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(71) Applicant: **Koblenz S.P.A.**
47853 Coriano (RN) (IT)

(72) Inventor: **Migliorini, Massimo**
47900 Rimini (IT)

(74) Representative: **Ghioni, Carlo Raoul Maria**
Bugnion S.p.A.
Via A. Valentini, 11/15
47900 Rimini (IT)

(54) **Device for slowing the closing of sliding parts of pieces of furniture**

(57) A device (1) for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, has a slowing unit (2) with a rotary body (11) and a damper for the rotation of the rotary body (11). A flexible motion transmission element (6) passes through the slowing unit (2), being operatively coupled to the rotary body (11) on a contact arc formed by a coupling stretch (110). Tensioning means (220) tension the motion transmission element (6) against the rotary body (11) at the contact arc. The motion of the slowing unit (2) along the motion transmission element (6) causes the rotary body (11) to rotate and the rotation damper consequently slows said motion. Also described are a closing device and a piece of furniture (4) using the slowing device (1).

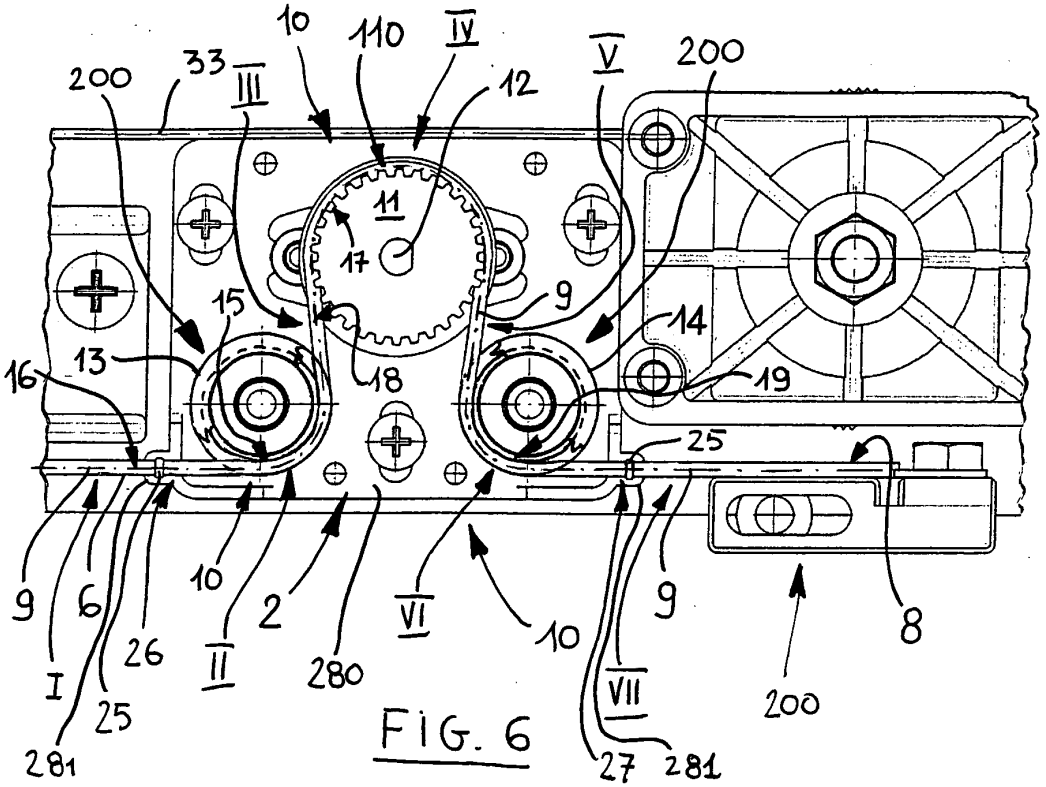

FIG. 6

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Description

[0001] The present invention relates to a device for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like.

[0002] The present invention also relates to a closing device for sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, which uses the slowing device.

[0003] The present invention also relates to pieces of furniture comprising sliding parts equipped with the slowing device in accordance with the invention.

[0004] The present invention also relates to pieces of furniture comprising sliding parts equipped with the closing device fitted with the slowing device in accordance with the invention.

[0005] The pieces of furniture referred t o m ay be sliding doors, wardrobes (with sliding wings), chests of drawers and the like. The sliding doors referred to relative to the present invention may be either for interiors or for exteriors.

[0006] Pieces of furniture such as doors, wardrobes, chests of drawers and the like, often have sliding parts slidably connected to a fixed frame. In the case of doors, the sliding part is the sliding wing of the door, whilst the fixed frame is the counterframe and, in some cases, the door frame (jambs and lintels), to which the door is connected. In the case of slide-away doors, the frame also comprises the box structure designed to contain the sliding wing.

[0007] In the case of wardrobes, the sliding parts are the sliding wings of the wardrobe, whilst the fixed frame is the box forming the container compartment of the wardrobe.

[0008] For chests of drawers, the sliding parts are the various drawers and the fixed frame is the chest of drawers box structure.

[0009] The sliding parts can move by sliding relative to the frame between a closed position, in which they prevent the user from accessing a compartment (the inside of a room or house, for a door; the inside of the wardrobe itself for a wardrobe; the inside of the drawer for the chest of drawers), and an open position in which they allow the user to access the compartment.

[0010] The user can close the sliding part by hand.

[0011] However, the pieces of furniture in question are often fitted with automatic closing devices for the sliding part. These devices are designed to automatically close the sliding part, or to automatically complete the closing step, once the user has released the sliding part in a position in which it is at least partly open. In particular, the closing devices comprise an accumulator of mechanical energy which can be connected to the sliding part and, simultaneously, also to the fixed frame, which gradually accumulates mechanical energy during the sliding part opening step. When the user is no longer holding back the sliding part in the position reached during the opening step, unless it was previously disengaged, the accumulator releases the mechanical energy accumulated, applying a closing force to the sliding part which automatically returns the sliding part to the closed position.

[0012] In the case of doors and wardrobes the accumulator usually consists of elastic return means stably connected on one side to the sliding part and on the other side to the fixed frame, and always active on the sliding part. In the case of chests of drawers, the accumulator usually accumulates energy only on an initial stretch of the drawer opening step, after which it is automatically disengaged from the drawer and kept loaded. When the user closes the drawer again, in the final stretch of the closing step (corresponding to the initial stretch of the opening step) the accumulator is automatically re-engaged on the drawer which, at this point, can be released by the user, its closing being automatically completed by the closing device. The elastic return means used may be spiral or helical springs, with one end engaged on the sliding part and one end engaged on the fixed frame.

[0013] Whether the piece of furniture is equipped with an automatic closing device for the sliding part, or such an automatic closing device is not present and closing is carried out by the user by hand, to prevent closing from being too violent, the pieces of furniture are fitted with devices for slowing the closing. These devices for slowing the closing dampen the motion of the sliding part at least during the closing step (or during the final part of the closing step).

[0014] There are known devices for slowing the closing comprising a straight rack and a slowing unit engaging on the rack. In the slowing unit a pinion, which engages on the rack, is subject to the action of a damper which slows the rotation of the pinion. The rack is positioned parallel with the direction of motion of the sliding part and may either be fixed to the frame (in which case the slowing unit is fixed to the sliding part), or to the sliding part (in which case the slowing unit is fixed to the frame). The rack may be the same length as the stroke of the sliding part, in which case the pinion always remains engaged on the rack. Alternatively, the rack may be shorter than the stroke of the sliding part, in which case the pinion and rack only engage with one another for a stretch of the sliding part stroke (usually the final stretch of the closing step). During sliding part motion, when the rack and pinion engage with one another, the rack transmits the motion of the sliding part to the pinion, which in turn begins to rotate about its own axis. The rotation of the pinion is slowed by the action of the damper and this causes the device to apply a slowing action on sliding part motion.

[0015] In particular, document JP 11-159237 illustrates a slowing device of this type, applied to a sliding door. The slowing unit is enclosed in a case fixed to the sliding wing of the door, whilst the rack, which is at least as long as the sliding wing stroke between the closed position and the open position, is fixed to the door frame parallel with the sliding wing direction of motion. The rack passes through the slowing unit, going through an inlet

and an outlet made in the case enclosing the slowing unit. The pinion, inside the case, is always engaged on the rack. During movement of the sliding wing, the case slides on the rack, which remains fixed to the frame, and the pinion is made to rotate by the rack which transmits the motion of the sliding part to it.

[0016] Slowing devices of this type have several disadvantages.

[0017] In particular, in order to operate the system requires the pinion and rack to always be perfectly engaged, at least in the stretch in which the slowing action must be applied. This necessitates precision mounting of the device and/or requires that between the sliding part and the frame, over time, there must not be any play which could cause the pinion to disengage from the rack. Irregularities in the mounting of the device and/or of the sliding part on the frame may also result in misalignments between the rack and pinion, causing irregularities in the interaction between the teeth of the pinion and of the rack, with consequent anomalous operation of the device and interference with sliding part normal sliding. Secondly, the rack and pinion are substantially rigid elements and the rack must be mounted at a precise angle and in a substantially predetermined position. This greatly limits the possibilities for housing the device, above all in systems with complex hardware and which must be placed on the piece of furniture in spaces which are small or subject to strict constraints. For example, this is the case for slide-away doors, in which the door is inserted in a box structure integrated in a counterframe and built into in a wall. This is also the case for full-height wardrobes, in which the hardware which allows the sliding doors to slide is positioned above the wardrobe box and behind the wings, in the limited space between the top of the wardrobe and the ceiling of the room in which the wardrobe is located. Moreover, in the latter case the usual machining of the parts of the piece of furniture by the manufacturers requires the fixing screws of the various parts of the hardware to be in positions predetermined by holes made by the machines used to machine the various parts of the piece of furniture. Therefore, in this case, the system is subject to further constraints, in particular constraints on the maximum depth of the system in the direction of movement away from the plane in which the sliding wings lie. The connection between the rack and pinion typical of the prior art also tends to be noisy.

