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(54) **Loading roll for a reeling shaft of a reel-up for a fiber web**

(57) The invention relates to a loading roll of locking and loading means for a reeling shaft of a reel-up for a fiber web, which loading roll (30) is provided for locking and/or loading the reeling shaft (15) of a reel-up (10). At least partially the loading roll (30) is made of elastic material.

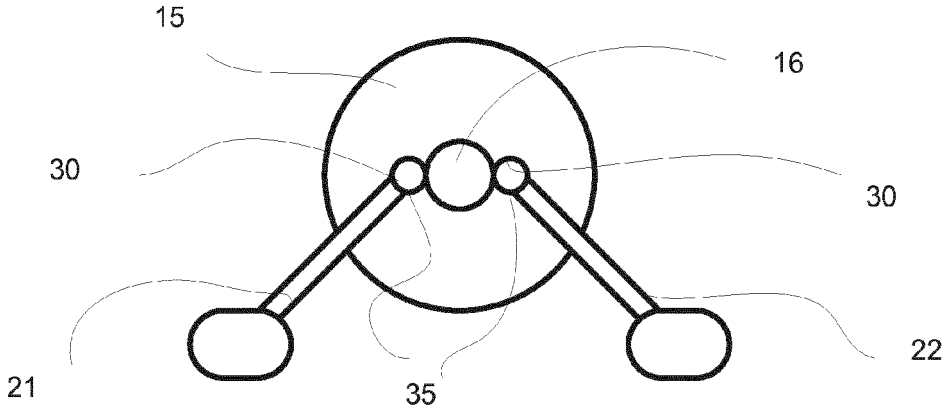

Fig. 2

EP 2 711 321 A1

Description

[0001] The invention relates to a loading roll a reel-up, in particular to a loading roll for a reeling shaft of a reel-up for a fiber web. Especially the invention relates to a loading roll according to the preamble of claim 1.

[0002] In this description and the following claims by the term loading roll is meant a rotating part of the locking and loading means of a reeling shaft of a reel-up for a fiber web.

[0003] As known from the prior art in fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production and treatment line comprises a head box, a wire section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise finishing devices, for example a calender and/ or a coater. The production and treatment line also comprises typically at least one slitter-winder for forming customer rolls as well as a roll packaging apparatus.

[0004] As known, fiber webs, such as paper or board webs, are manufactured in machines together forming a fiber web manufacturing line, which may be hundreds of meters long. Modern paper machines may produce more than 450,000 tons of paper per year. The speed of a paper machine may exceed 2000 m/min and the width of a paper web may be more than 11 meters.

[0005] In fiber web manufacturing lines, manufacturing operates as a continuous process. The finished fiber web being output from the machine is wound with a reel-up around a reeling shaft, i.e. a reel spool, into a machine roll (parent roll), the diameter of which may be more than 5 meters and which may weigh more than 160 tons. The purpose of the winding is to transfer the fiber web from its planar manufacturing form into a form in which it can be handled more easily. At the reel-up, which is located at the end of the main machine line, the continuous process of the machine is interrupted for the first time, after which the process continues in stages. Every attempt is made to interlink these stages as smoothly as possible so that the work already performed would not be wasted. In the reel-up the machine roll (parent roll) is formed around the reeling shaft operating as the reeling core i.e. the fiber web being wound on one parent roll has a start and an end. The trend in the field is a continuous increase in the size of parent rolls, which causes an on-going development requirement for reel-ups. However, as we are concerned with a dynamic environment and the fiber web is reelable material sensitive to various faults, the task performed by the reel-up as the maintainer of the efficiency of the paper or board machine is very considerable. A reason behind the continuous increase in the size of parent rolls is the desire to obtain fewer starts and ends in the production of the fiber web, which impedes or disturb the production and decrease the efficiency.

[0006] The reel-up which comprises a reeling cylinder and two pairs of carriages or a pair of carriages and a pair of forks, one carriage for each end of the reeling shaft / parent roll for moving and supporting the reeling shaft and the parent roll to be reeled. The web is reeled around the reeling shaft to a parent roll by means of a reeling nip between the reeling cylinder and the forming parent roll, which reeling takes place in a primary stage in a primary position and in a secondary stage in a secondary position.

