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(54) **DEVICE FOR DAMPING VIBRATIONS IN A CABLE**

(57) The device includes a first member (23) surrounding and secured to a section of the cable (6), a second member (25) arranged around the first member (23) and connected to an element to which a portion of the cable (6) is attached, and a damping system arranged between the first and second members (23, 25). The damping system includes deformable elements (32) disposed between the first and second members (23, 25) and arranged at different angular positions around the cable (6).

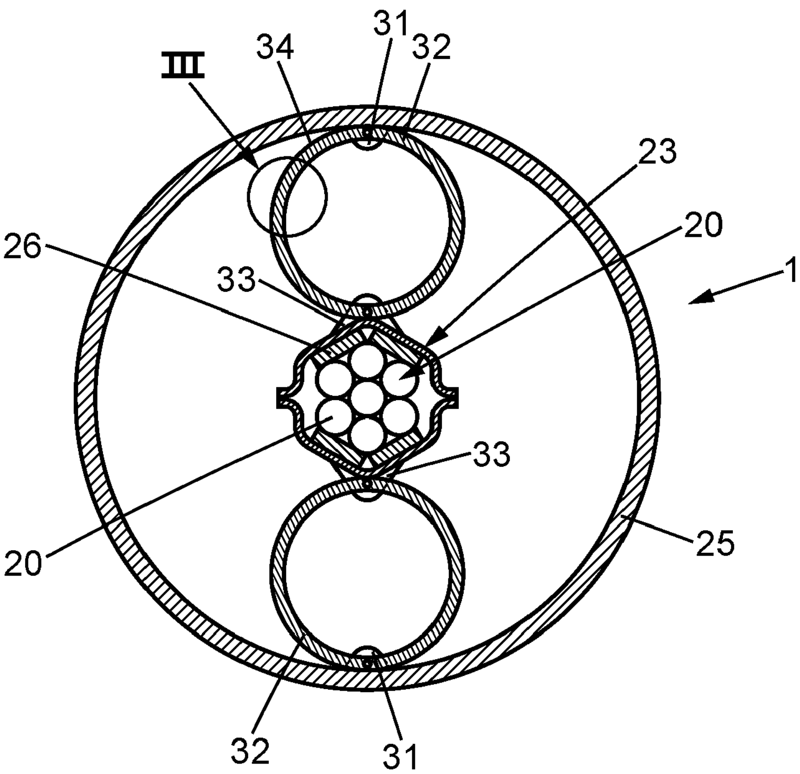

FIG. 2

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Description

[0001] The invention relates to a device for damping vibrations in a cable, and to a cable-stayed construction comprising such a device.

Technical background

[0002] It has particular but not exclusive application in the field of civil engineering works with a structure using such cables, for example suspension or cable-stayed bridges.

[0003] These cables or stays are subjected to vibration caused by the wind and/or the rain, frost, or else by vehicle or pedestrian traffic on the bridge.

[0004] The invention concerns more particularly a device including a first member surrounding and secured to a section of the cable, a second member arranged around the first member and connected to an element to which a portion of the cable is attached, and a damping system arranged between the first and second members.

[0005] In a known manner, structural cables such as stay cables used for the suspension of bridge decks, are affected by vibrations that may for example be due to vehicle or pedestrian traffic on the bridge, or wind applied to the cables, etc.

[0006] To damp these vibrations, damping devices coupled to these cables are frequently used to at least partly dissipate energy caused by these vibrations.

[0007] It is known from EP 0 914 521 A1 to use elastomeric dampers consisting of semi-annular IED (Internal Elastomeric Damper) elements with an optimized diabolo shape, manufactured by molding and installed around the cable near an anchor to dampen vibrations. These IED dampers are typically subjected to transverse forces in a range from 10kN to 75kN.

[0008] However, such elastomeric dampers are complex to manufacture due to their specific shape and are not adapted to all cable types.

[0009] EP 0 825 301 A1 discloses another cable damping device. An anchor pipe is secured, at its proximal end, to a girder of a tower of a bridge construction. The cable is drawn into the anchor pipe and anchored to the girder. An anchor flange is secured to the free end of the anchor pipe. An aligning flange is superposed on the anchor flange and secured to the anchor flange. The cable is clamped by a cable flange with a rubber sheet being interposed therebetween. Rubber bearings of a high damping characteristic formed from a visco-elastic body are disposed between the aligning flange and the cable flange. The rubber bearings damp shear forces applied to the cable.

[0010] An object of the present invention is to provide a damping device suitable for damping cable vibrations in compression and traction, especially in a cable-stayed construction, which is simple to manufacture and cost-effective.

Summary

[0011] There is provided a device for damping vibrations in a tensioned cable. The device includes a first member surrounding and secured to a section of the cable, a second member arranged around the first member and connected to an element to which a portion of the cable is attached, and a damping system arranged between the first and second members. The damping system includes a plurality of deformable elements disposed between the first and second members and arranged at different angular positions around the cable.

[0012] The damping device is compact, modular and easy to manufacture.

[0013] The deformable elements may have a tubular shape and be disposed parallel to the cable. Their cross-section may be convex. The convex cross-section may, in particular, be circular or elliptical, giving the deformable elements a simple geometry.

[0014] To improve the damping properties, at least one of the deformable elements may comprise a body of elastomeric material having a variable thickness.

[0015] The deformable elements may be arranged at regular angular intervals around the cable in order to provide substantially equivalent damping in any radial direction of vibration.

[0016] In an embodiment, at least one of the deformable elements is disposed in a vertical plane including a direction of the cable, which is generally a predominant direction of oscillation.

[0017] In a further aspect, each of the deformable elements has a first end attached to the first member and a second end attached to the second member. The deformable elements may be disposed between the first and second members in a pre-stretched state to provide an additional adjustment parameter for the damping device.

