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(72) Inventors:
• **MARTIN, David**
3008 AB Rotterdam (NL)
• **DEKKER, Nico**
3008 AB Rotterdam (NL)

(74) Representative: **Smith, Samuel Leonard**
J A Kemp
14 South Square
Gray's Inn
London WC1R 5JJ (GB)

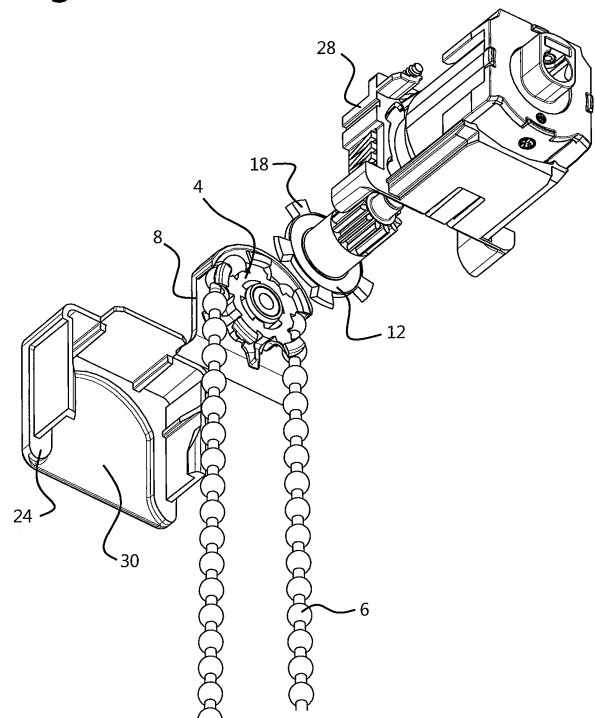
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(71) Applicant: **HUNTER DOUGLAS INDUSTRIES B.V.**
3071 EL Rotterdam (NL)

(54) **DRIVE UNIT FOR AN ARCHITECTURAL OPENING COVERING**

(57) A drive unit for mounting to the head rail of an architectural opening covering, the drive unit including a drive wheel (4) and an operating wheel (12). The drive wheel (4) has an outer periphery configured to receive and support an elongate portion of a continuous looped member, and is configured to rotate about a first axis by longitudinal translation of the continuous looped member with rotation of the outer periphery about the first axis. The operating wheel (12) is configured to rotate about a second axis and to rotate a winding core of the architectural opening covering. The drive wheel (4) is releasably attached coaxially to the operating wheel (12) and is configured, when attached to the operating wheel (12), to transfer rotation of the drive wheel (4) to rotation of the operating wheel (12).

Fig. 3a



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Description

[0001] The present invention relates to a drive unit for an architectural opening covering, in particular a drive unit for mounting to a head rail of an architectural opening covering allowing drive to be transmitted from an elongate continuous looped member to a winding core of the architectural opening covering.

[0002] It is well known to operate window coverings with continuous looped members such as bead chains. Child safety solutions have become increasingly important in this field. A bead chain forms a loop in which a child can become entangled if the chain hangs low enough. Several conventional ways have been proposed to solve this problem. For example, it is possible to secure the loop of the bead chain with a cord cleat against the wall such that a child cannot get between the bead chain loop and the wall and cannot become entangled. Alternatively, a break away can be provided in the bead chain itself so that it will break when a certain force acts upon it. Another option is to provide a loop which is sufficiently short that it hangs out of reach of any child.

[0003] WO 2011/078233 describes an operation device for sunshade equipment. An operation cord extends around and operates a chain wheel for the sunshade equipment. The chain wheel is composed of first and second chain wheel pieces between which the operation cord fits. If an excessive pulling force is applied to the operation cord, then the first and second chain wheel pieces separate from each other, allowing the operation cord to be pulled from between the two pieces of the chain wheel.

[0004] EP 1 319 793 describes a cord-operated blind with a housing. A first drive wheel is coaxial with and drives a member for opening and closing the covering. A second drive wheel is provided below the first drive wheel and engages with the first drive wheel at its periphery so as to drive it. The operating cord loops around the second drive wheel. When the operating cord is pulled with sufficient force, the second drive wheel disconnects from the first drive wheel and the housing.

[0005] EP 2 574 717 describes a braking device for a chain on a screen. The chain engages on to a sprocket which is connected to a first toothed wheel. The sprocket and the first toothed wheel rotate together about an axis substantially perpendicular to the axis of a second toothed wheel with which the first toothed wheel engages. The second toothed wheel rotates to operate the device. The device comprises a housing formed of first and second housing parts that are detachable. The first housing part supports the first toothed wheel and, when the chain is pulled with sufficient force, the first housing part detaches from the second housing part with the first toothed wheel and the chain.

[0006] US 2011/048657 describes a blind having a roll-up control unit with a coupled wheel for driving the blind. Beneath the coupled wheel and engaging with it is a wheel driven by a cord. That wheel is mounted such that,

when the roll-up control unit is subjected to synchronous excessive pulling from two sides of the cord, portions of the unit deform and allow the wheel, about which the cord extends, to detach.

[0007] With regard to these prior art arrangements, it would be desirable to provide a nondestructive disconnection which can be arranged more compactly with relatively easy reconnection when necessary.

[0008] According to the present invention, there is provided a drive unit for mounting to the head rail of an architectural opening covering. The drive unit may include a drive wheel, an operating wheel and an attachment arrangement. The drive wheel may have an outer periphery configured to receive and support an elongate portion of a continuous looped member. The longitudinal translation of the continuous looped member may cause rotation of the outer periphery of the drive wheel and the drive wheel itself so as to rotate the drive wheel about a first axis. The operating wheel may be configured to rotate about a second axis. It may be provided to rotate a winding core of the architectural opening covering. The attachment arrangement may be configured to releasably attach the drive wheel coaxially to the operating wheel. The attachment arrangement may further be configured to, when the drive wheel is attached to the operating wheel, transfer rotation of the drive wheel to rotation of the operating wheel.

[0009] In this way, the drive unit, having the drive wheel, may be assuredly driven by a continuous looped member whilst, when necessary, allowing the continuous looped member to become detached from the drive unit. In particular, the continuous looped member may remain engaged with the drive wheel when the drive wheel releases from attachment to the drive unit, by releasing from the operating wheel. The operating wheel need not act with the drive wheel to receive and support the elongate portion of the continuous looped member; the drive wheel may by itself support the continuous looped member. By releasably attaching the drive wheel coaxially with the operating wheel, it is possible to provide secure rotational drive to the operating wheel whilst allowing a compact assembly.

[0010] The attachment arrangement may be distributed between the drive wheel and the operating wheel. It may be configured to transfer a circumferential force in at least one of two opposite directions between the drive wheel and the operating wheel about the coaxial first and second axes. It may also be configured to release the drive wheel from the operating wheel under a radial/axial load (with respect to those axes). In particular, it may be configured to facilitate release under a radial/axial load when transferring substantially no circumferential force.

[0011] In this way, a simple construction may be provided for releasably attaching the drive wheel to the operating wheel, thereby effectively transferring a circumferential force from the drive wheel to the operating wheel. When the continuous looped member is pulled on both sides such that there is substantially no, or at least

only a small, circumferential force between the drive wheel and the operating wheel, the arrangement may be configured to allow release.

[0012] The attachment arrangement may include a plurality of first features on the drive wheel configured to engage with a corresponding plurality of second features on the operating wheel.

[0013] The first features may extend both axially from the drive wheel towards the operating wheel and circumferentially in a direction with respect to the drive wheel. Alternatively or in addition, the second features may extend both axially from the operating wheel towards the drive wheel and circumferentially in a second direction, opposite to the first direction, with respect to the operating wheel. In this way, when the drive wheel is attached to the operating wheel and transfers a circumferential force in one direction, the first features extend behind the second features and prevent the drive wheel separating axially from the operating wheel. On the other hand, when no load is transferred between the drive wheel and the operating wheel, the first and second features are not driven behind each other. As a result, it becomes possible to pull the drive wheel axially away from the operating wheel so as to release the drive wheel from the operating wheel.

[0014] The attachment arrangement may include a plurality of third features on the drive wheel configured to engage with a corresponding plurality of fourth features on the operating wheel.

[0015] The third features may extend both axially from the drive wheel towards the operating wheel and circumferentially in the second direction with respect to the drive wheel. Additionally or alternatively, the fourth features may extend both axially from the operating wheel towards the drive wheel and circumferentially in the first direction with respect to the operating wheel. In this way, when the drive wheel is attached to the operating wheel and transfers a circumferential force in an opposite direction to said one direction, the third features extend behind the fourth features and prevent the drive wheel separating axially from the operating wheel. Thus, similarly to as described above, when no circumferential force or load is transferred between the drive wheel and the operating wheel, the third and fourth features are not driven behind one another and it becomes possible to separate the drive wheel axially from the operating wheel.

[0016] The attachment arrangement may include a plurality of drive wheel attachments on the drive wheel and a corresponding plurality of operating attachments on the operating wheel. Each drive wheel attachment may include a first feature and/or a third feature. Each operating attachment may similarly include a second feature and/or a fourth feature.

[0017] The "plurality" as discussed above with regard to the first to fourth features, drive wheel attachments and operating attachments may be an odd number. Alternatively or additionally, it may be at least five.

[0018] The drive wheel attachments may be provided

as protrusions on the drive wheel. Where the drive wheel has the form of a toothed wheel for engaging beads of a chain, the protrusions might conveniently align with the teeth of the drive wheel. However, a similar protrusion might extend axially at any appropriate portion of the side surface of the drive wheel.

[0019] The operating attachments may be provided as teeth on the operating wheel. Alternatively, suitable operating attachments may be provided appropriately in an axial side surface of the operating wheel.

[0020] The drive wheel attachments and operating attachments may be provided as appropriately spaced and aligned protrusions and/or recesses which engage with one another.

[0021] The operating attachments of the operating wheel may extend radially. Lateral edges of the operating attachments (extending between axially opposite side surfaces of the wheel) may be angled so that the circumferential width of each operating attachment increases from a side of the operating wheel away from the drive wheel to a side of the operating wheel towards the drive wheel.

[0022] Additionally or alternatively, with the drive wheel attached to the operating wheel, the drive wheel attachments (e.g. protrusions) of the drive wheel may extend between respective operating attachments (e.g. teeth) of the operating wheel and (axially extending) lateral edges of the drive wheel attachments may be angled so that the circumferential width of each drive wheel attachment increases from a side of the drive wheel away from the operating wheel to a side of the drive wheel towards the operating wheel.