[0007] The nip load is formed between the parent roll and the reeling cylinder and it is provided by loading the reeling shaft by the primary carriages or by the secondary forks against the reeling cylinder. Upstream of the reeling cylinder the primary support carriages are supporting the parent roll against the reeling cylinder and downstream of the reeling cylinder mainly the secondary forks are supporting the parent roll against the reeling cylinder.

[0008] In reel-ups the supporting carriages and forks comprise a fastening/locking mechanism of the reeling shaft so that the reeling shaft stays on the carriages and forks at all reeling stages. In reeling carriages or in reeling forks are used different kinds of locking and loading means for example locking and loading clamps for the reeling shafts. In most arrangements the reeling shaft rotates on the guides supported by its rotating bearing housing, which means that the locking and loading means must be provided with rotating parts, i.e. rolls, so the locking and loading clamps are equipped with loading rolls. The loading rolls according to prior art are made of steel or brass based alloys.

[0009] In reel-ups for providing the required nip load the force needed is focused to a rather small area of the reeling shaft. In most prior art arrangements the reeling shaft moves and rotates during reeling on the guides supported by its rotating bearing housing, which means that the loading means must be provided with bearings. In some cases the lifetime of the bearings might cause problems due to the required high force to be transmitted to the parent roll via a small area.

[0010] In reeling vibrations may occur for example due to eccentricity of the parent roll or due to irregularities in the fiber web to be wound or due to vibration causing defects in machine parts of the reel-up or due to faulty operation of the reel-up. In prior art reel-ups vibrations are dampened for example by using soft cover of the reeling cylinder which soft cover has been made of rubber or polyurethane such that possible vibrations are dampened. In some cases of prior art the locking and loading clamps have been provided with a friction piece that dampens the vibrating movement of the parent roll by increasing friction in between the locking and loading clamp and the bearing housing of the reeling shaft. It is also known from prior art to dampen the vibrations of a reel-up by a brake connected to a hydraulic cylinder arm. In these arrangements the force sensor is connected to the end of the arm of the hydraulic cylinder and thus the impulse of the vibrations is dampened and the nip force can be measured. In this arrangement disadvantageous is that the adjustment of the nip force is difficult, since

the actuator i.e. the hydraulic cylinder must also influence against the as damper functioning brake.

[0011] In recent times in reel-ups the use of electro mechanic actuators has increased. The electro mechanical actuators are sensitive to impacts and to vibrations and thus dynamic loading forces need to be taken in special consideration in reel-ups for preventing possible damages of the actuators. It is known from prior art to increase the impact resistance of these actuators by providing them with sliding clutches or with spring set cylinders.

[0012] An object of the invention is to create a new type of a loading roll for a reel-up, especially for a reeling shaft of a reel-up for a fiber web.

[0013] An object of the invention is to eliminate or at least minimize the above explained disadvantages in a reel-up especially relating to vibrations, impacts and lifetime of bearings.

[0014] Further objects of the invention are to minimize the wear of the loading rolls and to reduce noise.

[0015] In order to achieve the above objects the loading roll for a reel-up is mainly characterized by the features of the characterizing part of claim 1.

[0016] According to one aspect of the invention the locking and loading means, preferably locking and loading clamps, for the reeling shaft of the reel-up are provided with elastic structure constructed by making the loading roll of the locking and loading means of at least partly of elastic material or by providing in the loading roll elastic material for example an elastic cover or layer. By this the loading element is provided with elasticity for example for impact situations and for dampening vibrations.

[0017] According to an advantageous feature of the invention the loading roll consist of elastic material or according to another advantageous feature the loading roll comprises a cover or a layer of elastic material.

[0018] According to an advantageous feature of the invention the elastic material is resilient polymeric material.

[0019] According to an advantageous feature the elastic material is elastomeric material.

[0020] According to an advantageous feature the elastic material is polyurethane or rubber, or plastics or epoxy.

[0021] According to an advantageous feature the hardness of the elastic material of loading roll is 50 - 103 Shore A, preferably 70 - 95 Shore A.

[0022] According to an advantageous feature the thickness of the cover or the layer of the elastic material in the loading roll is 5 - 150 mm, preferably 20 - 50 mm.

