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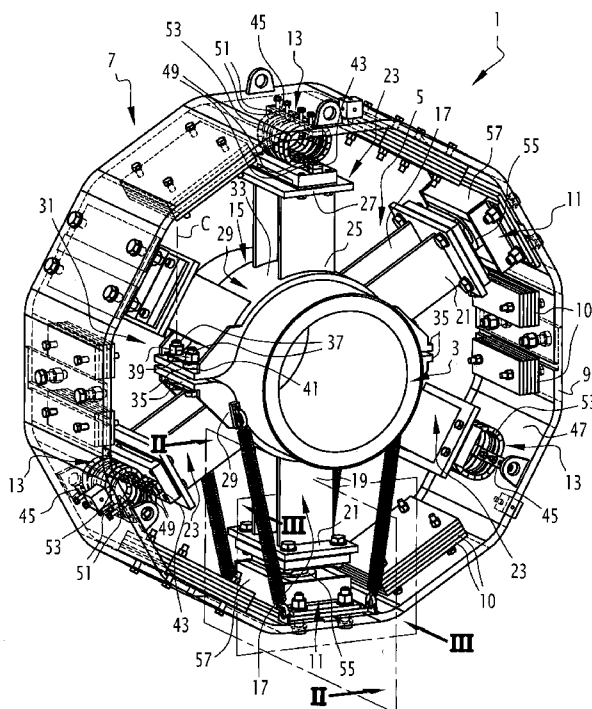
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(54) Title: TUNED MASS DAMPER FOR A PIPE

FIG.1



(57) Abstract: The tuned mass damper (1) comprises: - a mounting bracket (5) secured to the pipe (3); - a dynamic mass (7) comprising an annular member (9) extending around the pipe (3); - at least one resilient damper (13), connecting the dynamic mass (7) to the mounting bracket (5) such that vibrations transmitted from the pipe (3) to the dynamic mass (7) are damped by the resilient damper (13); - at least one limiting device (11), with a limited organ (55) secured to one of the mounting bracket (5) and the dynamic mass (7), and a limiting organ (57) secured to the other of the mounting bracket (5) and the dynamic mass (7), the limited organ (55) having no contact with the limiting organ (57) when the tuned mass damper (1) is at rest, the limiting organ (57) defining stops for the displacement of the limited organ (55) with respect to the limiting organ (57) along at least three mutually perpendicular directions.

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TUNED MASS DAMPER FOR A PIPE

The present invention concerns a tuned mass damper for a pipe, and more specifically a tuned mass damper for a pipe including a limiter of excessive movements.

5 PWR (Pressurized Water Reactor) nuclear reactors comprise a primary circuit in which pressurized water is circulated between the pressure vessel and one or several steam generators. The nuclear fuel elements are located in the pressure vessel.

The pressure in the primary circuit is controlled by mean of a pressurizer, fluidically connected to the primary circuit via a so-called expansion line.

10 The pressurizer is partially filled with water and partially filled with steam. It is equipped with heating rods. When the pressure inside the primary circuit must be increased, the heating rods are triggered on. A part of the water contained in the pressurizer is evaporated into steam, thereby increasing the static pressure inside the pressurizer. The pressure inside the primary circuit is increased as a consequence.

15 Conversely, the pressure inside the primary circuit is decreased by reducing the amount of steam inside the pressurizer.

The pressure variations inside the pressurizer create flows of water through the expansion line, thereby possibly creating sudden changes of the expansion line temperature. As a consequence, the expansion line might expand or retract as a function
20 of the thermal transient it is submitted to.

As the rest of the primary circuit, the surge line might also be subjected to vibrations originating from fluid turbulence, acoustic modes or dynamical movements of the primary circuit at its extremities.

It is particularly important to reduce the vibrations of the expansion line to acceptable
25 levels, in order to ensure a sufficient life expectancy for the expansion line and reduce maintenance requirements.

It is possible to use tuned mass dampers in order to reduce vibrations in a structure. A tuned mass damper usually comprises a dynamic mass connected to the vibrating structure by a resilient organ giving stiffness, and by a damper absorbing the mechanical
30 energy coming from the structure. The resilient organ is typically a metallic spring. The damper is typically a viscous damper.

The weight of the mass and the stiffness of the resilient organ are chosen such that the tuned mass damper interacts dynamically with the vibrating structure and energy is transferred from the vibrating structure to the tuned mass damper.

35 The tuned mass damper can be enclosed in a box, directly secured to the line by a collar.

It is particularly difficult to arrange such a tuned mass damper on the expansion line of a nuclear reactor. The expansion line is at a high temperature. It is covered by a layer of thermal insulation material.

In that context, the purpose of the invention is proposing a tuned mass damper that can be implemented on the expansion line of a PWR nuclear reactor or any pipes having similar operational conditions.

