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(54) **SYSTEM FOR AUTOMATICALLY ROLLING UP AND UNROLLING A ROLLABLE SCREEN**

(57) A system for automatically rolling up and unrolling a rollable screen (2), comprising: the rollable screen (2), comprising a magnetic field deforming structure (3), a rotatable tube (4) for rolling up and unrolling the rollable screen (2), a motor (5) for rotating the tube (4), at least one coil assembly (7) for generating a magnetic field and for detecting the generated magnetic field, arranged adjacent to a path along which the magnetic field deforming structure (3) travels when the rollable screen (2) is being rolled up and unrolled such that the magnetic field detected by the coil assembly (7) is dependent on the rolled-up and unrolled position of the rollable screen (2), and a controller (6) suitable for controlling the motor (5) based on the magnetic field detected by the coil assembly (7).

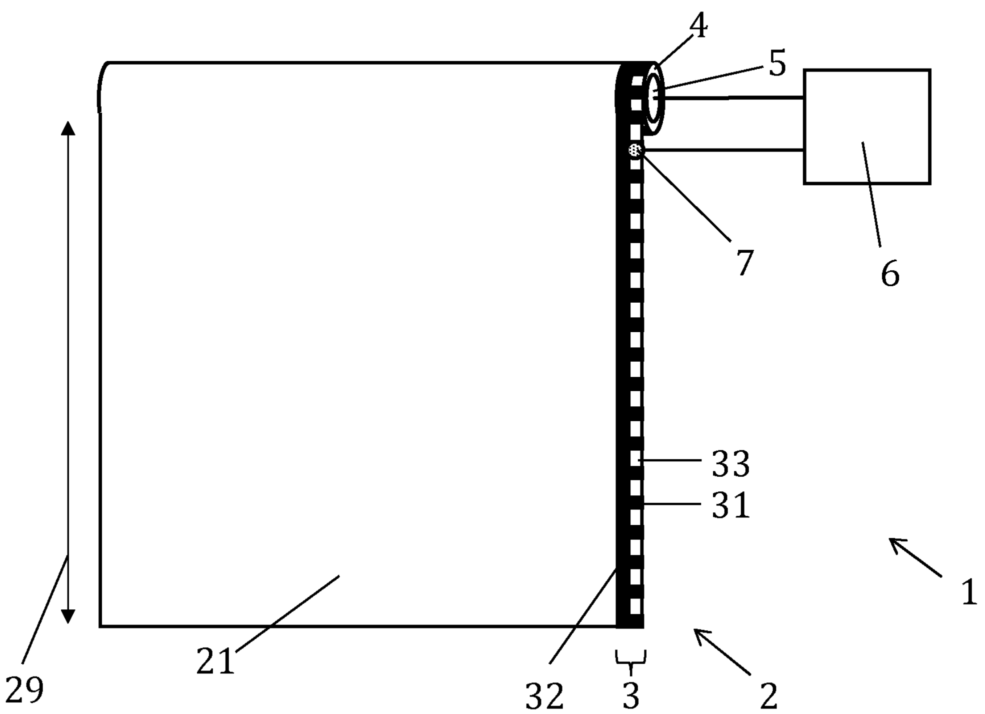

FIG. 1

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Description

Field of application of the invention

[0001] This invention generally relates to rollable screens, such as sun protection screens. More specifically, the present invention relates to automating the rolling up and unrolling of these rollable screens.

Background of the invention

[0002] Automating the rolling up and unrolling of a rollable screen allows the screen to be controlled easily and efficiently, for example with a single push of a button or, for example, in the absence of a user, by means of a timer. For this purpose, a system for automatically rolling up the rollable screen can comprise a motor for rotating a rotatable tube for rolling up and unrolling the rollable screen, and a controller for controlling the motor. To control the rollable screen correctly, it is advantageous for the controller to have information about the position of the screen, for example whether it is rolled up or unrolled. As a result, during rolling up or unrolling, the motor can be turned off at the right time, for example when the screen is completely rolled up or unrolled, or when the screen has reached a certain desired position.

[0003] In the prior art, systems for automatically rolling up and unrolling a rollable screen are known wherein use is made of a sensor that detects the angular position of the rotatable tube on which the screen can be rolled up, as, for example, described in EP1650625. However, such a system is technically difficult to implement in already existing non-automated systems for (manually) rolling up and unrolling a rollable screen. Furthermore, with such a system it is not possible to directly detect that the screen has collided with an obstacle: in the prior art, the power of the motor is measured for this purpose, which requires an additional sensor.

[0004] Alternative systems for automatically rolling up and unrolling a rollable screen according to the prior art, for example as described in EP2441911, EP2848758 or EP3105400, use optical detection of, for example, teeth on the side of, or holes in, the rollable screen to determine a position of the rollable screen. In particular, however, providing holes can result in weakening of and damage to the screen. Moreover, optical detection in a system for use outside a home - which is typically the case when the screen is a solar shading unit - is not appropriate, as dirt or dust can get onto the optical detector. This can negatively affect optical detection, and therefore automatic control.

[0005] WO2019175573 and US2021071476 describe magnets that can be attached to the screen, for example on an underside of the screen. A sensor, such as a Hall sensor, can detect the magnets and thus determine the position of the unrollable screen. EP2835490 and WO2014066158 also describe the use of magnets attached to the fabric. Because magnets are typically quite thick and can form protrusions on the fabric, such a system with magnets attached to the fabric is less suitable for flexible screens, such as rollable screens formed from a sunshade textile.

[0006] Thus, in the prior art, there is still a need for a system for automatically rolling up and unrolling a rollable screen that is simple and suitable for thin and flexible screens.

Summary of the invention

[0007] It is an object of embodiments of the present invention to provide an effective system for automatically rolling up and unrolling a rollable screen.

[0008] The above object is achieved by a system according to embodiments of the present invention.

[0009] It is an advantage of embodiments of the present invention that the rolling up and unrolling of the rollable screen can be automated. It is an advantage of embodiments of the present invention that the system can be rolled up and unrolled with precision.

[0010] It is an advantage of embodiments of the present invention that an existing non-automated system for (manually) rolling up and unrolling a rollable screen can be easily automated.

[0011] The present invention provides a system for automatically rolling up and unrolling a rollable screen. The system comprises the rollable screen, comprising a magnetic field deforming structure. The system further comprises a rotatable tube for rolling up and unrolling the rollable screen, and a motor for rotating the tube. The system further comprises at least one coil assembly for generating a magnetic field and for detecting the generated magnetic field, arranged adjacent to a path along which the magnetic field deforming structure travels when the rollable screen is being rolled up and unrolled such that the magnetic field detected by the coil assembly is dependent on the rolled-up and unrolled position of the rollable screen. The system further comprises a controller suitable for controlling the motor based on the magnetic field detected by the coil assembly.

[0012] It is an advantage of embodiments of the present invention that structures that can deform the magnetic field can be very thin and flexible, allowing them to be rolled up, with the screen, on the rotatable tube. It is further an advantage of embodiments of the present invention that coil assemblies are technically simple and typically inexpensive.