[0018] To provide an additional adjustment parameter for the damping device, at least one of the deformable elements is disposed between the first and second members in a pre-compressed state.

[0019] The cable may comprise a plurality of tendons and the first member comprises a collar which holds the tendons in a compact configuration.

[0020] A cable-stayed construction is also disclosed as comprising a cable having a bundle of load-bearing tendons, anchoring devices at both ends of the cable, for anchoring the tendons and keeping the cable in a tensioned state, and a device for damping vibrations of the tensioned cable as defined above.

[0021] The cable-stayed construction may comprise a deck portion, with the device for damping vibrations adjacent to the deck portion.

[0022] In an embodiment, the cable comprises less than 15 tendons. The damping device proposed here is well adapted to such a cable configuration because of its compacity, its modularity, and its simplicity.

[0023] A method for installing a device for damping vibrations in a tensioned cable in a cable-stayed construction is also disclosed. The cable comprises a bundle of load-bearing tendons. Anchoring devices are provided at both ends of the cable for anchoring the tendons and keeping the cable in a tensioned state. The method comprises:

- securing a first member around a section of the cable;
- arranging a second member around the first member, the second member being connected to an element to which a portion of the cable is attached; and
- arranging a plurality of deformable elements between the first and second members at different angular positions around the cable.

[0024] The deformable elements may be disposed by deforming them radially between the first and second members, at least one of the first and second members comprising fasteners for holding the deformable elements.

[0025] At least one port may be provided in the wall of the second member for adjusting the deformable elements.

[0026] A threaded rod may be inserted through the port and coupled with a nut disposed outside the second member to fasten the deformable elements to the second member and pre-deform the deformable elements. A cover may be provided to close and protect the nut outside the second member.

Brief description of figures

[0027] Further features, details and advantages will become apparent from the detailed description below, and from an analysis of the appended drawings, in which:

- figure 1 shows diagrammatically how a device according to a first embodiment is placed near the anchored end of a stay;
- figure 2 is a cross sectional view, along the plane II-II shown in figure 1, of a first embodiment of the device of figure 1 ;
- figure 3 is a detail view of a body of one of the deformable elements from the device of figure 2;
- figure 4 is a cross sectional view of a damping device according to a variant of figure 2;
- figure 5 is a cross sectional view of a damping device according to a second embodiment;
- figure 6 is a cross sectional view of a damping device according to a third embodiment;
- figure 7 is a cross sectional view of a damping device according to a fourth embodiment;
- figure 8 is a cross sectional view of a damping device according to a variant of figure 7;
- figure 9 is a cross sectional view of a damping device according to a fifth embodiment

Detailed description

[0028] Figure 1 shows diagrammatically a place where a damping device 1 may be placed on a structural cable 6, here a stay 6 of a cable-stayed construction 8 such as a cable-stayed bridge comprising a deck portion 12.

[0029] In a known way, the stay 6 is anchored at its two ends by respective anchoring devices. In the example shown in figure 1, the damping device 1 is placed near the lower end of the stay 6, which is attached to the bridge deck portion 12 by an anchoring device 10.

[0030] It will be understood that a similar structure may be placed near the upper end of the stay 6, anchored in a bridge tower.

[0031] The stay 6 includes a bundle of tendons 20 that are individually anchored in the anchoring device 10. For that, they need to be spaced apart so that individual clamping elements can hold them firmly in an anchor block of the anchoring device. At some distance of the anchoring device 10, a collar 23 is used to bring the tendons in a more compact configuration, so that the cross-section of the cable is reduced in its main part. By way of example, the anchoring device 10 may be of the kind disclosed in US patent No. 6,748,708. This anchoring device 10 comprises an anchor block 11 fixed relative to the deck 4 and receiving one end of the cable 6.

[0032] The anchoring device 10 also comprises an encasing tube 14. The encasing tube 14 may be placed either in the mold at the time of manufacturing a concrete deck portion 12, or embedded in a steel deck structure.

[0033] The encasing tube 14 is configured to bear and to protect the stay 6, the anchor block 11 and essential elements used to anchor the stay 6 in the deck portion 12. It is configured to guide the stay 6 in the vicinity of the anchor block 11. In embodiments in which the anchor block is not fixed to the bridge deck portion 12 directly, the encasing tube 14 is also fixed to the anchor block and is configured to transfer forces applied to the anchor block, to the deck. Advantageously, it is also configured to prevent third parties from accessing elements anchoring the stay 6 in the anchor block 11.

[0034] The device 1 presented here is well suited to damp vibrations of a tensioned cable having a relatively small number of tendons, in particular less than 15 tendons. In the example shown in figures 2 and 4 to 6, the stay 6 has seven tendons 20. The tendons 20 may be subjected to vibrations with moderate transverse forces, for example at most 10 kN.

[0035] The damping device 1, which is shown very diagrammatically in figure 1 and in more detail in figure 2, comprises a first member surrounding and secured to a section of the stay 6, a second member arranged around the first member and connected to an element to which a portion of the stay 6 is attached, and a damping system arranged between the first and second members.

[0036] In the embodiment considered here, the first member consists of the collar 23 which holds the tendons in a compact configuration at a distance of one to a few meters of the lower anchoring device 10, while the second member is a tubular member 25 connected to the anchoring device 10 and protruding on an upper side of the deck portion 12.

[0037] In the embodiment illustrated in figure 1, the tubular member 25 is a guide tube provided as an extension of the encasing tube 14. The guide tube 25 is rigidly connected to the encasing tube 14, for example by means of annular bolted flanges 27, 28 provided at their adjacent ends. A fire and/or anti-blast and/or anti-vandalism protection device (not shown) may also be provided around the guide tube 25

[0038] The collar 23 holding the tendons 20 in their compact configuration may be located near the upper end of the guide tube 25 and mounted there around a section of the stay 6. Beyond that point, a conical sheath 17 that covers the compacted tendons is bearing onto the upper end of the guide tube 25 and is connected to the cable bundle collective sheath (not shown).

