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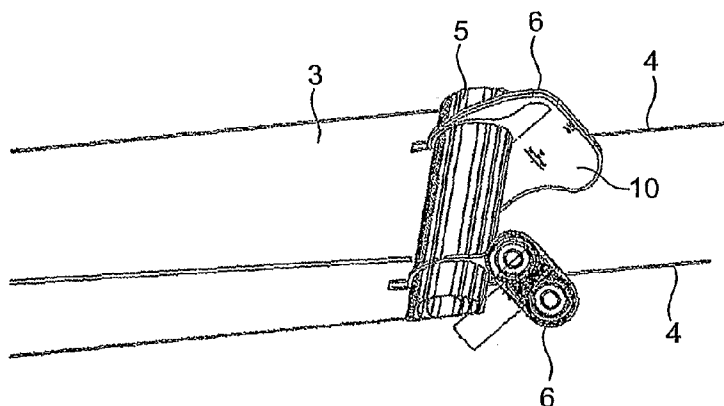
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(54) Title: COVERING SYSTEM



(57) Abstract: A covering apparatus comprising an extendible screen, a longitudinal flexible element and a rotatable member, wherein one of the longitudinal flexible element and the rotatable member is fixed and the screen is attached to the other of the longitudinal flexible element and the rotatable member so as to permit relative movement of the screen relative to the fixed part, wherein the rotatable member is frictionally engaged with the longitudinal flexible element, and wherein there is provided means for preventing rotation of the rotatable member, whereby the screen is held in position relative to the fixed part.

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Covering system.

5 The present invention relates to a covering apparatus such as a canopy or an awning for providing sun protection, rain protection or the like. More specifically, the present invention concerns a covering apparatus of the type where a covering screen is supported by and may engage with longitudinal flexible elements.

10 A variety of covering apparatuses are known in the art. For example some canopies are provided on the side of a building, with folding arms which can be extended when the canopy is to be deployed. Other covering systems have a covering screen attached to moveable wires which are operated to extend or retract the screen. Other covering systems employ fixed wires which support a covering screen when it is deployed.

15 A major problem with all of these types of covering screen is providing sufficient tension in the screen. In the past, tension has typically been provided by means of springs so that as the screen is extended further, more tension is applied by the springs. However, the limit of tension which can be provided by springs is fairly low and varies with the length of screen which has been extended. Also springs lose their
20 elasticity over time or if they are extended too far. This limit of tension has been a major factor in limiting the size of such covering systems.

Many applications require much larger covering systems. For example covering outdoor areas such as swimming pools, tennis courts or large patios would require a
25 larger covering system. Likewise for even larger applications such as in agriculture or for covering stadiums. As the area to be covered gets larger, the covering screen gets heavier. The screen also becomes more susceptible to winds. Therefore to make such systems useful, a great deal of tension must be applied to the screen.

30 According to a first aspect of the present invention, there is provided a covering apparatus for covering an outdoor area comprising a screen that can be operated between a retracted and an extended configuration, the screen having a leading portion and a trailing portion, the trailing portion being connected to a first support, the apparatus further comprising a plurality of longitudinal flexible elements

extending from the first support to respective second supports, and the leading portion of the screen being supported by the longitudinal flexible elements as the screen is operated from the retracted to the extended configuration, wherein the leading portion of the screen is moveably mounted to the longitudinal flexible elements such that the leading portion moves with respect to the longitudinal flexible elements during operation between retracted and extended positions, and wherein at least one engaging system is provided in association with the leading portion of the screen for releasably engaging the leading portion to at least one of the longitudinal flexible elements.

With such an arrangement, the screen can be extended to any desired position along the longitudinal flexible elements and then the engaging system can be applied to hold the screen in place relative to the longitudinal flexible elements. Tension can then be applied to the screen, e.g. by drawing the trailing portion of the screen back in the direction of retraction. Thus tension may readily be provided to the screen. This is limited only by the strength of the engaging system rather than by the strength of springs as in the prior art.

The engaging system may be in any form such as a clamping system having members that move together to grip the longitudinal flexible elements. These members may be rollers arranged to run along the longitudinal flexible elements. However, it is preferred that clamps in general and in particular clamps using moving rollers are not used. Nevertheless, it is preferred that the engaging system comprises rotatable members that co-operate with the longitudinal flexible elements. Thus, while the engaging system may be a separate element of the covering apparatus it is preferably formed integrally with a roller system which has rotatable members arranged to roll along the longitudinal flexible elements. The longitudinal flexible elements are preferably cables which are sized in order to support the screen and the tensile forces applied. Also the screen itself must be sufficiently strong to withstand the tension which is to be applied to it. Much of the loading may be due to wind, which may create much higher loading than the weight of the components. To achieve these objectives, the elements are preferably steel cables and these, for a typical application, should be at least 5 mm in diameter. Preferably cables between 5 and 10 mm are used, but where necessary, for large canopies, or where high wind loading is expected, cables of up to 15 or 20mm or even more may be used.

Preferably the roller(s) engage the longitudinal flexible elements by means of friction such that the roller(s) do not slide with respect to the elements. Thus the engaging system may engage the canopy with the element by preventing rotation of the rollers, e.g. by means of braking or gearing. The longitudinal flexible elements may be fixed and the screen attached to the rollers such that operation of the rollers pulls the screen along the longitudinal flexible elements. Alternatively, the rollers may be fixed and the screen attached to the longitudinal flexible elements. In this case, the longitudinal flexible elements are formed as loops around front and rear pulleys such that operation of the rollers moves the loops of longitudinal flexible elements and thereby moves the screen.

The use of rollers in this manner has a further advantage in that, were the canopy arranged to merely slide along the elongate flexible elements, the friction force between the screen and the longitudinal flexible elements could be quite high in the case of large canopies. Providing rollers on the leading portion reduces this friction and so it is desirable to provide these in any event. Integrating the engaging system with the rollers greatly simplifies the construction and operation of a covering system.

The use of frictionally engaging rollers to provide an engagement system for a canopy is, in itself regarded as an inventive concept and so, viewed from a further aspect, the invention provides a covering apparatus comprising an extendible screen, a longitudinal flexible element and a rotatable member, wherein one of the longitudinal flexible element and the rotatable member is fixed and the screen is attached to the other of the longitudinal flexible element and the rotatable member so as to permit relative movement of the screen relative to the fixed part, wherein the rotatable member is frictionally engaged with the longitudinal flexible element, and wherein there is provided means for preventing rotation of the rotatable member, whereby the screen is held in position relative to the fixed part.

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Preferably, the screen is extendible relative to the longitudinal flexible element, the screen is attached to the rotatable member, and the means for preventing rotation holds the screen in position relative to the longitudinal flexible element.

Alternatively, the rotatable member is fixed, the longitudinal flexible element is

movable relative to the rotatable member, the screen is attached to the longitudinal flexible element and the means for preventing rotation holds the screen in position relative to the rotatable member.

- 5 According to another aspect, the invention provides a covering apparatus comprising a screen which is extendible relative to a longitudinal flexible element, wherein the screen is attached to a rotatable member which is frictionally engaged with the longitudinal flexible element, there being provided means for preventing rotation of the rotatable member whereby the screen is held in position relative to the
10 longitudinal flexible element.

The rotatable member may be a roller, pulley, wheel, etc. It is preferably in the form of a pulley which is formed with flanges or the like to receive the longitudinal flexible element (e.g. a cable) without the element slipping off.

15

- Preferably the or each rotatable member has a friction hub for winding the longitudinal flexible element around. The friction hub is designed to provide maximum friction between the rotatable member and the longitudinal flexible element so as to prevent the longitudinal flexible element from sliding round the rotatable
20 member and thus preventing movement of the screen when the rotatable members are not rotated.