[0013] In embodiments, each coil assembly comprises a transmitter coil for generating the magnetic field and a receiver coil for detecting the generated magnetic field, wherein the transmitter coil and the receiver coil are arranged on opposite sides of the path. It is an advantage of these embodiments that the automation of the rolling up and unrolling of a rollable screen can be relatively simple.

[0014] In alternative embodiments, each coil assembly comprises a coil suitable for detecting the magnetic field generated by the coil itself. It is an advantage of these embodiments that only a single coil is required, which can make production of the system inexpensive and efficient.

[0015] In embodiments, the magnetic field deforming structure, in a direction of rolling up or unrolling the rollable screen, comprises magnetic field deforming elements spaced at substantially equal distances from each other and separated from each other by areas substantially transparent to the magnetic field. It is an advantage of these embodiments that simple determination of the position, direction and speed of the rolling up and unrolling of the rollable screen can be achieved. Thus, moreover, it can be easily determined whether the rolling up or unrolling of the screen is blocked by an obstacle. The invention is, however, not limited to these embodiments, and alternatively it is possible for the magnetic field deforming elements not to be spaced at equal distances.

[0016] In preferred embodiments, the magnetic field deforming structure has the shape of a comb. As a result, the magnetic field deforming elements are connected to each other (forming teeth of the comb fastened to a back of the comb), which allows them to be easily spaced at substantially equal distances from each other. Moreover, the back of the comb can be used to detect whether the beginning or end of the rollable screen has been reached, for example by providing a second coil assembly adjacent to a path along which the back of the comb travels when the rollable screen is being rolled up and unrolled.

[0017] Alternatively, the magnetic field deforming structure can, for example, variably deform the magnetic field along the path along which the magnetic field deforming structure travels when the rollable screen is being rolled up and unrolled. In a first alternative embodiment, a thickness of the magnetic field deforming structure varies along the path. In a second alternative embodiment, different materials, with different efficiency in deforming, e.g. blocking or reflecting a magnetic field, are arranged along the path. In a third alternative embodiment, a width of the magnetic field deforming structure is varied along the path. In these alternative embodiments, based on the magnitude of a magnetic field detected by a coil assembly, a controller can directly determine the state of the rollable screen.

[0018] In embodiments, the magnetic field deforming structure comprises a film, a wire, an electrically conductive ink, a magnetic field blocking material such as graphite, a zip or a magnetically conductive material. It is an advantage of these embodiments that these structures can be easily attached to the screen. The electrically conductive ink can be printed on the rollable screen, wherein the printed ink adheres to the screen. Electrically conductive or magnetic field blocking wire can be used to sew or stitch a pattern.

[0019] In embodiments, the magnetic field deforming structure has a thickness from 5 to 200 μm. It is an advantage of these embodiments that the magnetic field deforming structure can have a limited influence on the thickness of the rollable screen, and can also be rolled up on the rotatable tube.

[0020] In embodiments, the system comprises at least one side guide for receiving a side of the rollable screen so as to guide the rollable screen, wherein the magnetic field deforming structure is arranged on the side of the rollable screen, and wherein the at least one coil assembly is arranged in the side guide. It is an advantage of these embodiments that the magnetic field deforming structure and the coil assembly can be shielded from external influences, such as weather, flying materials, for example in case of wind, or touch.

[0021] In embodiments, the rollable screen contains a fabric, such as a sunshade textile, provided on at least one side with a zip for holding the fabric in the side guide, and wherein the magnetic field deforming structure is arranged between the fabric and the zip. In this case, the zip typically comprises a zip textile, such as a strip of fabric or another material, fastened to the fabric, for example by stitching or welding such as ultrasonic welding or high-frequency welding, and zip teeth fastened to the zip textile, wherein the zip teeth are connected to the fabric via the zip textile. Typically, the magnetic field deforming structure is arranged between the fabric and the zip textile of the zip. It is an advantage of these embodiments that the magnetic field deforming structure, e.g. film or wire, is well protected from possible damage by touch and when being rolled up on the tube.

[0022] In embodiments, the magnetic field deforming structure comprises a metal, preferably aluminium, copper or stainless steel. It is an advantage of these embodiments that the magnetic field deforming structure can be thin and still achieve good deformation, for example blocking, of the magnetic field.

[0023] In embodiments, the system is suitable for turning off the motor when the magnetic field detected by the coil assembly is substantially constant for a predetermined period of time. It is an advantage of these embodiments that it can be easily determined whether the screen is fully rolled up or fully unrolled, or blocked by an obstacle.

[0024] The rollable screen is typically used to block light that would enter through a window in the absence of the rollable screen, and is typically, when unrolled, parallel relative to the window. In embodiments, the rollable screen comprises a fabric, preferably a sunshade textile. The present invention is in particular suitable for sunshade textiles, such as screens, which are typically thin and flexible. It is a major advantage for the sunshade textile that the magnetic field deforming structure can also be thin and flexible.

[0025] Specific and preferred aspects of the invention are included in the appended independent and dependent claims. Features of the dependent claims may be combined with features of the independent claims and with features of other dependent claims as appropriate and not merely as expressly set out in the claims.

[0026] To summarise the invention and the advantages achieved relative to the prior art, certain objects and advantages of the invention have been described above.

It is of course to be understood that not necessarily all these objects or advantages can be achieved by each specific embodiment of the invention. Thus, for example, persons skilled in the art will recognise that the invention may be embodied or implemented in a manner that achieves or optimises one advantage or group of advantages as provided herein, without necessarily achieving other objects or advantages that may be provided or suggested herein.

[0027] The aspects above and other aspects of the invention will be apparent and elucidated with reference to the embodiment(s) described below.

Brief description of the figures

[0028] The invention will now be further described, by way of example, with reference to the accompanying figures, in which:

FIG. 1 is a schematic, three-dimensional depiction of an example of a system for automatically rolling up and unrolling a rollable screen, according to embodiments of the present invention.

FIG. 2 is a schematic, three-dimensional depiction of an example of a system for automatically rolling up and unrolling a rollable screen, with side guides, according to embodiments of the present invention.

FIG. 3 is a schematic, three-dimensional depiction of an example of a system for automatically rolling up and unrolling a rollable screen, comprising a coil assembly arranged adjacent to the path along which a back of a comb-shaped magnetic field deforming structure travels when the rollable screen is being rolled up and unrolled, according to embodiments of the present invention.

FIG. 4 is a schematic depiction of a side view of a system for automatically rolling up and unrolling a rollable screen according to embodiments of the present invention, wherein the coil assembly comprises a transmitter coil and a receiver coil.

FIG. 5 is a schematic depiction of a side view of a system for automatically rolling up and unrolling a rollable screen according to embodiments of the present invention, wherein the coil assembly comprises a single coil for generating and detecting a magnetic field.

FIG. 6 is a schematic depiction of a side view of a system for automatically rolling up and unrolling a rollable screen according to embodiments of the present invention, comprising a plurality of coil assemblies, each comprising a single coil for generating and detecting a magnetic field.

FIG. 7 is a schematic depiction of a rollable screen according to embodiments of the present invention, comprising a comb-shaped magnetic field deforming structure.

FIG. 8 is a schematic depiction of a vertical cross-section of the rollable screen of FIG. 7, and a plurality of coil assemblies arranged adjacent to a path along which the magnetic field deforming structure travels when the rollable screen is being rolled up and unrolled, according to embodiments of the present invention.