[0039] For a stay 6 made of seven tendons, the collar 23 may be composed of two halves of generally semi-hexagonal shape assembled after their installation on the stay 6, for example using bolts (not shown). Shims 26 may be interposed between the collar 23 and the tendons 20. The collar 23 may be made of metal, for example steel.

[0040] The damping system includes deformable elements 32 disposed between the first and second members and arranged at different angular positions around the stay 6.

[0041] In the embodiment shown in figures 2 and 4, the damping system comprises two deformable elements 32 having a tubular shape and disposed parallel to the stay 6. The deformable elements 32 have a convex cross-section, in particular a circular or elliptical cross-section. They are diametrically opposed around the stay 6 for optimum distribution of vibration absorption. The deformable elements 32 may be disposed in a vertical plane including a direction of the stay 6, and are then suited to absorb vibrations in preferential oscillation directions of the stay.

[0042] In the embodiment of figure 3, the deformable elements 32 comprise a body 34 of elastomeric material having a variable thickness. Varying the thickness along the circumference of the deformable elements 32 allows them to be deformed in preferential directions according to typical oscillation directions of the stay 6. In figure 3, the deformable element body 34 has a smaller thickness e1 in regions adjacent to the guide tube 25 and the collar 23, compared to the thickness e2 in an intermediate region. Thus, the deformable element 32 is more prone to deformations in compression or in traction than in other directions and its resistance to breakage in these directions is increased. Moreover, this specific shape may increase damping efficiency of each element 32.

[0043] Alternatively, the body 34 of the deformable elements 32 may comprise a polymeric material and/or elastomeric material, which may be combined with rigid elements such as steel elements to reinforce the deformable elements 32.

[0044] The installation of the damping device 1 described above may be carried out in the following way.

[0045] According to a first embodiment, the guide tube 25 is slidably mounted around the stay 6 and moved upwards to allow access to the intended location of the collar 23 and the damping system. The two halves of the collar 23 are installed around the stay 6 at some distance of the anchoring device 10, and then the guide tube 25 is slid downwards so that the damping system is, in use, located near the upper end of the guide tube 25. The two halves of the collar 23 are tightened, for example using bolts before bringing the guide tube 25 back downwards and attaching it to the encasing tube 14 via the flange connection 27, 28. Shims 26 may be interposed between the collar 23 and the tendons 20. The two deformable elements 32 are disposed by deforming them radially between the collar 23 and the guide tube 25. The deformable elements 32 are radially blocked between the collar 23 and the guide tube 25. The deformable elements 32 are preferably held on at least one of the collar 23 and the guide tube 25 not to move in the orthoradial direction. To this end, the guide tube 25 may comprise fasteners, for example lugs 31, on its internal wall for holding the deformable elements 32. The lugs 31 are for example welded to the internal wall of the guide tube 25.

[0046] The collar 23 may also comprise fasteners, for example external lugs 33, for holding the deformable elements 32.

[0047] The deformable elements 32 may be fastened by clamping to the guide tube 25 or the collar 23 or both.

[0048] Alternatively, the deformable elements 32 may be fastened by pinning to the guide tube 25 or the collar 23 or both. Holes are formed in the deformable elements 32 during molding to receive pins.

[0049] The first embodiment is particularly adapted to install a unique row of deformable elements 32.

[0050] According to a second embodiment illustrated in figure 4, a lateral access to the deformable elements 32 is allowed to ease installation or maintenance of the device 1 from the outside of the guide tube 25.

[0051] To this end, ports 35 are provided in the wall of the guide tube 25.

[0052] The two halves of the collar 23 are installed around the stay 6 at some distance of the anchoring device 10, for example near the upper end of the guide tube 25, by sliding upwards conical sheath 17, to bring the tendons 20 in a more compact configuration. Then the two halves of the collar 23 are tightened, for example using bolts. Shims 26 may be interposed between the collar 23 and the tendons 20.

[0053] The two deformable elements 32 are disposed by introducing them directly radially between the collar 23 and the guide tube 25 through the ports 35. The deformable elements 32 are radially blocked between the collar 23 and the guide tube 25. The deformable elements 32 are preferably held on at least one of the collar 23 and the guide tube 25 not to move in the orthoradial direction. To this end, the guide tube 25 may comprise fasteners, each comprising for example a threaded rod 37 extending radially through the port 35 and coupled with a nut 39 outside the guide tube 25.

[0054] Optionally, a plurality of covers 40 close and protect each fastener outside the guide tube 25. The covers 40 are disposed on the guide tube 25 for example using bolts (not shown).

[0055] The second embodiment is particularly adapted to install several rows of deformable elements 32 parallel to the stay 6.

[0056] For example, the device 1 may comprise a first row of circular deformable elements and, aligned with the first row, a second row of pre-stretched deformable elements. Combining different sets of deformable elements lead to an increased damping efficiency of the stay. Transverse movements or vibrations are damped by symmetrical or asymmetrical deformation of the deformable elements 32.

[0057] The damping device 1 illustrated in figure 2 is simple to manufacture and to install, compact, modular and light-weighted and thus well suited to damp vibrations of a tensioned cable having a relatively small number of tendons, in particular less than 15 tendons.

[0058] Figures 5 and 6 show alternative embodiments of the damping system of figure 2. The damping system of figure 5 comprise three tubular deformable elements 32 disposed between the collar 23 and the guide tube 25. They are disposed parallel to the stay 6. The deformable elements 32 have a circular or slightly elliptical cross-section and are arranged at regular angular intervals around the stay 6.