[0018] The aim of the present invention is to overcome the above-mentioned disadvantages, providing a device for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, which allows highly flexible mounting and use without the need for special and delicate mounting and adjustment operations and/or without upsetting its operation due to misalignments and/or settling of the parts of the piece of furniture relative to one another during use, at the same time guaranteeing a substantially constant s lowing force potentially on the entire stroke of the sliding part.

[0019] The invention also has for an a im to provide a closing device for sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, comprising the slowing device in accordance with the invention.

[0020] Another aim of the invention is to provide a piece of furniture comprising at least one sliding part associated with a fixed frame, in particular a sliding door or a wardrobe with sliding wings, which uses a slowing device in accordance with the invention and/or a c losing device in accordance with the invention.

[0021] Accordingly, the present invention achieves these aims and others, more apparent in the description which follows, with a device for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, with a closing device and with a piece of furniture, each having the structural and functional features described in the independent claims herein, further embodiments being described in the dependent claims herein.

[0022] The invention is described in more detail below with reference to the accompanying drawings, which illustrate a preferred, non-limiting embodiment and in which:

- Figure 1 is a front view of a piece of furniture (in the case in question a slide-away door) with the sliding part in the closed position, on which the slowing device in accordance with the invention is applied;
- Figure 1a illustrates a detail of Figure 1, showing the slowing device in accordance with the invention;
- Figure 2 is a top view, partly in cross-section and with some parts cut away to better illustrate others, of the piece of furniture of Figure 1 on which the slowing device of Figure 1 is applied. It also shows the presence of a closing device using the slowing device in accordance with the invention without the lid of the slowing unit case;
- Figure 3 illustrates a detail from Figure 2, but with the slowing device fitted with the lid of the slowing unit case, showing the slowing unit of the slowing device in accordance with the invention, in particular its case, with the related motion transmission element passing through it;
- Figure 4 is a schematic perspective view, with some part cut away to better illustrate others, of the piece of furniture, the slowing device applied to it and the closing device which uses it, illustrated in Figures 1 to 3;
- Figure 5 illustrates a detail from Figure 2, showing the slowing unit of the slowing device in accordance with the invention, with the motion transmission element passing through it;
- Figure 6 is an enlarged view of the detail of Figure 5, illustrating the structure of the slowing unit and its interaction with the related motion transmission element;
- Figure 7 illustrates another detail from Figure 2,

showing part of the fixing means of the motion transmission element in the particular case of a slide-away door;

- Figure 8 is a schematic perspective view of a detail of the slowing unit case, through which the motion transmission element passes;
- Figure 9 is a schematic perspective view of the detail of Figure 8, but showing removable means for locking the motion transmission element to the slowing unit;
- Figure 9a is a front view of the detail of Figure 9;
- Figure 9b is a front view of the slowing device slowing unit with the lid removed and showing removable means for locking the motion transmission element to the slowing unit;
- Figure 10 is a schematic plan view of the curved path, within the slowing unit, along which the motion transmission element extends, and also showing some geometrical relationships between the various parts;
- Figure 11 is a schematic plan view of an orthogonal projection of the elements of Figure 10 in a plane perpendicular to the axis of rotation of the slowing unit rotary body, showing some geometrical relationships between the parts.

[0023] With reference to the accompanying drawings, the numeral 1 denotes a device for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like.

[0024] The device 1 for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like comprises a slowing unit 2, which is applicable either on a sliding part 3 of a piece of furniture 4 or on a fixed frame 5 of the piece of furniture 4. The slowing device 1 also comprises a motion transmission element 6 which is applicable t o the fixed frame 5 when the slowing unit 2 is applied to the sliding part 3, or which is applicable to the sliding part 3 when the slowing unit 2 is applied to the fixed frame 5.

[0025] The motion transmission element 6 extends between its first end 7 and its second end 8, passing through the slowing unit 2 in a coupling zone 10 where the motion transmission element 6 is coupled to the slowing unit 2. The slowing unit 2 in turn comprises a rotary body 11 free to rotate about an axis of rotation 12 and a rotation damper (not illustrated) acting on the rotation of the rotary body 11. The rotary body 11 is operatively connected to the motion transmission element 6 in the coupling zone 10. During the motion of the slowing unit 2 along the motion transmission element 6 between the first and second ends 7, 8, (motion which when the slowing device 1 is applied is due to the relative motion between the sliding part 3 and the fixed frame 5), the coupling zone 10 slides along the motion transmission element 6 between the first and second ends 7, 8 and the rotary body 11 is made to rotate due to the operative connection with the motion transmission element 6, with a consequent slowing action by the rotation damper on the relative motion. Therefore, when the slowing device 1 is applied, this causes a slowing action on the motion of the sliding part 3 relative to the frame 5.

[0026] The motion transmission element 6 is flexible and, in the coupling zone 10, comprises a coupling stretch 110 for coupling to the rotary body 11 in which the motion transmission element 6 is in contact with a lateral surface portion 17 of the rotary body 11 and assumes a curvature predetermined by the lateral surface portion 17 of the rotary body 11, thus forming an arc of contact with the rotary body 11.

[0027] The slowing device 1 also comprises tensioning means 200, acting on the motion transmission element 6 at least when the slowing device 1 is applied, which tension the motion transmission element 6 against the rotary body 11 at least at the arc of contact of the motion transmission element 6 with the rotary body 11.

[0028] When the slowing device 1 is applied on the piece of furniture 4, (for example with the first and second ends of the motion transmission element 6 fixed either to the fixed frame 5 or to the sliding part 3), every time the sliding part 3 moves in one sliding direction, the slowing unit 2 moves relative to the line joining the first and the second ends 7, 8 of the motion transmission element 6 and the coupling zone 10 slides a long the motion transmission element 6. Due to the action of the tensioning means 200, the motion transmission element 6 is always coupled with the lateral surface portion 17 of the rotary body 11, so that it always maintains on it, during coupling zone 10 sliding along the motion transmission element 6, the arc of contact with the rotary body 11 formed by the coupling stretch 110. The coupling between the motion transmission element 6 and the rotary body 11 is guaranteed once the first and second ends 7, 8 have been fixed to the frame 5 (when the s lowing unit 2 is fixed to the sliding part 3) or to the sliding p art 3 (when t he s lowing u nit 2 is fixed t o the frame 5), s o as to generate a sufficient tension in the motion transmission element 6 at least in the coupling zone 10 by means of the action applied by the tensioning means 200 combined with the flexibility of the motion transmission element 6. The arc of contact of the motion transmission element 6 with the rotary body 11 (formed by the coupling stretch 110) allows the transmission of motion to the rotary body 11 and, therefore, rotation of the rotary body. The rotation damper acts on the rotation of the rotary body 11 and causes a consequent slowing action on the motion of the sliding part 3. The coupling between the motion transmission element 6 and the rotary body 11 in the invention is very different from the coupling between the pinion and the rack typical of the prior art. According to the prior art, the coupling between the pinion and the rack can substantially (in a generic cross-section normal to the axis of rotation of the pinion) be likened to the contact between two points belonging one to the pitch circle of the pinion (that is to say, to the circle whose radius is equal to the pitch circle radius of the pinion) and one to the pitch circle

of the rack (that is to say, the circle of substantially infinite radius which represents it, the rack having an infinite pitch circle radius). In fact, the points of contact are on the teeth of the two devices (pinion and rack) and move with variations in the coupling along involute curves of a circle (in one of the possible embodiments of the toothing). It is well known that this type of connection always results in three steps: an engagement step (the moment of first contact between the teeth), a transmission step (movement of the two points of contact a long the curve described by the tooth in a generic cross-section normal to the axis of rotation of the pinion), a detachment step. In the case of the coupling between the pinion and the rack, said three steps involve a very small number of teeth, even only one, and it is well known that the steps are noisy and there may be play between the components. If the idea expressed above were to be simplified using the term "point contact", the coupling between the pinion and the rack typical of the prior art could be described as a "point coupling". In contrast, it may be said that in the slowing device 1 in accordance with the invention the coupling between the motion transmission element 6 and the rotary body 11 is not a point coupling, like that of the rack and pinion typical of the prior art, but is created on an arc of contact wrapped around a lateral surface portion, which is not a point, of the rotary body 11. In practice the steps of first contact (in the previous case defined as engagement) and detachment, involve only the end points of the motion transmission element 6 belonging to the coupling stretch 110 and, that is to say, only the ends of the arc of contact, whilst all of the other points of the motion transmission element 6 belonging to the coupling stretch 110 (and not just two points as in the previous case) and, therefore, all of the other points of the arc of contact other than the ends, contribute to the transmission of mechanical energy between the two elements. Due to this, the coupling between the motion transmission element 6 and the rotary body 11 is also guaranteed in the presence of mounting irregularities of the slowing device 1 and/or in the presence of settling between the sliding part 3 and the frame 5 (and/or in the presence of tolerances or mounting irregularities in the latter components). Such irregularities, tolerances and settling may either be absorbed by relative reductions in the length of the arc of contact of the motion transmission element 6 with the rotary body 11 (length reductions which, at least within certain limits, do not have significant consequences on the transmission of motion from the motion transmission element 6 to the rotary body 11 and, therefore, on the related slowing action), or they may result in increases in the length of the arc of contact of the motion transmission element 6 with the rotary body 11 (length increases which, in contrast, promote further connection between the motion transmission element 6 and the rotary body 11).