- More preferably, at least one groove is provided in the friction hub. The groove holds the longitudinal flexible element in place on the friction hub, preventing lateral
25 movement of the longitudinal flexible element with respect to the hub. The groove also serves to increase the friction between the hub and the longitudinal flexible element by increasing the area of the hub which is in contact with the longitudinal flexible element.

- 30 In certain applications, the weight of the canopy may be sufficient to generate sufficient frictional engagement between the rotatable member and the longitudinal flexible element if one merely rests on the other. However, in most instances it will be necessary for the longitudinal flexible element to be wrapped at least partially

around the rotatable member so as to generate more friction than would be generated merely through gravity.

By wrapping the longitudinal flexible element around the rotatable member, enough friction can readily be created so that when tension is applied to the screen, the rotatable member does not slide with respect to the longitudinal flexible element. If necessary, a friction increasing surface may be formed on the rotatable member.

Although sufficient friction is created between the longitudinal flexible element and the rotatable member that the latter will not slide with respect to the longitudinal flexible element, the rotatable member can still rotate with the longitudinal flexible element passing around it and thereby roll along the longitudinal flexible element or pull the loop of longitudinal flexible element round. In other words, as the rotatable member is rotated, a portion of the longitudinal flexible element is taken up in a wind around the rotatable member. At the same time, the same length portion of longitudinal flexible element is paid out from the rotatable member. Thus the rotatable member does not slide with respect to the longitudinal flexible element, but rather, in a first embodiment, rolls along it, thereby moving longitudinally with respect to the longitudinal flexible element and, in a second embodiment, pulls a loop of longitudinal flexible element round front and rear pulleys, thus moving the screen with respect to the fixed parts.

After the screen has been deployed to the desired position, tension may be applied to the screen. In order to prevent this tension from causing the rotatable member to travel further along the longitudinal flexible element by means of rotation as described above, rotation of the rotatable member is prevented, e.g. a braking system is applied to the roller.

Thus, in this arrangement, a combination of the means for preventing rotational movement with respect to the longitudinal flexible element and the friction preventing sliding movement with respect to the longitudinal flexible element keeps the rotatable member engaged with the longitudinal flexible element and thereby holds the screen at the desired position, even when tension is applied to the screen.

Thus viewed from a still further aspect, the invention provides a covering apparatus, comprising: a screen; a longitudinal flexible element; a roller system for attaching a leading portion of the screen to the longitudinal flexible element so that the screen is movably mounted to the longitudinal flexible element and moves with respect to the longitudinal flexible element when the roller system is operated, the roller system comprising: a rotatable member around which the longitudinal flexible element is wound so as to create friction between the rotatable member and the longitudinal flexible element; and a braking system for preventing rotation of the rotatable member with respect to the longitudinal flexible element.

As mentioned above, it is necessary to provide enough friction between the rotatable member and the longitudinal flexible element to prevent relative sliding motion when the desired degree of tension is applied to the screen. Therefore, where more tension is required in the screen, the longitudinal flexible element is preferably wound at least once, more preferably at least twice round the rotatable member. Because the longitudinal flexible element is itself under high tension, this will provide a significant frictional force. However if more friction is required, the longitudinal element may be wound around the rotatable member more times, thus increasing the length of longitudinal flexible element which is in contact with the surface of the rotatable member.

Although a single rotatable member (hereinafter "first rotatable member") is suitable for many applications, in a preferred embodiment of the invention, the apparatus further comprises a further rotatable member (hereinafter "second rotatable member"), and the longitudinal flexible element is wound around the first rotatable member and the second rotatable member. This has a similar frictional effect to wrapping the longitudinal element twice around the same rotatable member as it increases the contact area between the rotatable member surfaces and the longitudinal flexible element. However, when the longitudinal flexible element is wound around a single rotatable member, it will necessarily be translated laterally along the rotatable member as the winding progresses. If two rotatable members are provided, this translation can be cancelled out by winding the longitudinal flexible element in the opposite direction along the second rotatable member. Also, due to the width of the windings, if the longitudinal flexible element is wound several times around a single

rotatable member, a high torque is applied to the rotatable member. By providing two rotatable members, this torque is distributed between the rotatable members. The two rotatable members can also be wound in opposite lateral directions, thereby cancelling out the lateral displacement of the longitudinal flexible element.

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The longitudinal flexible element may be wound, or partially wound around several rollers in order to provide the desired level of friction.

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In a particularly preferred embodiment, the longitudinal flexible element is wound around the first and second rotatable members in a figure-of-eight pattern. In other words, the longitudinal flexible element is wound around the two rotatable members in opposite senses, e.g. clockwise around the first rotatable member and anti-clockwise around the second rotatable member. In addition to the previous advantages, this arrangement causes the rotatable members to rotate in opposite senses as they roll along the longitudinal flexible element. Therefore the rotatable members may be meshed together or frictionally engaged together so that one rotatable member drives the other. With this arrangement, the braking system can be applied to only one of the rotatable members, but still prevent both rotatable members from rotating.

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In an even more preferred embodiment, the longitudinal flexible element passes between the first and second rotatable members, then round the second rotatable member, then between the first and second rotatable members again, then round the first rotatable member in the opposite sense to the wind around the second rotatable member, then between the first and second rotatable members a third time, before continuing in its original direction. With this arrangement, one rotatable member is situated on (and, in use, rolls with respect to) each side of the longitudinal flexible element. This provides a better balanced and more compact and stable mechanism.

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Preferably, the apparatus further comprises a motor for rotatably driving at least one rotatable member. In this way, the screen can be deployed or retracted remotely or automatically. This is particularly useful for large heavy screens or for covering systems which are awkward to reach. In the preferred forms of the invention, the means for preventing rotation is applied to or associated with the motor. Thus by

preventing rotation of the motor, the screen is prevented from further extending or retracting.

The covering apparatus may further comprise gearing between the motor and the at least one rotatable member. Motors tend to rotate at high speeds, whereas the screen will need to be deployed somewhat slower. Also, the large heavy screens will need the extra power provided by gearing down the motor. In the most preferred arrangements the gearing comprises a worm gear. The worm gear is particularly beneficial in that it provides a simple arrangement with a high ratio of gearing down. It is also particularly suitable for driving two rotatable members by placing the rotatable members on opposite sides of the worm gear. The worm gear will cause the two rotatable members to rotate in opposite senses.

The means for preventing rotation may comprise the gearing. As many rotations of the motor cause only a small movement of the screen, reversing the system means that a small movement of the screen can only occur by inducing many rotations of the motor which incurs significant resistance. Thus a "braking" system is effected. This is particularly advantageous where an additional brake is applied to the motor. The braking force of that brake will only be overcome by a much greater force applied to the screen downstream of the gearing. Again the system is particularly advantageous when a worm gear is included in the gearing because a worm gear is a one way drive mechanism. No rotational force on the rotatable members can cause the worm gear to operate in reverse. Therefore no further braking system will be required.

Preferably the or each rotatable member has a toothed portion for driving the rotatable member. The rotatable members can engage with each other, or with a worm gear so that they rotate in opposite senses or they can engage with a third central drive gear so that they rotate in the same sense.

The covering apparatus preferably comprises a plurality of longitudinal flexible elements and has a roller system provided on each longitudinal flexible element (or at least a plurality of them). Providing a plurality of longitudinal flexible elements with roller systems increases the stability of the covering apparatus and increases the

amount of friction force and braking force that can be applied to provide tension in the screen.