[0059] The damping system of figure 6 comprise four tubular deformable elements 32 disposed between the collar 23 and the guide tube 25. They are disposed parallel to the stay 6. The deformable elements 32 have a circular or elliptical cross-section and are arranged at regular angular intervals around the stay 6.

[0060] Arranging the deformable elements 32 at regular angular intervals around the stay 6 provides substantially equivalent damping in any radial direction of vibration.

[0061] Alternatively, the deformable elements 32 could be arranged another way according to the damping needs.

[0062] The installation of the damping device 1 of figures 5 and 6 may be carried out in the same way as for the embodiment shown in figure 2.

[0063] Figure 7 shows another embodiment of the damping system. The damping system comprises six deformable elements 32 arranged at regular angular intervals around the stay 6. Each deformable element 32 has a first end 36 attached to the collar 23 and a second end 38 attached to the guide tube 25. The deformable elements 32 are disposed between the collar 23 and the guide tube 25 in a pre-stretched state. The cross-section of each deformable element 32 is elliptical.

[0064] In variants, the deformable elements may be less or more than six and may be arranged differently around the stay not necessarily at regular intervals.

[0065] The installation of the damping device 1 of figure 7 may be carried out in the same way as the one of figure 2 and the first end 36 of each deformable element 32 is attached to the collar 32 and the second end 38 of each deformable element 32 is attached to the guide tube 25. When installing the deformable elements 32, they can be stretched prior to attaching their ends 36, 38 to the collar 23 and the guide tube 25.

[0066] In the embodiment illustrated in figure 8, ports 35 are provided in the wall of the guide tube 25.

[0067] The deformable elements 32 are disposed by introducing them directly radially between the collar 23 and the guide tube 25 through the ports. The deformable elements 32 are radially blocked between the collar 23 and the guide tube 25. The deformable elements 32 are held on the collar 23 and the guide tube 25 not to move in the orthoradial direction. To this end, fasteners are used, each comprising for example a threaded rod 37 extending radially through the port 35 and coupled with a nut 39 that is outside the guide tube 25.

[0068] The length of the threaded rod 37 from the port 35 is adjusted to stretch the deformable element 32 between the collar 23 and the guide tube 25. A torque wrench may be used for fine-tuning.

[0069] The collar 23 also comprises fasteners, for example lugs 33, on its external wall for holding the deformable elements 32.

[0070] The deformable elements 32 may be fastened to the collar 23 by clamping.

[0071] Alternatively, the deformable elements 32 may be fastened to the collar 23 by pinning. Holes are formed in the deformable elements 32 during molding to receive pins.

[0072] Optionally, covers 40 close and protect each fastener outside the guide tube 25. The covers 40 are disposed (or arranged) on the guide tube 25 for example using bolts (not shown).

[0073] Pre-stretching the deformable elements 32 provides an additional setting parameter of the damping device 1.

[0074] As shown in figure 9, it is also possible to arrange the deformable elements 32 between the collar 23 and the guide tube 25 in a pre-compressed state.

[0075] Considering the installation disclosed above to pre-stretch the deformable elements 32, the length of the threaded rod 37 from the port 35 is here adjusted longer to compress the deformable element 32 between the collar 23 and the guide tube 25.

[0076] Pre-compressing the deformable elements 32 provides an additional setting parameter of the damping device.

[0077] Varying the pre-deformation of the deformable elements 32 in precompression or pre-stretch allows fine-tuning of an optimum damping frequency, corresponding to a dominant vibration mode of the cable, possibly among the lowest frequencies modes.

[0078] The damping features of the deformable elements 32 are typically defined by their shape, thickness (constant or variable over their circumference), Shore hardness, stiffness, material damping coefficient.

[0079] Thus, the number, shape, composition, in particular for the viscosity, stiffness and hardness properties, and arrangement of the deformable elements are adaptable to best meet the specifications of a specific construction work project.

[0080] The above-described embodiments are illustrations and it will be understood that variants may be provided to these examples without departing from the context of the claims. Thus, a device as disclosed herein may be used to damp vibration in a cable other than a stay, such as a suspension cable or a hanger of a suspension bridge, or even a submarine cable.

Claims

1. A device for damping vibrations in a tensioned cable (6), the device (1) including:

   a first member (23) surrounding and secured to a section of the cable (6);
   a second member (25) arranged around the first member (23) and connected to an element to which a portion of the cable (6) is attached; and
   a damping system arranged between the first and second members (23, 25),
   wherein the damping system includes a plurality of deformable elements (32) disposed between the first and second members (23, 25) and arranged at different angular positions around the cable (6).

2. The device (1) as claimed in claim 1, wherein the deformable elements (32) have a tubular shape and are disposed parallel to the cable (6).

3. The device (1) as claimed in claim 2, wherein the deformable elements (32) have a convex cross-section.

4. The device (1) as claimed in claim 3, wherein the convex cross-section is circular or elliptical.

5. The device (1) as claimed in any one of claims 2 to 4, wherein at least one of the deformable elements (32) comprises a body (34) of elastomeric material having a variable thickness.

6. The device (1) as claimed in any one of the preceding claims, wherein the deformable elements (32) are arranged at regular angular intervals around the cable (6).

7. The device (1) as claimed in any one of the preceding claims, wherein at least one of the deformable elements (32) is disposed in a vertical plane including a direction of the cable (6).

8. The device (1) as claimed in any one of the preceding claims, wherein at least one of the deformable elements (32) is disposed between the first and second members (23, 25) in a pre-compressed state.

9. The device (1) as claimed in any one of the preceding claims, wherein each of the deformable elements (32) has a first end (36) attached to the first member (23) and a second end (38) attached to the second member (25).