To that end, the invention is directed to a tuned mass damper for a pipe comprising:

- a mounting bracket secured to the pipe;
- a dynamic mass comprising an annular member extending around the pipe;
- at least one resilient damper, connecting the dynamic mass to the mounting bracket such that vibrations transmitted from the pipe to the dynamic mass are damped by the resilient damper;
- at least one limiting device, with a limited organ secured to one of the mounting bracket and the dynamic mass, and a limiting organ secured to the other of the mounting bracket and the dynamic mass, the limited organ having no contact with the limiting organ when the tuned mass damper is at rest, the limiting organ defining stops for the displacement of the limited organ with respect to the limiting organ along at least three mutually perpendicular directions.

The dynamic mass is located away from the line. A layer of thermal insulation, if necessary can be arranged between the dynamic mass and the pipe. Only the mounting bracket is secured to the pipe, and it can be arranged under the layer of thermal insulation.

Since the dynamic mass comprises an annular member extending around the pipe, it is possible to distribute the mass around the pipe and it is possible to avoid creating a bending moment in the pipe.

Since the at least one limiting device and the at least one resilient damper are arranged between mounting bracket and the annular dynamic mass, they can be located radially outside the layer of thermal insulation.

The limiting device let the dynamic mass oscillate freely with respect to the mounting bracket. However, it restricts the magnitude of the displacements of the dynamic mass, particularly in case of earthquake. When a major earthquake happens, it prevents the resilient damper from breaking. In absence of the limiting device, a major earthquake could break the resilient damper, the dynamic mass becoming free from the mounting bracket and being allowed to ride freely and damage other surrounding equipment.

The tune mass damper may include one or several of the following features, alone or according to any technically feasible combination:

- the mounting bracket comprises a clamp secured to the pipe, at least one guide arm having a proximal end secured to the clamp and a distal end bearing the limiting organ or the limited organ of the at least one limiting device, and at least one damper arm having a proximal end secured to the clamp and a distal end connected to the dynamic mass by the at least one resilient damper;

- the at least one resilient damper comprises an inner plate secured to the at least one damper arm and an outer plate secured to the dynamic mass, the inner plate and the outer plate having respective inner and outer holes, the at least one resilient damper comprising a wire rope connecting the inner and outer plates to one another by passing through the inner holes and through the outer holes;

- the clamp comprises two half-clamps clamping the pipe between them in a given clamping direction, and securing means securing the two half-clamps to one another while allowing a resilient displacement of the two half-clamps with respect to one another along the clamping direction;

- the tuned mass damper comprises at least two of said limiting device, the at least two limiting device being angularly shifted around the pipe with respect to one another;

- at least two guide arms bear the limiting organ or the limited organ of the at least two limiting devices, the at least two guide arms being angularly shifted around the pipe with respect to one another;

- the limiting organ defines stops for the displacement of the limited organ with respect to the limiting organ in two opposite axial directions substantially parallel to a central axis of the pipe, in a radial direction toward or away from the central axis of the pipe, and in two opposite tangential directions tangential to a circle centered on the central axis of the pipe;

- when the tuned mass damper is at rest, the limited organ is separated from the limiting organ by first and second tangential gaps in said two opposite tangential directions, by a radial gap in said radial direction, and by first and second axial gaps in said two opposite axial directions;

- the first and second axial gaps are larger than the first and second tangential gaps and larger than the radial gap;

- the limiting organ is a box, with an internal volume where the limited organ is accommodated, the internal volume being closed by a bottom toward or away from the central axis of the pipe, by two transverse walls substantially perpendicular to the central axis of the pipe, and two axial walls substantially parallel to the central axis of the pipe;

- the limited organ comprises a first rolling body for rolling against the bottom, and a second rolling body for rolling against the axial walls;
- the limited organ is secured to the mounting bracket and the limiting organ is secured to the dynamic mass.

5 Other features and advantages of the invention will become apparent from the detailed description thereof provided below, purely by way of an indication and without any limitation, reference being made to the following figures:

- the figure 1 is a view in perspective of a tuned mass damper according to the invention;

10 - the figures 2 and 3 are sections of the limiting device of the figure 1, taken along the lines II-II and III-III respectively; and

- the figure 4 is a view in perspective of the limited organ of the figures 1 to 3.

The tuned mass damper shown 1 on the figure 1 is for damping the vibrations in the pipe 3.

15 The pipe 3 is typically the expansion line fluidically connecting the pressurizer of a PWR nuclear reactor to the primary circuit.

Alternatively, the pipe 3 is another pipe submitted to high temperatures, and particularly submitted to cycles of thermal expansions and contractions.

20 The pipe 3 may as well be a pipe which is not submitted to high temperatures, and which is not submitted to cycles of thermal expansions and contractions.