In the system of the present invention, if the roller casings are to be motorised, electricity must somehow be supplied to the roller casings. This can be done by running a power cable down the side of the screen to one of the roller casings. Power can then be supplied to the other roller casing by running a cable along the leading portion of the screen. However with this method, if the screen is rolled up, the cable causes the rolled up screen to be significantly thicker at the side where the cable is mounted. Therefore, preferably the cable is run diagonally through the screen from one side at the trailing portion of the screen to the opposite side at the leading portion of the screen. Thus, when the screen is rolled up, the cable is evenly spread throughout the length of the roll and the thickness of the roll is uniform. This makes for a more efficient storage of the rolled up screen by minimising the maximum diameter of the screen roll. An alternative way of achieving an even diameter of rolled up screen is to run a power cable from each corner by the trailing portion of the screen diagonally towards the centre of the screen and then diagonally from the centre of the screen to the corners by the leading portion of the screen where the roller cases are mounted. The wires may cross over in the centre, each carrying power from a corner of the screen at the trailing portion to the diagonally opposite corner on the leading portion of the screen or they may change direction in the centre, each carrying power from a corner of the screen at the trailing portion to the corner on the same side of the screen at the leading portion. In the latter arrangement, the two power carrying wires are preferably held together to help maintain the X-shape which reduces the overall diameter of the rolled up screen.

These cables also provide the function of reinforcing the screen. Alternatively, separate reinforcing members may be attached to the screen which run diagonally across the screen from a trailing portion of the screen to a leading portion of the screen. These reinforcing members may be wires or cables or straps.

Sometimes, when the tension in the screen becomes too high, e.g. in high winds, it becomes necessary to retract the screen so as to prevent it from being damaged.

Therefore, in a preferred embodiment, the apparatus may be further provided with an automatic retraction system.

Automatic retraction systems which use wind sensors to determine when to retract the screen are known. However, wind is not the only factor in increasing tension in the screen. Accumulation of water or snow also increases the tension in the screen and would go undetected by a wind sensor.

Therefore, a particularly preferred embodiment of the invention further comprises an automatic retraction system comprising a tension sensor which senses the tension in the screen and retracts the screen when a threshold tension is exceeded. In one embodiment the tension sensor senses the tension in the screen directly. In an alternative embodiment, the tension sensor senses the tension in at least one longitudinal flexible element. The tension sensor may be located in the roller casing or it may be located on a support. If it is located in the roller casing it may be combined with a clamping arrangement by sensing the pressure on the clamping element of the clamping arrangement.

As described above, the tension sensor may directly sense the tension in the screen or it may determine the tension in the screen by sensing the tension in a support of the screen. In this latter arrangement, the tension sensor is preferably calibrated each time the screen is deployed or retracted.

A further problem of large covering systems where the screen is rolled up when retracted is that for a long screen, the diameter of the cylinder of retracted screen can be quite large. This has not previously been a problem with covering systems because known covering systems have not been capable of extending as far as the system described above.

However, in order to avoid such a large diameter of retracted screen a preferred embodiment of the covering system of the invention provides a plurality of rollers around which the screen is wrapped when retracted. In one embodiment, two storage rollers are provided which are driven synchronously so as to wind the screen around them in such a way as to provide a generally oval cross-section.

The rollers may be driven by a third driving roller, smaller in diameter than the storage rollers and located between them in driving contact with both rollers. Alternatively the storage rollers may be synchronously driven by a drive belt or chain.

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In another alternative embodiment, three rollers are provided in a triangular arrangement and are driven synchronously so as to retract the screen around the three rollers in such a way as to provide a generally triangular cross-section.

By using a plurality of smaller storage rollers instead of a single storage roller, the covering system may be made more space efficient.

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In this way, rollers can be arranged so as to make the best use of available space and the sheet can be stored with high spatial efficiency.

15 A flexible base member may be provided around the storage rollers and driven by the storage rollers. The sheet is attached to the flexible base member. Alternatively the sheet may be wound around the storage rollers and attached to itself so as to form a closed loop around the rollers at the trailing end thereof.

20 The flexible base member or the loop of fabric formed at the trailing end of the sheet must have sufficient frictional engagement with the storage rollers that when at least one of the storage rollers is driven, the sheet or the base member is also driven and the sheet is retracted around the storage rollers.

25 In a preferred embodiment, the friction between the storage rollers and the sheet or base member is increased by providing a spring or springs which bias the storage rollers apart. Friction can also be increased by giving the rollers a rough or sticky surface, e.g. by providing rubber strips on the rollers.

30 The apparatus can also be applied to other applications beyond the field of covering systems. Thus, in the above description, the screen can be replaced with other objects that need to be releasably engaged with a longitudinal flexible element.

Preferred embodiments of the invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

- Figure 1 shows a perspective view of a covering system according to a first embodiment of the invention;
- Figure 2 shows a more detailed view of the leading edge of the screen of the covering system of the first embodiment;
- Figure 3 shows an elevation of a roller system used in the first embodiment of the invention;
- Figure 4 shows the roller system of Figure 3 in an exploded view;
- Figure 5 shows a roller forming part of the roller system of the first embodiment;
- Figure 6 shows a perspective view of the roller system of the first embodiment in operation.
- Figure 7 shows a perspective view of a second embodiment of the invention; and
- Figure 8 shows a perspective view of a third embodiment of the invention.
- Figure 9 shows an embodiment of a tension sensor according to the invention when the screen is in a state of low tension.
- Figure 10 shows the tension sensor of figure 9 when the screen is in a state of high tension.
- Figure 11 shows an embodiment of a covering system of the invention including a tension sensor as shown in figures 9 and 10.
- Figure 12 is an enlarged view of figure 11.
- Figure 13 shows another embodiment of a tension sensor according to the invention when the cable is in a state of low tension.
- Figure 14 shows the tension sensor of figure 13 when the cable is in a state of high tension.
- Figure 15 shows an embodiment of a covering system of the invention with a tension sensor as shown in figures 13 and 14.
- Figure 16 shows an enlarged view of figure 15.
- Figure 17 shows an embodiment of a storage system according to the invention.
- Figures 18 and 19 show alternative ways of operating the storage system of figure 17.
- Figures 20 and 21 show alternative power cable arrangements for transferring electric power along the screen of a covering system according to the invention.

Figures 1 and 2 show a covering apparatus 1 comprising a storage roller 2 at the trailing end of a screen 3. Any portion of the screen which is not deployed is rolled up on the storage roller 2. The storage roller 2 is motorized so that when tension is required in the screen, the storage roller 2 is driven in the direction of retracting the
5 screen until sufficient tension has been applied.

Two cables (longitudinal flexible elements) 4 are provided (partially shown in Figures 1 and 2) which support the screen 3 when it is deployed. The cables 4 are under high tension so as to support the screen 3 without allowing it to sag too much under its own
10 weight. Although not shown in the figures, these cables are attached to supports at either end. For example, the wall of a house could provide a first support and a second support could be formed by a pole fixed in the ground and anchored with guy ropes. These supports must be capable of maintaining tension in the cables 4.

15 At the leading end of the screen 3 (shown in more detail in Figure 2), a transverse bar 5 is attached. The transverse bar 5 provides support so as to prevent transverse sag of the screen. The screen 5 is attached to roller systems 6 (one on each of the cables 4). In Figure 2, the nearest roller system 6 is shown without a case and the furthest roller system 6 is shown in a case 10. However, the two roller systems 6 are identical and
20 therefore only one will be described here.

The roller system 6 is shown in Figure 3 attached to a longitudinal flexible element 4. It is also shown in Figure 4 in exploded view. The roller system comprises two rollers 7. As can be seen from Figure 5, each roller 7 comprises a toothed portion 7a
25 and a friction hub 7b of smaller diameter than the toothed portion 7a. The friction hub 7b contains grooves 7c. Referring back to Figure 4, the toothed portions 7a of the rollers 7 are meshed with a worm gear 8 which is driven by a DC motor 9. The cable (longitudinal flexible element) 4 is wrapped around the first roller 7 in a clockwise sense as viewed in the figure, and then in an anti-clockwise sense around the second
30 roller 7 before continuing in its original direction. The cable 4 fits into the grooves 7c of the rollers 7 to prevent it from slipping off the hub 7b in use. The cable 4 is shown wrapped around the rollers 7 in Figure 6.