[0023] According to an aspect of the invention the elastic material layer, for example the polyurethane layer is provided in between of two metallic surfaces by casting or by adhesion by which the surface load when loading the loading roll against the reeling shaft is more evenly divided and thus local overruns of the load do not exceed the limit values.

[0024] According to an aspect of the invention the loading roll is provided with bearings made of spring steel by which the bearings and thus also the loading roll are resistant to impacts and vibrations. The spring steel as bearing material for the loading roll thus provides for longer service life of the loading element and also protects the electro mechanic actuators from impacts and vibrations.

[0025] According to an advantageous feature of the invention the loading roll is a loading roll of locking and loading means of primary reeling devices of the reel-up. The primary reeling devices are for example primary carriages or primary forks. According to a further advantageous feature of the invention the loading roll is a loading roll of locking and loading means of secondary reeling devices of the reel-up. The secondary reeling devices are for example secondary forks or secondary carriages.

[0026] According to an aspect of the invention for dampening vibrations of the reeling cylinder or reeling shaft in a reel-up in the movement arrangement of the reeling cylinder or reeling shaft a friction damper is located parallel to a cylinder or a spring with low rigidity but in series with a force sensor. The spring damper can also be constructed as a single unit. The vibration movements are strong at a resilient reeling cylinder or reeling shaft and thus this aspect provides a very advantageous location for the damper. By this arrangement the friction force of the vibration damper does not disturb the force measurement and the force adjustment. Advantageously according to this aspect the force adjustment is provided by a screw jack with a servo motor or by a corresponding rigid actuator. The nip force can also be calculated based on the moment of the servo motor of the screw jack or measured by a force sensor at the end of the screw jack. By this arrangement nip vibrations of a reel-up can be dampened without disturbances in force measurement or force adjustment due to the friction of the damper. Also resonance frequencies can be avoided by adjusting the friction force of the friction damper to alter the natural frequency of the nip.

[0027] In the following the invention is describe in more detail by referring to the accompanying drawing in which

Figure 1 shows schematically a reel-up.

Figure 2 shows schematically one example of a loading roll for a reeling shaft according to the invention.

Figure 3 shows schematically another example of a loading roll for a reeling shaft according to the invention.

Figure 4 shows schematically further an example of a loading roll for a reeling shaft according to the invention.

Figure 5 shows schematically an example of supporting a reeling shaft.

[0028] In the following figures the corresponding parts

and part components have been denoted by same reference signs unless otherwise mentioned.

[0029] Fig. 1 shows an example of a reel-up 10 for continuous reeling up of the fiber web W around a reeling shaft 15 for forming the parent roll 17, the reel-up 10 comprising a reeling cylinder 11, whereby a nip load can be formed between the parent roll 17 and the reeling cylinder 11, the parent roll 17 being arranged so as to be movable during the reeling along an substantially horizontal path, such as reeling rails 20, from the starting point of the reeling to the point of transfer of the completed parent roll, the starting point of the reeling being upstream of the reeling cylinder 11 and the point of transfer downstream of the same, whereby upstream of the reeling cylinder, there are primary reeling devices for example primary carriages 12 for supporting the parent roll 17 against the reeling cylinder 11, and downstream of the reeling cylinder 11, there are secondary reeling devices for example secondary forks 18 for supporting the parent roll 17 against the reeling cylinder 11. In the figure 1 the reel-up 10 is shown in a position, wherein the primary carriers 12 have transferred to fetch the next reeling shaft 15 from its storage position or the place, where the reeling shafts are placed by the crane. The primary carriers 12 are fitted with bearings to be linearly movable in the x-direction onto guides (not shown) and the secondary forks 18 are pivotably articulated on their pivots 29.

[0030] In the example of figure 1 the reel-up 10 comprises loading rolls 30 in connection with the primary carriages 12 and in connection with the secondary forks 18. In the primary carriage 12 the loading rolls 30 are attached to the locking and loading means i.e. locking and loading clamps 13, 14 for the reeling shaft 15. The locking and loading clamps 13, 14 of the primary carriage support the reeling shaft 15 at the bearing houses 16 of the reeling shaft 15 by the loading rolls 30. In the secondary forks 18 the loading rolls 30 are also located at the locking and loading means i.e. locking and loading clamps 19 for supporting the parent roll 17 and the reeling shaft 15 at the bearing houses by the loading rolls 30.