[0029] The non-point, contact arc type of coupling between the motion transmission element 6 and the rotary body 11 tends to cause the slowing force to vary very little (or be constant) along much of the stroke of the sliding part 3 (and, therefore, of the coupling zone 10 and the slowing unit 2) along the motion transmission element 6.

[0030] As already indicated, the slowing device 1 in accordance with the invention may also be used when the user closes the sliding part 3 manually.

[0031] The slowing device 1 in accordance with the invention is particularly useful, as indicated, if a sliding part 3 closing device is present.

[0032] In particular, again with reference to the accompanying drawings, consider a closing device for sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, comprising an accumulator 30 of mechanical energy which is stably connectable to the sliding part 3 of the piece of furniture 4 and, at the same time, to the fixed frame 5 of the piece of furniture 4, and gradually accumulating mechanical energy during a sliding part 3 opening step. When the sliding part 3 is no longer held in the position reached during the opening step, the accumulator releases the mechanical energy accumulated, applying a closing force on the sliding part 3 which returns the sliding part 3 to the closed position. When this closing device is connected to a slowing device 1 in accordance with the invention, the slowing device 1 applies a slowing action on the automatic closing of the sliding part 3 due to the action of the accumulator 30. The accumulator 30 comprises elastic return means 31 which are stably connectable on one side to the sliding part 3 and on the other side to the fixed frame 5. The elastic return means 31 may comprise various types of springs. In particular, as illustrated in the accompanying drawings, the elastic return means 31 may comprise a helical spring, or (not illustrated) a spiral spring. The closing device may also comprise preloading means 32 for preloading the elastic return means 31, of the substantially known type (for example a rotary reel on which a cable 33 may be wound, the cable being connected to one end of the elastic return means 31). The slowing device 1, although it can be coupled to the action of the closing device (and, therefore, can be part of the latter, once both are installed in the piece of furniture 4), is independent of it and may be produced and marketed separately. Moreover, as already indicated, the slowing device 1 may even be applied in the absence of the closing device and perform the task of slowing manual closing of the sliding part by the user, to prevent closing from being too violent.

[0033] As indicated, the invention also relates to a piece of furniture 4, such as a door, wardrobe, chest of drawers and the like, of the type comprising a fixed frame 5 and a sliding part 3 connected to the frame 5 and slidably mobile, relative to the frame 5, along a sliding direction, between a closed position and an open position, comprising a slowing device 1 in accordance with the invention.

[0034] The accompanying drawings illustrate the particular case in which the slowing unit 2 is applied to the

sliding part 3, whilst the motion transmission element 6 is applied to the frame 5. Obviously, the opposite configuration (slowing unit 2 applied to the frame 5 and motion transmission element 6 applied to the sliding part 3) is also possible.

[0035] The piece of furniture 4 may also, preferably, comprise a closing device such as that described, coupled to a slowing device 1 in accordance with the invention.

[0036] The piece of furniture 4 may be a sliding door 40 comprising a sliding wing 41, the sliding wing 41 coinciding with the sliding part 3. The fixed frame 5 comprises elements fixed to the door jambs and lintel (which may be the jambs and lintel themselves). In the case of slide-away doors, the fixed frame 5 comprises a counterframe 42 forming a box structure 43 into which at least part of the sliding wing 41 slides with the door in the open position.

[0037] The slowing device 1 acts on the motion of the sliding wing 41. If there is a closing device, the closing device and the related slowing device 1 act on the sliding wing 41.

[0038] The slowing unit 2 is illustrated applied on an upper face 44 of the sliding wing 41, the face hidden by the upper horizontal cornice of the sliding door when the sliding door is of the slide-away type. In particular, in this case, the axis of rotation 12 of the rotary body 11 is parallel to the plane in which the sliding wing 41 lies. The slowing unit 2 may also be fixed on one of the lateral faces 45, 46 of the sliding wing 41. In this case, the axis of rotation 12 of the rotary body 11 is preferably perpendicular to the plane in which the sliding wing 41 lies. In particular situations, the slowing unit may be inserted in the front striker side 47 of the sliding wing 41, or on the side 48 of the sliding wing 41 opposite the front striker side 47. The side 48 of the sliding wing 41 opposite the front striker side 47 is usually hidden in the box structure 43 if the latter is present.

[0039] In the accompanying drawings, the slowing device 1 is illustrated applied to a piece of furniture 4 consisting of a door with a slide-away wing (for example a partition between two rooms inside a building, or separating the outside and inside of a building). However, it may also be applied without particular problems to other types of pieces of furniture 4, in particular: to sliding doors not of the slide-away type (for example even sliding doors for exteriors), to wardrobes with sliding wings, to chests of drawers and the like.

[0040] The following is a description of some examples of preferable application.

[0041] The piece of furniture 4 may be a wardrobe with at least one sliding wing associated with the frame 5, the sliding wing coinciding with the sliding part 3. In this case, the slowing device 1 acts on the motion of the sliding wing. If there is a closing device, the latter and the slowing device 1 both act on the sliding wing.

[0042] Appropriately, the wardrobe may comprise at least two sliding wings and at least two respective slowing devices in accordance with the invention, each acting on the motion of a respective sliding wing. In this case, the wardrobe may also have at least two closing devices, each acting on a respective sliding wing. Coupled to each closing device and acting on the same sliding wing, there is one respective slowing device 1 of the at least two slowing devices 1 in accordance with the invention and referred to above.

[0043] Preferably (to avoid taking up space inside the wardrobe container compartment) the slowing device 1 may be mounted on the outside of the wardrobe, above the high part of the fixed frame 5, in particular hidden from view by a portion of the sliding wing rising above the high part of the frame 5. In this case, the slowing unit 2 of the slowing device 1 may be mounted on the sliding wing on the outside of the wardrobe and above the high part of the frame 5, the motion transmission element 6 being fixed to the frame 5 by its first and second ends 7, 8. Obviously, the opposite configuration (that is to say, with the slowing unit 2 fixed to the frame 5, above the high part of the latter, whilst the motion transmission element 6 is fixed to the sliding wing by its first and second ends 7, 8) is also possible.

[0044] Alternatively to the configuration described above, the slowing device 1 may be mounted inside the wardrobe, below the high part of the fixed frame 5, in the container compartment of the wardrobe, in particular hidden from view by the respective sliding wing. In this case, the slowing device 1 slowing unit 2 may be mounted on the sliding wing 3 inside the wardrobe and below the high part of the frame 5, the motion transmission element 6 being fixed to the frame 5 by its first and second ends 7, 8. Obviously, the opposite configuration (that is to say, with the slowing unit 2 fixed to the frame 5, below the high part of the latter, whilst the motion transmission element 6 is fixed to the sliding wing by its first and second ends 7, 8) is also possible.

[0045] In both of the configurations described above the slowing unit 2 may be mounted with the axis of rotation 12 of the rotary body 11 perpendicular to the plane of the sliding wing. Alternatively, the slowing unit 2 may be mounted with the axis of rotation 12 of the rotary body 11 parallel to the plane of the sliding wing.

[0046] Below is a detailed description of further details of the slowing device 1 in accordance with the invention which, unless otherwise specified, are understood to be applicable to all of the examples of the closing device and pieces of furniture indicated above.

[0047] Advantageously, as illustrated in particular in Figures 10 and 11, in the slowing device 1 in accordance with the invention, the arc of contact of the motion transmission element 6 with the rotary body 11 (formed by the coupling stretch 110), has two extremities E1, E2 whose orthogonal projections P1, P2 in a plane P perpendicular to the axis of rotation 12 of the rotary body 11 form, with the point of intersection PI between the plane P perpendicular to the axis of rotation 12 of the rotary body 11 and the axis of rotation 12 itself, two segments 20, 21 which

between them form, at the point of intersection PI, a predetermined angle A other than zero and a function of the desired degree of coupling between the motion transmission element 6 and the rotary body 11. In Figure 11 the plane P perpendicular to the axis of rotation 12 of the rotary body 11 coincides with the plane of the drawing.

[0048] Opportunely, the predetermined angle A is at least 120 degrees. This guarantees that in most conditions and for every type of coupling between the motion transmission element 6 and the rotary body 11, the motion transmission element 6 always transmits the motion of the sliding part 3 to the rotary body 11, causing the latter to rotate.

[0049] The predetermined angle A is preferably 180 degrees. However, greater angles are allowed (and in some cases they are preferable, as indicated below, depending on the type of coupling between the rotary body 11 and the motion transmission element 6).

[0050] The tensioning means 200 comprise fixing means 22 for fixing the first and second ends 7, 8 either to the fixed frame 5 when the slowing unit 2 is applied to the sliding part 3, or to the sliding part 3 when the slowing unit 2 is applied to the fixed frame 5. In the absence of other elements in the tensioning means 200, by appropriately positioning the fixing means 22 it is possible to directly define and/or vary the length of the arco of contact of the motion transmission element 6 with the rotary body 11 (formed by the coupling stretch 110).

[0051] Advantageously, in the slowing device 1 in accordance with the invention:

- the motion transmission element 6 extends, between its first and second ends 7, 8, along a curve 9;
- the slowing unit 2 comprises a first direction diverter 13 located in a predetermined position relative to the rotary body 11 and before the rotary body 11 going along the curve 9 from the first end 7 to the second end 8;
- the motion transmission element 6 comprises, one consecutive to the other: a first stretch I between the first end 7 and the first diverter 13; a second stretch II of contact with a portion 15 of a contact surface of the first diverter 13, in which the motion transmission element 6 assumes a curvature determined by the portion 15 of the contact surface of the first diverter 13 and is subject to a first direction diversion maintaining the portion 15 of the contact surface of the first diverter 13 on a first side 16 of the curve 9; a third stretch III between the first diverter 13 and the rotary body 11; a fourth stretch IV of coupling to the rotary body 11, in which the motion transmission element 6 assumes a curvature determined by the lateral surface portion 17 of the rotary body 11 and is subject to a second direction diversion maintaining the rotary body 11 on a second side 18 of the curve 9 located on the opposite side to the first side 16.