[0023] By angling one or both of the lateral edges of the operating attachments and the lateral edges of the drive wheel attachments, when a circumferential load is transferred between the drive wheel and the operating wheel, the drive wheel and operating wheel may be securely attached to one another. However, without such a circumferential load, an axial or radial force on the drive wheel will cause the angled lateral edges to produce relative rotation between the drive wheel and the operating wheel so as to allow the drive wheel attachments to disengage from the operating attachments and the drive wheel to release from the operating wheel.

[0024] Radially outer circumferential edges of the operating wheel between respective operating attachments may be inclined from a larger radius at the operating wheel side to a smaller radius at the drive wheel side so as to provide an axial force acting to separate the drive wheel from the operating wheel in response to a radial force on the drive wheel with respect to the operating wheel.

[0025] Additionally or alternatively, radially inner circumferential surfaces of the drive wheel attachments extending against the corresponding respective outer edges of the operating wheel may be inclined from a larger radius at the operating wheel side to a smaller radius at the drive wheel side so as to provide an axial force acting

to separate the drive wheel from the operating wheel in response to a radial force on the drive wheel with respect to the operating wheel.

[0026] The continuous looped member may extend around substantially half the outer periphery of the drive wheel. It may extend away from the drive wheel at respective diametric opposite sides of the drive wheel. The drive wheel may release from the operating wheel only when the continuous looped member pulls the drive wheel on both diametric sides simultaneously.

[0027] In this way, there need not be any limit to the force which the continuous looped member is able to drive the drive wheel.

[0028] One of the drive wheel and the operating wheel may include a hub having a truncated conical outer surface. The other of the drive wheel and the operating wheel may include a truncated conical cavity. The hub and the cavity may be coaxial with the first and second axes.

[0029] The hub and cavity may assist in locating the drive wheel to the operating wheel. They may also assist in providing a secure engagement between the drive wheel and the operating wheel during operation. Also, by being conical, they may assist in release when appropriate.

[0030] One or both of the drive wheel and the operating wheel may include one or more magnets for attaching the respective drive wheel or operating wheel to the other of the drive wheel and the operating wheel.

[0031] In this way, when reassembling the drive wheel to the operating wheel, such magnets may assist in re-locating the drive wheel against the operating wheel.

[0032] According to the present invention, there may also be provided a drive unit including the features described above, together with a continuous looped member having an elongate portion received and supported by the outer periphery of the drive wheel.

[0033] The drive unit may further include a backing plate. A side of the drive wheel, opposite to a side for releasable attachment to the operating wheel, may be mounted to the backing plate for rotation about the first axis. The backing plate, drive wheel and a continuous looped member may be provided as a unit for attachment and detachment from the operating wheel and the head rail to which the operating wheel is mounted.

[0034] The backing plate may be configured to be resiliently engaged within a head rail of an architectural opening covering. The resilience of that engagement may be provided by one or both of the backing plate and the head rail. For example, one or both of the backing plate and the head rail may flex slightly so as to release the engagement and allow the backing plate, together with the rest of the drive unit to disengage from the head rail of the architectural opening covering.

[0035] With this arrangement, it is possible to reduce the risk of the drive wheel inadvertently detaching from the operating wheel when the drive wheel is at rest and not being operated. The arrangement offers some resistance to the drive unit separating from the head rail, but

nevertheless allows the drive wheel to releasably detach from the operating wheel and pull away from the head rail in the intended circumstances, for example when a child becomes caught in the continuous looped member extending from the drive wheel. The arrangement is particularly useful for use with long and/or heavy continuous looped members which are otherwise more prone to causing the drive wheel to detach from the operating wheel.

[0036] The backing plate may include at least one of a recess and a protrusion configured to engage resiliently with the head rail. In this respect, the head rail may be provided with a corresponding protrusion configured to engage resiliently either with a recess or a protrusion of the backing plate. Similarly, the head rail may be provided with a recess configured to engage resiliently with a protrusion of the backing plate.

[0037] In some arrangements, the backing plate may be configured to engage with an inherent feature of the head rail. For example, the head rail may include an outer housing and the backing plate may be configured, for instance with a protrusion, to engage with an inner peripheral edge of the housing.

[0038] In an architectural opening covering arranged to guide the continuous loop member from a lower surface and arranged for the backing plate and drive wheel to separate directly from that lower surface, the backing plate may be configured to resiliently engage with the head rail on opposite respective sides of the backing plate. In this way, the backing plate may be pulled away from those opposite sides substantially simultaneously. On the other hand, in arrangements where the continuous looped member is to extend from a side face of the head rail and the backing plate and drive wheel separate from that side face before then being pulled downwardly away from the lower face, it may be preferred to provide only resilient engagement between the backing plate and the head rail towards the top of the head rail such that, when that resilient engagement is released, the backing plate substantially pivots around a lower portion whilst being pulled sideways out of the head rail.

[0039] According to the present invention, there may also be provided an architectural opening covering including a rotatable winding core and a drive unit as described above with the operating wheel of the drive unit configured to rotate the winding core.

[0040] The invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings, in which:

Figures 1(a) and 1(b) illustrate an embodiment of the present invention in conjunction with the head rail of an architectural opening covering;

Figures 2(a), (b) and (c) illustrate operation of a drive unit embodying the present invention;

Figures 3(a) and (b) illustrate component parts of the embodiment of Figures 1(a) and (b);

Figures 4(a) and (b) illustrate an alternative embodiment;

Figures 5(a) and (b) illustrate a releasable attachment of the present invention as embodied in the arrangement of Figures 4(a) and (b);

Figure 6 illustrates a cross-section through an arrangement embodying the present invention;

Figure 7 illustrates a cross-section through an arrangement embodying the present invention;

Figures 8(a) and (b) illustrate an alternative embodiment; and

Figures 9(a) and (b) illustrate an alternative embodiment.

[0041] The present invention relates to a means of driving a winding core of an architectural opening covering with a continuous looped member, such as a bead chain. This may be applied to any type of blind, such as a venetian blind, pleated blind, honeycomb blind, roman shade, roller blind, or the like. The driven winding core may for instance include an operating shaft with spools for receiving a lift and/or tilt cord, or a roller for receiving wound layers of blind material, such as a fabric, foil, sheet, tape, or the like.

[0042] Figures 1(a) and (b) illustrate an embodiment of the present invention. As illustrated, the drive unit (2) includes a rotatable drive wheel (4) having an outer periphery which receives and supports the elongate portion of a continuous looped member which, in the illustrated embodiment, comprises a bead chain (6).

[0043] As illustrated, the drive wheel (4) takes the form of a chain wheel. Although not essential to the present invention, in the illustrated embodiment, the drive wheel (4) is attached rotatably to a backing plate (8). The drive wheel (4) rotates about a central axis coaxial with its mounting on the backing plate (8). The drive wheel (4), together with the backing plate (8) when provided, forms a single unit which is easy to assemble and replace when pulled out of a head rail.

[0044] The continuous looped member, formed as the bead chain (6) as illustrated, extends around the periphery of the drive wheel (4). By pulling on one side of the bead chain (6) as it extends away from one diametric side of the drive wheel (4), the drive wheel (4) may be rotated. By pulling on the opposite side of the bead chain (6) extending away from the opposite diametric side of the drive wheel (4), the drive wheel (4) may be rotated in the opposite direction.

[0045] As illustrated in Figure 1(b), the drive unit is also provided with an operating wheel (12), which, in the illustrated embodiment, takes the form of a toothed wheel (12). The operating wheel or toothed wheel (12) is rotatable about a central axis and is configured to rotate and operate some portion of an architectural opening covering with which it is to be used. As illustrated, the operating wheel (12) may be attached to or integral with an axial member (14) having gear teeth (16) around an outer peripheral portion for driving some portion of the architec-

tural opening covering. Irrespective, rotation of the operating wheel or toothed wheel (12) is configured to rotate a winding core of the architectural opening covering.

[0046] In the illustrations provided by Figures 1(a) and 1(b), the drive wheel (4) and operating wheel (12) are separated from one another. However, as will be described in greater detail below, in an assembled state, the drive wheel (4) is releasably attached coaxially to the operating wheel (12). The operating wheel (12) may include operating attachments, which in the illustrated embodiment have the form of teeth (18) which extend radially with respect to the operating wheel (12). The drive wheel (4) include corresponding drive wheel attachments, which in the illustrated embodiment have the form of protrusions (20) (as best seen in figures 5(a) and 5(b)) which, with the drive wheel (4) releasably attached to the operating wheel (12), engage with the operating wheel (12) between the operating attachments, more particularly the teeth (18).

[0047] If a child becomes entangled in a lower loop of the bead chain (6), the unit comprising the drive wheel (4) and the backing plate (8) (where provided) will be released from the operating wheel (12), thereby preventing injury to the child without damaging the blind. The entire unit can thereafter be easily inserted back into position for normal operation to be resumed.

[0048] Figures 1(a) and 1(b) illustrate the various components in conjunction with the end of a head rail (22) of an architectural opening covering. As illustrated, the operating wheel (12) may be rotatably mounted at the far end of the head rail (22) for operating components inside the head rail (22). An end cap (24) may be provided and configured to fit over the very end of the head rail (22) and to cover the operating wheel (12), drive wheel (4) and backing plate (8) where provided. The head rail (22) and end cap (24) may together define an opening (26) from which the two sides of the looped member (6) extend. Indeed, as illustrated, the opening (26) is sufficient to allow passage of the drive wheel (4) (and backing plate (8) where provided) when it becomes detached from the operating wheel (12).

[0049] After the drive wheel (4) has become detached and is pulled away from the head rail (22), it may be possible to insert the drive wheel (4) through the opening (26) and reattach it to the operating wheel (12). However, in some circumstances, it may be preferable to remove the end cap (24) from the head rail (22), for example by sliding the end cap (24) axially away from the head rail (22), so as to facilitate reattachment of the drive wheel (4) onto the operating wheel (12).

[0050] Referring to Figures 2(a), (b) and (c) operation of an embodiment will be described.

[0051] In Figure 2(a) the drive wheel (4) and the operating wheel (12) are in engagement and aligned. This situation remains when the looped member (6) is not pulled or when only one side of the looped member (6) is pulled, for example in order to lower or raise a blind.

[0052] As illustrated in Figure 2(b), when both sides of

the looped member (6) are pulled, for example when a child becomes entangled in the looped member (6), the unit formed from the backing plate (8) and drive wheel (4) tilts away from the operating wheel (12) and out of alignment. In the illustrated embodiment, this is possible because there is some free space between the back plate (8) and the inner surface of the end cap (24) of the head rail (22).

[0053] As illustrated in Figure 2(c), as the protrusions (20) of the drive wheel (4) clear the operating wheel (12) and the unit formed of the drive wheel (4) and backing plate (8) tilts out of alignment, that entire unit is released from the head rail of the blind. Subsequently, it is relatively easy for a user to reinsert the unit formed from the drive wheel (4) and backing plate (8) and re-engage the drive wheel (4) on the operating wheel (12). The backing plate (8), although not necessary, may then facilitate handling and (re)positioning/alignment of the drive wheel (4).