[0031] In the example of figure 2 the loading rolls 30 are attached to the end of locking and loading means 21, 22 for transmitting the force from the locking and loading means to the bearing houses 16 of the reeling shaft 15. The loading rolls 30 are provided with an elastic cover 35 for elasticity for impact situations and for dampening vibrations. The loading rolls 30 can also be constructed of elastic material.

[0032] In the example of figure 3 the loading roll 30 is supporting and loading the bearing housing 16 of a reeling shaft. In this example the elastic material 33, for example the polyurethane, is provided in between of two metallic surfaces 31, 32 by casting or by adhesion by which the surface load when loading the loading roll 30 against the bearing housing 16 of the reeling shaft is more evenly divided and thus local overruns of the load do not exceed the limit values.

[0033] In the example of figure 4 the elastic material 34 is located in the middle layer of the loading roll 30 between metallic surfaces 31, 32 by which the bearings and thus also the loading roll are resistant to impacts and vibrations. The maximum resiliency of the elastic material layer 34 of the loading roll 30 is indicated by reference 36 and room for expansion of the elastic material 34 is indicated by reference 37.

[0034] In figure 5 a schematical example of a support arrangement for a reeling shaft is shown for dampening vibrations in a reel-up. In the figure the reeling shaft is schematically indicated by reference sign 41 and further the mass of the reeling shaft 41 is indicated by an arrow and reference sign M. The support structures are indicated by reference sign 42. Underneath the reeling shaft 41 a force sensor 43 for measuring the nip force is located and the force sensor 43 is connected by a cylinder or a spring 44 and by a friction damper 45 to the support structure 42 of the reeling shaft 41. The support structure 42 is supported by a screw jack 46 onto the foundation or corresponding structure 47. The reeling shaft 41 is exposed to vibrations if impulses of vibration causing frequencies exist in the reeling. In the example of the figure 5 in a movement arrangement of the reeling shaft 41 a friction damper 45 is located parallel to a cylinder or a spring 44 with low rigidity but in series with the force sensor 43. The spring damper can also be constructed as a single unit. The vibration movements are strong at the resilient shaft and thus a very advantageous location for the damper. By this arrangement the friction force of the vibration damper does not disturb the force measurement and the force adjustment as the force adjustment is provided by the screw jack 46 or by a corresponding rigid actuator. The nip force can also be calculated based on the moment of the servo motor of the screw jack 46 or measured by a force sensor at the end of the screw jack 46. By this arrangement nip vibrations of a reel-up can be dampened without disturbances in force measurement or force adjustment due to the friction of the damper. Also resonance frequencies can be avoided by adjusting the friction force of the friction damper to alter the natural frequency of the nip. This example has been described referring to a reeling shaft but this example is also well applicable for dampening vibrations of a reeling cylinder.

[0035] Above the invention has been described referring to some advantageous examples only to which the invention is not to be narrowly limited. It should be understood that many modifications and variations are possible within the inventive idea.

Claims

1. Loading roll for a reeling shaft of a reel-up for a fiber web, which loading roll (30) is provided for locking and/or loading the reeling shaft (15) of a reel-up (10), **characterized in, that** at least partially the loading roll (30) is made of elastic material.

2. Loading roll according to claim 1, **characterized in, that** the loading roll (30) comprises an elastic cover (35) or an elastic layer (33, 34).

3. Loading roll according to claim 1, **characterized in, that** the loading roll (30) consist of an elastic material.

4. Loading roll according to any of claims 1 -3, **characterized in that** the elastic material is resilient polymeric material.

5. Loading roll according to any of claims 1 -3, **characterized in that** the elastic material is elastomeric material.

6. Loading roll according to any of claims 1 - 3, **characterized in, that** the elastic material is polyurethane.

7. Loading roll according to any of claims 1 - 6, **characterized in, that** the loading roll (30) is a loading roll (30) of locking and loading means (13, 14) of primary reeling devices (12) of the reel-up (10).