The two rollers 7 are driven in opposite senses by the worm gear 8 when the motor 9 is driven. As the rollers 7 rotate, one of the rollers 7 (which roller depends on the direction of travel) winds cable 4 up around itself, while the other roller 7 pays out the same amount of cable (as the rollers 7 are the same size and are driven at the same speed). In this manner the rollers 7 and hence the transverse bar 5 and the screen 3 move longitudinally along the longitudinal flexible elements (cables) 4.

When the screen 3 has been deployed to the desired position, the storage roller 2 is driven so as to retract the screen until sufficient tension has been created in the screen 3. The rollers 7 do not slide along the cables 4 because of the friction created by the cables 4 (which are under high tension) being wrapped around the first and second rollers 7 in the grooves 7c. The rollers 7 do not rotate relative to the cables 4 because the motor 9 is not being driven and the rollers 7 are incapable of turning the worm gear 8.

Thus the roller system grips the cable 4 securely and holds the screen in place against the tension force provided by the storage roller 2 being driven backwards.

It will be appreciated that although in this embodiment tension is created by fixing the rollers 7 in place and then driving the roller 2 backwards, the tension could equally well be created by locking the storage roller 2 and driving the rollers 7 further forward in the direction of extending the screen 3.

Figures 7 and 8 show second and third embodiments of the invention. The second embodiment shown in Figure 7 has a similar drive mechanism as described above in relation to the first embodiment, but housed inside a case 210 attached to a transverse bar 205. Two rollers (not shown) are housed inside the case 210 and the cable 204 passes into the case 210 at one end, round the rollers in a figure-of-eight pattern and out of the case 210 at the opposite end. One of the rollers is driven by a motor 209 to move the screen along the cable 204.

The third embodiment shown in Figure 8 has a similar drive mechanism to the first and second embodiments, but with the rollers lying in a plane perpendicular to those of the first and second embodiments and substantially parallel with the screen. The

cable 304 passes into and out of the case 310 at either end. The case 310 is attached to a transverse bar 305.

In another embodiment (not shown in the figures), instead of the longitudinal flexible elements being fixed and the rollers rolling along them, the rollers are fixed (e.g. to a support) and the longitudinal flexible elements are movable relative to the rollers. The longitudinal flexible elements are formed as continuous loops, extending round pulleys at the front and back of the canopy system. When the rollers are operated, the longitudinal flexible elements are moved past the rollers and the loops rotate around the pulleys. The screen is attached to the longitudinal flexible elements so that as the loops are rotated, the screen is extended or retracted. The same rollers and braking and gearing systems apply to this embodiment as they do to the other embodiments.

Figures 20 and 21 show an embodiment of the invention in which the screen 401 can be extended or retracted electrically. The rollers 417, 417' in the roller cases 413, 414 are electrically powered so as to extend or retract the screen 401. Any clamping mechanism can also be electrically actuated.

In order to operate the motors in the roller cases 413, 414, electrical power must be transferred from an external power supply. In figure 20 an electrical wire 437 runs diagonally from one corner at the trailing edge 404 of the screen 401 to the diagonally opposite corner at the leading edge 402 of the screen 401. When the screen 401 is rolled up, the wire 437 is distributed evenly across the width of the screen roll and the diameter of the roll is uniform and minimised. In this way, power can be transmitted from an external power supply, through the wire 437 to the roller case 413. Power can then be transferred to the other roller case 414 by running another wire (not shown) along the transverse rod 408 at the leading portion 402 of the screen 401.

In figure 21, two electrical wires 438, 438' run diagonally to the centre of the screen 401, one from each corner at the trailing edge 404 of the screen 401. Each wire 438, 438' changes direction at the centre of the screen 401 and they run diagonally to the corners at the leading edge of the screen 401. The wires 438, 438' are held together at the centre so as to maintain the X-shape formed by the wires 438, 438'.

At the trailing edge 404 of the screen 401 the wires 437, 438, 438' are connected to an external power supply (not shown).

5 The wires 437, 438, 438', whether carrying electricity or not, also serve to reinforce the material of larger screens. For the purpose of reinforcement, straps may be used instead of wires.

10 Figures 9 and 10 show a tension sensor 426 for an automatic retraction system for use with the invention. Figure 9 shows the tension sensor 426 when the screen 401 is in a state of low tension and figure 10 shows the tension sensor 426 when the screen 401 is in a state of high tension. The tension sensor 426 shown in figures 9 and 10 has two upper rollers 427, 427' located above the screen 401 and a single lower roller 428 located below the screen 401. The lower roller 428 is mounted on a pressure sensor 429 so that when the screen 401 is under no tension or under low tension, the lower roller 428 biases the screen 401 upwardly between the two upper rollers 427, 427'.
15 When tension in the screen 401 increases, the lower roller 428 is biased downwardly and pressure sensor 429 senses a greater pressure. If the pressure sensor 429 senses a pressure greater than a predetermined threshold value, a warning may be generated, or if the screen is motorised, the screen may be automatically retracted.

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Figure 11 shows the tension sensor 426 of figures 9 and 10 mounted on a wall 407 which forms the first support of a covering apparatus according to the invention. Figure 12 is an enlarged view of figure 11.

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Figures 13 and 14 show another embodiment of a tension sensor 426 for use with the invention. In this embodiment, the tension sensor 426 senses the tension in a wire 411, 412 of the covering system rather than sensing the tension in the screen 401. (as in figures 9 and 10). The tension in the screen 401 is directly transmitted to the wires 411, 412. Each time the screen 401 is deployed or retracted, the pressure sensor 429 is calibrated. If the pressure sensor 429 senses a pressure greater than a
30 predetermined threshold, it issues a warning or, if the screen 401 is motorised, causes the screen 401 to be retracted. In this embodiment, the tension sensor 426 can easily be combined with the roller casings.

Figure 15 shows the tension sensor 426 of figures 13 and 14 mounted on a wall 407 which forms the first support of a covering apparatus according to the invention.

Figure 16 is an enlarged view of figure 15.

- 5 It will be appreciated that figures 9 to 16 show the bend in the wire 411, 412 or screen 401 slightly exaggerated. A digital pressure sensor would be used that does not require such a bend in the wire 411, 412.

- 10 The tension sensors 426 shown in figures 9 to 16 are enclosed within a housing 430 and therefore are protected from the weather. These systems are therefore more reliable than those involving wind sensors which must necessarily be exposed to the elements.

- 15 Figure 17 shows a storage system for a flexible sheet 401. The storage system has two rollers 433, 434 which are synchronously driven so that the sheet 401 is stored around the rollers 433, 434 with a cross-sectional shape determined by the arrangement of the rollers 433, 434 (i.e. substantially oval in this embodiment). By storing the flexible sheet 401 around more than one roller, space can be used more efficiently. For example in figure 17, the sheet 401 is kept more flat against the wall 407 than would
20 be possible if it was all stored on a single roller.

- Figures 18 and 19 show two ways in which the storage system of figure 17 can be driven. In figure 18 the two storage rollers 433, 434 are driven by a third drive roller 435 of smaller diameter than the storage rollers 433, 434 and located between the
25 storage rollers 433, 434 in driving contact therewith. In this way, both storage rollers 433, 434, which have the same diameter, are driven in the same direction at the same speed. In figure 19 the two storage rollers 433, 434 are connected by a chain 436 so that when one roller 433, 434 is driven, the other roller 434, 433 is also driven synchronously.