The pipe 3 belongs to a PWR nuclear reactor, or to another type of nuclear reactor, or belongs to an industrial facility which is not a nuclear reactor.

The tuned mass damper 1 comprises:

- a mounting bracket 5 secured to the pipe 3;
- 25 - a dynamic mass 7 comprising an annular member 9 extending around the pipe 3;
- at least one limiting device 11, limiting the movements of the dynamic mass 7 with respect to the mounting bracket 5, and
- at least one resilient damper 13, connecting the dynamic mass 7 to the mounting bracket 5 such that vibrations transmitted from the pipe 3 to the dynamic mass 7 are damped by
- 30 the resilient damper 13.

The annular member 9 is cylindrical or polyhedral. Its central axis X is aligned with the central axis of the pipe 3. Weights 10 are secured to the inner surface of the annular member by screws.

35 The annular member 9 has a closed contour and extends all around the pipe 3. Its inner section is empty, and sufficiently large to accommodate the mounting bracket 5, at least one limiting device 11, and at least one resilient damper 13.

5

The mounting bracket 5 comprises a clamp 15 secured to the pipe 3, at least one guide arm 17 having a proximal end 19 secured to the clamp 15 and a distal end 21 connected to the at least one limiting device 11, and at least one damper arm 23 having a proximal end 25 secured to the clamp 15 and a distal end 27 connected to the dynamic mass 7 by the at least one resilient damper 13.

The clamp 15 comprises two half-clamps 29 clamping the pipe 3 between them in a given clamping direction C, and securing means 31 securing the two half-clamps 29 to one another while allowing a resilient displacement of the two half-clamps 29 with respect to one another along the clamping direction C.

Each half-clamp 29 has a central part 33 with a shape chosen to adapt around the pipe 3. The central part 33 is directly in contact against the outer surface of the pipe 3, and covers substantially half the perimeter of the pipe 3.

Each half-clamp 29 has two ends 35, one on each side of the central part 33, defining a flange.

The two ends 35 extend in a plane substantially perpendicular to the clamping direction.

The securing means 31 secure the flanges of the two half-clamps 29 to one another.

The securing means 31 comprise for example several screws 37, one nut 39 screwed on each screw, and resilient washers 41 interposed between each nut and the corresponding flange.

The resilient washer 41 allows keeping the two half-clamps 29 tightly clamped to the pipe, even though the pipe is submitted to thermal expansion/contraction cycles.

The mounting bracket 5 typically comprises several damper arms 23 and a resilient damper 13 associated to each damper arm 23. Each damper arm 23 has a proximal end 25 secured to the clamp 15 and a distal end 27 connected to the dynamic mass 7 by the corresponding resilient damper 13.

The damper arms 23 extend substantially radially with respect to the central axis X of the pipe 3.

The damper arms 23 are angularly shifted with respect to one another around the central axis X, preferably regularly shifted with respect to one another.

In the example depicted on the figures, the mounting bracket 5 has three damper arms 23 and three resilient dampers 13. The arms extend radially and are arranged at 120° from one another around the central axis C.

The at least one resilient damper 13 comprises an inner plate 43 secured to the at least one damper arm 23 and an outer plate 45 secured to the dynamic mass 7.

The inner plate 43 is secured to the distal end 27 of the corresponding damper arm. The outer plate 45 is secured to the inner surface 47 of the annular member 9.

The inner plate 43 and the outer plate 45 have respective inner and outer holes 49, 51.

5 The inner holes 49 are arranged in a line substantially parallel to the central axis X.

The outer holes 51 are arranged as well in a line substantially parallel to the central axis X.

Advantageously, the at least one resilient damper 13 comprises a wire rope 53 connecting the inner and outer plates 43, 45 to one another by passing through the inner
10 holes 49 and through the outer holes 51.

The wire rope 53 is a rope made of wires of metal, the wires being weaved against one another to constitute the rope.

The wire rope 53 is passed alternatively through one inner hole 49 and one outer hole 51, forming substantially an helix having its axis parallel to the central axis X.

15 As indicated above, a usual tuned mass damper has a resilient organ giving stiffness and a damper absorbing the mechanical energy coming from the vibrating structure. In the invention, the at least one resilient damper 13 ensures the function of both the resilient organ and the damper. It is rather stiff due to its structure with a wire rope arranged in an helix. The mechanical energy coming from the pipe is dissipated by the wire ropes rubbing
20 against one another.

It must be pointed out that the damper is dry, and does not require using a liquid, for example an oil of the type usually used in a viscous damper. This is a significant advantage when the tuned mass damper is implemented in a nuclear reactor, since using such organic liquid should be avoided in a nuclear facility.

25 The or each limiting device 11 comprises a limited organ 55 secured to one of the mounting bracket 5 and the dynamic mass 7, and a limiting organ 57 secured to the other of the mounting bracket 5 and the dynamic mass 7.