10. The device (1) as claimed in claim 9, wherein the deformable elements (32) are disposed between the first and second members (23, 25) in a pre-stretched state.

11. The device (1) as claimed in any one of the preceding claims, wherein the cable (6) comprises a plurality of tendons (20) and the first member (23) comprises a collar which holds the tendons (20) in a compact configuration.

12. A cable-stayed construction, comprising:

    a cable (6) having a bundle of load-bearing tendons (20);
    anchoring devices (10) at both ends of the cable (6), for anchoring the tendons (20) and keeping the cable (6) in a tensioned state; and
    a device (1) for damping vibrations of the tensioned cable (6) as claimed in any one of the preceding claims.

13. The cable-stayed construction as claimed in claim 12, comprising a deck portion (12), wherein the device (1) for damping vibrations is adjacent to the deck portion (12).

14. The cable-stayed construction as claimed in any one of claims 11 to 13, wherein the cable (6) comprises less than 15 tendons (20).

15. A method for installing a device for damping vibrations in a tensioned cable (6) in a cable-stayed construction, wherein the cable (6) comprises a bundle of load-bearing tendons (20), wherein anchoring devices (10) are provided at both ends of the cable (6) for anchoring the tendons (20) and keeping the cable (6) in a tensioned state, the method comprising:

    - securing a first member (23) around a section of the cable (6);

- arranging a second member (25) around the first member (23), the second member (25) being connected to an element to which a portion of the cable (6) is attached; and
- arranging a plurality of deformable elements (32) between the first and second members (23, 25) at different angular positions around the cable (6).

16. The method as claimed in claim 15, wherein the deformable elements (32) are disposed by deforming them radially between the first and second members (23, 25), at least one of the first and second members (23, 25) comprising fasteners (31, 33) for holding the deformable elements (32).

17. The method as claimed in claim 15 or 16, wherein at least one port (35) is provided in the wall of the second member (25) for adjusting the deformable elements (32).

18. The method as claimed in claim 17, wherein a threaded rod (37) is inserted through the port (35) and coupled with a nut (39) disposed outside the second member (25) to fasten the deformable elements (32) to the second member (25) and pre-deform the deformable elements (32).

19. The method as claimed in claim 18, wherein a cover (40) closes and protects the nut (39) outside the second member (25).