Claims

1. A covering apparatus comprising an extendible screen, a longitudinal flexible element and a rotatable member, wherein one of the longitudinal flexible element and
5 the rotatable member is fixed and the screen is attached to the other of the longitudinal flexible element and the rotatable member so as to permit relative movement of the screen relative to the fixed part, wherein the rotatable member is frictionally engaged with the longitudinal flexible element, and wherein there is provided means for preventing rotation of the rotatable member, whereby the screen
10 is held in position relative to the fixed part.
2. A covering apparatus as claimed in claim 1, wherein the screen is extendible relative to the longitudinal flexible element, wherein the screen is attached to the rotatable member, and wherein the means for preventing rotation holds the screen in
15 position relative to the longitudinal flexible element.
3. A covering apparatus as claimed in claim 1, wherein the rotatable member is fixed, the longitudinal flexible element is movable relative to the rotatable member, and the screen is attached to the longitudinal flexible element and wherein the means
20 for preventing rotation holds the screen in position relative to the rotatable member.
4. A covering apparatus as claimed in claim 1, 2 or 3, wherein the longitudinal flexible element is wound at least once round the rotatable member.
- 25 5. A covering apparatus as claimed in claim 4, wherein the longitudinal flexible element is wound at least twice round the rotatable member.
6. A covering apparatus as claimed in any preceding claim, further comprising a second rotatable member, wherein the longitudinal flexible element is wound around
30 the first rotatable member and the second rotatable member.
7. A covering apparatus as claimed in claim 6, wherein the longitudinal flexible element is wound around the first and second rotatable members in a figure-of-eight pattern.

8. A covering apparatus as claimed in claim 7, wherein the longitudinal flexible element passes between the first and second rotatable members, then round the second rotatable member, then between the first and second rotatable members again, then
5 round the first rotatable member in the opposite sense to the wind around the second rotatable member, then between the first and second rotatable members a third time, before continuing in its original direction.

9. A covering apparatus as claimed in any preceding claim, further comprising a
10 motor for rotatably driving at least one rotatable member.

10. A covering apparatus as claimed in claim 9, wherein the means for preventing rotation is applied to the motor.

11. A covering apparatus as claimed in claim 9 or 10, further comprising gearing
15 between the motor and the at least one rotatable member.

12. A covering apparatus as claimed in claim 11, wherein the gearing comprises a
worm gear.

20

13. A covering apparatus as claimed in claim 11 or 12, wherein the means for preventing rotation comprises the gearing.

14. A covering apparatus as claimed in any preceding claim, wherein the means
25 for preventing rotation is a braking system.

15. A covering apparatus as claimed any preceding claim, wherein the or each rotatable member has a toothed portion for driving the rotatable member.

16. A covering apparatus as claimed in any preceding claim, wherein the or each
30 rotatable member has a friction hub for winding the longitudinal flexible element around.

17. A covering apparatus as claimed in claim 16, wherein at least one groove is provided in the friction hub.

18. A covering apparatus as claimed in any preceding claim, comprising a plurality of longitudinal flexible elements and wherein a roller system is provided on each longitudinal flexible element.

19. A covering apparatus, comprising:

a screen;

10 a longitudinal flexible element;

a roller system for attaching a leading portion of the screen to the longitudinal flexible element so that the screen is movably mounted to the longitudinal flexible element and moves with respect to the longitudinal flexible element when the roller system is operated, the roller system comprising:

15 a rotatable member around which the longitudinal flexible element is wound so as to create friction between the rotatable member and the longitudinal flexible element; and

a braking system for preventing rotation of the rotatable member with respect to the longitudinal flexible element.

20

20. A covering apparatus for covering an outdoor area comprising a screen that can be operated between a retracted and an extended configuration, the screen having a leading portion and a trailing portion, the trailing portion being connected to a first support, the apparatus further comprising a plurality of longitudinal flexible elements extending from the first support to respective second supports, and the leading portion of the screen being supported by the longitudinal flexible elements as the screen is operated from the retracted to the extended configuration, wherein the leading portion of the screen is moveably mounted to the longitudinal flexible elements such that the leading portion moves with respect to the longitudinal flexible elements during operation between retracted and extended positions, and wherein at least one engaging system is provided in association with the leading portion of the screen for releasably engaging the leading portion to at least one of the longitudinal flexible elements.

30

21. An apparatus as claimed in any preceding claim, further comprising an automatic retraction system.

5 22. An apparatus as claimed in claim 21, wherein the automatic retraction system comprises a tension sensor which senses the tension in the screen and causes the automatic retraction system to retract the screen when a threshold tension is exceeded.

10 23. An apparatus as claimed in claim 21, wherein the automatic retraction system comprises a tension sensor which senses the tension in at least one of the longitudinal flexible elements and causes the automatic retraction system to retract the screen when a threshold tension is exceeded.

15 24. An apparatus as claimed in claim 23, wherein the tension sensor is calibrated each time the screen is deployed or retracted.

25. An apparatus as claimed in claim 23 or 24, wherein the tension sensor is located in the roller case.

20 26. An apparatus as claimed in claim 25, wherein the tension sensor forms an integral part of the clamping system.

27. An apparatus as claimed in any preceding claim, wherein the apparatus comprises a plurality of storage rollers around which the screen is wrapped when retracted.

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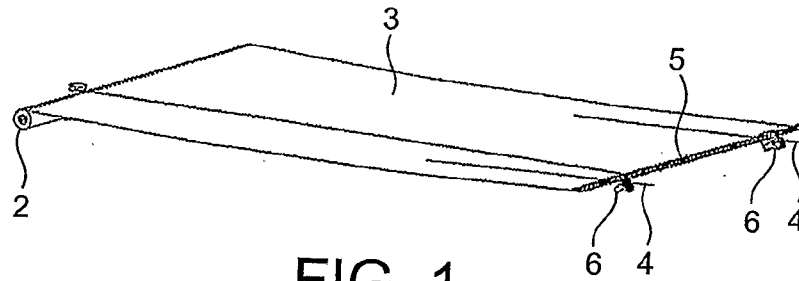