The limited organ 55 has no contact with the limiting organ 57 when the tuned mass damper 1 is at rest or in normal operation. However, the limiting organ 57 defines
30 stops for the displacement of the limited organ 55 with respect to the limiting organ 57 along at least three mutually perpendicular directions.

The tuned mass damper 1 is at rest when it is not submitted to external actions, such as vibrations or accelerations transmitted via the pipe 3.

35 The tuned mass damper 1 is in normal operation when it experiences vibrations transmitted via the pipe 3 corresponding to the level of vibration it is designed for.

Preferably, the limited organ 55 is secured to the mounting bracket 5 and the limiting organ 57 is secured to the dynamic mass 7, as illustrated on the figures.

The tuned mass damper 1 preferably comprises at least two limiting devices 11. The at least two limiting device 11 are angularly shifted around the pipe 3 with respect to one another, preferably regularly angularly shifted around the pipe 3.

The mounting bracket 5 in that case comprises at least two guide arms 17.

The at least two guide arms 17 bear the limiting organ 57 or the limited organ 55 of the at least two limiting devices 11,

The at least two guide arms 17 are angularly shifted around the pipe 3 with respect to one another, preferably regularly angularly shifted around the pipe 3.

In the example depicted on the figures, the mounting bracket 5 comprises three guide arms 17 angularly shifted of 120° around the pipe 3, the three corresponding limiting device 11 being angularly shifted of 120° around the pipe 3.

The guide arms 17 are substantially radial.

In the example depicted on the figures, the distal end 21 of a guide arm 17 bears the limited organ 55 of the corresponding limiting device 11.

The limiting devices are typically all identical to one another. The description below applies to all the limiting devices 11.

The limiting organ 57 defines stops for the displacement of the limited organ 55 with respect to the limiting organ 57 in two opposite axial directions substantially parallel to a central axis X of the pipe 3, in a radial direction toward or away from the central axis X of the pipe 3, and in two opposite tangential directions tangential to a circle centered on the central axis X of the pipe 3.

The radial direction is defined here as a direction substantially perpendicular to the central axis X and intersecting the central axis X.

The two tangential directions are tangential to a circle perpendicular to the central axis X and having a center belonging to the central axis X. The circle passes through the limited organ 55.

In the example depicted on the figures, the limiting organ 57 defines stops for the displacement of the limited organ 55 with respect to the limiting organ 57 in the radial direction away from the central axis X of the pipe 3.

When the tuned mass damper 1 is at rest, the limited organ 55 is separated from the limiting organ 57 by first and second tangential gaps t , t' in said two opposite tangential directions, by a radial gap r in said radial direction, and by first and second axial plays a , a' in said two opposite axial directions (see figures 2 and 3).

In the example depicted on the figures, the first and second axial gaps a' a' are larger than the first and second tangential plays t , t' and larger than the radial play r .

For example, the first and second axial plays a' a' are about 60 mm. The first and second tangential plays t , t' and the radial play r are about 8 mm.

Advantageously, the limiting organ 57 is a box, with an internal volume 59 where the limited organ 55 is accommodated.

The internal volume 59 is closed by a bottom 61 toward or away from the central axis X of the pipe 3, by two transverse walls 63 substantially perpendicular to the central axis X of the pipe 3, and two axial walls 65 substantially parallel to the central axis X of the pipe 3.

The internal volume 59 is open at the opposite of the bottom 61.

In the example depicted, the bottom 61 is secured against the inner surface 47 of the annular member 9. The box is open radially toward the center axis X. The bottom 61 defines the stop in the radial direction for the limited organ 55.

The two axial walls 65 and the bottom 61 are one piece. Together, the two axial walls 65 and the bottom 61 have the shape of a rail. The two axial walls 65 define the stops in the two opposite tangential directions.

The two transverse walls 63 are secured to the inner surface 47 of the annular member 9. They are located at the two opposite axial ends of the rail defined by the two axial walls 65 and the bottom 61. They close the rail at its two opposite ends. The two transverse walls 63 define the stops in the two opposite axial directions.

The limited organ 65 is depicted on the figure 4. It comprises a first rolling body 67 for rolling against the bottom 61, and a second rolling body 69 for rolling against the axial walls 65.

More precisely, it comprises a circular hub 71 secured to the distal end of corresponding the guide arm 17. The first rolling body 67 is a roller arranged on a face 73 of the hub 71 facing the bottom 61. The second rolling body 69 is a wheel, arranged around the circular hub 71.

The axis of rotation of the second rolling body 69 is substantially radial. The axis of rotation of the first rolling body 67 is substantially perpendicular to the radial direction and parallel to the central axis X.