[0052] The first direction diverter 13 tensions the motion transmission element 6 against the rotary body 11 and is part of the tensioning means 200.

[0053] Obviously, the fourth stretch IV of coupling to the rotary body 11 coincides with the coupling stretch 110 between the motion transmission element 6 and the rotary body 11 and, therefore, coincides with the arc of contact they form.

[0054] The second, third and fourth stretches II, III, IV of the motion transmission element 6 are in the coupling zone 10. The presence and action of the first direction diverter 13 (which also tensions the motion transmission element 6 against the rotary body 11) and of the rotary body 11, once the first and second ends 7 and 8 have been fixed to the frame 5 (when the slowing unit 2 is applied on the sliding part 3) or to the sliding part 3 (when the slowing unit 2 is applied to the frame 5) so as to generate sufficient tension on the motion transmission element 6, forces the motion transmission element 6 to follow a "slalom" in the coupling zone 10, thanks to the flexibility of the motion transmission element 6 itself. Thanks to this, the length of the arc of contact of the motion transmission element 6 with the rotary body 11 (formed by the coupling stretch 110) is independent, within ample tolerance limits, of the positioning of the first end 7 and the angle (or inclination) of the first stretch I relative to the other portions of the motion transmission element 6. This allows a considerable increase in the flexibility of use and mounting thanks to the relative freedom of positioning of the first end 7 and angling of the first stretch I relative to the other portions of the motion transmission element 6. Moreover, as indicated (and all the more so in this case), the non-point, contact arc type of coupling between the motion transmission element 6 and the rotary body 11 tends to cause the slowing force to vary very little (or even to be constant) along much of the stroke of the sliding part 3 (and, therefore, of the coupling zone 10 and of the slowing unit 2 along the motion transmission element 6).

[0055] Advantageously, the position of the first direction diverter 13 relative to the rotary body 11 is adjustable. This means that the motion transmission element 6 can always be kept taut at least in the coupling zone 10, always guaranteeing optimum operating conditions even when the motion transmission element 6 is subject to settling (for example, settling due to variations in length caused by thermal effects or the like if the motion transmission element 6 is made of rubber or flexible plastic) and/or when the piece of furniture 4 is subject to settling during use.

[0056] The first direction diverter 13 preferably has a position variable around a predetermined point which is fixed relative to the rotary body 11 and is subject to the action of elastic preloading means designed to hold it constantly pressed against the motion transmission element 6 at least when the first and second ends 7, 8 of the motion transmission element 6 are both fixed to the fixed frame 5, if the slowing unit 2 is fixed to the sliding part 3, or when said ends are fixed to the sliding part 3,

if the slowing unit 2 is fixed to the fixed frame 5.

[0057] Moreover, advantageously and preferably:

- the slowing unit 2 comprises a second direction diverter 14 located in a predetermined position relative to the rotary body 11 and after the rotary body 11 giong along the curve 9 from the first end 7 to the second end 8;
- the motion transmission element 6 comprises, one consecutive to the other: a fifth stretch V between the rotary body 11 and the second diverter 14 consecutive to the fourth stretch IV; a sixth stretch VI of contact with a portion 19 of a contact surface of the second diverter 14, in which the motion transmission element 6 assumes a curvature determined by the portion 19 of the contact surface of the second diverter 14 and is subject to a third direction diversion, maintaining the portion 19 of the contact surface of the second diverter 14 on the first side 16 of the curve 9; a seventh stretch VII between the second diverter 14 and the second end 8;
  the second direction diverter 14 tensioning the motion transmission element 6 against the rotary body 11 and being part of the tensioning means 200.

[0058] Thus, the action of the second direction diverter 14 assists the action of the first direction diverter 13. In this case, the second, third, fourth, fifth and sixth stretches II, III, IV, V, VI of the motion transmission element 6 are in the coupling zone 10. Due to the "slalom" which the motion transmission element 6 has to follow, thanks to its flexibility, in the coupling zone 10 as a result of the presence and action of the first and second direction diverters 13, 14 (which also tension the transmission element 6 against the rotary body 11) and of the rotary body 11, the connection between the motion transmission element 6 and the rotary body 11 is guaranteed, once the first and second ends 7, 8 have been fixed to the frame 5 or to the sliding part 3 so as to generate sufficient tension on the motion transmission element 6. Thanks to the above-mentioned devices, said connection between the motion transmission element 6 and the rotary body 11 is guaranteed even when the first and the seventh stretches I, VII of the motion transmission element 6 are angled differently to one another within ample angular limits. The length of the arc of contact of the motion transmission element 6 with the rotary body 11 (formed by the coupling stretch 110 for the coupling of the motion transmission element 6 to the rotary body 11) is independent, within ample tolerance limits, not only of the positioning of the first end 7 and the angle (or inclination) of the first stretch I relative to the other portions of the motion transmission element 6, but also of the positioning of the second end 8 and the angle (or inclination) of the seventh stretch VII relative to the other portions of the motion transmission element 6. This allows a further, considerable increase in the flexibility of use and mounting thanks to the relative freedom of positioning of the first and second ends 7, 8 and angling of the first and seventh stretches I, VII relative to the other portions of the motion transmission element 6. Consequently, guaranteeing the stable connection between the motion transmission element 6 and the rotary body 11 within such a wide range of possible conditions means also guaranteeing the presence and effectiveness of the slowing action on the motion of the sliding part 3 due to the action developed by the rotation damper on the rotary body 11 in an equally wide range of conditions.

[0059] In this way, the slowing device 1 in accordance with the invention guarantees a very high level of flexibility of use and mounting in very different situations, even where it would be impossible to apply prior art devices. Moreover, as indicated (and all the more so in this case), the non-point, contact arc type of connection between the motion transmission element 6 and the rotary body 11 tends to cause the slowing force to vary very little (or even to be constant) along much of the stroke (or all of the stroke) of the sliding part 3 (and, therefore, of the coupling zone 10 and the slowing unit 2 along the motion transmission element 6). Moreover, thanks to the structure of the slowing device 1 according to this preferred embodiment of the invention, operation of the slowing device 1 is largely insensitive to tolerances for mounting the sliding part 3 on the fixed frame 5, and to relative settling between the two during use.

[0060] Again, with the aim to keep the motion transmission element 6 continuously taut at least in the coupling zone 10, so as to always guarantee optimum operating conditions even when the motion transmission element 6 is subject to settling (for example, if made of rubber or flexible plastic material, to variations in the length caused by thermal effects or the like) and/or when the piece of furniture 4 is subject to settling during use, when both the first and second direction diverters 13, 14 are present in the slowing device 1, the position of at least one of the first and second direction diverters 13, 14 relative to the rotary body 11 is adjustable. Appropriately, the position of both the first and the second direction diverters 13, 14 relative to the rotary body 11 is adjustable.

[0061] In a preferred embodiment of the invention, at least one of the first and second direction diverters 13, 14 has a position variable around a predetermined point which is fixed relative to the rotary body 11 and is subject to the action of elastic preloading means designed to keep it constantly pressed against the motion transmission element 6 at least when the first and second ends 7, 8 of the motion transmission element 6 are both fixed to the fixed frame 5, if the slowing unit 2 is fixed to the sliding part 3, or when said ends are fixed to the sliding part 3, if the slowing unit 2 is fixed to the fixed frame 5.

[0062] In this way the system adjusts itself according to any settling. Advantageously, both the first direction diverter 13 and the second diverter 14 have a position variable around a respective predetermined point which is fixed relative to the rotary body 2 and they are subject

to the action of elastic preloading means designed to hold them constantly pressed against the motion transmission element 6 at least when the first and second ends 7, 8 of the motion transmission element 6 are both fixed to the fixed frame 5, if the slowing unit 2 is fixed to the sliding part 3, or when said ends are fixed to the sliding part 3, if the slowing unit 2 is fixed to the fixed frame 5.

[0063] Opportunely, the middle point M2 of the second stretch II, the middle point M4 of the fourth stretch IV and the middle point M6 of the sixth stretch VI form the vertices of a first triangle T1.

[0064] In one embodiment of the invention, the axis of rotation 12 of the rotary body 11 is transversal to the plane of the first triangle T1. The axis of rotation 12 of the rotary body 11 is preferably perpendicular to the plane of the first triangle T1.

[0065] Appropriately, the geometric centre of gravity of the first direction diverter 13, the geometric centre of gravity of the second direction diverter 14 and the geometric centre of gravity of the rotary body 11 are the vertices of a second triangle T2.

[0066] The rotary body 11 has cylindrical symmetry about the axis of rotation 12.

[0067] The rotation damper (not illustrated) acting on the rotation of the rotary body 11 is an element of the known type. In particular, it may engage in various ways on the axis of rotation 12 of the rotary body 11 and act on the latter by means of a rheological device (for example containing one or more viscous liquids). Moreover, again in the known way, the rotation damper may be configured to exert damping action only on one of the two directions of rotation of the rotary body 11, in particular on that corresponding to motion of the sliding part 3 in the closing direction.

[0068] The diameter of the rotary body 11 is predetermined according to the desired slowing force.

[0069] In a preferred embodiment of the invention, illustrated in the accompanying drawings, the third and fifth stretches III, V are straight. The third and fifth stretches III, V may also be parallel with one another (this case usually corresponds to the condition in which the predetermined angle A is 180 degrees).