[0054] Figures 3(a) and (b) illustrate the arrangement of Figures 1(a) and (b) removed from the head rail (22). They illustrate an operating unit (28) for use in the head rail of an architectural opening covering, including aforementioned winding core. Figure 3(a) also illustrates an inner surface of the end cap (24) having profiling for guiding the backing plate (8). In the illustrated embodiment, the end wall of the end cap (24) has a reduced thickness corresponding to the shape of the backing plate (8) so that the inner surface forms a recessed section (30) corresponding to the backing plate (8). With the end cap (24) in place, the inner surface of the end cap (24) formed by the recess (30) is preferably in close proximity to the backing plate (8) so as to keep the overall construction as small as possible. However, the arrangement leaves sufficient space between the recessed surface (30) and the backing plate (8) for the drive wheel (4) to move axially away from the operating wheel (12) and become detached.

[0055] The above arrangement is advantageously used with blinds having limited depth, i.e. having a depth that is smaller than the diameter of the drive wheel (4). Such blinds include for instance roller blinds or roman shades where the leading and return portion of the looped member (6) can hang in front and behind respectively the blind without interfering with the blind material.

[0056] Figures 4(a) and 4(b) illustrate an alternative front side embodiment which may be more suitable for blinds of larger depth, such as venetian blinds, honeycomb blinds, pleated blinds, or the like. With this arrangement, the looped member (6) can hang in front of the blind material, with some clearance between the two so that the looped member (6) does not interfere with the blind material.

[0057] In the illustrated embodiment, the end cap (24a) defines an opening (26a) at one side. In the illustrated embodiment, to assist with guiding the looped member (6), a backing plate (8a) may additionally be provided with a guide portion (8b) for guiding the two sides of the looped member (6) in and out of the opening (26a). In

one arrangement, the guide portion (8b) may be arranged to guide the upper side of the looped member (6) laterally further out than the lower side of the looped member (6).

[0058] Figures 5(a) and (b) illustrate in more detail the drive wheel (4) and operating wheel (12) provided with a backing plate (8 a) for use, for example, for providing a looped member outlet directed to the front side.

[0059] Figures 5(a) and (b) illustrate more clearly the interaction between the teeth (18) of the operating wheel (12) with the protrusions (20) of the drive wheel (4).

[0060] By virtue of the operating attachments, such as for instance the illustrated teeth (18) and the drive wheel attachments, such as for instance the illustrated protrusions (20), the drive wheel (4) can be considered to include a plurality of features, more particularly a first and/or third feature which engage with a corresponding plurality of features, more particularly a second and/or fourth feature on the operating wheel (12), as will be explained in further detail below.

[0061] When the drive wheel (4) is rotated by a looped member (6) in the direction as indicated by the arrow in Figures 5(a) and 5(b), one side of the drive wheel attachments, or more particularly the protrusions (20) abuts a facing side of the operating attachments, or more particularly the teeth (18). The facing sides may form the first, respectively second feature as mentioned above. As illustrated and perhaps best seen in Figure 5(b), an abutting side of a protrusion (20) extends not only axially away from the drive wheel (4), but also circumferentially towards the abutting tooth (18) so as to form a first feature. Similarly, the abutting tooth has a profile extending both radially and circumferentially so as to form a second feature. In the illustrated embodiment, the abutting surfaces are a substantially planar but angled surfaces. Other alternative abutting surfaces are possible including curved surfaces and surfaces with discontinuities. Embodiments are also possible with aforementioned first, respectively second feature provided on only one of the drive wheel (4) and the operating wheel (12). Indeed, where these are provided merely on a drive wheel and/or an operating wheel, one or other of the components can merely be provided with apertures, rather than teeth or protrusions. Similarly, the relevant features might be provided alternately around the periphery of the drive wheel and the operating wheel between those two components.

[0062] As will be understood, the purpose of the features extending both axially and circumferentially so as to locate behind the opposite features is to firmly secure the drive wheel (4) to the operating wheel (12) in an axial direction whilst a load is being transmitted in one rotational direction between the drive wheel (4) and operating wheel (12).

[0063] For embodiments where operation requires drive in only one direction, the arrangement as described above is sufficient. However, embodiments, such as that illustrated, may be provided which provide operating drive in either direction whilst securely maintaining the attachment of the drive wheel (4) to the operating wheel

(12). In this regard, opposite sides of the protrusions (20) and teeth (18) may be considered to have third and fourth features which engage with one another. Similarly to the first and second features as described above, they extend both axially and circumferentially. The protrusions (20) and teeth (18) are spaced apart by at least the maximum circumferential length of each other so that, with no load being transmitted between the drive wheel (4) and operating wheel (12), they may separate from one another, in axial direction. With the drive wheel (4) rotated in the direction opposite to that illustrated in Figures 5(a) and (b), the sides of the protrusions (20) and teeth (18) opposite to those discussed above abut one another. Those sides thus forming features extending axially and circumferentially behind one another to prevent the drive wheel (4) separating axially from the operating wheel (12).

[0064] In the illustrated embodiment, both lateral edges of each respective tooth (18) of the operating wheel (12) and also both lateral edges of the respective protrusions (20) of the drive wheel (4) are angled or "wedge shaped" when viewed from the outside looking radially inward toward the centre. In other words, those top surfaces are substantially trapezoidal. When only one side of the looped member (6) is pulled, for example to raise or lower a corresponding blind, the drive wheel (4) will rotate with respect to the operating wheel (12) until the protrusions (20) abut the teeth (18). Because of the wedge shape of the engaging edges, the drive wheel (4) and operating wheel (12) become interlocked both in circumferential and in axial directions. Indeed, the angled lateral edges act to pull the drive wheel (4) towards the operating wheel (12) under a rotational load. Any rotational load or force is transferred from the drive wheel (4) to the operating wheel (12). As long as only one side of the looped member (6) is pulled, the drive wheel (4) and the operating wheel (12) remain securely engaged and will rotate in unison with the facing wedge shaped edges abutted.

[0065] When both sides of the looped member (6) are pulled simultaneously, there will no longer be a resultant rotational force or load on the drive wheel (4). As a result, the protrusions (20) and teeth (18) are no longer actively pulled against each other. The wedge shaped edges may still abut each other, but they will no longer be actively (in other words forcefully) engaged. The force, therefore, on the drive wheel (4) (acting on both sides of the drive wheel (4)) is able to pull the drive wheel (4) axially away from the operating wheel (12). Noting that the looped member (6) extends around a top surface of the periphery of the drive wheel (4) (or at least a surface opposite to the direction from which the looped member (6) pulls on the drive wheel (4) irrespective of its orientation) and that this is above the axis of the drive wheel (4) (or at least beyond the axis irrespective of orientation) and noting also that the looped member (6) wraps around the periphery of the drive wheel (4) at a portion stepped axially away from the engagement between the protrusions (20)

and teeth (18), the force of the looped member (6) acting on the drive wheel (4) will inevitably produce a moment tending to pull the top (opposite) side of the periphery of the drive wheel (4) away from the operating wheel (12).

[0066] Figure 6 illustrates a cross-section through an embodiment including a feature arranged to promote this effect.

[0067] As illustrated, the protrusions (20) of the drive wheel (4) includes an angled radial inner edge. In other words, the edge of the protrusions (20) on the radial inner side of the protrusions (20) are angled (A) outwardly from a smaller diameter towards the drive wheel (4) to a larger diameter away from the drive wheel (4). This angled inner edge is arranged to engage with a radial outer edge of the operating wheel between the teeth (18). The angled inner edge causes a pulling force (from the looped member (6) on the drive wheel (4)) to have a normal component (in other words orthogonal to the angled inner edge) and a lateral component (in other words parallel to the angled inner edges). Without the drive wheel (4) and the operating wheel (12) being kept in engagement by their wedge-shaped edges as explained above, then the lateral force component will allow the drive wheel (4) to become separated from the operating wheel (12). A similar effect may be achieved by, in addition or alternatively, the radial outer edge of the operating wheel between its teeth being angled.

[0068] Figure 6 also illustrates the space provided between the inner surface (30) of the end cap (24) and the backing plate (8). This allows the unit formed by the backing plate (8) and drive wheel (4) to move radially away from the operating wheel (12) until the protrusions (20) are completely disengaged from the operating wheel (12) and the unit falls out from the head rail.

[0069] Figure 7 further illustrates how separation of the drive wheel (4) from the operating wheel (12) is helped by the fact that the work line of the pulling force F is offset from the work line of the reaction forces, i.e. the point where the inner edges of the drive wheel protrusions (20) contact the operating wheel (12). Thus, as described above, the pulling force on the drive wheel (4) exerts a moment on the drive wheel (4) (and the unit it forms with the backing plate (8)) that causes the unit to tilt away. As described above, this may be aided by angled radial inner edges on the protrusions (20) of the drive wheel (4) and/or angled radial outer edges of the operating wheel (12) between its teeth (18).

[0070] Figures 6 and 7 also illustrate an embodiment having a drive wheel (4) with a central hub (40) having a truncated conical outer surface that, in the mounted condition, fits into a truncated conical cavity (42) of the operating wheel (12). As illustrated, the central hub (40) and conical cavity (42) are coaxial with the drive wheel (4) and operating wheel (12).

[0071] As illustrated, the diameter of the hub (40) decreases with distance away from the drive wheel (4). Correspondingly, the conical cavity (42) decreases in diameter inwardly of the operating wheel (12). In this way, the

load bearing surfaces of the central hub (40) and conical cavity (42) at the bottom are sloped (B) so as to facilitate disengagement of the drive wheel (4) from the operating wheel (12).

[0072] It will be appreciated that a similar effect can be achieved with a central hub on the operating wheel (12) being inserted into a conical cavity in the drive wheel (4). The load bearing surfaces at the top will then facilitate disengagement.

[0073] The interaction of the central hub and conical cavity is not only helpful to the user for locating the drive wheel (4) onto the operating wheel (12), but it may also be beneficial in the case of larger, heavier blinds or for blinds provided with a heavy looped member, for instance a metal bead chain. It provides a more reliable centering between the drive wheel (4) and the operating wheel (12). In particular, with such blinds, the operating forces on the drive wheel (4) when pulling on the looped member (6) are larger than with other blinds and potentially large enough to cause the drive wheel (4) to lose its centred position with regard to the operating wheel (12).