Preferably, the pipe 3 is covered by a layer of thermal insulation material, not depicted on the figures. The length of guide arms 17 and of the damper arms 23 is chosen such that the distal ends 21 and 27 are located outside the insulation material.

The behavior of the tuned mass damper 1 will be explained below.

At rest, the dynamic mass 7 is connected to the mounting bracket 5 only by the resilient damper(s) 13, and more precisely only by the wire rope(s) 53.

Vibrations are transmitted from the pipe 3 to the dynamic mass 7 through the damper arms 23 and the or each resilient damper 13.

5 The displacement of the dynamic mass 7 with respect to the bracket 5 is damped by the or each resilient damper 13. Said displacement changes the shape of the or each resilient damper 13, making the wires of the wire rope 53 rub against one another. This dissipates the mechanical energy transmitted by the vibrations from the pipe 3 to the dynamic mass 7.

10 As long as the movements of the dynamic mass 7 are moderate, the or each limiting device 11 does not restrict the magnitude of the movements of the dynamic mass. There is no interaction between the limited organ 55 and the limiting organ 57. The gaps between the limited organ 55 and the limiting organ 57 are such that the dynamic mass 7 is free to move with respect to the mounting bracket 5 in translation in any direction and in
15 rotation around any axis. There are no interactions or shocks between the limited organ and the limiting organ.

The or each limiting device 11 allow for rather large displacement of the dynamic mass 7 along the central axis X, which is the main damping direction of the tuned mass damper depicted in the figures.

20 In case of earthquake, the limited organ 55 contacts the limiting organ 57. This restricts the movement of the dynamic mass 7 with respect to the mounting bracket 5. This limits the load applied to the resilient damper (s) 13, and prevents the resilient damper(s) from breaking.

25 The contact between the limited organ 55 and the limiting organ 57 is facilitated by the rolling bodies. The first rolling body 67 allows the limited organ 55 to roll axially against the bottom 61. The second rolling body 69 allows the limited organ 55 to roll axially against the axial walls 65. The limited organ 55 is guided in translation axially, until it contacts the transverse wall 63.

30 When the pipe 3 expands, for example because its temperature increases, the guide arms 17 are displaced radially away from the central axis of the pipe 3. Said displacement is possible because of the radial play existing between the limited organ 55 and the limiting organ 57. The same happens when the pipe 3 contracts.

35 The tuned mass damper 1 preferably includes at least two limiting device 11, angularly shifted around the pipe with respect to one another, to make sure that the displacement of the dynamic mass is limited along any possible direction.

5

CLAIMS

1.- A tuned mass damper for a pipe, the tuned mass damper (1) comprising:

- a mounting bracket (5) secured to the pipe (3) ;
- a dynamic mass (7) comprising an annular member (9) extending around the pipe (3) ;
- 10 - at least one resilient damper (13), connecting the dynamic mass (7) to the mounting bracket (5) such that vibrations transmitted from the pipe (3) to the dynamic mass (7) are damped by the resilient damper (13);
- at least one limiting device (11), with a limited organ (55) secured to one of the mounting bracket (5) and the dynamic mass (7), and a limiting organ (57) secured to the other of the mounting bracket (5) and the dynamic mass (7); the limited organ (55) having no contact with the limiting organ (57) when the tuned mass damper (1) is at rest, the limiting organ (57) defining stops for the displacement of the limited organ (55) with respect to the limiting organ (57) along at least three mutually perpendicular directions.

2.- The tuned mass damper according to the claim 1, wherein the mounting bracket (5) comprises a clamp (15) secured to the pipe (3), at least one guide arm (17) having a proximal end (19) secured to the clamp (15) and a distal end (21) bearing the limiting organ (57) or the limited organ (55) of the at least one limiting device (11), and at least one damper arm (23) having a proximal end (25) secured to the clamp (15) and a distal end (27) connected to the dynamic mass (7) by the at least one resilient damper (13).

3.- The tuned mass damper according to the claim 2, wherein the at least one resilient damper (13) comprises an inner plate (43) secured to the at least one damper arm (23) and an outer plate (45) secured to the dynamic mass (7), the inner plate (43) and the outer plate (45) having respective inner and outer holes (49, 51), the at least one resilient damper (13) comprising a wire rope (53) connecting the inner and outer plates (43, 45) to one another by passing through the inner holes (49) and through the outer holes (51).

4.- The tuned mass damper according to the claim 2 or 3, wherein the clamp (15) comprises two half-clamps (29) clamping the pipe (3) between them in a given clamping direction (C), and securing means (31) securing the two half-clamps (29) to one another while allowing a resilient displacement of the two half-clamps (29) with respect to one another along the clamping direction (C).

5.- The tuned mass damper according to anyone of the claims 1 to 4, wherein the tuned mass damper (1) comprises at least two of said limiting device (11), the at least two limiting device (11) being angularly shifted around the pipe (3) with respect to one another.