[0070] In a preferred embodiment, illustrated in the accompanying drawings, the first and seventh stretches I, VII are straight at least when the first and second ends 7, 8 of the motion transmission element 6 are both fixed to the fixed frame 5, if the slowing unit 2 is fixed to the sliding part 3, or when said ends are fixed to the sliding part 3, if the slowing unit 6 is fixed to the fixed frame 5.

[0071] The first and seventh stretches I, VII may be collinear at least when the first and second ends 7, 8 of the motion transmission element 6 are both fixed to the fixed frame 5, if the slowing unit 2 is fixed to the sliding part 3, or when said ends are fixed to the sliding part 3, if the slowing unit 6 is fixed to the fixed frame 5. This condition may be used if both the first and seventh stretches I, VII are parallel to the direction of sliding of the sliding part 3.

[0072] Figures 10 and 11 illustrate this embodiment, showing the first and seventh stretches I, VII with continuous lines.

[0073] However, in a preferred embodiment of the invention, the first and seventh stretches I, VII between them form an acute angle forming a concavity facing the opposite way to the concavity formed by the arc of contact of the motion transmission element 6 with the rotary body 11 (Figures 10 and 11 illustrate this embodiment, showing the first and seventh stretches I, VII with dashed lines). In particular, advantageously, between the first and second ends 7, 8, the motion transmission element 6 assumes a "W"-shaped configuration with rounded corners at the second, fourth and sixth stretches II, IV, VI.

[0074] This condition is preferable, because it allows conditions which are the least anomalous possible for coupling between the slowing unit 2 and the motion transmission element 6. However, given the flexibility of the motion transmission element 6 and the fact that the structure of the slowing device 1 in the coupling zone 10 is such that it makes the coupling quite insensitive to external conditions, between the coupling zone and the first and/or second end 7, 8 of the element 6 there may be one or more direction diverters to adapt mounting of the slowing device 1 even to a situation in which the piece of furniture 4 is complex and has many hardware elements and accessories, so as to avoid problems of the latter interfering with slowing device 1 operation.

[0075] The first and second direction diverters 13, 14 are usually, preferably, pulleys.

[0076] In one embodiment of the invention the first and second direction diverters 13, 14 are rolling elements.

[0077] The motion transmission element 6 is an open belt whose two ends are the first and second ends 7, 8.

[0078] In a first embodiment, in the coupling stretch 110 coupling the motion transmission element 6 to the rotary body 11 the belt is coupled to the rotary body 11 by friction caused by the tension to which the belt is subjected. In this solution, the belt is preferably basically kept completely taut along its entire length at a high (even if not uniform) level of tension, fixing the first and second ends 7, 8 of the belt forming the motion transmission element 6 appropriately. In embodiments in which there is at least the first direction diverter 13, as said, the coupling is made on the fourth stretch IV of the motion transmission element 6, which coincides with the coupling stretch 110 coupling the motion transmission element 6 to the rotary body 11. In cases in which the coupling between the belt and the rotary body 11 is made by friction, it is also particularly important that the predetermined angle A (formed, at the point of intersection PI between the axis of rotation 12 and the plane P perpendicular to it, by the two segments 20, 21 defined by the point of intersection PI and by the orthogonal projections P1, P2 of the extremities E1, E2 of the arc of contact of the motion transmission element 6 with the rotary body 11 in the plane P perpendicular to the axis of rotation 12 of the rotary body 11) is, in the relative embodiment, at least

120 degrees. This guarantees a coupling between the motion transmission element 6 and the rotary body 11 sufficient to always cause the rotary body 11 to rotate. In this situation, the predetermined angle A may be (and preferably is) greater than 180 degrees.

[0079] The rotary body 2 is preferably a pinion and the belt has teeth on a face which in the coupling stretch 110 coupling the motion transmission element 6 to the rotary body 11 faces the rotary body 11, thus creating a pinion - toothed belt coupling. This type of pinion - toothed belt coupling creates a transmission of the so-called "synchronous" type. The coupling between the motion transmission element 6 and the rotary body 11 preferably produces a synchronous transmission. In embodiments in which there is at least the first direction diverter 13, as said, the coupling is made on the fourth stretch IV of the motion transmission element 6, which coincides with the coupling stretch 110 coupling the motion transmission element 6 to the rotary body 11. In cases in which the coupling between the belt and the rotary body 11 is the pinion - toothed belt coupling described above, the predetermined angle A (formed, at the point of intersection PI between the axis of rotation 12 and the plane P perpendicular to it, by the two segments 20, 21 defined by the point of intersection PI and the orthogonal projections P1, P2 of the extremities E1, E2 of the arc of contact of the motion transmission element 6 with the rotary body 11 in the plane P perpendicular to the axis of rotation 12 of the rotary body 11) may be less than 120 degrees. Rotation of the rotary body 11 under the action of the motion transmission element 6 may be guaranteed sufficiently by the coupling of even a few teeth. This latter statement is all the more valid in embodiments of the invention with simultaneous presence of both the first and the second direction diverters 13, 14. Moreover, when the coupling is of the pinion - toothed belt type, there is no need to keep the belt, which forms the motion transmission element 6, at a high level of tension (even if not uniform) along its entire length: it is sufficient for the tension to be at a good level in the coupling zone 10.

[0080] In the preferred case, with simultaneous presence of both the first and second direction diverters 13, 14, this good coupling can be guaranteed simply by the type of coupling made between the toothed belt and the slowing unit 2 in the coupling zone 10, once the belt is pulled tight enough in the first stretch I and in the seventh stretch VII. Therefore, this configuration is particularly advantageous because it subjects the motion transmission element 6 to a lower level of stress and wear during use, prolonging its life.

[0081] Even if, as already indicated, the opposite mounting configuration is possible, the slowing unit 2 is preferably applicable on the sliding part 3, whilst the motion transmission element 6 is applicable on the fixed frame 5. In this case, the slowing device 1 in accordance with the invention comprises fixing means 22 which connect the first and second ends 7, 8 to the fixed frame 5. These fixing means 22 may coincide with those which are part of the tensioning means 200. In turn these fixing means 22 comprise at least one fixing element 23 with a predominant dimension, to which a corresponding end 7, 8 of the motion transmission element 6 is fixed and which has a slot 24 aligned according to the predominant dimension of the fixing element 23 for the insertion of screws for fixing to the fixed frame 5. The fixing element 23 is particularly useful when the features of the piece of furniture 4 make it particularly complicated to fix at least one of the ends 7, 8 of the motion transmission element 6 to the fixed frame 5. In particular this may happen when the relative optimum fixing point is located in a position which is difficult to reach. Let's take as an example the first end 7. Once the second end 8 has been fixed to the frame 5 at the side of the sliding part 3 opening - closing stroke opposite that to which the first end 7 must be fixed, the fitter fixes the first end 7 to the fixing element 23 and inserts the fixing element 23 in the zone which is difficult to reach, keeping the slot 24 towards him. Once a sufficient level of tension of the motion transmission element 6 is reached, the fitter can fix the fixing element 23 to the frame 5, inserting the fixing screws in the slot 24 which is still accessible, if the fixing element 23 is long enough. This device is particularly important when the piece of furniture 4 is a sliding door 40 with the sliding part 3 consisting of a wing 41 which slides away into a box structure 43. In this case the fixing element 23 is fixed in the box structure 43 and the slot 24 is located at one end 34 of the fixing element 23 located towards the outside of the box structure 43 along the sliding direction of the sliding wing 41.

[0082] Advantageously, in a preferred embodiment the slowing device 1 in accordance with the invention comprises locking means 25 for locking the motion transmission element 6 to the slowing unit 2, acting at least at an inlet 26 and an outlet 27 delimiting the coupling zone 10. The locking means 25 can be removed after mounting the slowing device 1 on the piece of furniture 4. In this way, even when the motion transmission element 6 is extremely flexible (for example when it is a belt) the slowing device 1 can be transported free and disassembled from the piece of furniture 4, keeping the transmission element 6 taut in the coupling zone 10 and bending or winding over itself the portion of motion transmission element 6 outside the coupling zone 10. For example, in the embodiments of the invention involving use of at least the first direction diverter 13, said portion comprises at least the first stretch I. In another example, in embodiments of the invention involving simultaneous use of the first and second direction diverters 13, 14, said portion comprises both the first stretch I and the seventh stretch VII.

[0083] After mounting the slowing device 1 on the piece of furniture 4, the fitter removes the locking means 25, so that the coupling zone 10 can move along the motion transmission element 6 and, therefore, allowing slowed movement of the sliding part 3.

[0084] As illustrated in particular in Figures 9, 9a, 9b,

the locking means 25 comprise, for example, two split pins 250 which are applied on the motion transmission element 6. The two split pins 250 may be inserted in two respective through holes made in a base 280 of the slowing unit respectively at the inlet 26 and the outlet 27. In particular, the through holes can be made at projections 281 of base 280, made on an outer edge of the base.

[0085] Appropriately, the slowing device 1 comprises a slowing unit case 28 with an inlet 26 and an outlet 27 for the motion transmission element 6, delimiting the coupling zone 10. The case 28 may comprise a base 280 of the slowing unit 2 (a base which in this case may coincide with the above-mentioned base) and a lid 282 which can be applied on the base 280. The locking means 25 comprise interference elements 29 acting between the motion transmission element 6 and the walls of the case 28 at the inlet 26 and the outlet 27. Said interference elements 29 may be, for example, again two split pins 250 fixed on the motion transmission element 6. As described above, the two split pins 250 may be inserted in two respective through holes made in the base 280 of the slowing unit respectively at the inlet 26 and the outlet 27. In particular, the through holes can be made at projections 281 of base 280, made on an outer edge of the base. In this case, the outer edge of the base 280 and the corresponding projections 281 are considered part of the walls of the case 28.