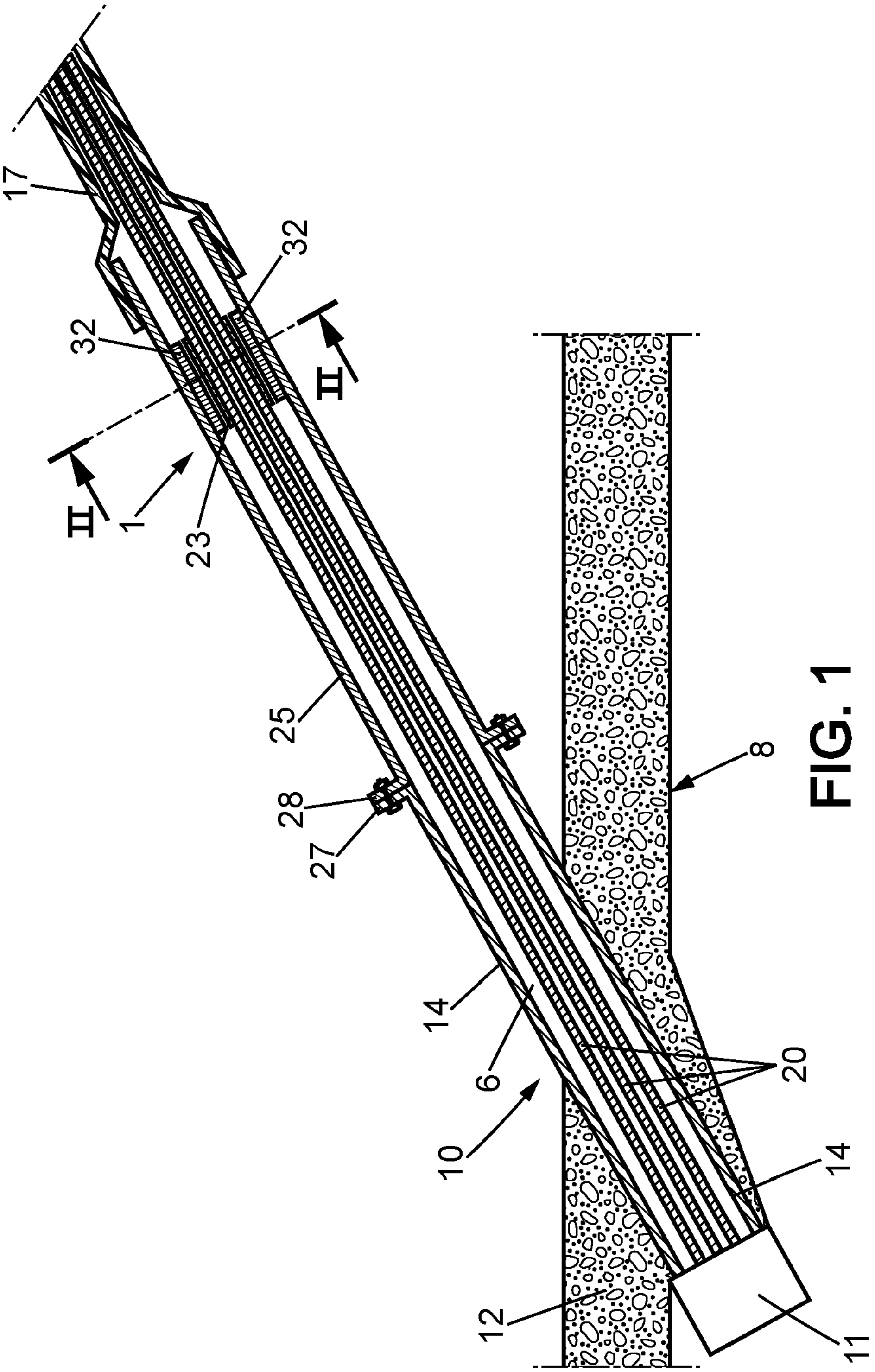

FIG. 1

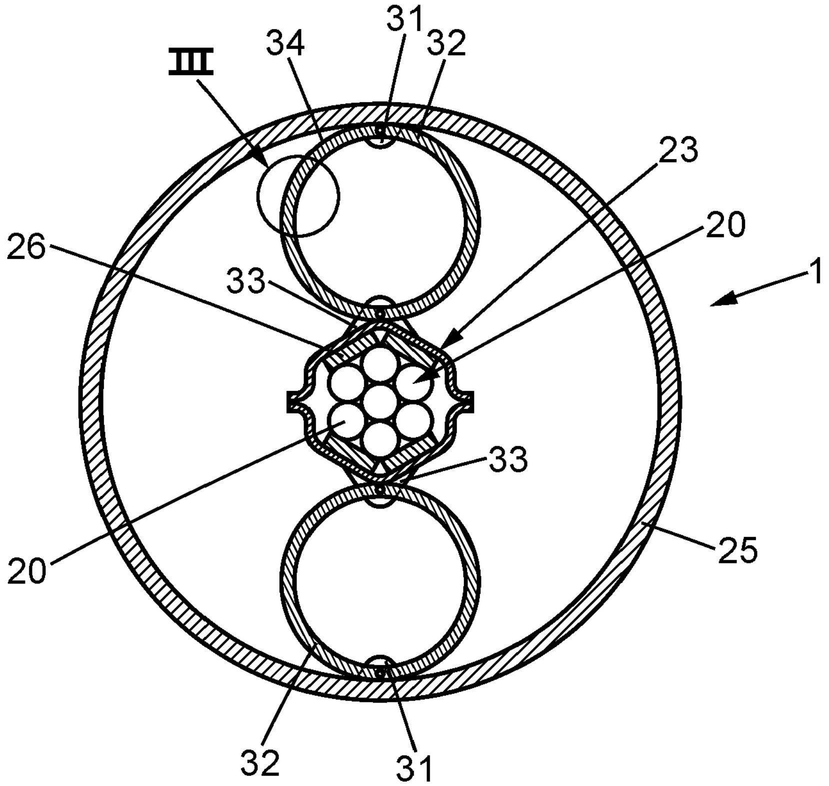

FIG. 2

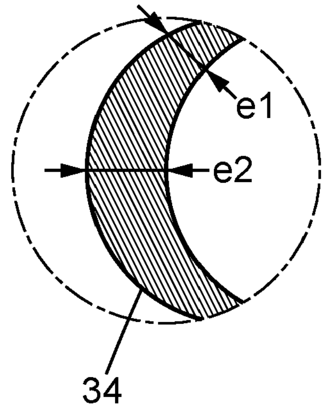

FIG. 3

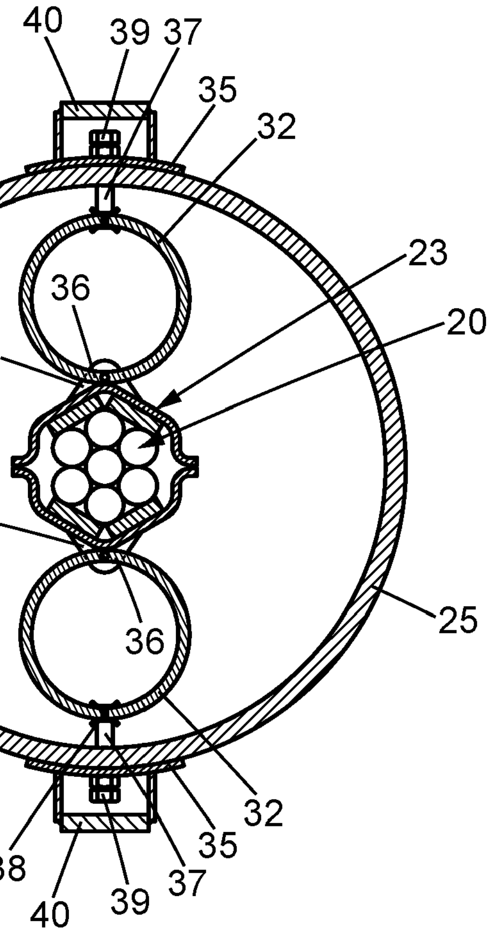

FIG. 4

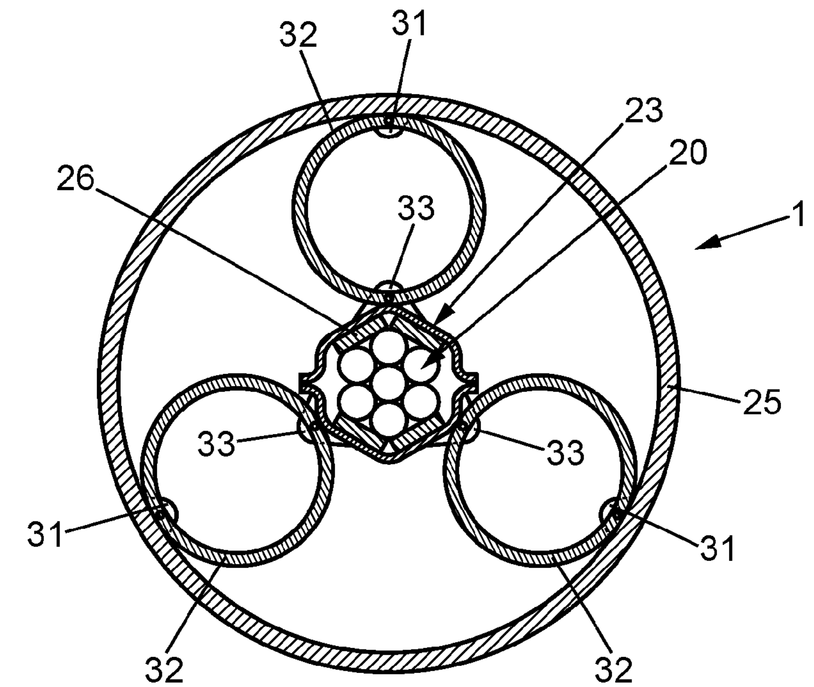
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FIG. 5