FIG. 9, FIG. 10 and FIG. 11 are schematic depictions of rollable screens with different magnetic field deforming structures according to embodiments of the present invention.

[0029] The figures are only schematic and not limiting. In the figures, the dimensions of some parts may be exaggerated and not to scale for illustrative purposes. Dimensions and relative dimensions do not necessarily correspond to actual embodiments of the invention.

[0030] Reference numerals in the claims should not be interpreted as limiting the scope of protection.

[0031] In the different figures, the same reference numerals refer to the same or similar elements.

Detailed description of illustrative embodiments

[0032] The present invention will be described with reference to particular embodiments and with reference to certain drawings; however, the invention is not limited thereto but is limited only by the claims.

[0033] The terms first, second, third and the like in the description and in the claims are used to distinguish between similar elements and not necessarily to describe an order, either temporally, spatially, in rank or in any other way. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are suitable for operation in a different order from that described or shown herein.

[0034] It should be noted that the term "comprises", as used in the claims, is not to be construed as limited to the means described thereafter; this term does not exclude other elements or steps. It can therefore be interpreted as specifying the presence of the stated features, values, steps or components referred to, but does not exclude the presence or addition of one or more other features, values, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with regard to the present invention, A and B are the only relevant components of the device.

[0035] Reference throughout this specification to "one embodiment" or "an embodiment" means that a specific feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, occurrences of the phrases "in one embodiment" or "in an embodiment" at various places throughout this specification do not necessarily all refer to the same embodiment, but may do so. Furthermore, the specific features, structures or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art, based on this disclosure, in one or more embodiments.

[0036] Similarly, it should be appreciated that in the description of exemplary embodiments of the invention, various features of the invention are sometimes grouped together into a single embodiment, figure or description thereof for the purpose of streamlining disclosure and aiding in the understanding of one or more of the various inventive aspects. In any case, this method of disclosure should not be interpreted as reflecting an intention that the invention requires more features than those explicitly stated in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all the features of a single previously disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing alone as a separate embodiment of this invention.

[0037] Furthermore, while some embodiments described herein include some, but not other, features included in other embodiments, combinations of features of different embodiments are intended to be within the scope of the invention, and constitute different embodiments, as would be understood by those skilled in the art. For example, in the following claims, any of the described embodiments may be used in any combination.

[0038] The description provided here highlights numerous specific details. In any case, it is to be understood that embodiments of the invention can be implemented without these specific details. In other instances, well-known methods, structures and techniques have not been shown in detail in order to keep this description clear.

[0039] The present invention provides a system for automatically rolling up and unrolling a rollable screen. The system comprises the rollable screen, comprising a magnetic field deforming structure. The system further comprises a rotatable tube for rolling up and unrolling the rollable screen, and a motor for rotating the tube. The system further comprises at least one coil assembly for generating a magnetic field and for detecting the generated magnetic field, arranged adjacent to a path along which the magnetic field deforming structure travels when the rollable screen is being rolled up and unrolled such that the magnetic field detected by the coil assembly is dependent on the rolled-up and unrolled position of the rollable screen. The system further comprises a controller suitable for controlling the motor based on the magnetic field detected by the coil assembly.

[0040] FIG. 1 is a schematic depiction of an example of a system 1 for automatically rolling up and unrolling a rollable screen 2, according to embodiments of the present invention. The system 1 further comprises a rotatable tube 4 on which the rollable screen 2 can be rolled up, and from which it can be unrolled. Arrow 29 shows the direction along which the rollable screen 2 rolls up and unrolls.

[0041] The tube 4 is coupled to a motor 5, in this example a tube motor 5 that is located in a cavity in the tube 4 and thus can drive the tube in rotation, although the present invention is not limited thereto. The motor 5 is communicatively connected to a controller 6, which can be used to control the motor 5.

[0042] The rollable screen 2 comprises a magnetic field deforming structure 3, wherein the magnetic field deforming structure 3 is arranged on the side of the rollable screen 2. In this example, the magnetic field deforming structure 3 is fastened to a fabric or textile, such as the sunshade textile 21, of the rollable screen 2.

[0043] In this example, the magnetic field deforming structure 3 has the shape of a comb, comprising a plurality of teeth 31 and a back 32 to which the teeth 31 are connected. The teeth 31 form, in a direction of rolling up or unrolling the rollable screen 2, magnetic field deforming elements spaced at substantially equal distances from each other and separated from each other by areas 33 substantially transparent to magnetic fields. Typically, the areas 33 that are substantially transparent to magnetic fields do not contain magnetic field deforming material. Typically, the fabric or textile, such as the sunshade textile 21, of the rollable screen 2 is substantially transparent to the magnetic field.

[0044] The system 1 further comprises a coil assembly 7 arranged adjacent to a path along which the magnetic field deforming structure 3 travels when the rollable screen is being rolled up and unrolled. In other words, the coil assembly is located along the path that the magnetic field deforming structure 3 travels when the rollable screen 2 is being rolled up and unrolled. In embodiments of the present embodiment, at least one coil assembly 7 is preferably arranged at the rotatable tube 4, such that the position of the rollable screen 2 can be determined even if the rollable screen 2 is substantially fully rolled up on the rotatable tube 4.

[0045] More specifically, in this example, the coil assembly 7 is arranged adjacent to a path along which the teeth 31, or the magnetic field deforming elements spaced at substantially equal distances from each other, travel. The coil assembly 7 is suitable for generating a magnetic field and for detecting the generated magnetic field. When the rollable screen 2 is being rolled up and unrolled, the magnetic field deforming structure 3 deforms the magnetic field generated by the coil assembly 7, such that the magnetic field detected by the coil assembly 7 is a dependent on the rolled-up and unrolled position of the rollable screen 2.

[0046] The magnetic field deforming structure 3 can comprise, for example, a magnetic field blocking material, or a magnetic field absorbing material. In that case, the magnetic field detected by the coil assembly 7 can be weaker if one of the teeth 31 is located at the coil assembly 7, than if one of the areas 33 substantially transparent to magnetic fields is located at the coil assembly 7. In this way, the magnetic field detected by the coil assembly 7 will become weaker (when a tooth 31 passes) and stronger (when a substantially transparent area 33 passes) during the rolling up or unrolling of the rollable screen. The controller 6 can detect how often the detected magnetic field becomes alternately strong and weak, and on the basis thereof, in combination with information, for example from the motor 5, about the rotation direction of the motor 5 - that is, whether the motor 5 is rolling up or unrolling the rollable screen 2 -, and typically in combination with the known distance between consecutive teeth 31, determine the position of the rollable screen 2. The controller 6 can be suitable for determining, based on how often the detected magnetic field strengthens and weakens within a certain time period, the speed at which the rollable screen 2 is rolled up or unrolled.

[0047] In this example, the teeth 31 are magnetic field deforming elements spaced at substantially equal distances from each other. Alternatively, the magnetic field deforming elements could be spaced at unequal distances from each other: the distance between successive magnetic field deforming elements could in this case, for example, increase as the distance from one end of the rollable screen 2 increases. Thus, based on the frequency of the up and down movement of the detected magnetic field, a direction of movement (rolling up or unrolling of the rollable screen 2) could also be determined.