[0074] In some embodiments, one or more magnets (50) may be provided in one of the drive wheel (4) and the operating wheel (12). A corresponding opposite plurality of magnets or ferrous material may be provided on a facing surface of the other of the drive wheel (4) and operating wheel (12). Such an arrangement will assist with axial engagement between the drive wheel and the operating wheel (12). In the embodiment illustrated in Figures 6 and 7, magnets (50) are provided within the hub (40) of the drive wheel (4) and behind the innermost surface of the conical cavity (42). In this way, the outermost front surface of the hub (40) will engage magnetically with the innermost surface of the cavity (42). With this arrangement, the magnetic attraction/engagement will only occur once with hub (40) moves within the cavity (42). When the drive wheel (4) is released, it can be inserted back into a head rail towards the operating wheel (12) and the magnets (50) help to snap the drive wheel (4) back into its correct position. It is not necessary for the back plate (8) to play any part in securing the unit formed of the back plate (8) and drive wheel (4) to the inside of the head rail.

[0075] In some embodiments, the features formed on the drive wheel and the operating wheel for release of attachment may be provided in an odd number. In other words, there may be provided an odd number of drive wheel attachments, such as the protrusions (20) and an odd number of operating attachments such as the teeth (18). This has an advantage that the attachments are then never directly opposite each other due to their spacing around the circumference of their respective wheels. In this way, there are never forces opposite each other to reduce the effectiveness of releasing the drive wheel.

[0076] Although arrangements are possible with only two attachments on each of the drive wheel and the operating wheel, in order to spread the effectiveness of attachment around the circumference of the drive wheel

and the operating wheel and in order to provide a substantially equal releasing effectiveness at any rotational orientation, there are preferably at least five attachments on each of the drive wheel and the operating wheel.

[0077] In order to reduce the likelihood of the drive wheel and associated components falling out of the head rail, even without external forces on the looped member (6), in some arrangements, the backing plate (8) may be configured to be resiliently engaged within the architectural opening covering. It may engage with any part of the head rail (22), for instance the end cap (24). This may be particularly advantageous where the looped member (6) is heavy, for example where the blind is very large and a lot of looped member length is needed to operate it, thereby increasing the weight of the looped member. Similarly, it may be advantageous where the looped member is made of metal, thereby adding to its weight and/or where a cord weight is looped onto the looped member in order to keep it hanging straight down.

[0078] In Figures 8(a) and (b), there is illustrated an example equivalent to that of Figures 3(a) and (b) where the looped member exits from the bottom. This may be used, for example, for a roman shade.

[0079] In this arrangement, the backing plate (8) resiliently engages with the end cap (24) on opposite respective sides. In the illustrated embodiment, backing plate (8) is formed with respective protrusions (108) which are engaged behind (above) ridges or protrusions (124) of the housing formed by the backing plate (24). As illustrated in Figure 8(a), during normal use, the protrusions (108) of the backing plate (8) are held resiliently in recesses behind (above) the protrusions (124) of the end cap (24). The corresponding respective components are shaped such that, with sufficient force acting on the backing plate (8) via the looped member (6) and drive wheel (4), the walls of the end cap (24) flex outwardly so as to allow the protrusions (108) of the backing plate (8) to pass beyond the protrusions (124) of the end cap (24) and so as to allow the backing plate (8), together with the drive wheel (4) and looped member (6), out of the head rail. The resilient interaction/engagement between the backing plate (8) and head rail thus provides an initial threshold. When a force acts on the looped member, that force has to be greater than that initial threshold before the sidewalls of the housing will flex away and allow the backing plate to fall out of the head rail. The threshold may be set to be greater than the weight of the looped member (and a cord weight if provided).

[0080] Figures 9(a) and (b) illustrate an arrangement equivalent to that of Figures 4(a) and (b) where the looped member exits from a side face, for example at the front. This may be useful in arrangements such as with venetian blinds.

[0081] With this arrangement, as illustrated in Figure 9(b), the backing plate (8a, 8b) will tend to pivot sideways out of the housing formed by the end cap (24a). Hence, it is only necessary to provide resilient engagement on one side, namely the upper side, of the backing plate (8a,

8b).

[0082] As with the previous embodiment, a protrusion (108) on the backing plate (8a, 8b) is held resiliently behind a protrusion (124a). However, in the illustrated arrangement, the protrusion (124a) may be provided as an inherent part of the head rail itself. As illustrated, the housing formed by the end cap (24a) forms an inner peripheral edge (124a). the protrusion (108a) of the backing plate (8a,8b) is held behind that edge (124a) until the initial threshold is exceeded where upon the walls of the housing formed by the end cap (24a) may flex so as to release the protrusion (108a) and backing plate (8a,8b) as illustrated in Figure 9(b).

[0083] In the manner described above, the weight of the looped member (and optionally the weight of a cord weight on that looped member) is carried at least partially by the housing of the head rail (optionally the end cap) and not just by the central hub, conical cavity and magnets. In this way, operation is greatly improved.

Claims

1. A drive unit for mounting to the head rail of an architectural opening covering, the drive unit including:

a drive wheel having an outer periphery configured to receive and support an elongate portion of a continuous looped member, the drive wheel being configured to rotate about a first axis by longitudinal translation of the continuous looped member with rotation of the outer periphery about the first axis;

an operating wheel configured to rotate about a second axis and to rotate a winding core of the architectural opening covering; and

an attachment arrangement configured to releasably attach the drive wheel coaxially to the operating wheel, and configured, when the drive wheel is attached to the operating wheel, to transfer rotation of the drive wheel to rotation of the operating wheel.

2. A drive unit according to claim 1, wherein the attachment arrangement is configured to transfer a circumferential force in at least one of two opposite directions between the drive wheel and the operating wheel about the coaxial first and second axes, and configured to release the drive wheel from the operating wheel under a radial load when transferring substantially no circumferential force.

3. A drive unit according to claim 1 or 2, wherein the attachment arrangement includes a plurality of drive wheel attachments on the drive wheel and a corresponding plurality of operating attachments on the operating wheel.

4. A drive unit according to claim 3, wherein each drive wheel attachment includes a first feature configured to engage with a second feature on an operating attachment, and wherein optionally one or both of:

the first features extend both axially from the drive wheel towards the operating wheel and circumferentially in a first direction with respect to the drive wheel; and

the second features extend both axially from the operating wheel towards the drive wheel and circumferentially in a second direction, opposite to the first direction, with respect to the operating wheel;

wherein, when the drive wheel is attached to the operating wheel and transfers a circumferential force in one direction, the first features extend behind the second features and prevent the drive wheel separating axially from the operating wheel.

5. A drive unit according to claim 3 or 4, wherein each drive wheel attachment includes a third feature configured to engage with a fourth feature on an operating attachment, and wherein optionally one or both of:

the third features extend both axially from the drive wheel towards the operating wheel and circumferentially in the second direction with respect to the drive wheel; and

the fourth features extend both axially from the operating wheel towards the drive wheel and circumferentially in the first direction with respect to the operating wheel; and

wherein, when the drive wheel is attached to the wheel member and transfers a circumferential force in an opposite direction to said one direction, the third features extend behind the fourth features and prevent the drive wheel separating axially from the operating wheel.

6. A drive unit according to any one of claims 3 to 5, wherein the operating attachments of the operating wheel extend radially and lateral edges of the operating attachments are angled so that the circumferential width of each operating attachment increases from a side of the operating wheel away from the drive wheel to a side of the operating wheel towards the drive wheel.

7. A drive unit according to any one of claims 3 to 6, wherein the drive wheel attachments of the drive wheel extend radially and lateral edges of the drive wheel attachments are angled so that the circumferential width of each drive wheel attachment increases from a side of the drive wheel away from the op-

erating wheel to a side of the drive wheel towards the operating wheel.

8. A drive unit according to any one of claims 3 to 7, wherein one or both of:

- 1) radially outer circumferential edges of the operating wheel between respective operating attachments; and
- 2) radially inner circumferential surfaces of the drive wheel attachments extending against corresponding respective edges;

are inclined from a larger radius at the operating wheel side to a smaller radius at the drive wheel side so as to provide an axial force acting to separate the drive wheel from the operating wheel in response to a radial force on the drive wheel with respect to the operating wheel.

9. A drive unit according to any preceding claim, wherein the continuous looped member extends around substantially half the outer periphery of the drive wheel and extends away from the drive wheel at respective diametric opposite sides of the drive wheel, wherein attachment of the drive wheel to the operating wheel is released only when the continuous looped member pulls the drive wheel on both diametric sides simultaneously.

10. A drive unit according to any preceding claim, wherein one of the drive wheel and the operating wheel includes a hub having a truncated conical outer surface configured to fit into a truncated conical cavity provided in the other of the drive wheel and the operating wheel, the hub and cavity being coaxial with the first and second axes.

11. A drive unit according to any preceding claim, wherein one or both of the drive wheel and the operating wheel includes one or more magnets for attaching the respective drive wheel or operating wheel to the other of the drive wheel and operating wheel.

12. A drive unit according to any preceding claim further including a continuous looped member having an elongate portion received and supported by the outer periphery of the drive wheel.

13. A drive unit according to any preceding claim, further including a backing plate, wherein a side of the drive wheel, opposite to a side for releasable attachment to the operating wheel, is mounted to the backing plate for rotation about the first axis, and the backing plate, drive wheel and a continuous looped member are provided as a unit for attachment and detachment from the operating wheel and the head rail to which the operating wheel is mounted.

14. A drive unit according to claim 13 wherein the backing plate is configured to be resiliently engaged within a head rail of an architectural opening covering, may include at least one of a recess and a protrusion configured to engage resiliently with the head rail, and may include a protrusion configured to engage with an inner peripheral edge of a housing of the head rail.

15. An architectural opening covering including a drive unit according to claim 14 including a housing configured to resiliently engage with the backing plate, and optionally including at least one of: a recess configured to engage resiliently with a protrusion on the backing plate; and a protrusion configured to engage resiliently with a recess or protrusion on the backing plate.