5 6.- The tuned mass damper according to the claim 5 and to the claim 2, wherein at least two guide arms (17) bear the limiting organ (57) or the limited organ (55) of the at least two limiting devices (11), the at least two guide arms (17) being angularly shifted around the pipe (3) with respect to one another.

10 7.- The tuned mass damper according to anyone of the claims 1 to 6, wherein the limiting organ (57) defines stops for the displacement of the limited organ (55) with respect to the limiting organ (57) in two opposite axial directions substantially parallel to a central axis (X) of the pipe (3), in a radial direction toward or away from the central axis (X) of the pipe (3), and in two opposite tangential directions tangential to a circle centered on the central axis (X) of the pipe (3).

15 8.- The tuned mass damper according to the claim 7, wherein, when the tuned mass damper (1) is at rest, the limited organ (55) is separated from the limiting organ (57) by first and second tangential gaps in said two opposite tangential directions, by a radial gap in said radial direction, and by first and second axial gaps in said two opposite axial directions,

20 9.- The tuned mass damper according to the claim 8, wherein the first and second axial gaps are larger than the first and second tangential gaps and larger than the radial gap.

10.- The tuned mass damper according to anyone of the claims 7 to 9, wherein the limiting organ (57) is a box, with an internal volume (59) where the limited organ (55) is accommodated, the internal volume (59) being closed by a bottom (61) toward or away from the central axis (X) of the pipe (3), by two transverse walls (63) substantially perpendicular to the central axis (X) of the pipe (3), and two axial walls (65) substantially parallel to the central axis (X) of the pipe (3).

25 11.- The tuned mass damper according to the claim 10, wherein the limited organ (55) comprises a first rolling body (67) for rolling against the bottom (61), and a second rolling body (69) for rolling against the axial walls (65).

30 12.- The tuned mass damper according to anyone of the claims 1 to 11, wherein the limited organ (55) is secured to the mounting bracket (5) and the limiting organ (67) is secured to the dynamic mass (7).

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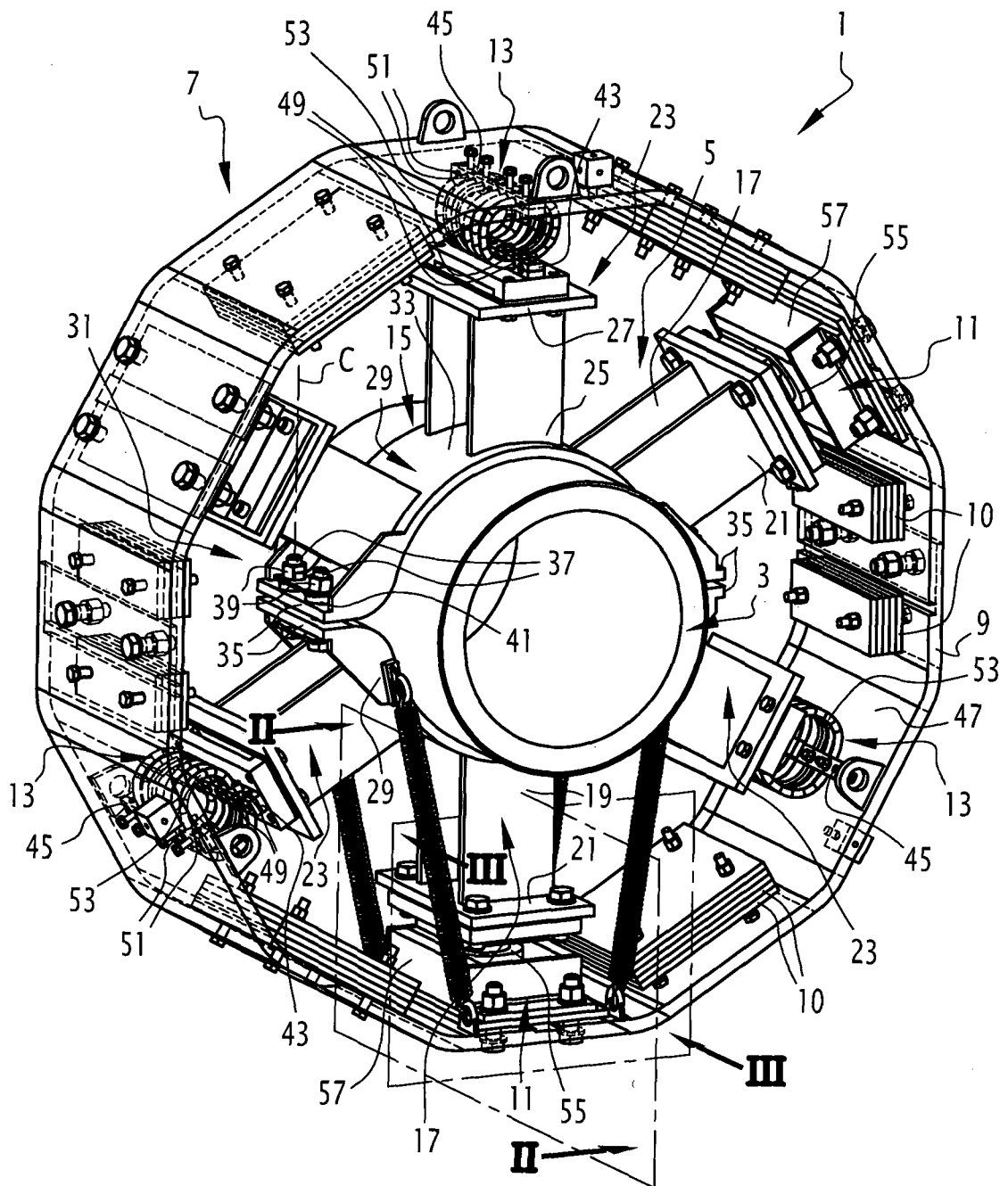