[0048] FIG. 2 shows a similar system 1 to FIG. 1, wherein the system 1 further comprises a first side guide 81 for receiving the side of the rollable screen 2 comprising the magnetic field deforming structure 3. The magnetic field deforming structure 3 is thereby protected by the side guide 81 from external influences, such as rain or flying materials. The coil assembly is also provided in the side guide 81 (and is therefore not shown in FIG. 2). The system comprises, in this example, a second side guide 82 for receiving an opposite side of the rollable screen 2, lying opposite the side of the rollable screen 2 comprising the magnetic field deforming structure 3. As a result, effective guidance of the rollable screen 2 can be achieved, wherein the rollable screen 2 can only move from top to bottom, or along direction of movement 29, while a lateral movement is limited by the side guides 81 and 82.

[0049] FIG. 3 shows a similar system 1 to FIG. 1, wherein, in addition to the coil assembly 7 arranged adjacent to the path along which the teeth 31 move during the rolling up and unrolling of the rollable screen 2, the system comprises a further coil assembly 70 arranged adjacent to a path along which the back 32 moves during the rolling up and unrolling of the rollable screen 2 and which is also communicatively coupled to the controller 6. The further coil assembly 70 is also provided for generating a magnetic field and for detecting the magnetic field generated by the further coil assembly 70. Preferably, this further coil assembly 70 is arranged at an end, away from the rotatable tube 4, of the path along which the back 32 moves, such that this further coil assembly 70 can detect whether an end of the back 32 has been reached, and hence whether an end of the rollable screen 2 has been reached. This further coil assembly 70 can, for example, serve to further regulate the position as determined by the coil assembly 7, or to calibrate the position as determined by the coil assembly 7.

[0050] FIG. 4 shows a side view of a system 1 for automatically rolling up and unrolling a rollable screen 2. In this example, the coil assembly comprises a transmitter coil 71 for generating the magnetic field and a receiver coil 72 for detecting the generated magnetic field, wherein the transmitter coil 71 and the receiver coil 72 are arranged on either side (for example, front and back) of the path along which the magnetic field deforming structure moves when the rollable screen is being rolled up and unrolled. Here, the transmitter coil 71 and the receiver coil 72 are controlled by the controller 6. In this example, the magnetic field deforming structure, in a direction of rolling up or unrolling the rollable screen, comprises magnetic field deforming elements 31 spaced at substantially equal distances from each other and separated from each other by areas 33 substantially transparent to the magnetic field. The magnetic field deforming structure can comprise, or the magnetic field deforming elements 31 can comprise, a material that blocks, absorbs or reflects the generated magnetic field, such that, if one of the magnetic field deforming elements 31 is located between the transmitter coil 71 and the receiver coil 72, the receiver coil 72 can detect the magnetic field generated by the transmitter coil 71 only weakly, or not at all. If, on the other hand, one of the areas 33 that are substantially transparent to the magnetic field is located between the transmitter coil 71 and the receiver coil 72, the receiver coil 72 detects the magnetic field generated by the transmitter coil 71, which in this case is not weakened or is weakened only slightly.

[0051] FIG. 5 shows a side view of another example of a system 1 for automatically rolling up and unrolling a rollable screen 2. In this example, the coil assembly can comprise a single coil 73 which can generate a magnetic field, and is suitable for detecting the magnetic field generated by the coil 73 itself. This has the advantage that only a single coil 73 is needed per coil assembly. In this example, the magnetic field deforming structure 3 can, for example, be magnetically reflective. As a result, the magnetic field generated by the coil 73 can be reflected by a magnetic field deforming element 31 of the magnetic field deforming structure 3 located near the coil 73, wherein the magnetic field detected by the coil 73 can be strengthened by the magnetic field deforming element 31. A substantially transparent area 33 does not display that reflection of the generated magnetic field, such that the magnetic field measured by the coil 73 is not strengthened by reflection if the coil 73 is located next to the substantially transparent area 33.

[0052] In the previous examples, the system always comprised only a single coil assembly, the coil assembly comprising either a single coil for generating a magnetic field and detecting the magnetic field generated by the single coil itself, or a transmitter coil and a receiver coil.

FIG. 6 shows another example of a system 1 according to embodiments of the present invention, wherein the system 1 comprises a plurality of coil assemblies: more specifically, in this example, four coil assemblies are shown. In this example, the coil assemblies are spaced at regular distances from each other adjacent to the path travelled by the magnetic field deforming structure 3 during the rolling up and unrolling of the rollable screen, but the present invention is not limited thereto. In this example, each of the four coil assemblies comprises a single coil 73 for generating a magnetic field and detecting the magnetic field generated by the single coil 73 itself, but the invention is not limited thereto, and coil assemblies with separate transmitter and receiver coils can also be implemented. Each of the plurality of coil assemblies, for example each of the four coils 73, is connected to the controller 6. Although in principle a single coil assembly can suffice to determine the position, direction and speed at which the rollable screen is rolled up and unrolled, the use of multiple coil assemblies can provide a more accurate determination of the position, direction and speed. The use of multiple coil assemblies eliminates the need to rely on information from the motor, and consequently avoids, for example, the need to provide sensors for determining the rotation direction of the motor 5. Moreover, the use of multiple coil assemblies makes it possible to detect that a rollable screen is being pushed up or pulled down when the motor is stationary.

[0053] FIG. 7 shows a rollable screen 2 according to embodiments of the present invention comprising a fabric 21, such as a sunshade textile 21, provided on at least one side with a zip 9 for holding the fabric 21 in a side guide. More specifically, the zip 9 comprises zip teeth 91 that can be included in the side guide, and a zip textile 92, typically in the form of a strip of fabric, to which the zip teeth 91 are fastened, and which is fastened to the fabric 21, i.e., the sunshade textile 21. The zip 9 can be guideably fastened into a side guide (not shown in FIG. 7, but for example as shown in FIG. 2). The side guide can comprise, for example, a groove for receiving the zip teeth 91, wherein the zip teeth 91 can slide up and down through the groove to move the rollable screen 2 up and down.

[0054] In certain embodiments, the zip teeth 91 are formed from a magnetic field deforming material, and the zip 9, i.e., the zip teeth 91, thus comprise the magnetic field deforming structure. As an example, in a direction of rolling up or unrolling the rollable screen 2, the zip teeth 91 can comprise magnetic field deforming elements spaced at substantially equal distances from each other - that is, each of the zip teeth 91 forms a magnetic field deforming element - separated from each other by areas substantially transparent to the magnetic field. Alternatively, the zip teeth 91 of the zip 9 can be located at irregular distances from each other. No other magnetic field deforming structure need be provided in these embodiments. The zip 9 can be fastened to the fabric 21 by means of magnetic field deforming stitching, or by means of a magnetic field deforming adhesive.

