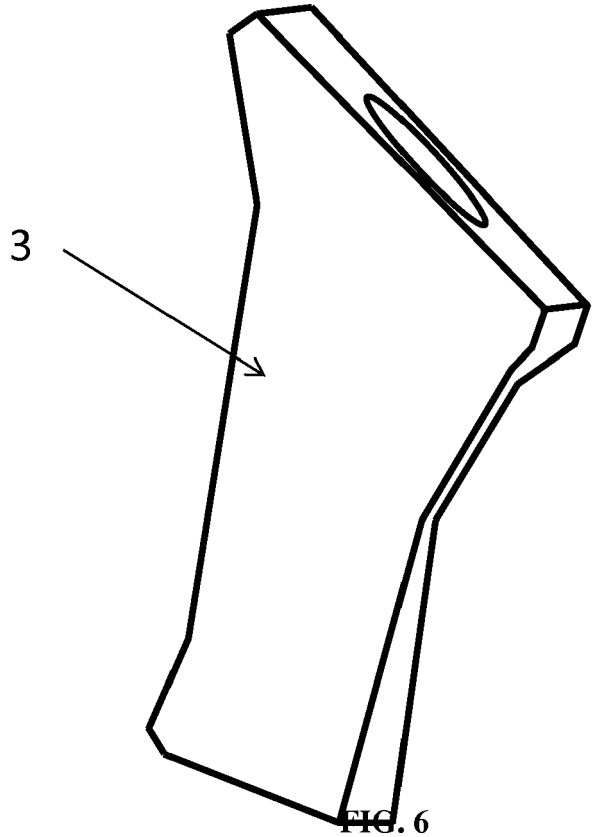

FIG. 6

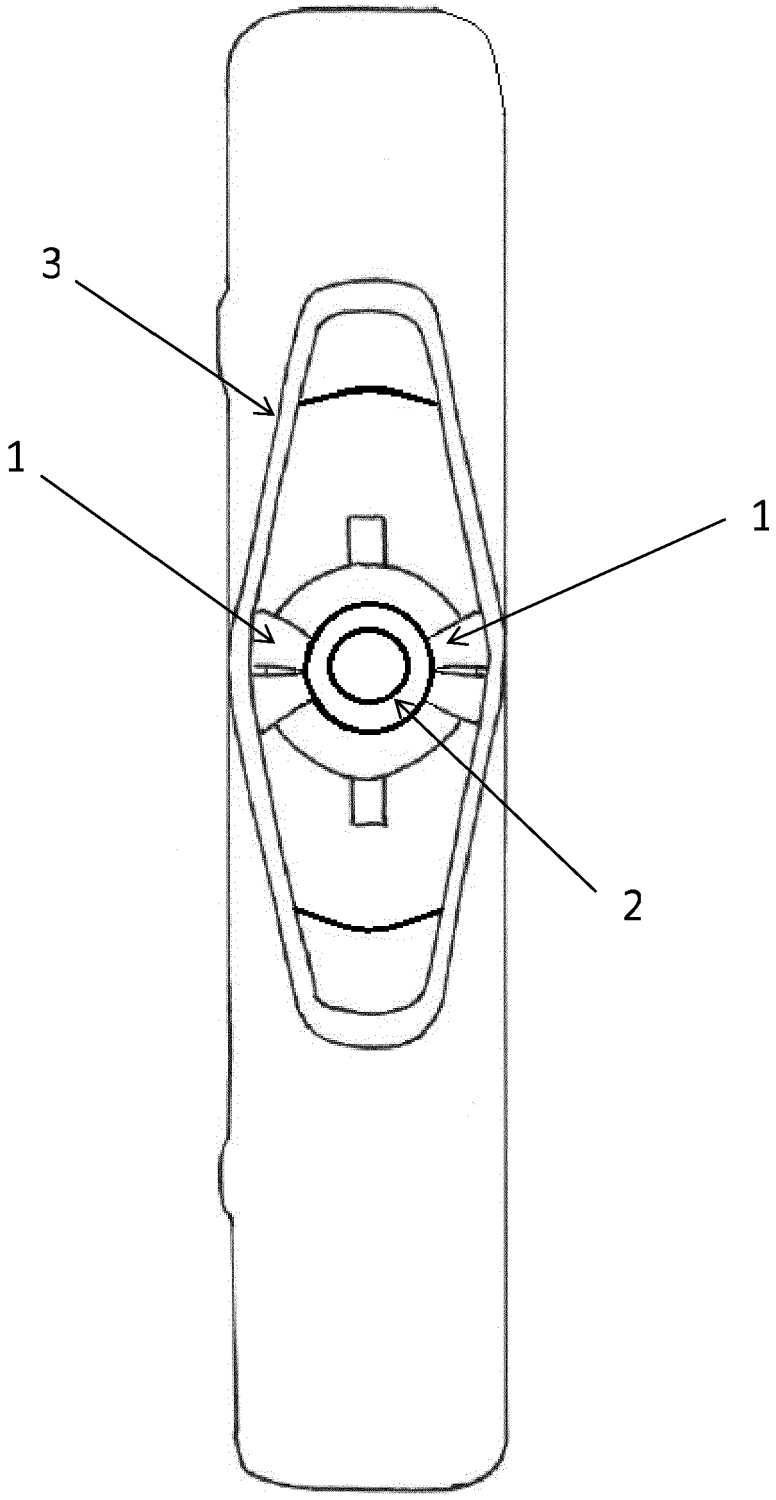

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 3738

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	FR 3 050 229 A1 (SNECMA [FR]) 20 October 2017 (2017-10-20) * figures 1-8 * * page 5, line 17 - page 10, line 11 * -----	1,3,6-8 2,4,5	INV. F01D9/06 F01D25/04 F01D25/16
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TECHNICAL FIELDS SEARCHED (IPC)

F01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 October 2018	Lutoschkin, Eugen

CATEGORY OF CITED DOCUMENTS

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