FIG. 1

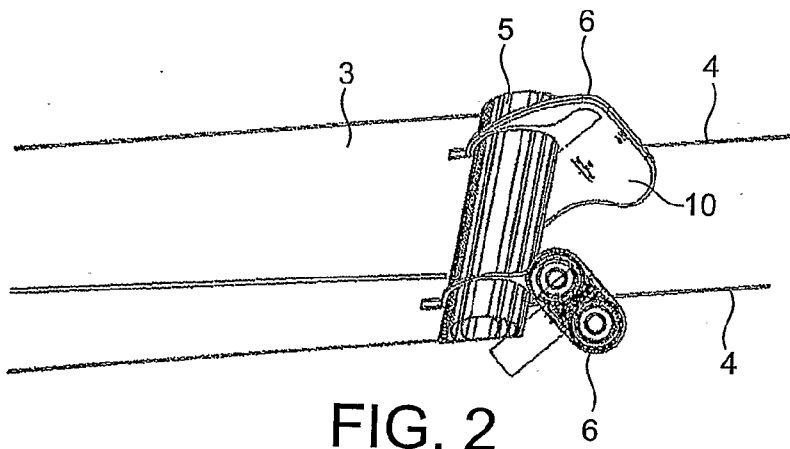


FIG. 2

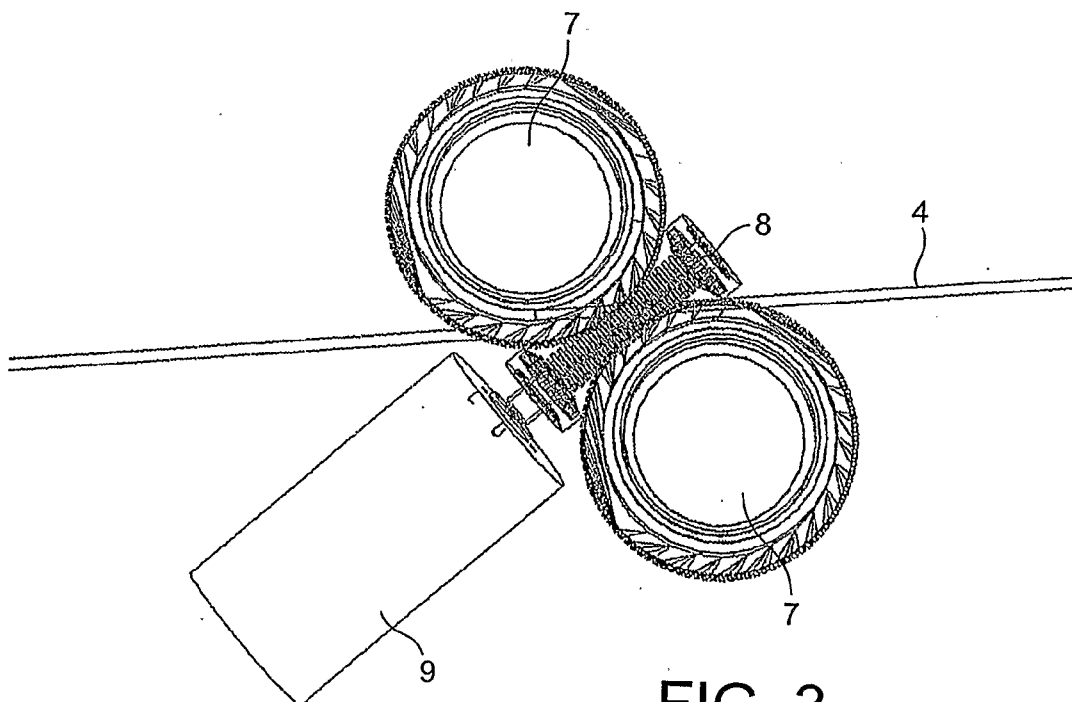


FIG. 3

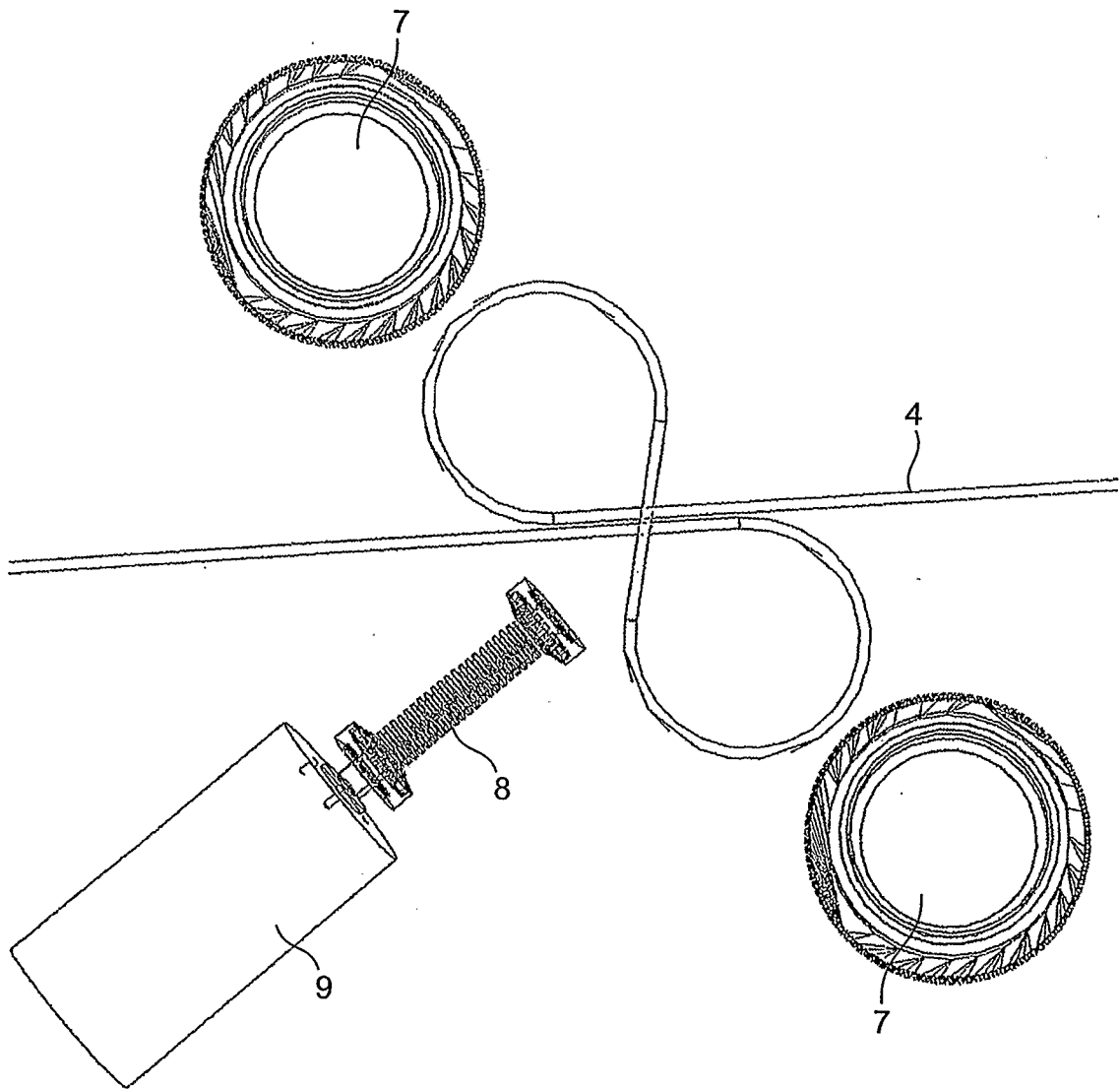


FIG. 4

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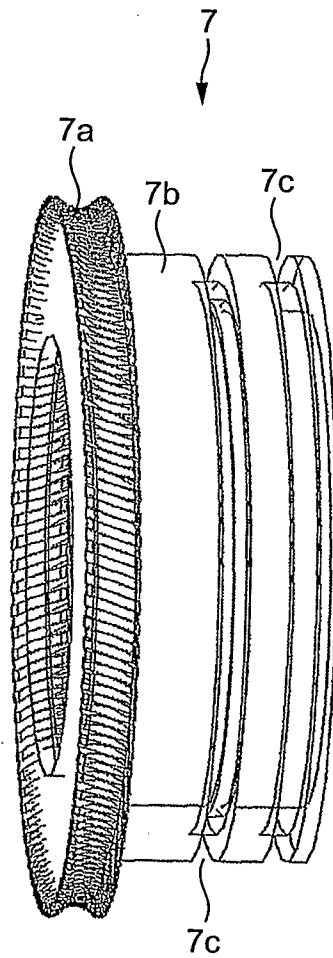
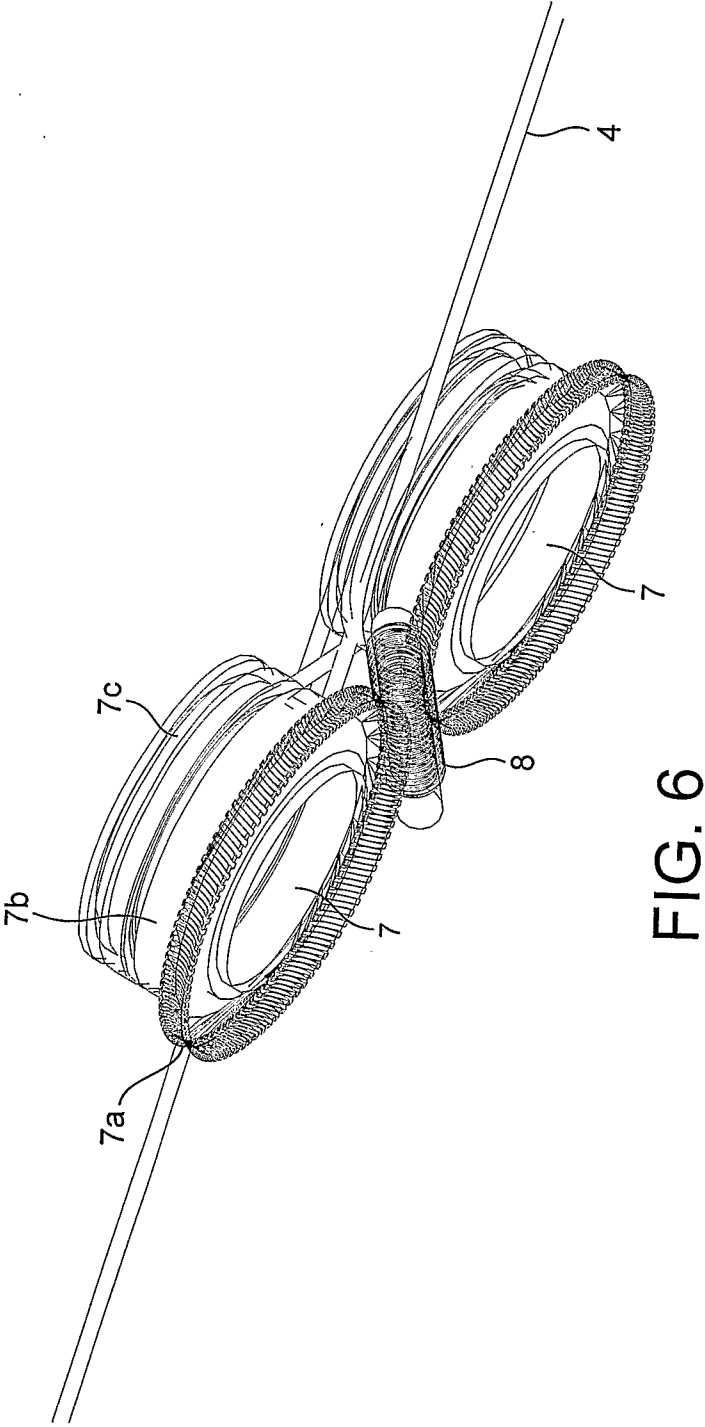