Fig. 1a

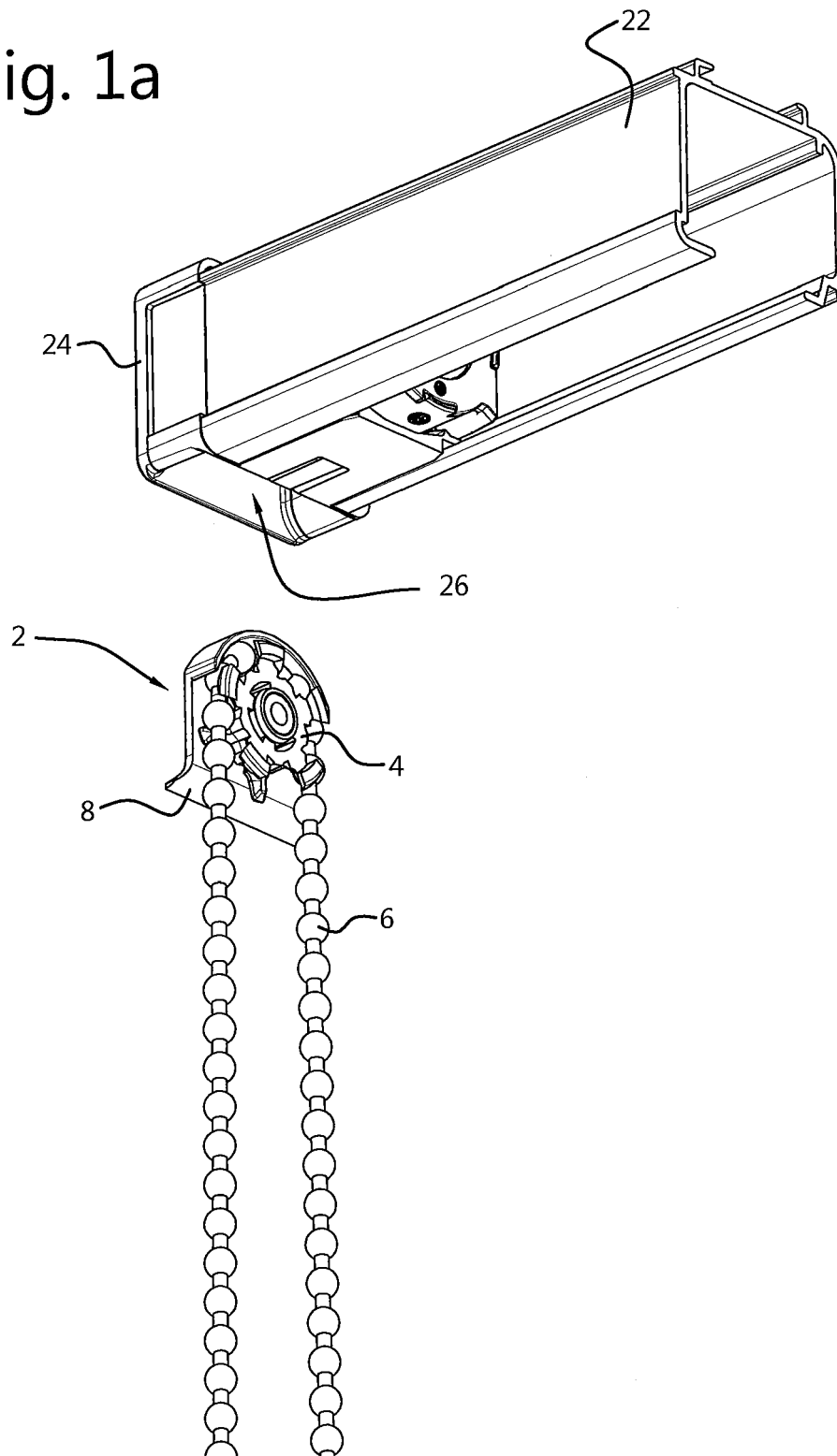


Fig. 1b

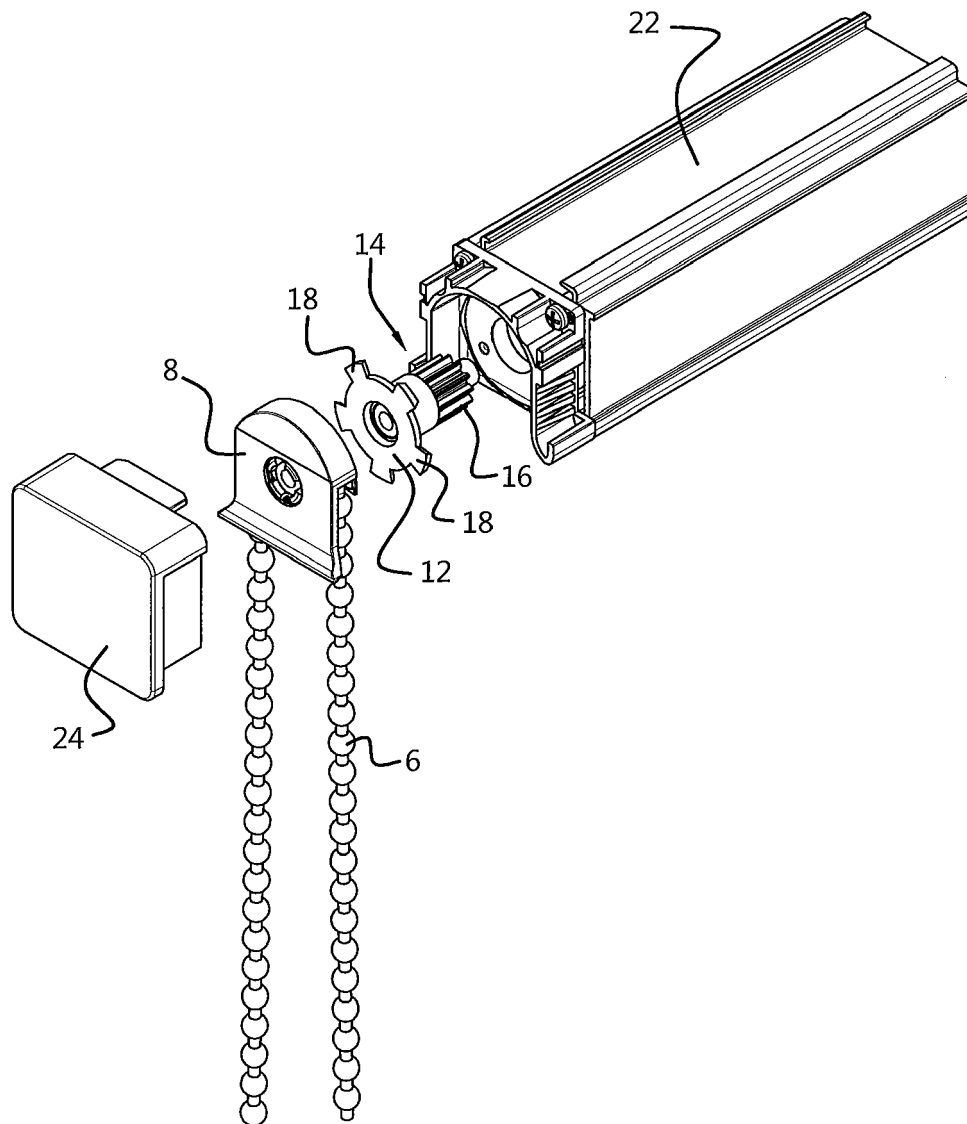


Fig. 2a

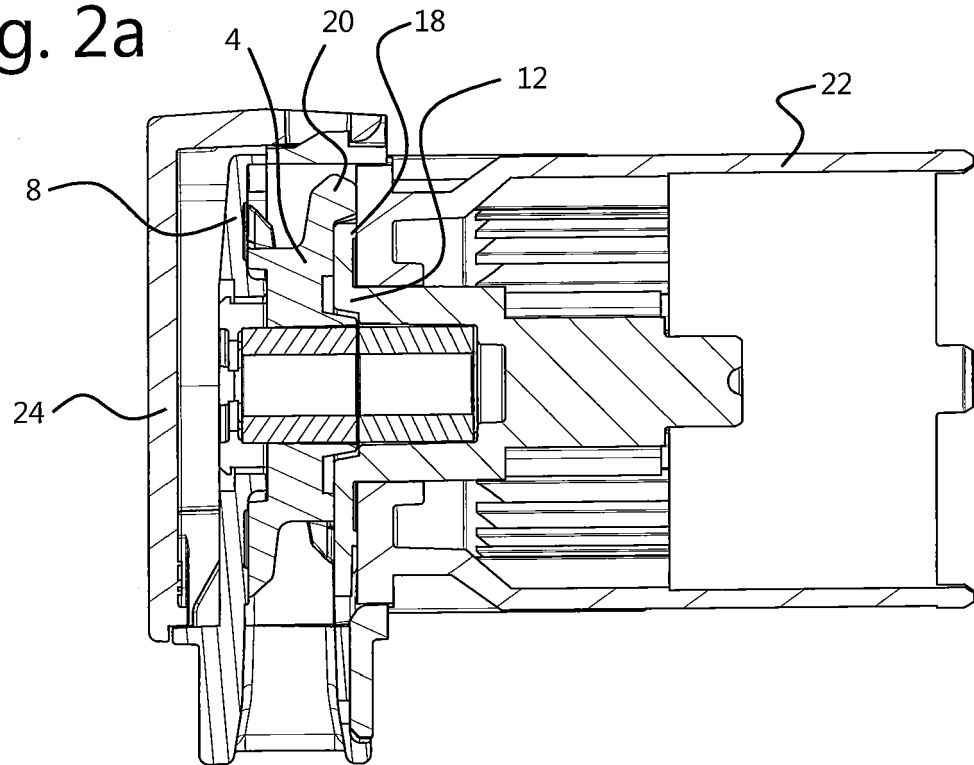


Fig. 2b

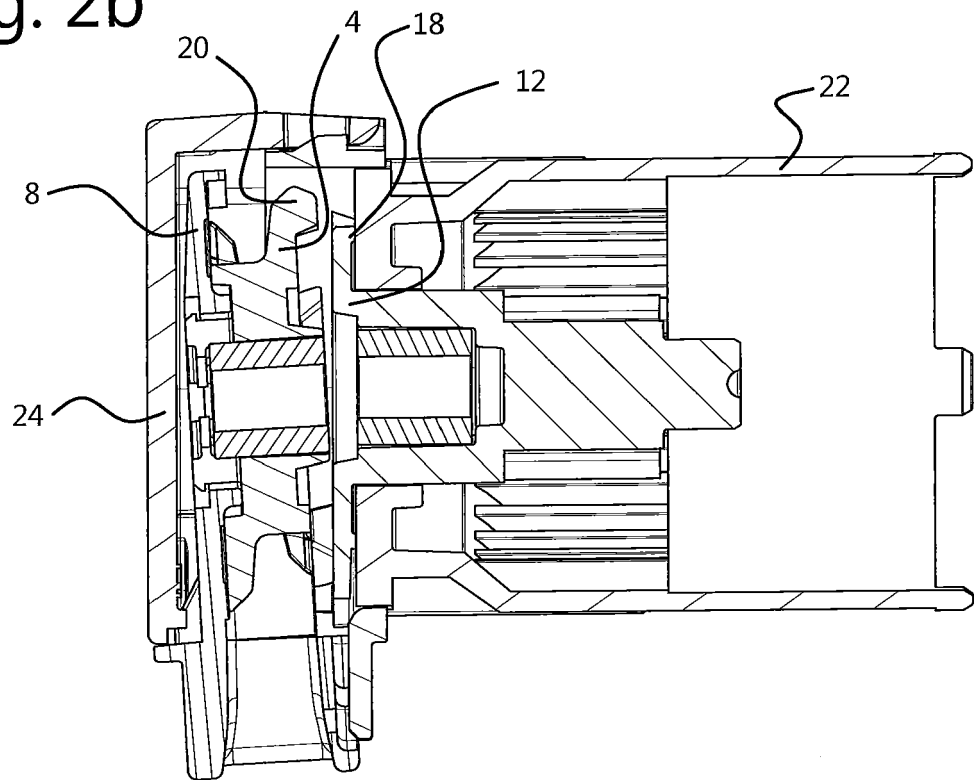


Fig. 2c

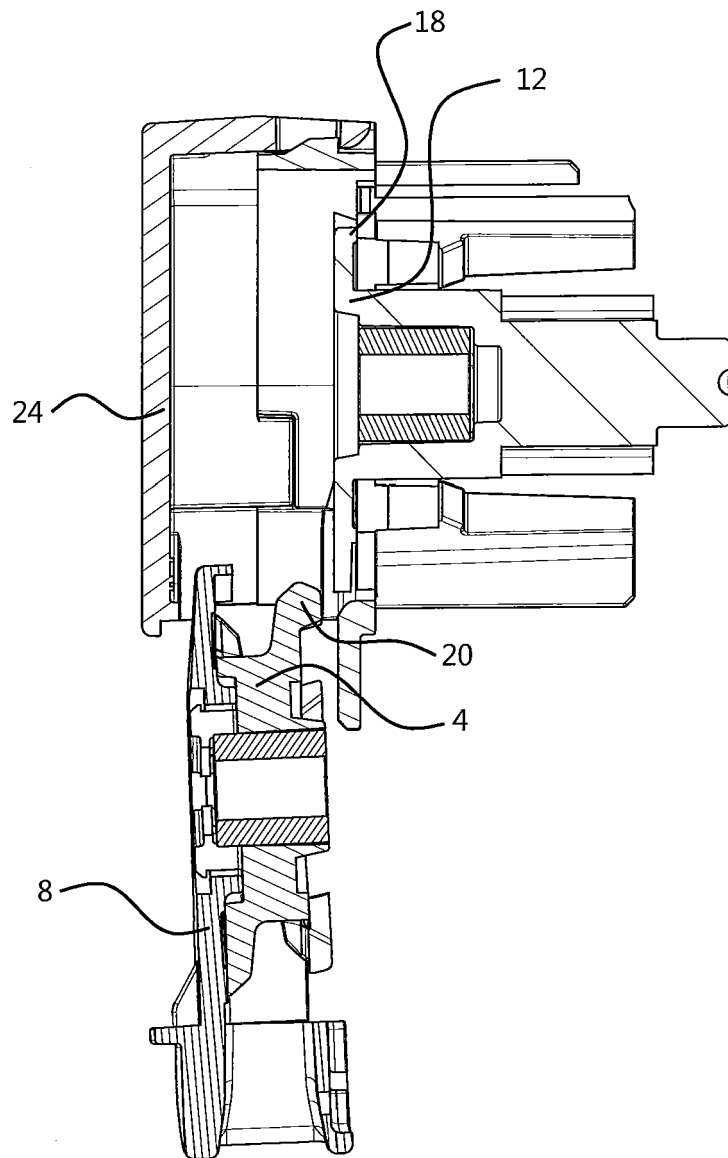