[0086] The invention has important advantages.

[0087] The slowing device disclosed may be effectively applied to many situations and different structures of pieces of furniture, in which mounting other slowing devices would be difficult if not impossible. Moreover, the non-point, contact arc type of coupling between the motion transmission element and the rotary body tends to cause the slowing force to vary very little (or be constant) along much of the stroke (or the entire stroke) of the sliding part 3.

[0088] The non-point, contact arc type of coupling between the motion transmission element and the rotary body allows a significant reduction in noise compared with the rack and pinion coupling typical of the prior art. In the case of the rack and pinion coupling typical of the prior art, as indicated, a substantially "point" coupling is created (in the sense described above) in which even only one rack tooth at a time is coupled with a single corresponding pinion tooth and when, during movement of the sliding part, the couplign passes from one tooth to the next there are detachments and impacts which tend to be noisy. This effect is eliminated or greatly limited by the arc coupling. The motion transmission element is constantly in contact with the rotary body.

[0089] Even when, in the invention, the coupling is made between a motion transmission element consisting of a toothed open belt and a rotary body consisting of a pinion, the coupling is never a point coupling, but always an arc coupling, therefore many teeth are always engaged on each other. In this case the term synchronous transmission is used and the force transmitted by the system is constant along the entire coupling arc.

[0090] Operation of the slowing device in accordance with the invention requires very few or no adjustments and is not very sensitive to variations caused by settling inside the device or slackening or movements by or play between the various parts of the piece of furniture to which the slowing device is applied. The invention described can be modified and adapted in several ways without thereby departing from the scope of the inventive concept.

Claims

1. A device (1) for slowing the closing of sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, comprising:

- a slowing unit (2) which is applicable either on a sliding part (3) of a piece of furniture (4) or on a fixed frame (5) of the piece of furniture (4);
- a motion transmission element (6) which is applicable to the fixed frame (5) when the slowing unit (2) is applied to the sliding part (3), or which is applicable to the sliding part (3) when the slowing unit (2) is applied to the fixed frame (5);

where:

- the motion transmission element (6) extends between its first and second ends (7, 8), passing through the slowing unit (2) in a coupling zone (10)

where the motion transmission element (6) is coupled to the slowing unit (2);

- the slowing unit (2), in turn, comprises a rotary body (11) free to rotate about an axis of rotation (12) and a rotation damper acting on the rotation of the rotary body (11), the rotary body (11) being operatively connected to the motion transmission element (6) in the coupling zone (10);
- during the motion of the slowing unit (2) along the motion transmission element (6) between the first and second ends (7, 8), motion which when the slowing device (1) is applied is due to the relative motion between the sliding part (3) and the fixed frame (5), the coupling zone (10) slides along the motion transmission element (6) between the first and second ends (7, 8) and the rotary body (11) is made to rotate due to the operative connection with the motion transmission element (6), with a consequent slowing action by the rotation damper on the relative motion;

the slowing device being **characterised in that**:

- the motion transmission element (6) is flexible

and, in the coupling zone (10), comprises a coupling stretch (110) for coupling to the rotary body (11) in which the motion transmission element (6) is in contact with a lateral surface portion (17) of the rotary body (11) and assumes a curvature predetermined by the lateral surface portion (17) of the rotary body (11), thus forming an arc of contact with the rotary body (11);
- the slowing device (1) also comprises tensioning means (200), acting on the motion transmission element (6) at least when the slowing device (1) is applied, which tension the motion transmission element (6) against the rotary body (11) at least at the arc of contact of the motion transmission element (6) with the rotary body (11).

2. The slowing device (1) according to claim 1, **characterised in that** the arc of contact of the motion transmission element (6) with the rotary body (11), formed by the coupling stretch (110), has two extremities (E1, E2) whose orthogonal projections (P1, P2) in a plane (P) perpendicular to the axis of rotation (12) of the rotary body (11) form, with the point of intersection (PI) between the plane (P) perpendicular to the axis of rotation (12) of the rotary body (11) and the axis of rotation (12) itself, two segments (20, 21) which between them form, at the point of intersection (PI), a predetermined angle (A) other than zero and a function of the desired degree of coupling between the motion transmission element (6) and the rotary body (11).

3. The slowing device (1) according to claim 2, **characterised in that** the angle (A) is at least 120 degrees.

4. The slowing device (1) according to claim 3, **characterised in that** the angle (A) is 180 degrees.

5. The slowing device (1) according to any of the foregoing claims, **characterised in that** the tensioning means (200) comprise fixing means (22) for fixing the first and second ends (7, 8) either to the fixed frame (5) when the slowing unit (2) is applied to the sliding part (3), or to the sliding part (3) when the slowing unit (2) is applied to the fixed frame (5).

6. The slowing device (1) according to any of the foregoing claims,
characterised in that:

- the motion transmission element (6) extends, between its first and second ends (7, 8), along a curve (9);
- the slowing unit (2) comprises a first direction diverter (13) located in a predetermined position relative to the rotary body (11) and before the rotary body (11) going along the curve (9) from the first end (7) to the second end (8);
- the motion transmission element (6) comprises, one consecutive to the other: a first stretch (I) between the first end (7) and the first diverter (13); a second stretch (II) of contact with a portion (15) of a contact surface of the first diverter (13), in which the motion transmission element (6) assumes a curvature determined by the portion (15) of the contact surface of the first diverter (13) and is subject to a first direction diversion maintaining the portion (15) of the contact surface of the first diverter (13) on a first side (16) of the curve (9); a third stretch (III) between the first diverter (13) and the rotary body (11); a fourth stretch (IV) of coupling to the rotary body (11), in which the motion transmission element (6) assumes a curvature determined by the lateral surface portion (17) of the rotary body (11) and is subject to a second direction diversion maintaining the rotary body (11) on a second side (18) of the curve (9) located on the opposite side to the first side (16);
the first direction diverter (13) tensioning the motion transmission element (6) against the rotary body (11) and being part of the tensioning means (200).

7. The slowing device (1) according to claim 6, **characterised in that**:

- the slowing unit (2) comprises a second direction diverter (14) located in a predetermined position relative to the rotary body (11) and after the rotary body (11) going along the curve (9) from the first end (7) to the second end (8);
- the motion transmission element (6) comprises, one consecutive to the other: a fifth stretch (V) between the rotary body (11) and the second diverter (14) consecutive to the fourth stretch (IV); a sixth stretch (VI) of contact with a portion (19) of a contact surface of the second diverter (14), in which the motion transmission element (6) assumes a curvature determined by the portion (19) of the contact surface of the second diverter (14) and is subject to a third direction diversion, maintaining the portion (19) of the contact surface of the second diverter (14) on the first side (16) of the curve (9); a seventh stretch (VII) between the second diverter (14) and the second end (8);
the second direction diverter (14) tensioning the motion transmission element (6) against the rotary body (11) and being part of the tensioning means (200).

8. The slowing device (1) according to claim 7, **characterised in that** the middle point (M2) of the second

stretch (II), the middle point (M4) of the fourth stretch (IV) and the middle point (M6) of the sixth stretch (VI) form the vertices of a first triangle (T1).

9. The slowing device (1) according to claim 8, **characterised in that** the axis of rotation (12) of the rotary body (11) is transversal to the plane of the first triangle (T1).

10. The slowing device (1) according to claim 9, **characterised in that** the axis of rotation (12) of the rotary body (11) is perpendicular to the plane of the first triangle (T1).

11. The slowing device (1) according to any of the claims from 7 to 10, **characterised in that** the geometric centre of gravity of the first direction diverter (13), the geometric centre of gravity of the second direction diverter (14) and the geometric centre of gravity of the rotary body (11) are the vertices of a second triangle (T2).

12. The slowing device (1) according to any of the claims from 7 to 11, **characterised in that** the third stretch (III) and the fifth stretch (V) are straight.

13. The slowing device (1) according to claim 12, **characterised in that** the third stretch (III) and the fifth stretch (V) are parallel with one another.

14. The slowing device (1) according to any of the claims from 7 to 13, **characterised in that** the first and seventh stretches (I, VII) are straight at least when the first and second ends (7, 8) of the motion transmission element (6) are both fixed to the fixed frame (5), if the slowing unit (2) is fixed to the sliding part (3), or when said ends are fixed to the sliding part (3), if the slowing unit (6) is fixed to the fixed frame (5).

15. The slowing device (1) according to claim 14, **characterised in that** the first and seventh stretches (I, VII) between them form an acute angle forming a concavity facing the opposite way to the concavity formed by the arc of contact of the motion transmission element (6) with the rotary body (11).

16. The slowing device (1) according to claim 15 when it is dependent on claim 12, **characterised in that** between the first and second ends (7, 8) the motion transmission element (6) assumes a "W"-shaped configuration with rounded corners at the second, the fourth and the sixth stretches (II, IV, VI).

17. The slowing device (1) according to claim 14, **characterised in that** the first and seventh stretches (I, VII) are collinear at least when the first and second ends (7, 8) of the motion transmission element (6) are both fixed to the fixed frame (5), if the slowing unit (2) is fixed to the sliding part (3), or when said ends are fixed to the sliding part (3), if the slowing unit (6) is fixed to the fixed frame (5).

18. The slowing device (1) according to claim 6, **characterised in that** the position of the first direction diverter (13) relative to the rotary body (11) is adjustable.

19. The slowing device (1) according to claim 18, **characterised in that** the first direction diverter (13) has a position variable around a predetermined point which is fixed relative to the rotary body (11) and is subject to the action of elastic preloading means designed to hold it constantly pressed against the motion transmission element (6) at least when the first and second ends (7, 8) of the motion transmission element (6) are both fixed to the fixed frame (5), if the slowing unit (2) is fixed to the sliding part (3), or when said ends are fixed to the sliding part (3), if the slowing unit (2) is fixed to the fixed frame (5).

20. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** the position of at least one of the first and second direction diverters (13, 14) relative to the rotary body (11) is adjustable.

21. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** the position of both the first and second direction diverters (13, 14) relative to the rotary body (11) is adjustable.

22. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** at least one of the first and second direction diverters (13, 14) has a position variable around a predetermined point which is fixed relative to the rotary body (11) and is subject to the action of elastic preloading means designed to hold it constantly pressed against the motion transmission element (6) at least when the first and second ends (7, 8) of the motion transmission element (6) are both fixed to the fixed frame (5), if the slowing unit (2) is fixed to the sliding part (3), or when said ends are fixed to the sliding part (3), if the slowing unit (2) is fixed to the fixed frame (5).

23. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** both the first and second direction diverters (13, 14) have a position variable around a predetermined point which is fixed relative to the rotary body (2) and are subject to the action of elastic preloading means designed to hold them constantly pressed against the motion transmission element (6) at least when the first and second ends (7, 8) of the motion transmission element (6) are both fixed to the fixed frame (5), if the slowing unit (2) is fixed to the sliding part (3), or when said ends are fixed to the sliding part (3), if the slowing

unit (2) is fixed to the fixed frame (5).

24. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** the first and second direction diverters (13, 14) are rolling elements.

25. The slowing device (1) according to any of the claims from 7 to 17, **characterised in that** the first and second direction diverters (13, 14) are pulleys.

26. The slowing device (1) according to any of the foregoing claims, **characterised in that** the motion transmission element (6) is an open belt whose two ends are the first and second ends (7, 8).

27. The slowing device (1) according to claim 26, **characterised in that** in the coupling stretch (110) coupling the motion transmission element (6) to the rotary body (11) the belt is coupled to the rotary body (11) by friction caused by the tension to which the belt is subjected.

28. The slowing device (1) according to claim 26, **characterised in that** the rotary body (2) is a pinion and the belt has teeth on a face which in the coupling stretch (110) coupling the motion transmission element (6) to the rotary body (11) faces the rotary body (11), thus creating a pinion - toothed belt coupling.

29. The slowing device (1) according to any of the foregoing claims, **characterised in that** the rotary body (11) has cylindrical symmetry about the axis of rotation (12).

30. The slowing device (1) according to claim 29, **characterised in that** the diameter of the rotary body (11) is predetermined depending on the desired slowing force.

31. The slowing device (1) according to any of the foregoing claims, **characterised in that** the slowing unit (2) is applicable to the sliding part (3), whilst the motion transmission element (6) is applicable to the fixed frame (5).

32. The slowing device (1) according to claim 31 when it is dependent on any of the claims from 26 t o 28, **characterised in that** it comprises fixing means (22) for fixing the first and second ends (7, 8) to the fixed frame (5) these means in turn comprising at least one fixing element (23) with a predominant dimension, to which a corresponding end (7, 8) of the motion transmission element (6) is fixed and which has a slot (24) aligned according to the predominant dimension of the fixing element (23) for the insertion of screws for fixing to the fixed frame (5).

33. The slowing device (1) according to any of the foregoing claims, **characterised in that** it comprises locking means (25) for locking the motion transmission element (6) to the slowing unit (2) acting at least at an inlet (26) and an outlet (27) delimiting the coupling zone (10), the locking means (25) being removable after mounting the slowing device (1) on the piece of furniture (4).

34. The slowing device (1) according to any of the foregoing claims, **characterised in that** it comprises a slowing unit case (28) with an inlet (26) and an outlet (27) for the motion transmission element (6), delimiting the coupling zone (10).

35. The slowing device (1) according to claim 34 when it is dependent on claim 33, **characterised in that** the locking means (25) comprise interference elements (29) acting between the motion transmission element (6) and the walls of the case (28) at the inlet (26) and the outlet (27).

36. The slowing device (1) according to any of the foregoing claims, **characterised in that** the coupling between the motion transmission element (6) and the rotary body (11) produces a synchronous motion transmission.

37. A closing device for sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like, comprising an accumulator (30) of mechanical energy which is stably connectable to a sliding part (3) of a piece of furniture (4) and, at the same time, to a fixed frame (5) of the piece of furniture (4), the accumulator gradually accumulating mechanical energy during a sliding part (3) opening step and, when the sliding part (3) is no longer held in the position reached during the opening step, releasing the mechanical energy accumulated to apply a closing force on the sliding part (3) which returns the sliding part (3) to the closed position, the closing device being **characterised in that** it also comprises a slowing device (1) in accordance with any of the claims from 1 to 36.

38. A closing device for sliding parts of pieces of furniture such as doors, wardrobes, chests of drawers and the like according to claim 37, **characterised in that** the accumulator (30) comprises elastic return means (31) which are stably connectable on one side to the sliding part (3) and on the other side to the fixed frame (5).

39. A piece of furniture (4), in particular a door, wardrobe, chest of drawers and the like, of the type comprising a fixed frame (5) and a sliding part (3) associated with the frame (5) and slidably mobile, relative to the frame (5), along a sliding direction, between a closed position and an open position, **characterised in that**

it comprises a slowing device (1) in accordance with any of the claims from 1 to 36.

40. A piece of furniture (4), such as a door, wardrobe, chest of drawers and the like, of the type comprising a fixed frame (5) and a sliding part (3) associated with the frame (5) and slidably mobile, relative to the frame (5), along a sliding direction, between a closed position and an open position, **characterised in that** it comprises a closing device in accordance with claim 37 or 38.

41. The piece of furniture (4) according to claim 39 or 40, **characterised in that** it is a sliding door (40) comprising a sliding wing (41), the sliding wing (41) coinciding with the sliding part (3).

42. The piece of furniture (4) according to claim 41, **characterised in that** the fixed frame (5) comprises a counterframe (42) forming a box structure (43) into which at least part of the sliding wing (41) slides with the door in the open position.

43. The piece of furniture (4) according to claim 42 when it is dependent on claim 32, **characterised in that** the fixing element (23) is fixed in the box structure (43) and the slot (24) is located at one end (34) of the fixing element (23) located towards the outside of the box structure (43) along the sliding direction of the sliding wing (41).

44. The piece of furniture (4) according to claim 39 or 40, **characterised in that** it is a wardrobe with at least one sliding wing associated with the frame (5), the sliding wing coinciding with the sliding part (3).

45. The piece of furniture (4) according to claim 44, **characterised in that** it comprises at least two sliding wings and at least two respective slowing devices (1) according to any of the claims from 1 to 36, each acting on the respective sliding wing.

46. The piece of furniture (4) according to claim 44, when it is dependent on claim 40, **characterised in that** it comprises at least two sliding wings and at least two respective closing devices according to claim 37 or 38, each acting on the respective sliding wing and having a respective slowing device (1) according to any of the claims from 1 to 36 acting on the same sliding wing as the corresponding closing device of which it is a part.

47. The piece of furniture (4) according to any of the claims from 44 to 46, **characterised in that** the slowing unit (2) of the slowing device (1) is mounted on the sliding wing on the outside of the wardrobe and above the high part of the frame (5), the motion transmission element (6) being fixed by its first and second ends (7, 8) to the frame (5).

48. The piece of furniture (4) according to any of the claims from 44 to 46, **characterised in that** the slowing unit (2) of the slowing device (1) is mounted on the sliding wing inside the wardrobe and below the high part of the frame (5), the motion transmission element (6) being fixed by its first and second ends (7, 8) to the frame (5).