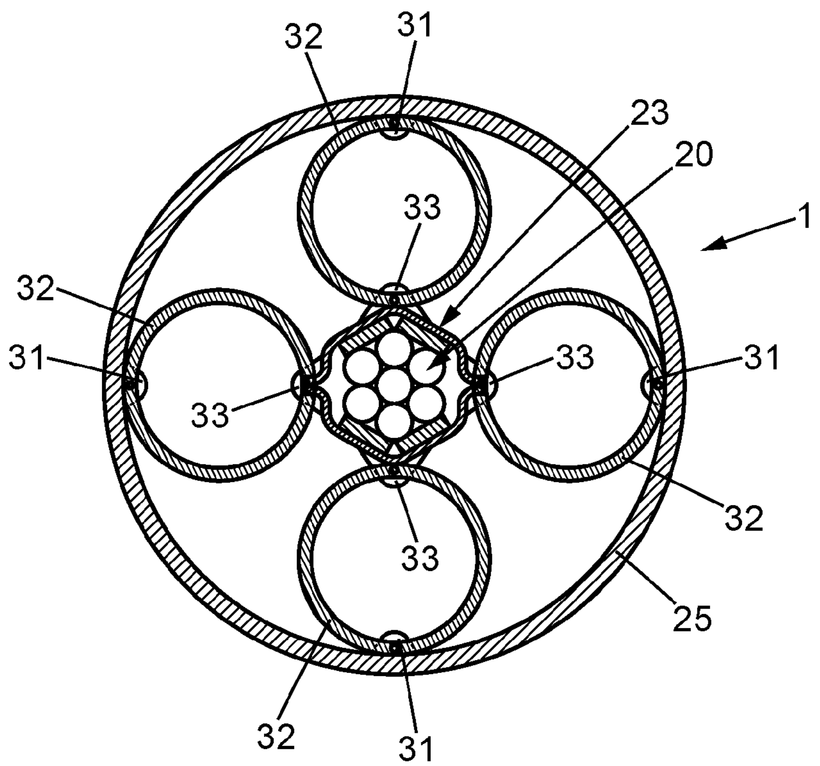
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FIG. 6

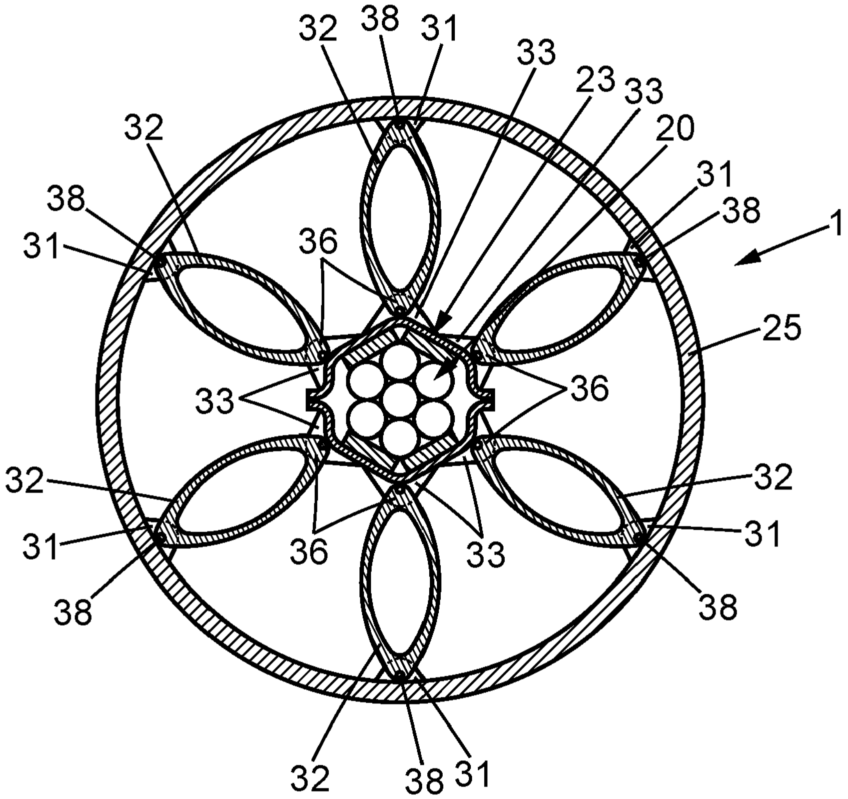
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FIG. 7