[0055] The zip 9, in this example the zip textile 92, can be fastened to the fabric 21 by means of stitches. Alternatively, the zip textile 92 can be fastened to the fabric 21 by gluing, or welding, such as ultrasonic welding or high-frequency welding. In the case of welding, a surface of the zip textile 92 and/or a surface of the fabric 21 can be melted (for example, by using ultrasonic or high-frequency mechanical vibrations), after which the surface of the zip textile 92 is contacted with the surface of the fabric 21. The melted surface then solidifies, which can result in a solid bond between the fabric 21 and the zip 9, e.g., the zip textile 92. The zip 9 can be fastened to the fabric 21 by means of magnetic field deforming stitching, or by means of a magnetic field deforming adhesive. No other magnetic field deforming structure need be provided in these embodiments. Preferably, welding or gluing is used, as these techniques for fastening the zip 9 to the fabric 21 can have a limited influence on the thickness of the rollable screen 2.

[0056] The zip textile 92 is not necessary and, in specific embodiments, the zip teeth 91 are directly fastened to the fabric 21. However, in preferred embodiments, and this example, the zip 9 comprises a zip textile 92. In the example shown, a magnetic field deforming structure 3, in the form of a comb, is arranged between the fabric 21 and the zip 9, more specifically between the fabric 21 and the zip textile 92. The magnetic field deforming structure 3, which can comprise, for example, a film with a thickness of 5 to 200 μm, can thus be pressed tightly between the fabric 21, i.e., the sunshade textile 21, and the zip textile 92, which can provide physical support to the magnetic field deforming structure 3. Furthermore, the zip textile 92 and the fabric 21 can thus provide protection to the magnetic field deforming structure 3 from external influences, such as weather or physical contact, which could damage the magnetic field deforming structure 3 (in this example, a thin, typically delicate, film).

[0057] FIG. 8 shows a vertical cross-sectional view of the rollable screen 2 of FIG. 7, wherein the magnetic field deforming structure 3 is arranged between the zip textile of the zip 9 and the sunshade textile 21 of the rollable screen 2. Three coil assemblies 7 are arranged adjacent to the path along which the magnetic field deforming elements 31 of the magnetic field deforming structure 3 move when the rollable screen 2 is being rolled up and unrolled. (In the example shown, the rollable screen 2 moves up when rolling up, and down when unrolling). More specifically, a transmitter coil 71 for generating a magnetic field and a receiver coil 72 for detecting the generated magnetic field are arranged on either side of the rollable screen 2, in front of each of the three coil assemblies 7 (or included therein). The zip textile and the sunshade textile 21 are typically substantially transparent to the magnetic field. In this example, the entirety of the zip 9 (including the zip teeth) is substantially transparent to the magnetic field.

[0058] Although the magnetic field deforming structure in the above examples is typically in the form of a comb, which, in a direction of rolling up or unrolling the rollable screen, comprises magnetic field deforming elements spaced at substantially equal distances from each other and separated from each other by areas substantially transparent to the magnetic field, and connected to a back of the comb, the invention is not limited thereto.

[0059] As a first alternative example, FIG. 9 shows a magnetic field deforming structure 30 comprising, in a direction of rolling up or unrolling the rollable screen 2, magnetic field deforming elements 310 spaced at substantially equal distances from each other and separated from each other by areas 330 substantially transparent to the magnetic field, yet without these magnetic field deforming elements 310 being connected to each other by, for example, a magnetic field deforming back.

[0060] As a second alternative example, FIG. 10 shows a magnetic field deforming structure 301 comprising, in a direction of rolling up or unrolling the rollable screen, magnetic field deforming elements 311 spaced at unequal distances from each other and separated from each other by areas 331 substantially transparent to the magnetic field. Also in this second alternative example, the magnetic field deforming elements 311 are not connected by, for example, a magnetic field deforming back, but the invention is not limited thereto. More specifically, the distance between successive magnetic field deforming elements 311 becomes smaller in a direction of unrolling the rollable screen 2. Alternatively, the distance between successive magnetic field deforming elements 311 could become larger in a direction of unrolling the rollable screen 2. Given a known speed of rolling up or unrolling (for example, a known rotation speed of the rotatable tube 4), the time between detection of successive magnetic field deforming elements 311 can easily be used to determine how far the rollable screen 201 has been rolled up or unrolled, for example, by a controller (not shown).

[0061] As a third alternative example, FIG. 11 shows a magnetic field deforming structure 302 comprising, in a direction of rolling up or unrolling the rollable screen 2, magnetic field deforming elements 312 spaced at unequal distances from each other and separated from each other by areas 332 substantially transparent to the magnetic field. Also in this third alternative example, the magnetic field deforming elements 312 are not connected by, for example, a magnetic field deforming back, but the invention is not limited thereto. More specifically, the magnetic field deforming elements 312 are grouped 342, wherein different groups 332 contain a different number of magnetic field deforming elements 312. In this example, the number of magnetic field deforming elements 312 in successive groups 342 becomes smaller in a direction of unrolling the rollable screen 2, but the invention is not limited thereto and instead of becoming smaller, the number could become larger, or the number could be varying or arbitrary. In this example, the number of grouped 342 magnetic field deforming elements 312 can be used to derive how far the rollable screen 201 has been rolled up or unrolled, for example by a controller (not shown).

[0062] The preceding description provides details of certain embodiments of the invention. However, it should be clear that no matter how detailed the preceding appears in terms of text, the invention can be applied in many ways. It should be noted that the use of certain terminology in describing certain features or aspects of the invention should not be construed as implying that the terminology herein is redefined so as to be limited to specific features of the characteristics or aspects of the invention with which this terminology is linked.

Claims

1. A system for automatically rolling up and unrolling a rollable screen (2), comprising:

   the rollable screen (2), comprising a magnetic field deforming structure (3),
   a rotatable tube (4) for rolling up and unrolling the rollable screen (2),
   a motor (5) for rotating the tube (4),
   at least one coil assembly (7) for generating a magnetic field and for detecting the generated magnetic field, arranged adjacent to a path along which the magnetic field deforming structure (3) travels when the rollable screen (2) is being rolled up and unrolled such that the magnetic field detected by the coil assembly (7) is dependent on the rolled-up and unrolled position of the rollable screen (2), and
   a controller (6) suitable for controlling the motor (5) based on the magnetic field detected by the coil assembly (7).

2. The system according to claim 1, wherein each coil assembly (7) comprises a transmitter coil (71) for generating the magnetic field and a receiver coil (72) for detecting the generated magnetic field, wherein the transmitter coil (71) and the receiver coil (72) are arranged on opposite sides of the path.

3. The system according to claim 1, wherein each coil assembly (7) comprises a coil (73) suitable for detecting the magnetic field generated by the coil (73) itself.

4. The system according to any one of the preceding claims, wherein the magnetic field deforming structure (3), in a direction of rolling up or unrolling the rollable screen (2), comprises magnetic field deforming elements (31) spaced at substantially equal distances from each other and separated from each other by areas (33) substantially transparent to the magnetic field.

5. The system according to claim 4, wherein the magnetic field deforming structure (3) has the shape of a comb.

6. The system according to any one of the preceding claims, wherein the magnetic field deforming structure (3) comprises a film, a wire, an electrically conductive ink, a magnetic field blocking material such as graphite, a zip or a magnetically conductive material.

7. The system according to any one of the preceding claims, wherein the magnetic field deforming structure (3) has a thickness from 5 to 200 μm.

8. The system according to any one of the preceding claims, wherein the system comprises at least one side guide (81) for receiving a side of the rollable screen (2) so as to guide the rollable screen (2), wherein the magnetic field deforming structure (3) is arranged on the side of the rollable screen (2), and wherein the at least one coil assembly is arranged in the side guide (81).