8. Loading roll according to any of claims 1 - 6, **characterized in, that** the loading roll (30) is a loading roll (30) of locking and loading means (19) of secondary reeling devices (18) of the reel-up (10).

9. Loading roll according to claims 1 or 2, **characterized in, that** the elastic layer (33, 34) of the loading roll (30) is located between two metallic surfaces (31, 32).

10. Loading roll according to claims 1 or 2, **characterized in, that** the loading roll (30) comprises bearings of spring metal.

11. Loading roll according to any of the previous claims 1 - 8, **characterized in, that** the elastic material is made by casting.

12. Loading roll according to any of the previous claims 1 - 8, **characterized in, that** the elastic material is attached by an adhesive to the loading roll (30).

13. Loading roll according to any of the previous claims, **characterized in, that** the loading roll (30) supports the reeling shaft (15) by the bearing housing (16) of the reeling shaft (15).

14. Loading roll according to any of the previous claims, **characterized in, that** thickness of the elastic material layer is 5 - 150 mm, preferably 20 - 50 mm.

15. Loading roll according to any of the previous claims, **characterized in, that** hardness of the elastic material is 50 - 103 Shore A, preferably 70 - 95 Shore A.

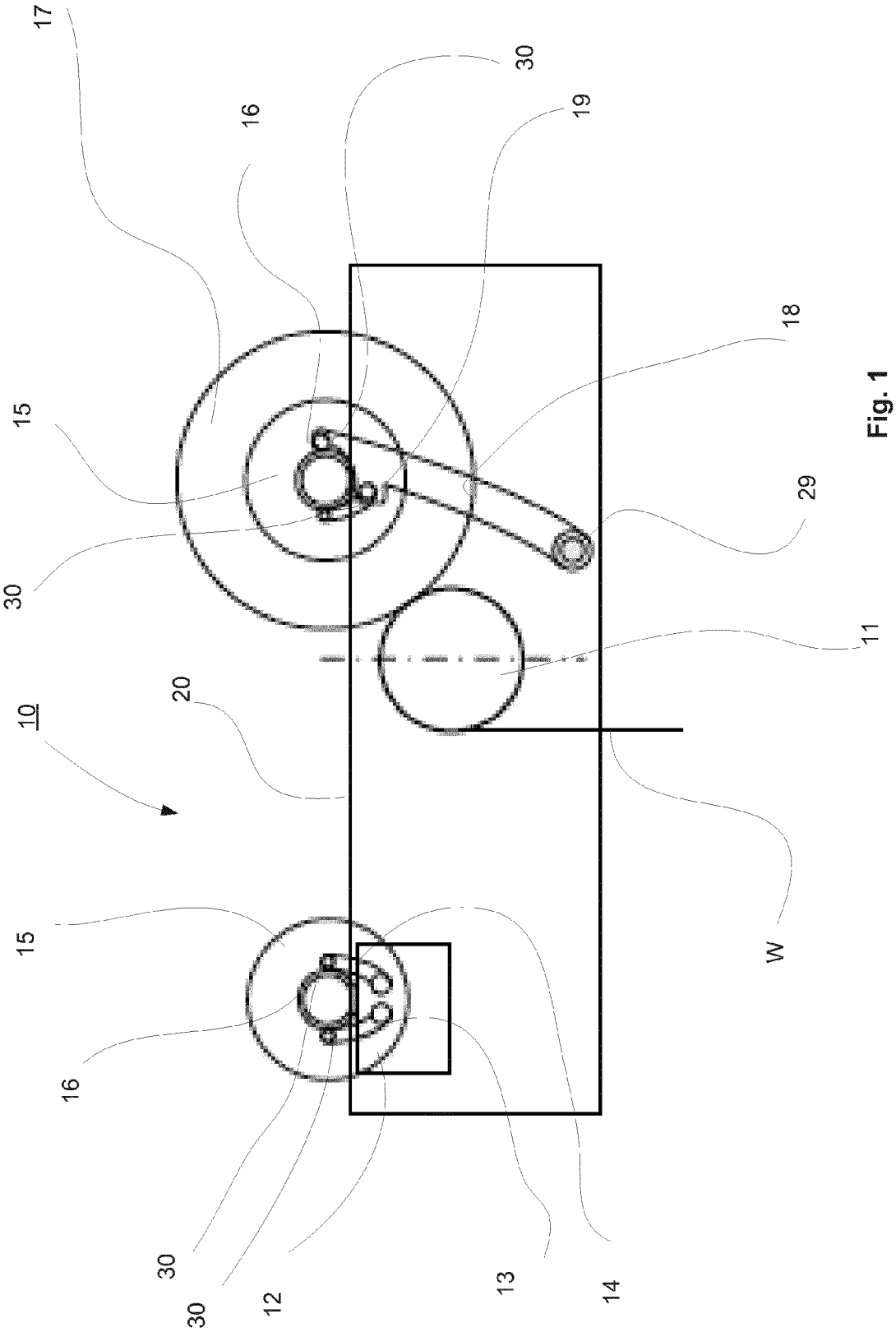

Fig. 1

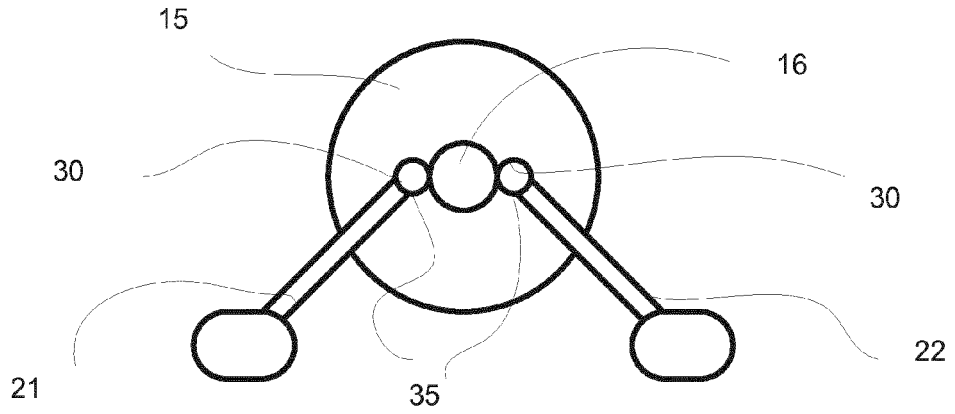

Fig. 2