FIG.1

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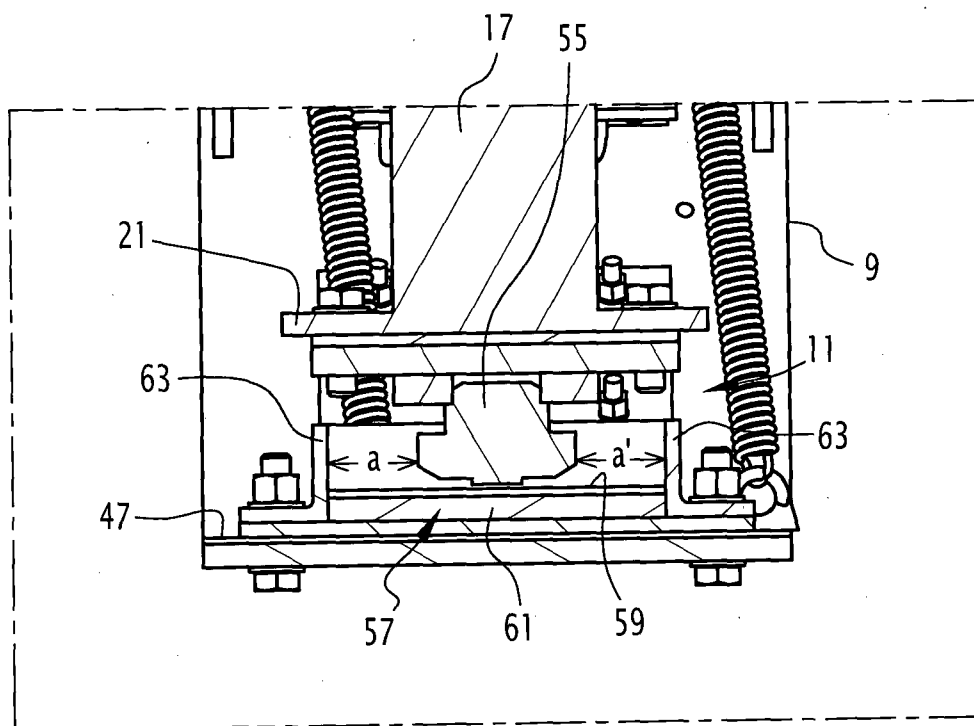


FIG.2

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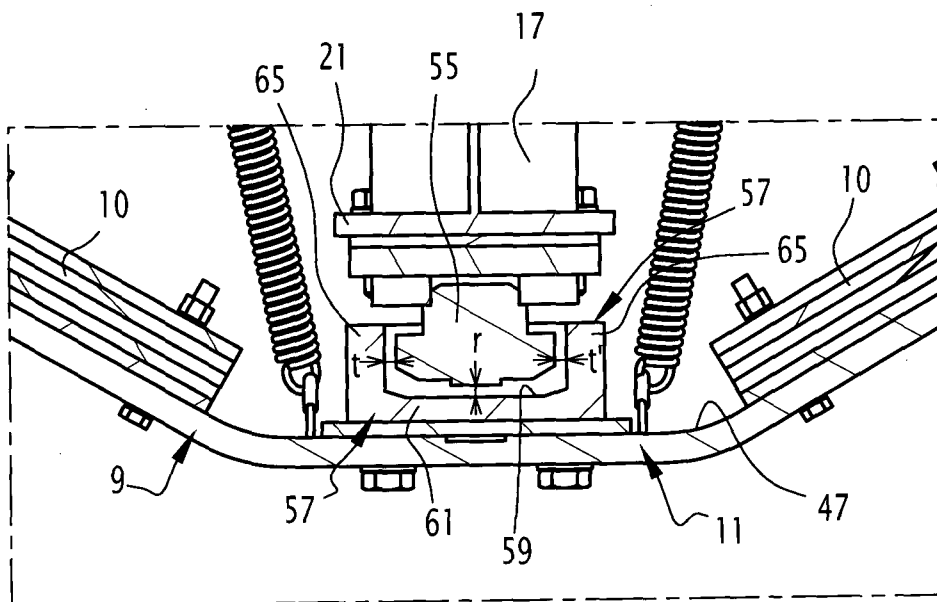