Fig. 3a

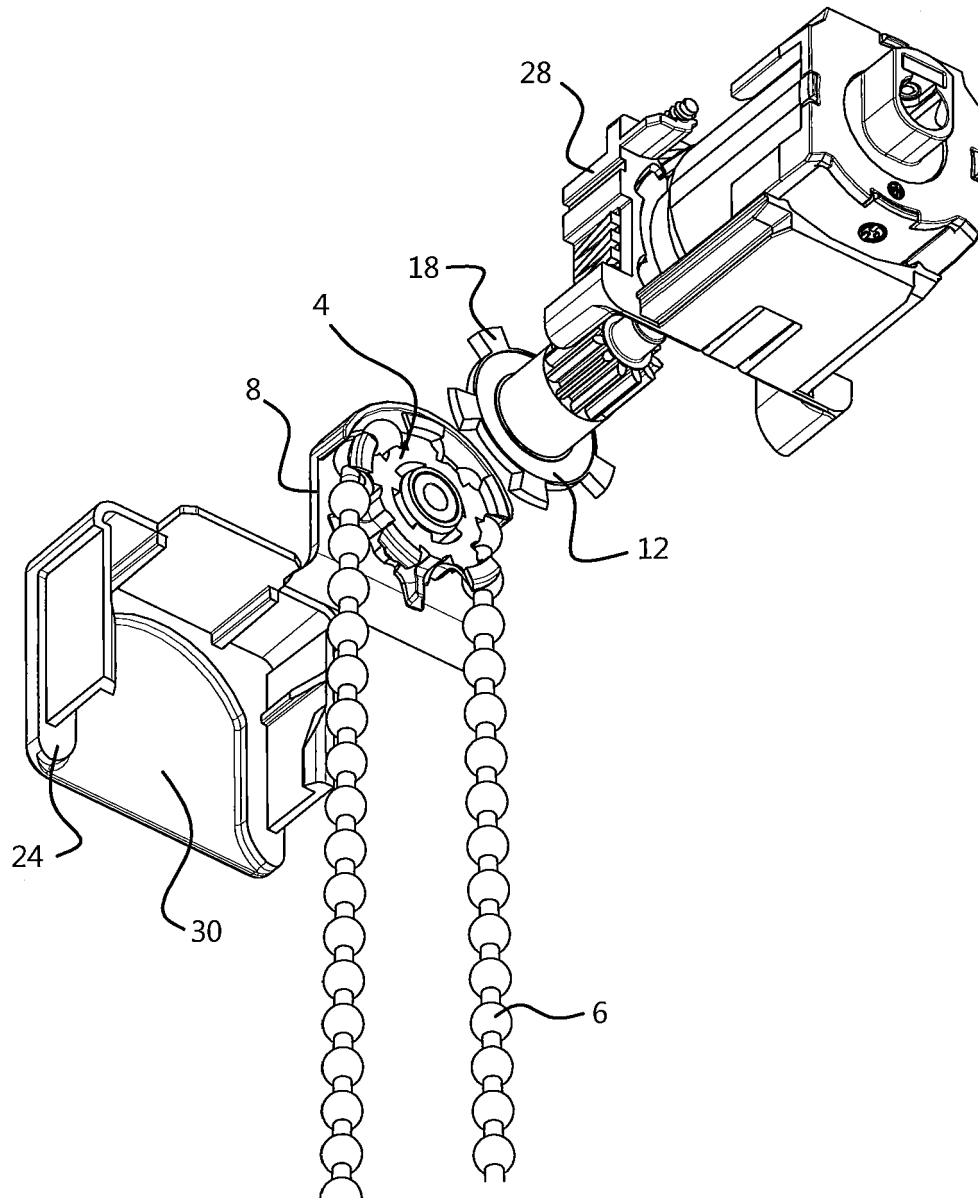


Fig. 3b

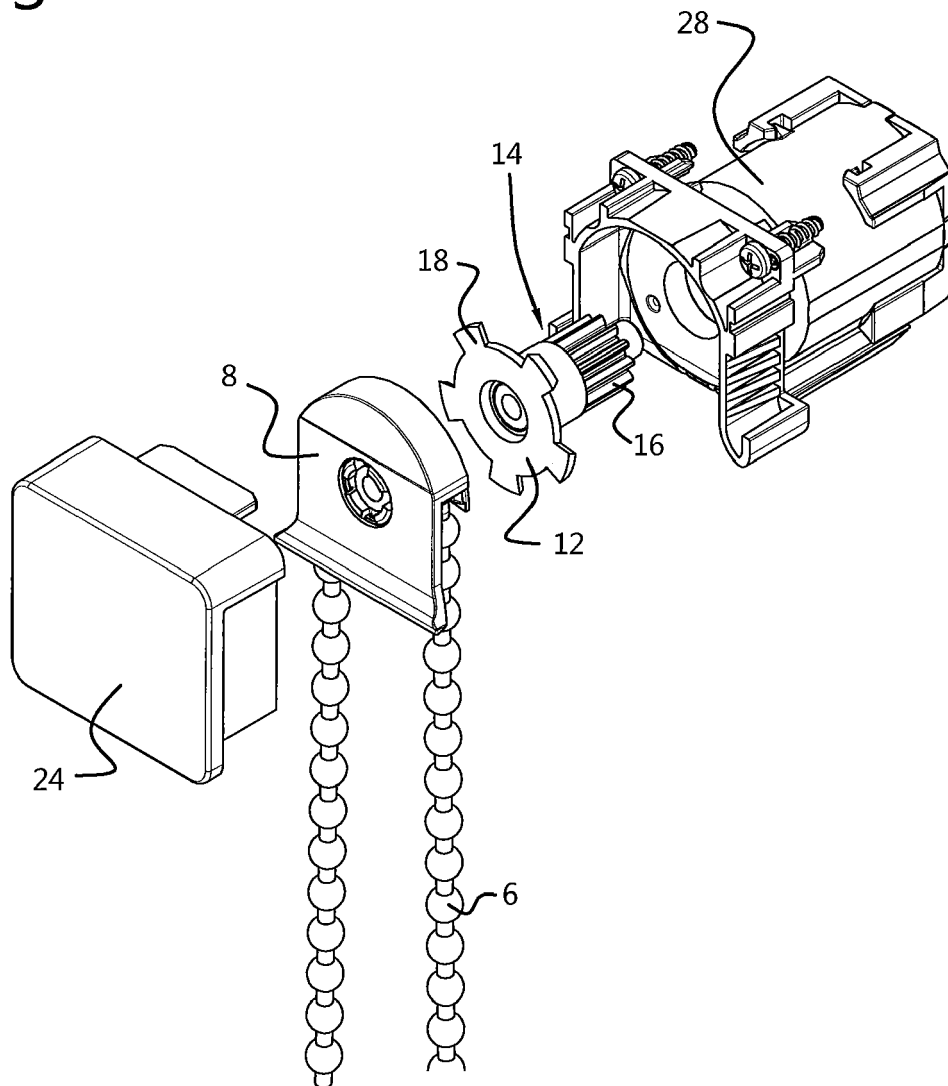


Fig. 4a

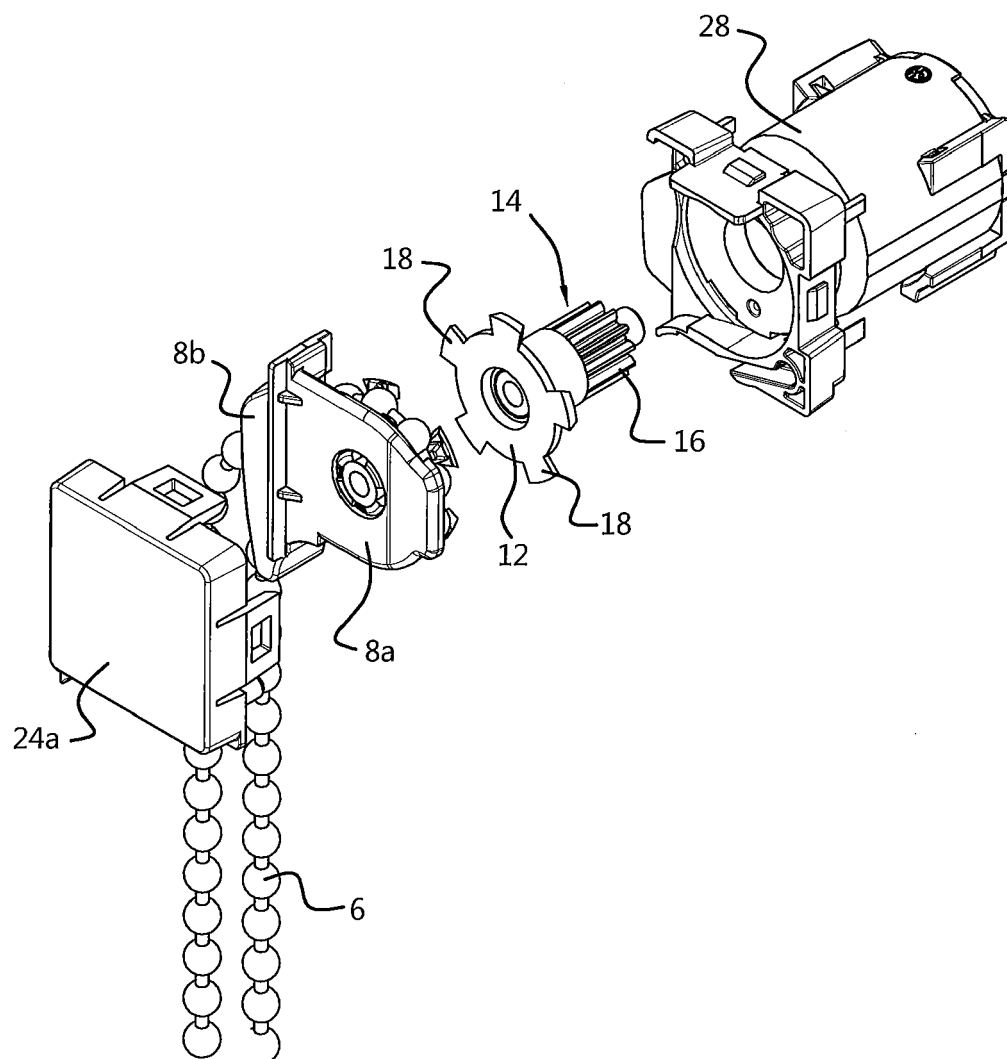


Fig. 4b

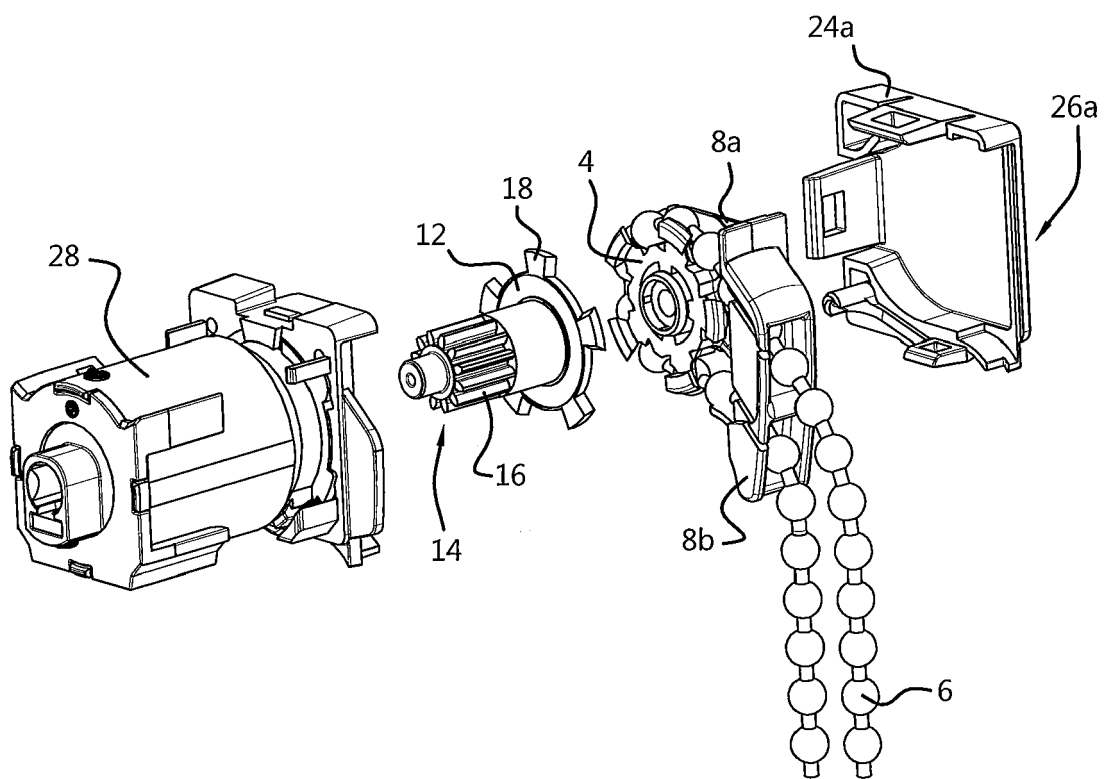


Fig. 5a