9. The system according to claim 8, wherein the rollable screen (2) comprises a fabric (21) provided on at least one side with a zip (9) for holding the fabric (21) in the side guide (81), and wherein the magnetic field deforming structure (3) is arranged between the fabric (21) and the zip (9).

10. The system according to any one of the preceding claims, wherein the magnetic field deforming structure (3) comprises a metal, preferably aluminium, copper or stainless steel.

11. The system according to any one of the preceding claims, the system being suitable for turning off the motor (5) when the magnetic field detected by the coil assembly (7) is substantially constant for a predetermined period of time.

12. The system according to any one of the preceding claims, wherein the rollable screen (2) comprises a sunshade textile (21).

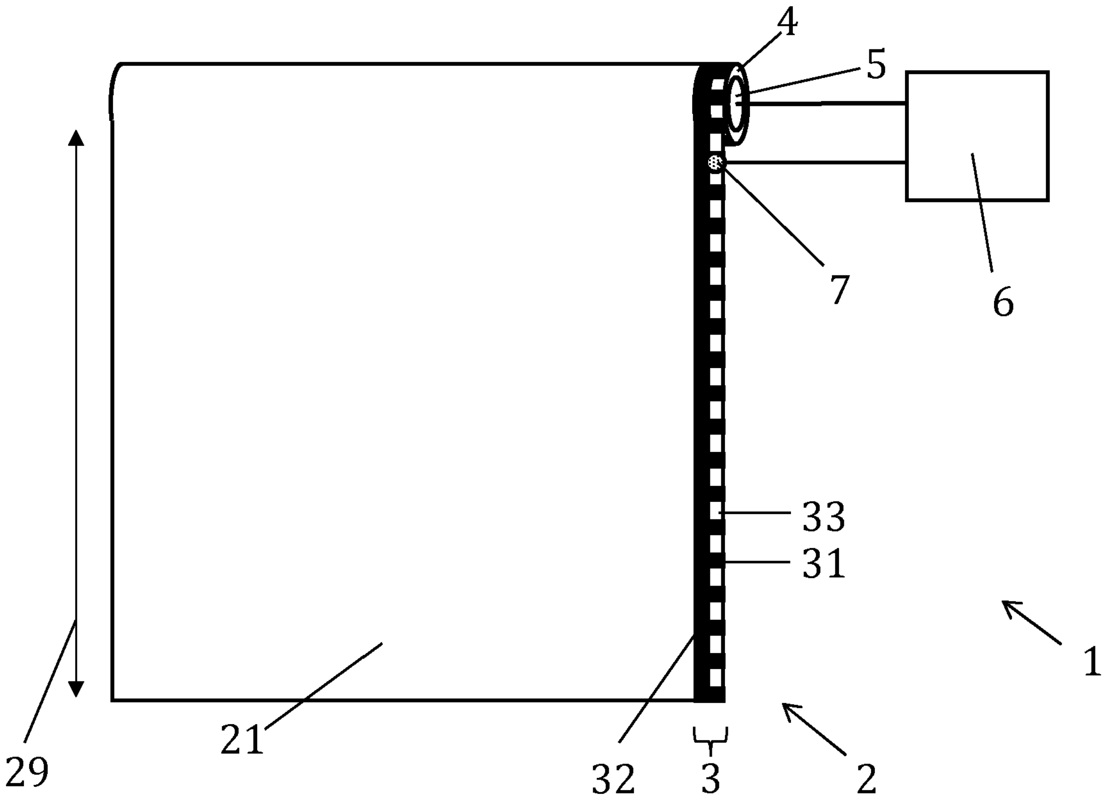

FIG. 1

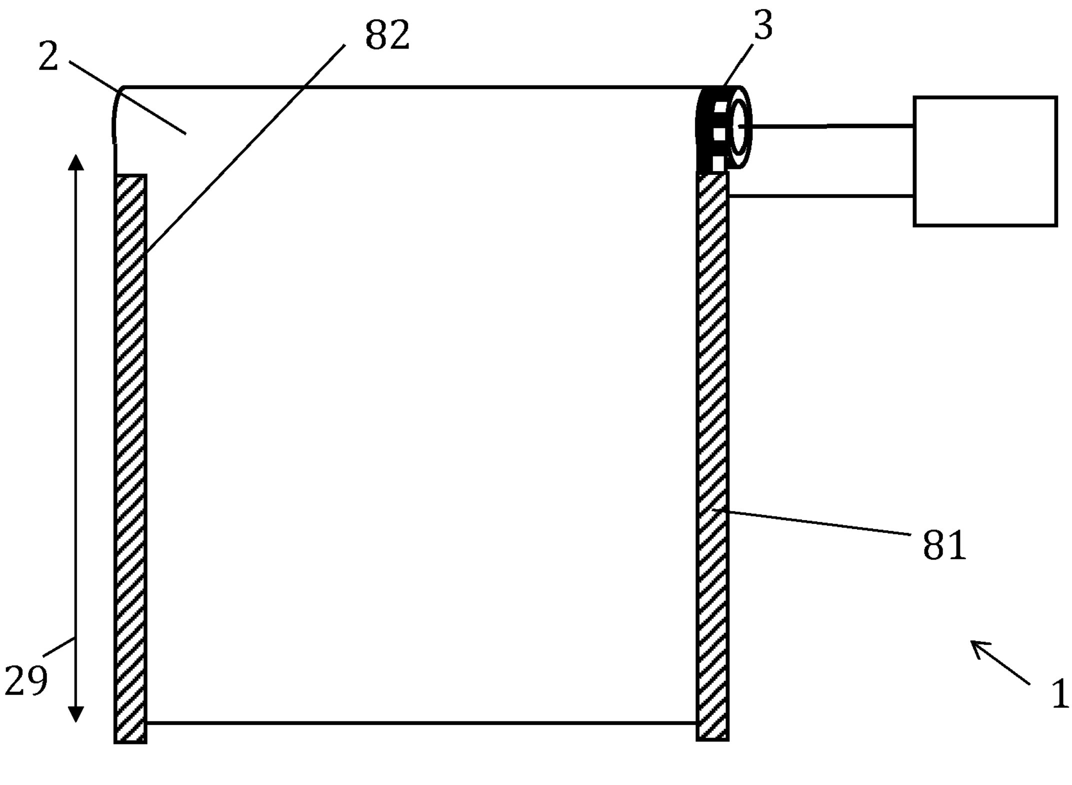

FIG. 2

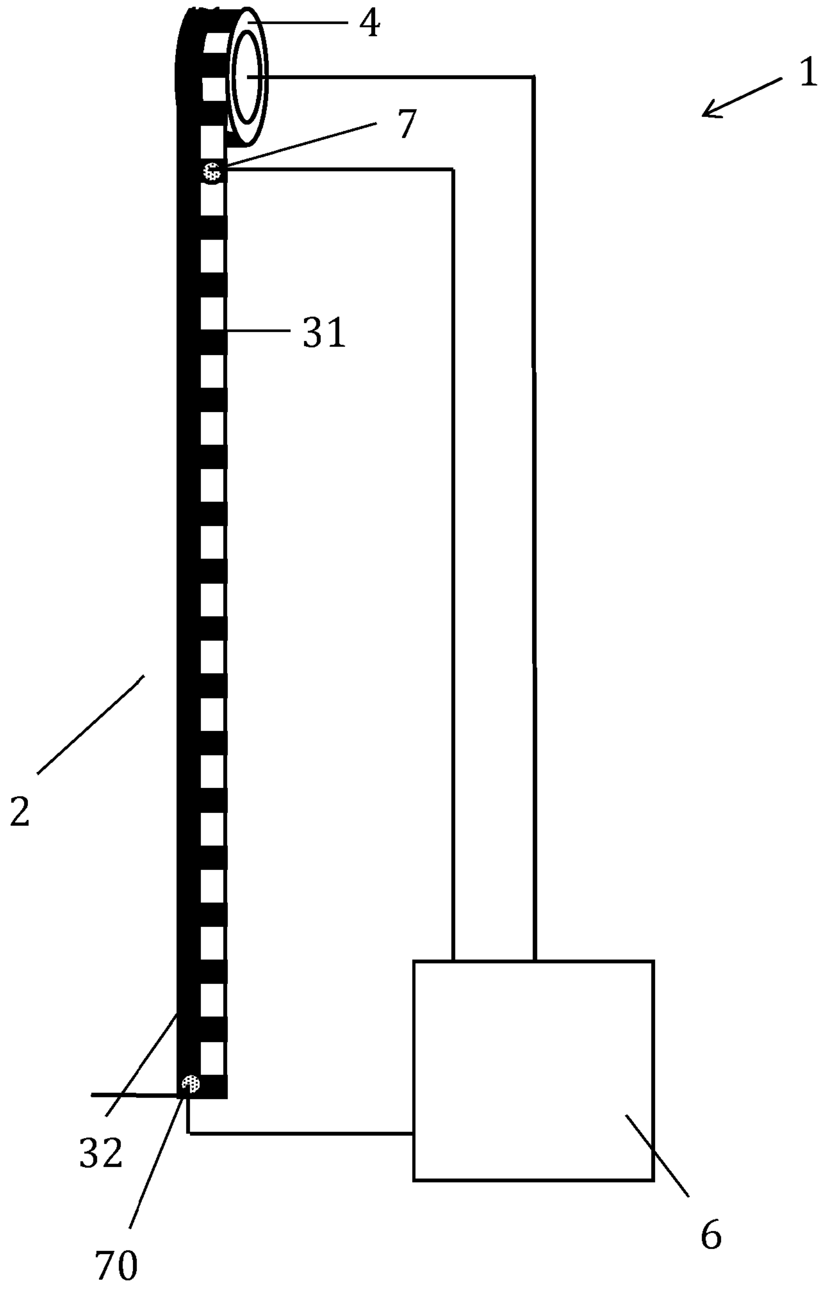

FIG. 3

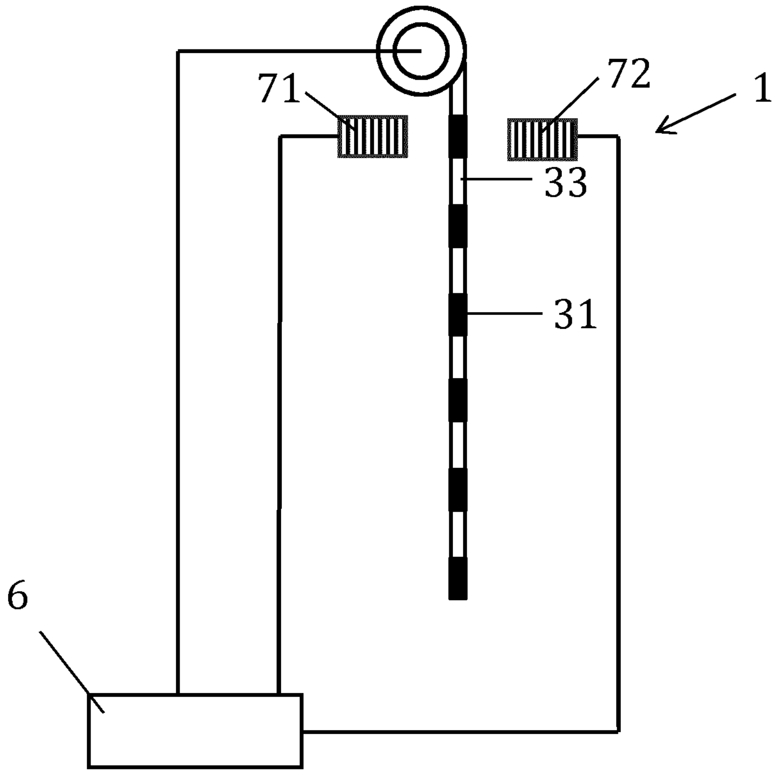

FIG. 4

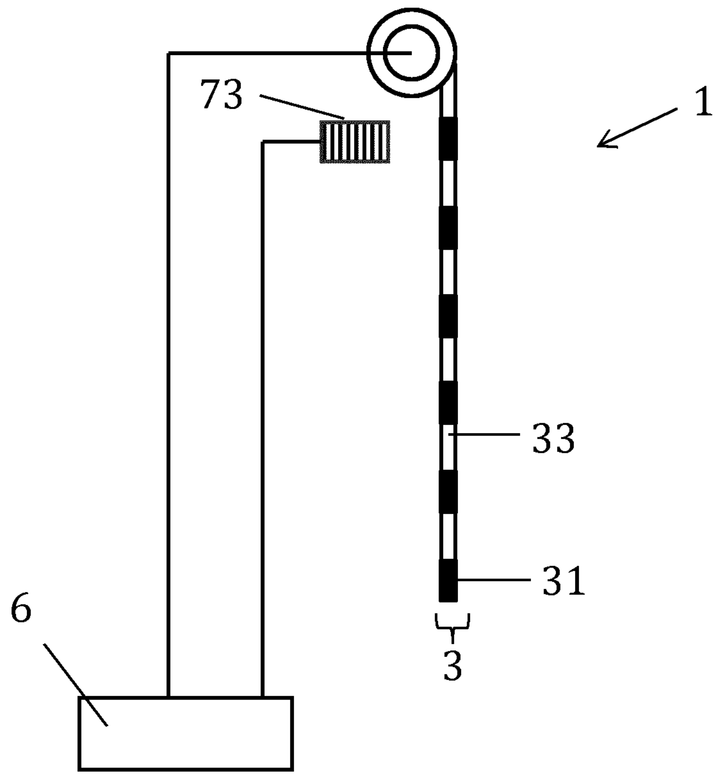

FIG. 5