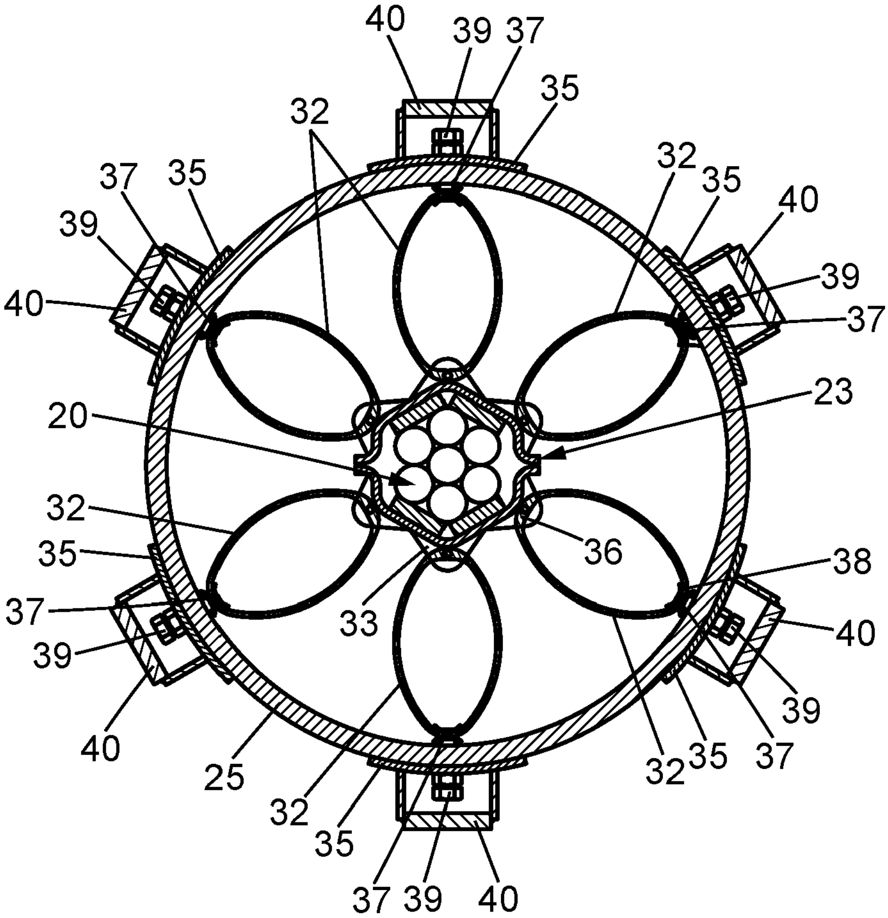
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FIG. 8

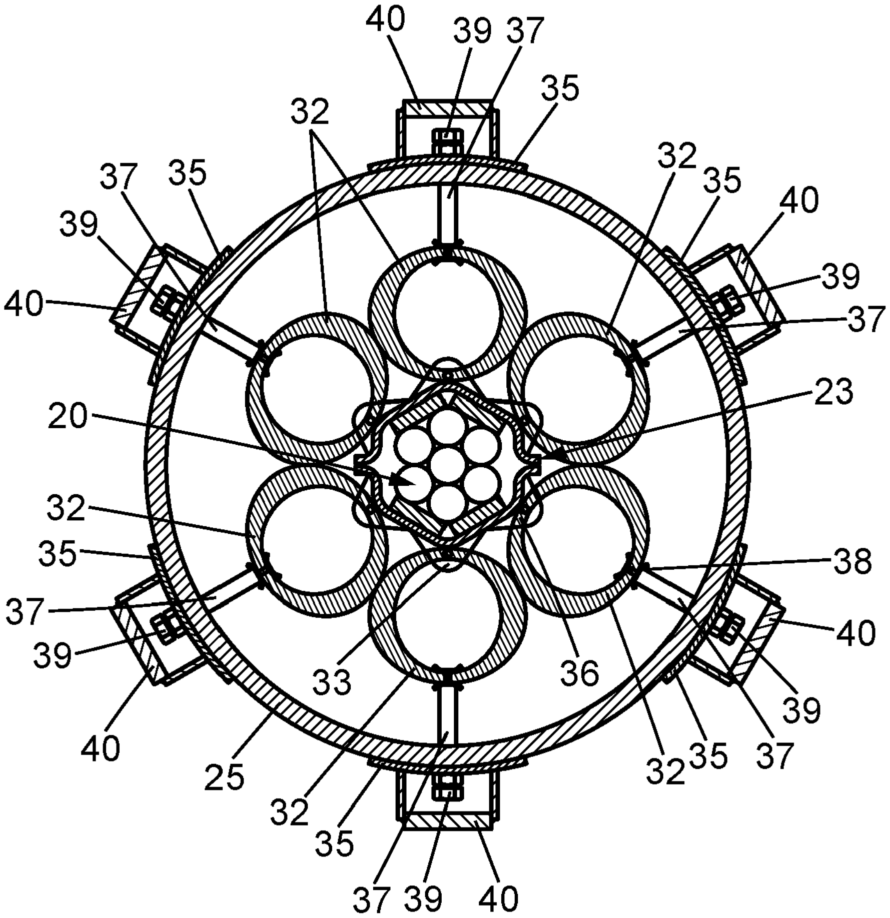
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FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 23 30 7422

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	CN 107 354 860 B (HARBIN INST TECHNOLOGY) 11 June 2019 (2019-06-11) * the whole document *	1-19	INV. E01D19/14 E01D19/16
X	CN 102 518 040 A (UNIV SHENZHEN) 27 June 2012 (2012-06-27) * the whole document *	1-10,14, 15	
X	JP H06 193015 A (NIPPON MENTETSUKU KK) 12 July 1994 (1994-07-12) * the whole document *	1	
X	KR 100 741 555 B1 (CABLETEK CO LTD [KR]) 20 July 2007 (2007-07-20) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

E01D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	28 May 2024	Beucher, Stefan

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 30 7422

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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28-05-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 107354860 B	11-06-2019	NONE	
CN 102518040 A	27-06-2012	NONE	
JP H06193015 A	12-07-1994	NONE	
KR 100741555 B1	20-07-2007	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- EP 0825301 A1 **[0009]**
- US 6748708 B **[0031]**