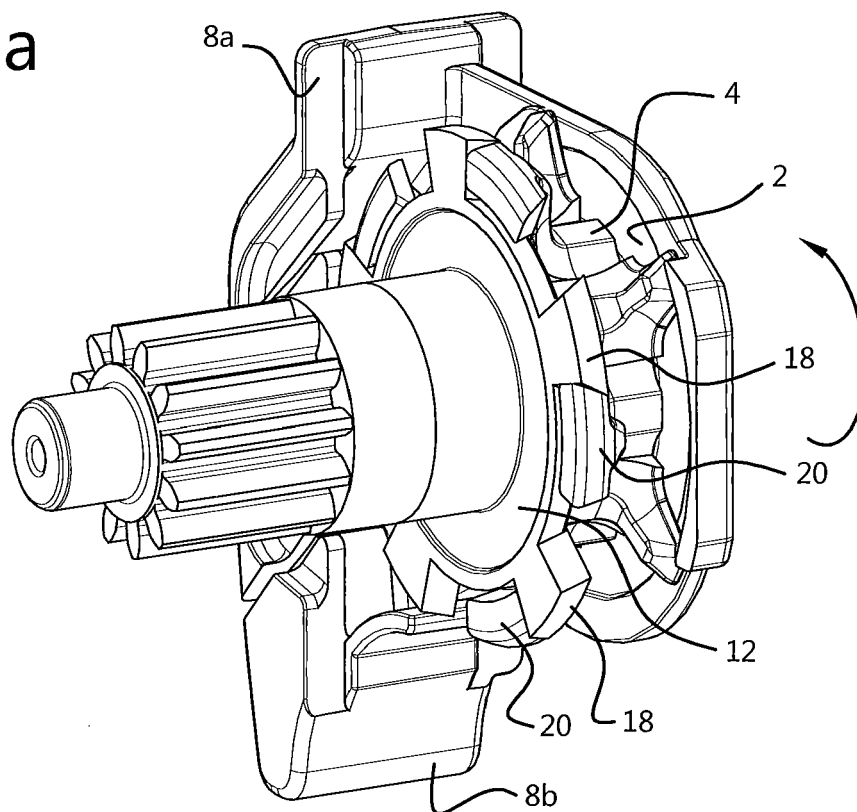


Fig. 5b

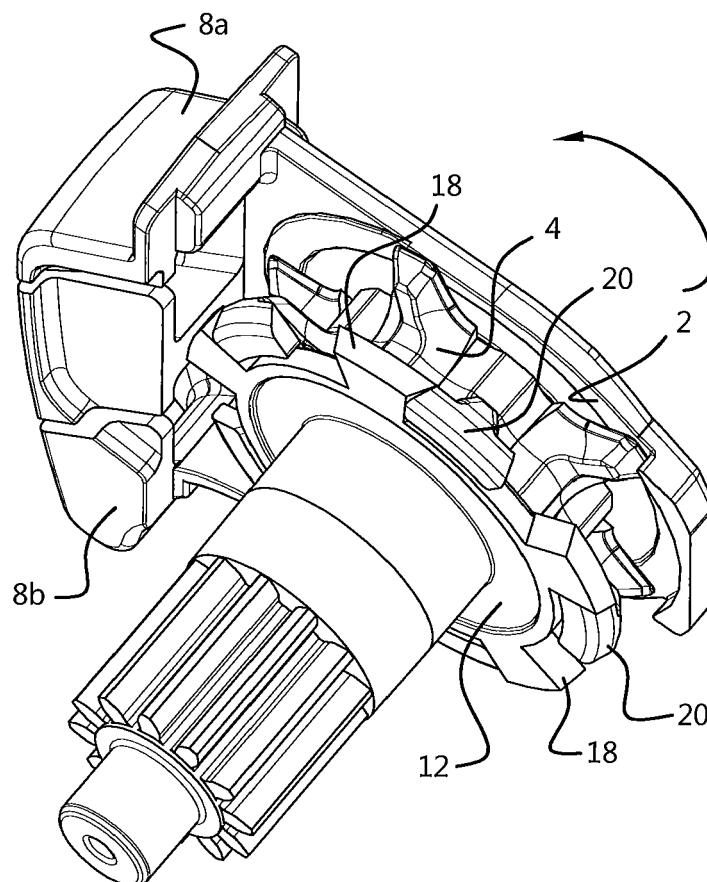


Fig. 6

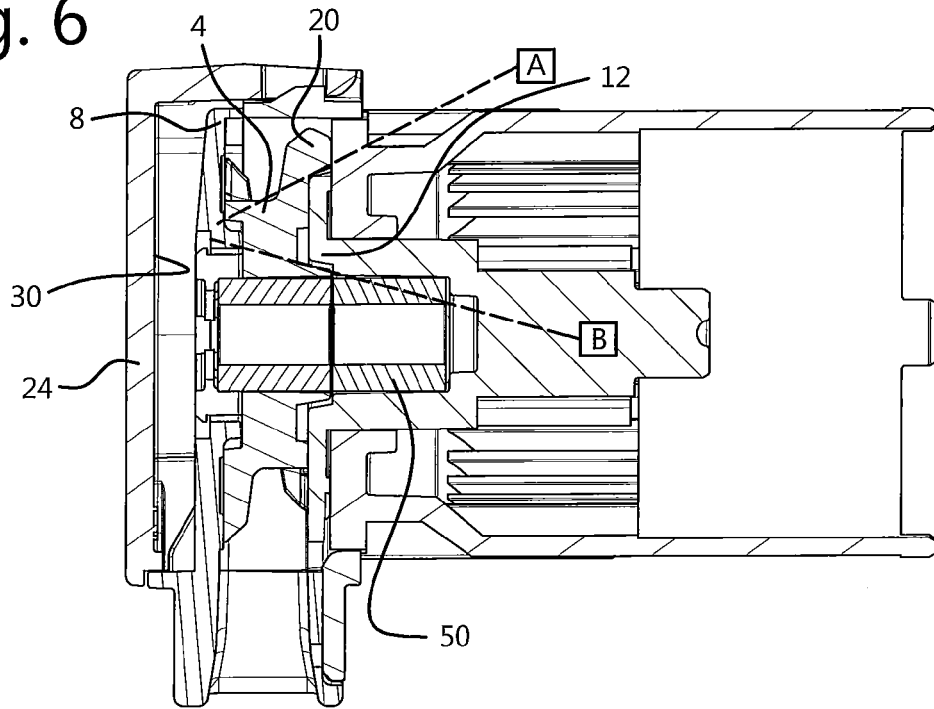


Fig. 7

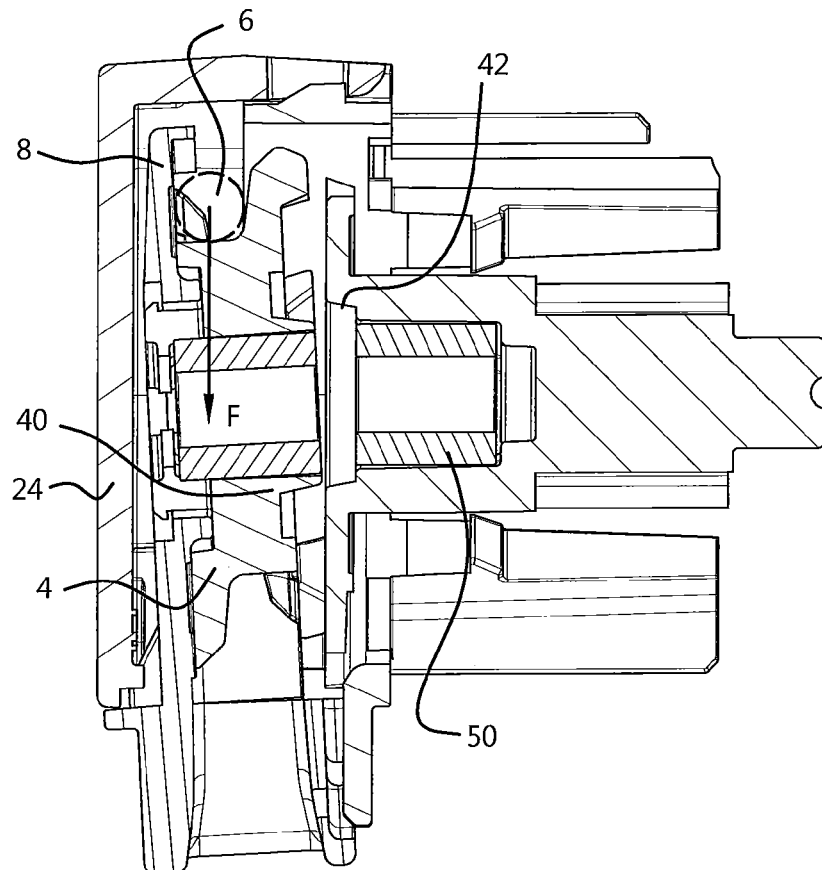


Fig. 8a

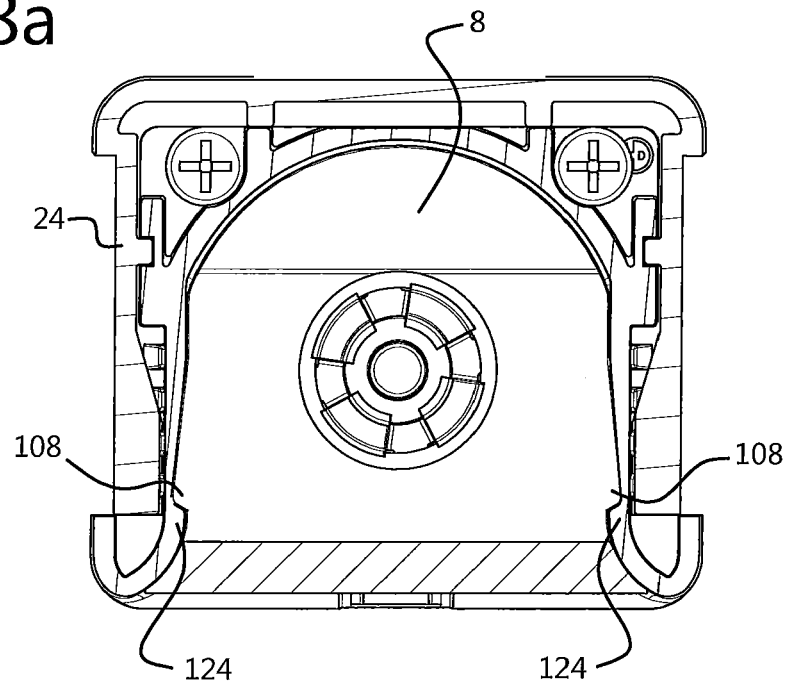