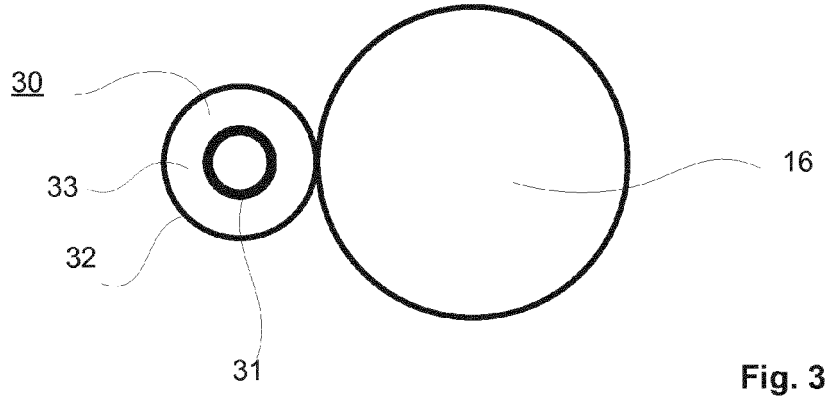

Fig. 3

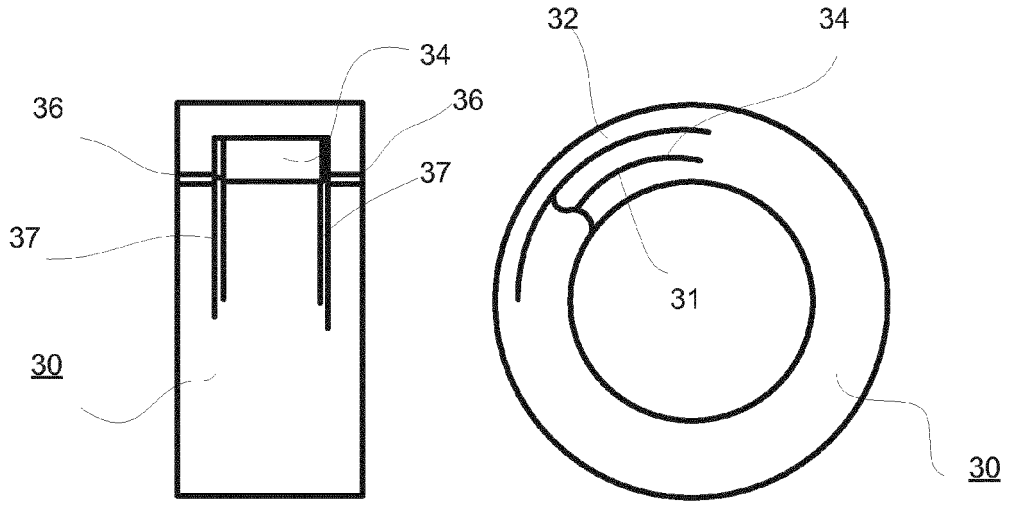

Fig. 4

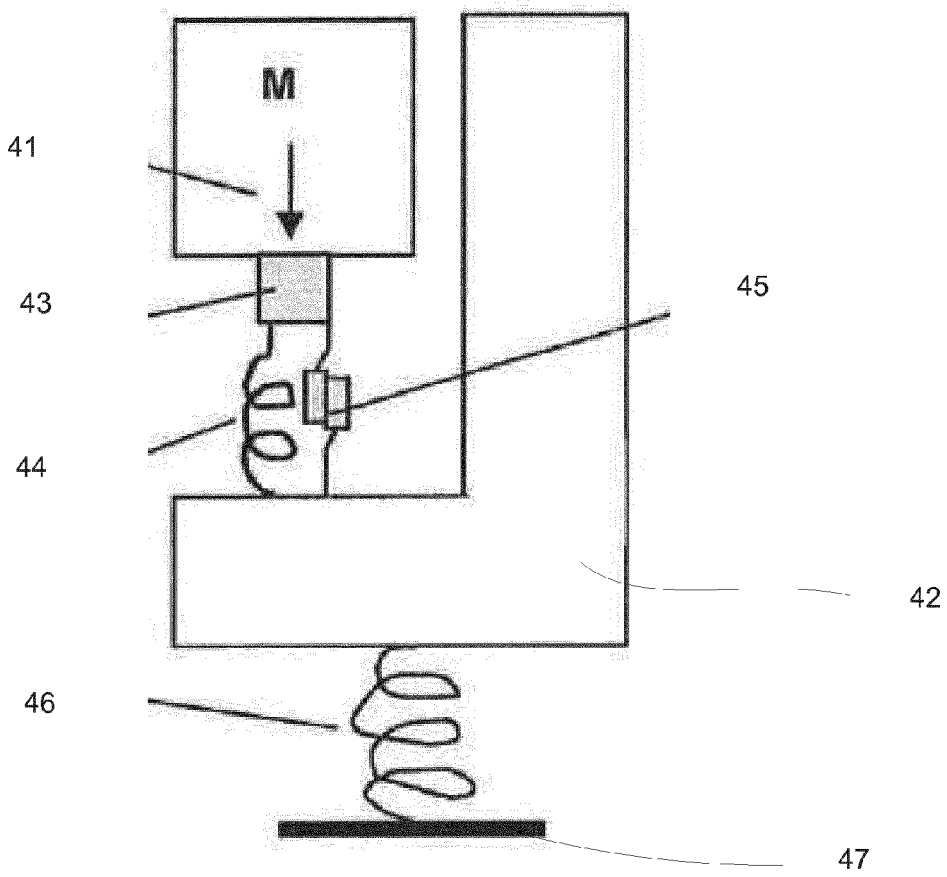

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 12 18 5776

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 036 137 A (MYREN H INGEMAR [SE]) 14 March 2000 (2000-03-14) * column 6, line 24 - line 58; figure e * -----	1	INV. B65H19/22 B65H18/26
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A	US 3 258 217 A (MACARTHUR FULTON H ET AL) 28 June 1966 (1966-06-28) * sentence 63, paragraph 4 - sentence 39, paragraph 5; figure 3 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 February 2013	Haaken, Willy

CATEGORY OF CITED DOCUMENTS

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