FIG. 5



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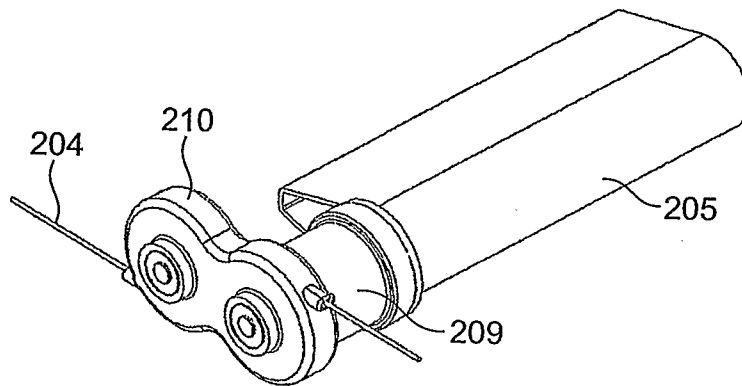


FIG. 7

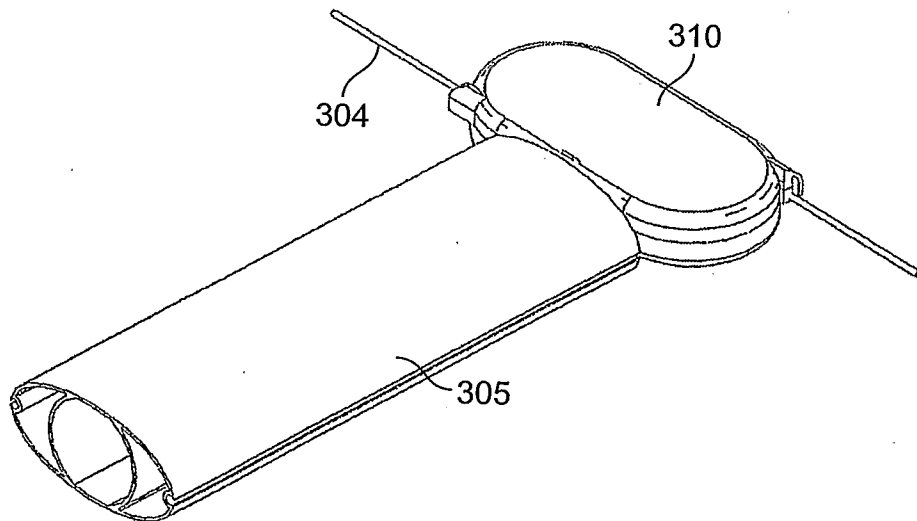


FIG. 8

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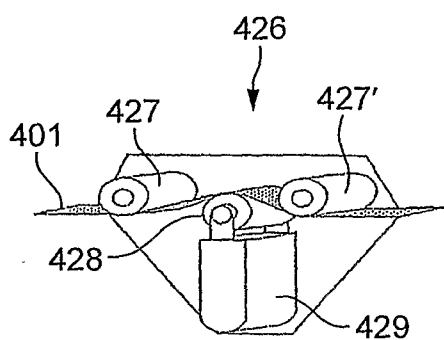


FIG. 9

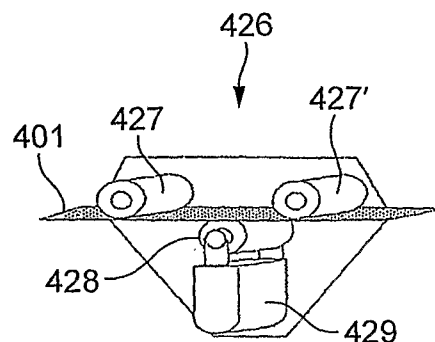


FIG. 10

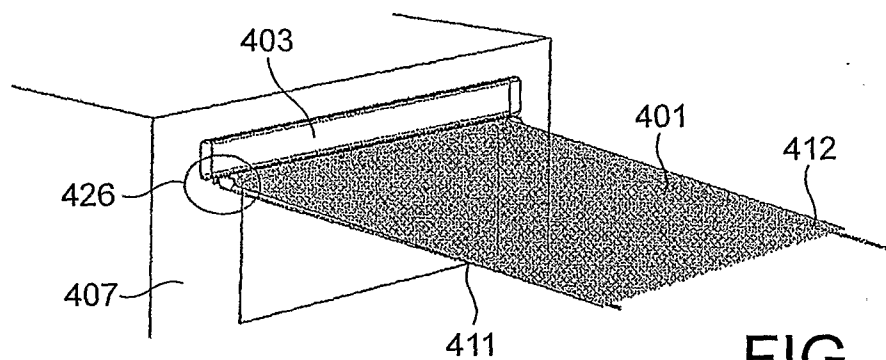


FIG. 11

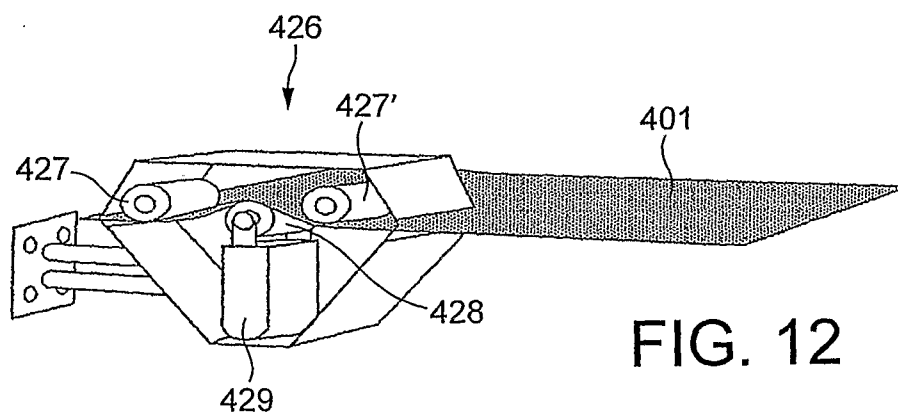


FIG. 12

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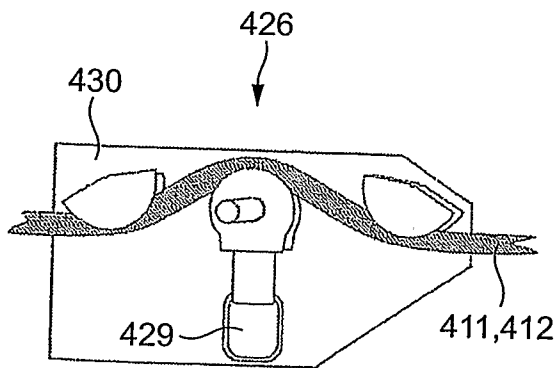