Fig. 8b

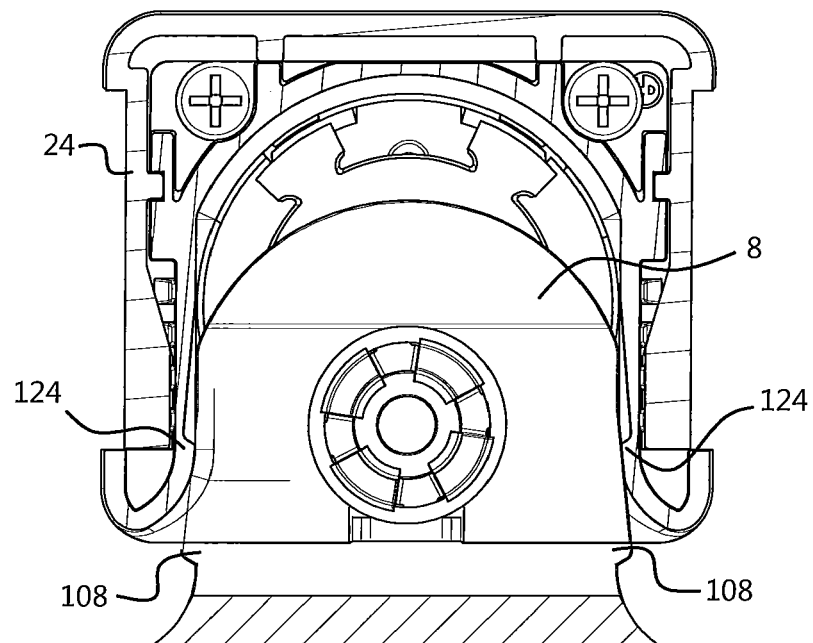


Fig. 9a

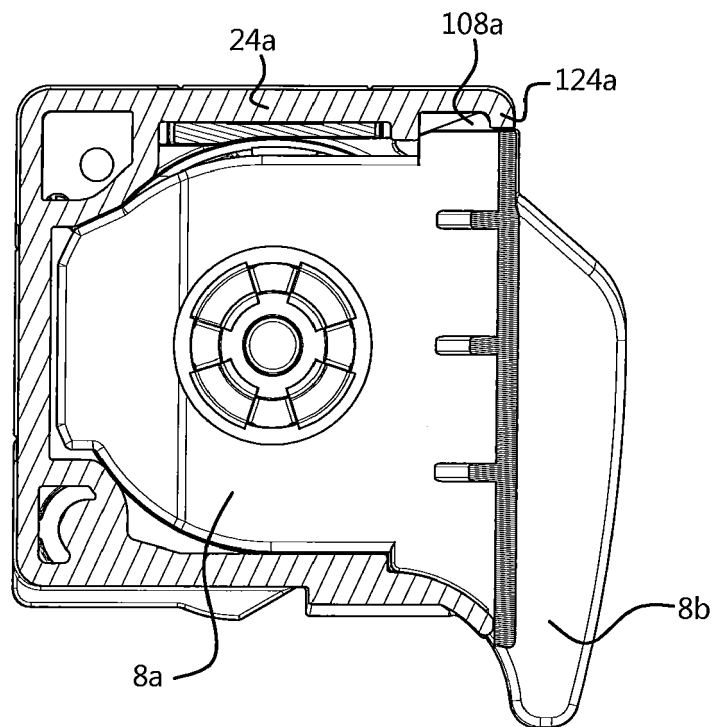
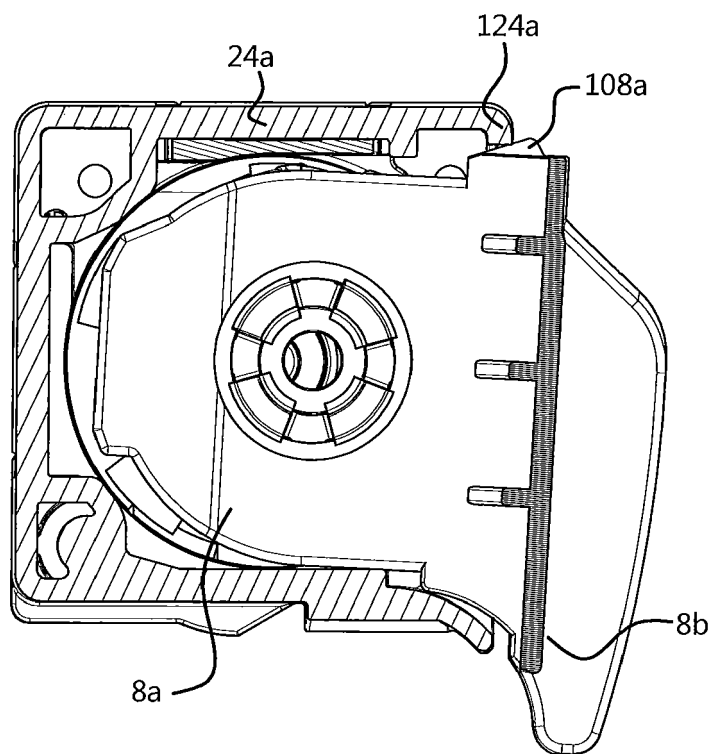


Fig. 9b



REFERENCES CITED IN THE DESCRIPTION

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