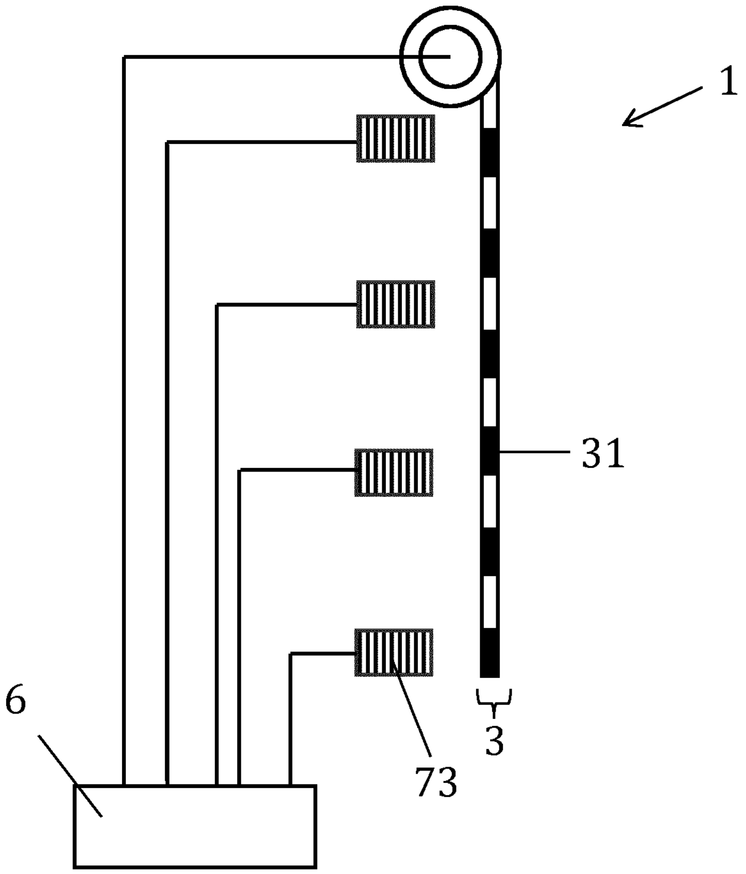

FIG. 6

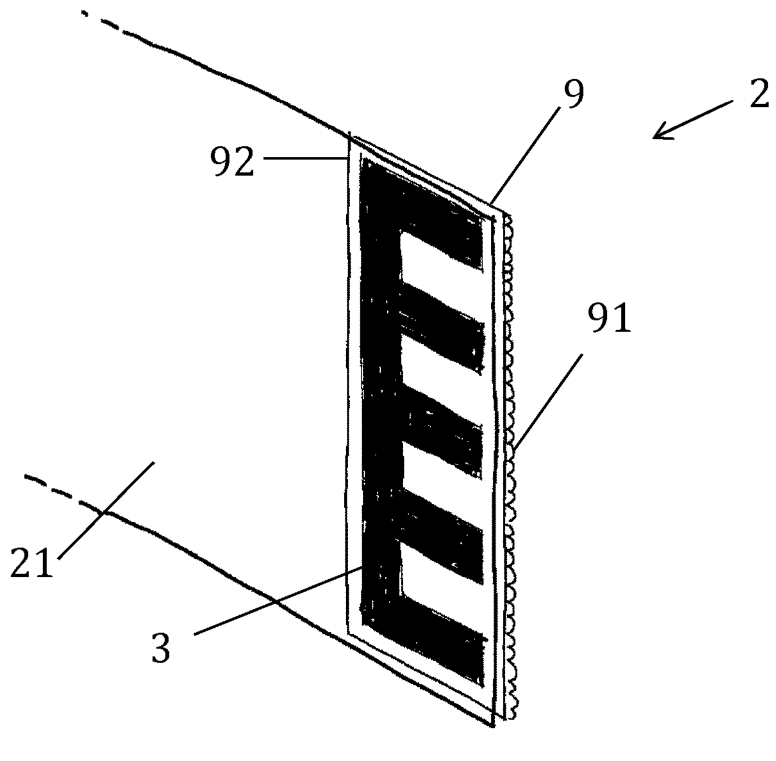

FIG. 7

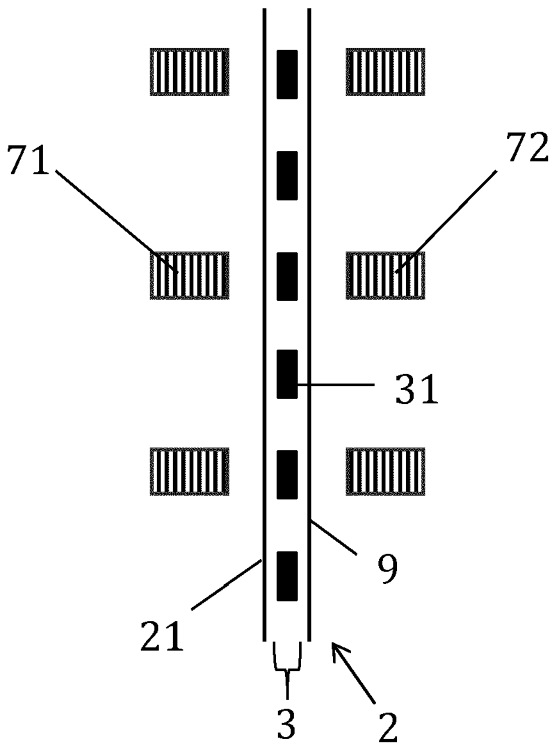

FIG. 8

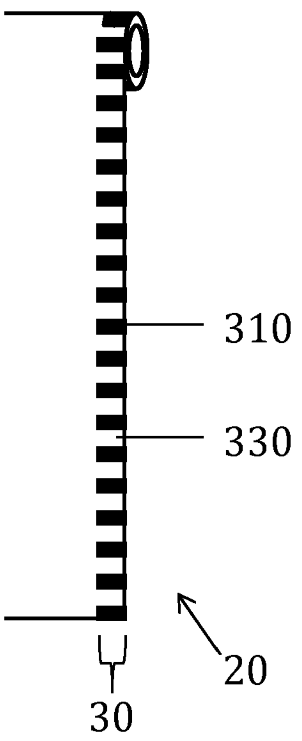

FIG. 9

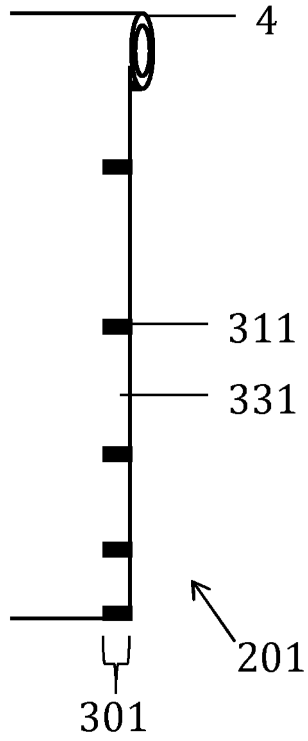

FIG. 10

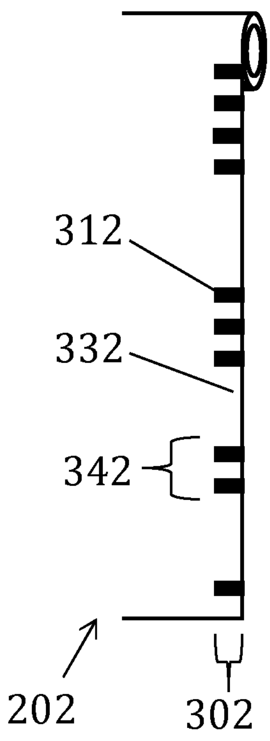

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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E06B

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	20 January 2025	Kofoed, Peter

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