FIG. 13

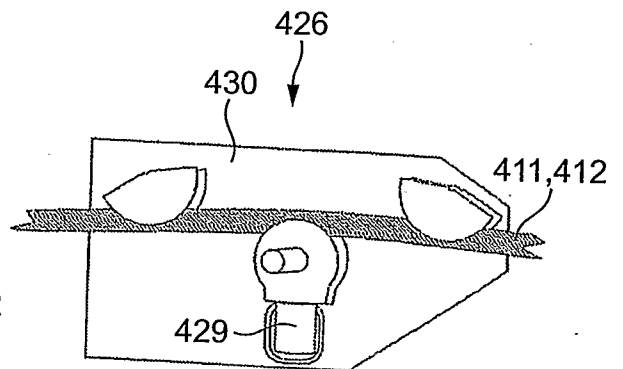


FIG. 14

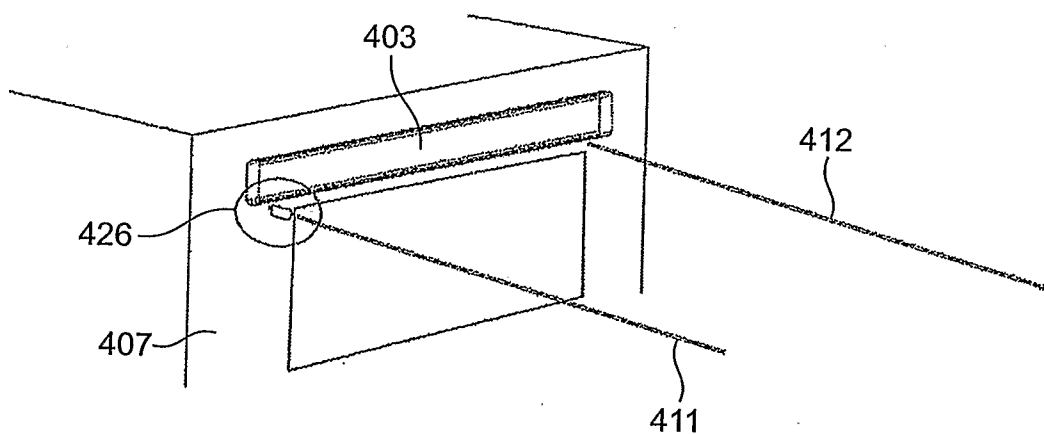


FIG. 15

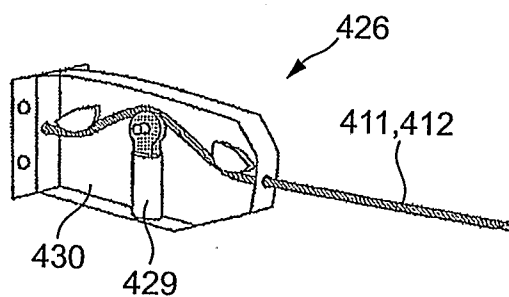


FIG. 16

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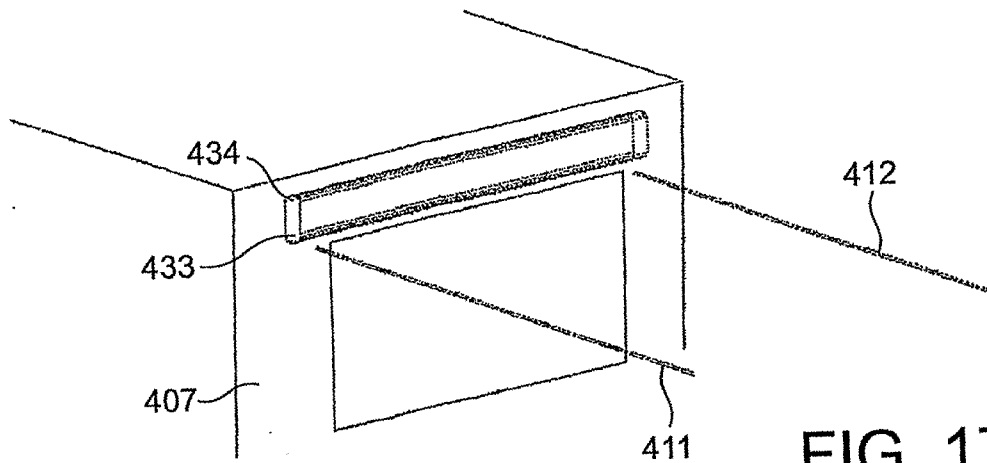


FIG. 17

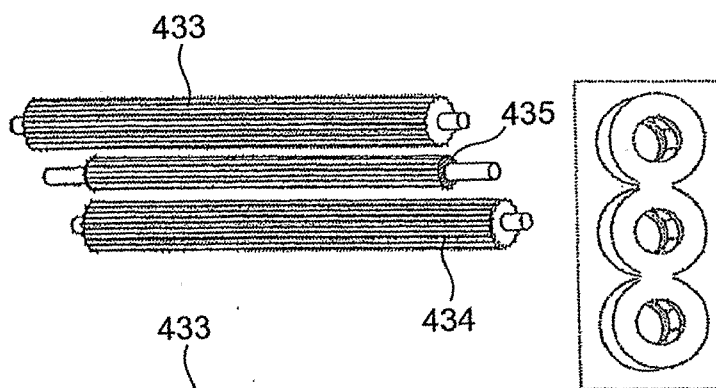


FIG. 18

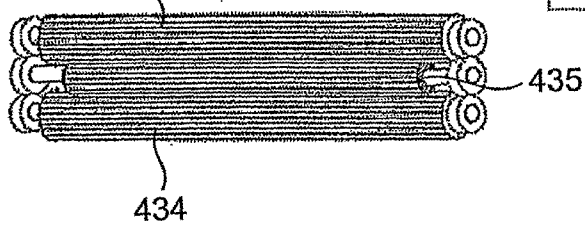
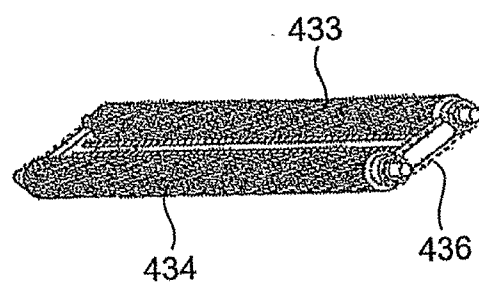
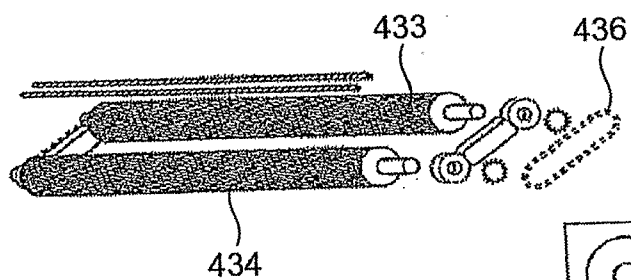


FIG. 19



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