FIG.3

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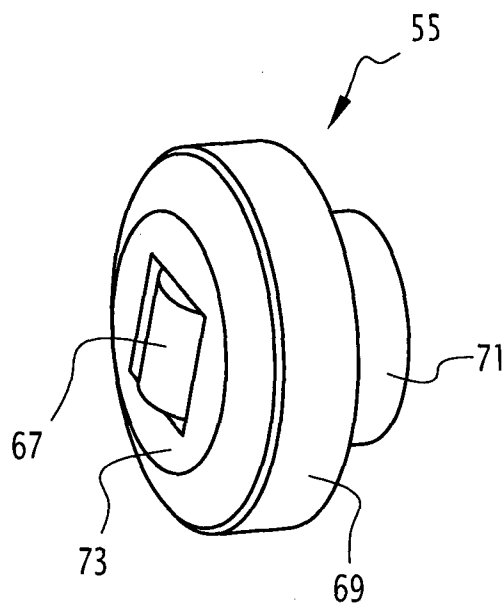


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2019/001443

A. CLASSIFICATION OF SUBJECT MATTER**F16L 3/205**(2006.01)i; **F16F 7/116**(2006.01)i; **F16F 7/14**(2006.01)i

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)

F16L; F16F

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CH 277098 A (GERB WILLIAM [AT]) 15 August 1951 (1951-08-15)	1,7-9,12
A	figure 1	2-6,11
A	CN 103803033 A (JIANGSU MARITIME INST; SHEN ZHONGXIANG) 21 May 2014 (2014-05-21)	1-12
	figure 1	
A	CN 102052518 A (UNIV ZHEJIANG) 11 May 2011 (2011-05-11)	1-12
	figure 1	



Further documents are listed in the continuation of Box C.



See patent family annex.

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“&” document member of the same patent family

Date of the actual completion of the international search

14 April 2020

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/IB2019/001443

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CH	277098	A	15 August 1951	NONE	
CN	103803033	A	21 May 2014	NONE	
CN	102052518	A	11 May 2011	NONE	

RAPPORT DE RECHERCHE INTERNATIONALE

Demande internationale n°

PCT/IB2019/001443

A. CLASSEMENT DE L'OBJET DE LA DEMANDE

INV. F16L3/205 F16F7/116 F16F7/14
ADD.

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)

F16L F16F

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela est réalisable, termes de recherche utilisés)

EPO-Internal

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie*	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
X	CH 277 098 A (GERB WILLIAM [AT]) 15 août 1951 (1951-08-15)	1,7-9,12
A	figure 1	2-6,11

A	CN 103 803 033 A (JIANGSU MARITIME INST; SHEN ZHONGXIANG) 21 mai 2014 (2014-05-21)	1-12
	figure 1	

A	CN 102 052 518 A (UNIV ZHEJIANG) 11 mai 2011 (2011-05-11)	1-12
	figure 1	

☐ Voir la suite du cadre C pour la fin de la liste des documents

☒ Les documents de familles de brevets sont indiqués en annexe

* Catégories spéciales de documents cités:

"A" document définissant l'état général de la technique, non considéré comme particulièrement pertinent

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"O" document se référant à une divulgation orale, à un usage, à une exposition ou tous autres moyens

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"Y" document particulièrement pertinent; l'invention revendiquée ne peut être considérée comme impliquant une activité inventive lorsque le document est associé à un ou plusieurs autres documents de même nature, cette combinaison étant évidente pour une personne du métier

"Z" document qui fait partie de la même famille de brevets

Date à laquelle la recherche internationale a été effectivement achevée

14 avril 2020

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Nom et adresse postale de l'administration chargée de la recherche internationale

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RAPPORT DE RECHERCHE INTERNATIONALE

Renseignements relatifs aux membres de familles de brevets

Demande internationale n°

PCT/IB2019/001443

Document brevet cité au rapport de recherche		Date de publication	Membre(s) de la famille de brevet(s)	Date de publication
CH 277098	A	15-08-1951	AUCUN	

CN 103803033	A	21-05-2014	AUCUN	

CN 102052518	A	11-05-2011	AUCUN	