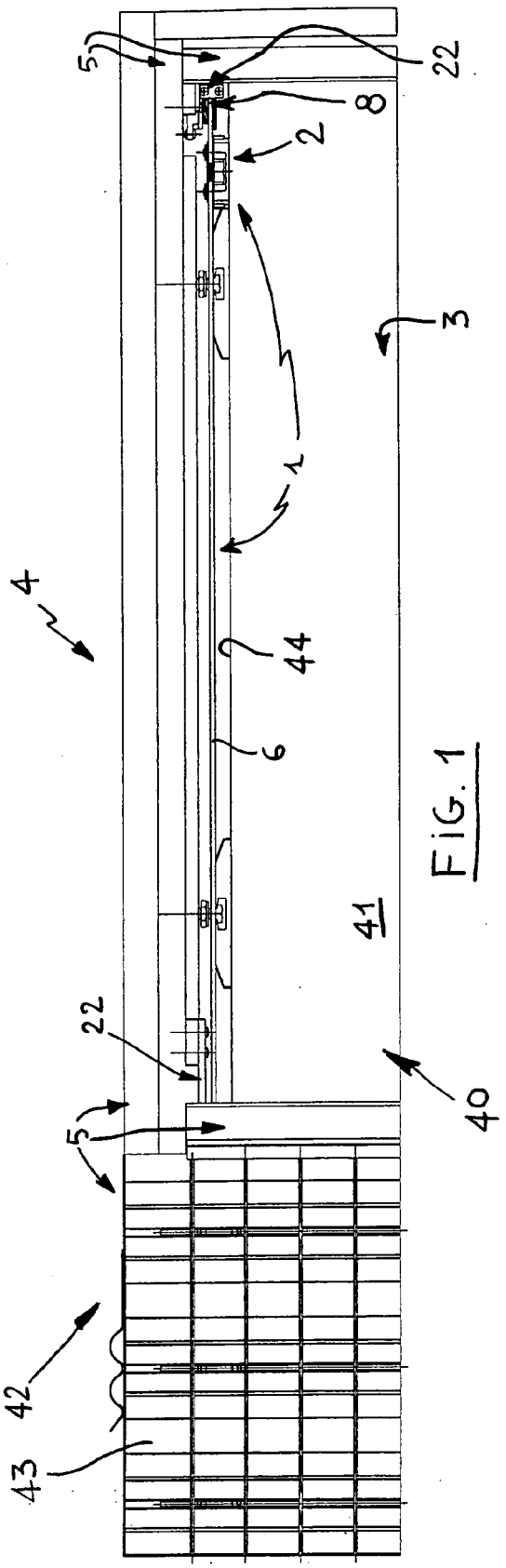

FIG. 1

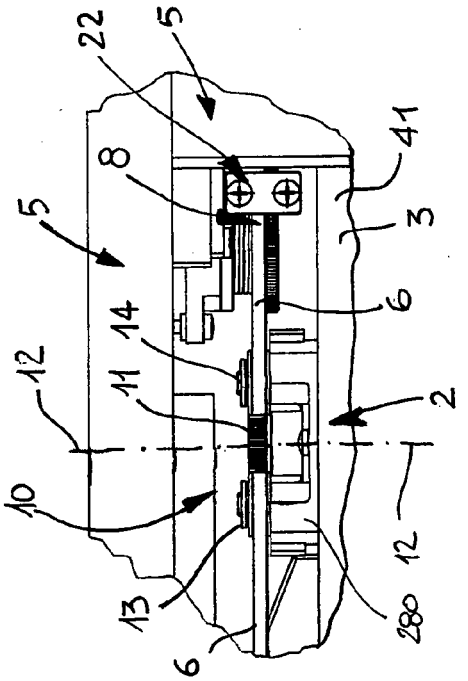

FIG. 1a

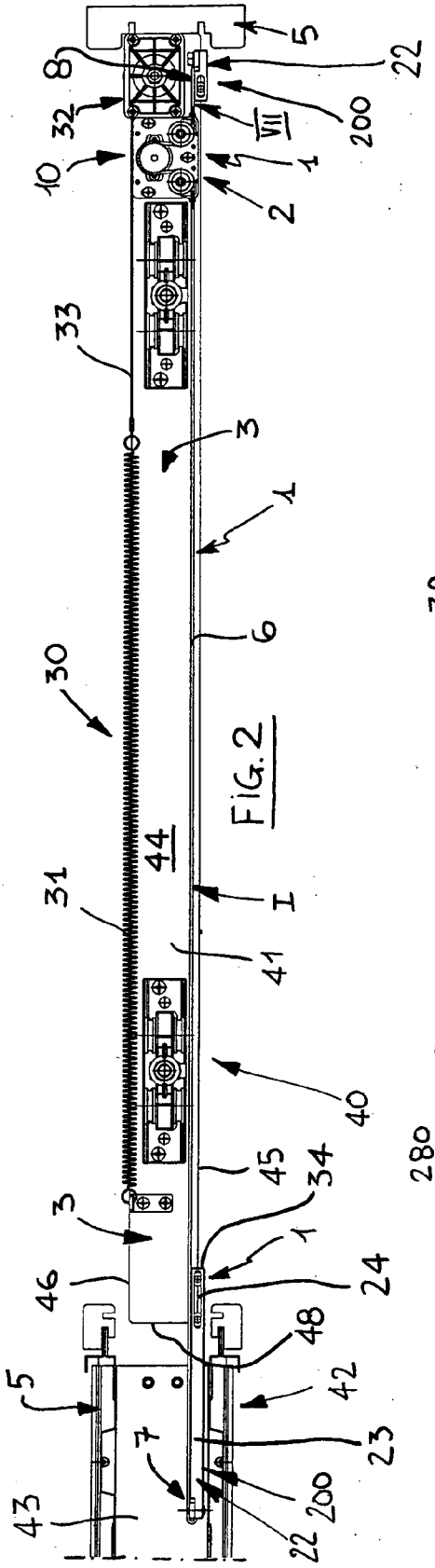
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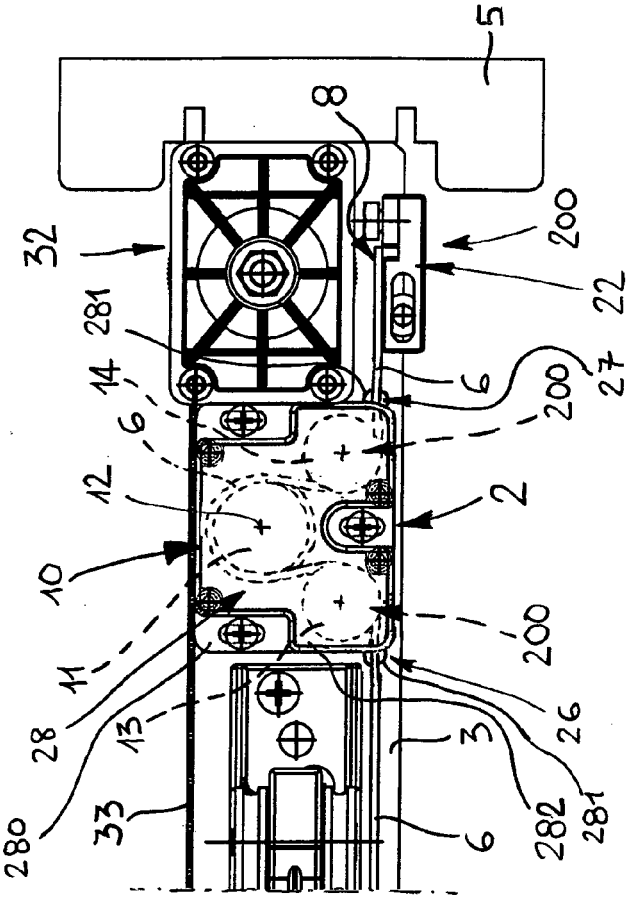
FIG. 2

FIG. 3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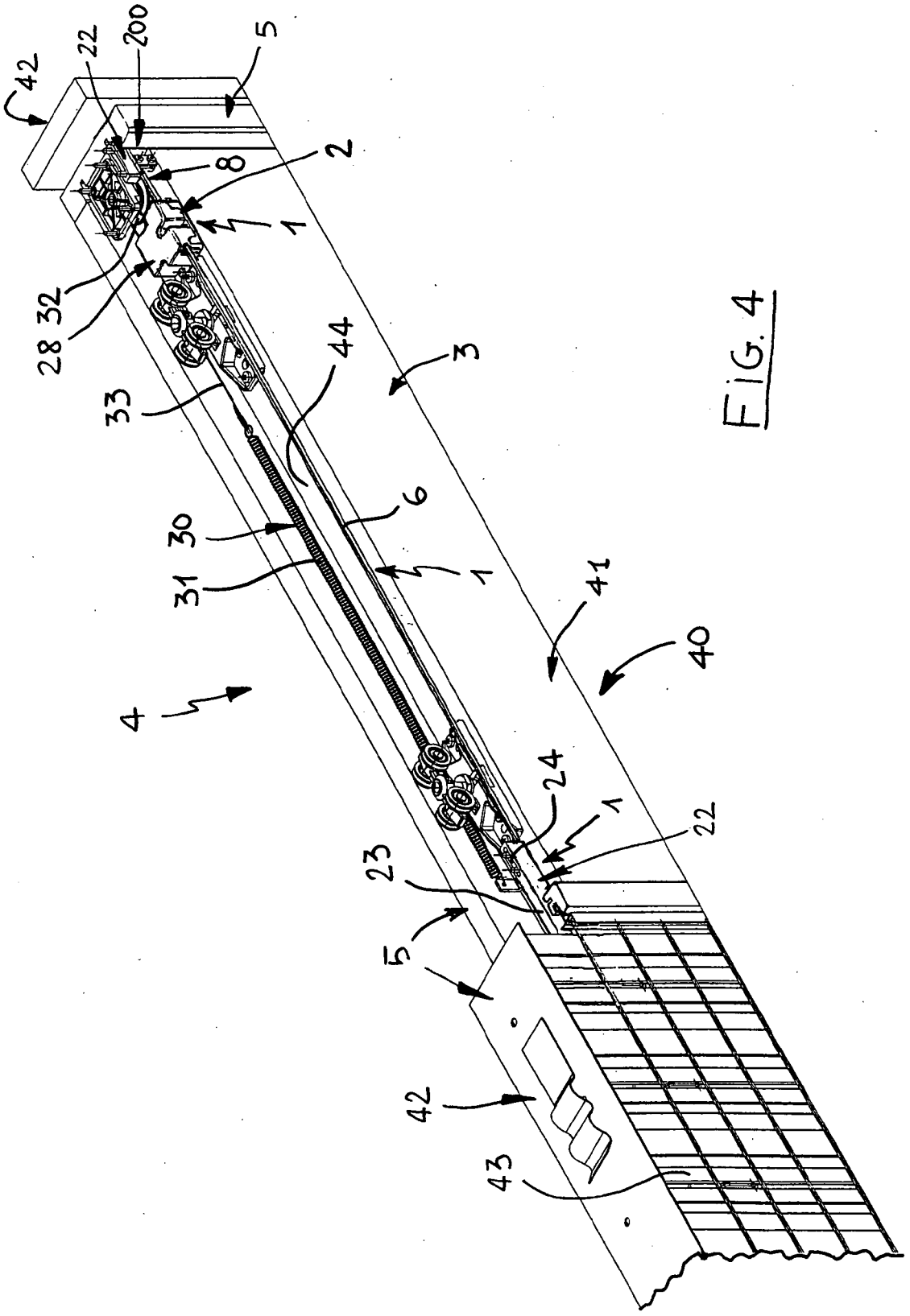

FIG. 4

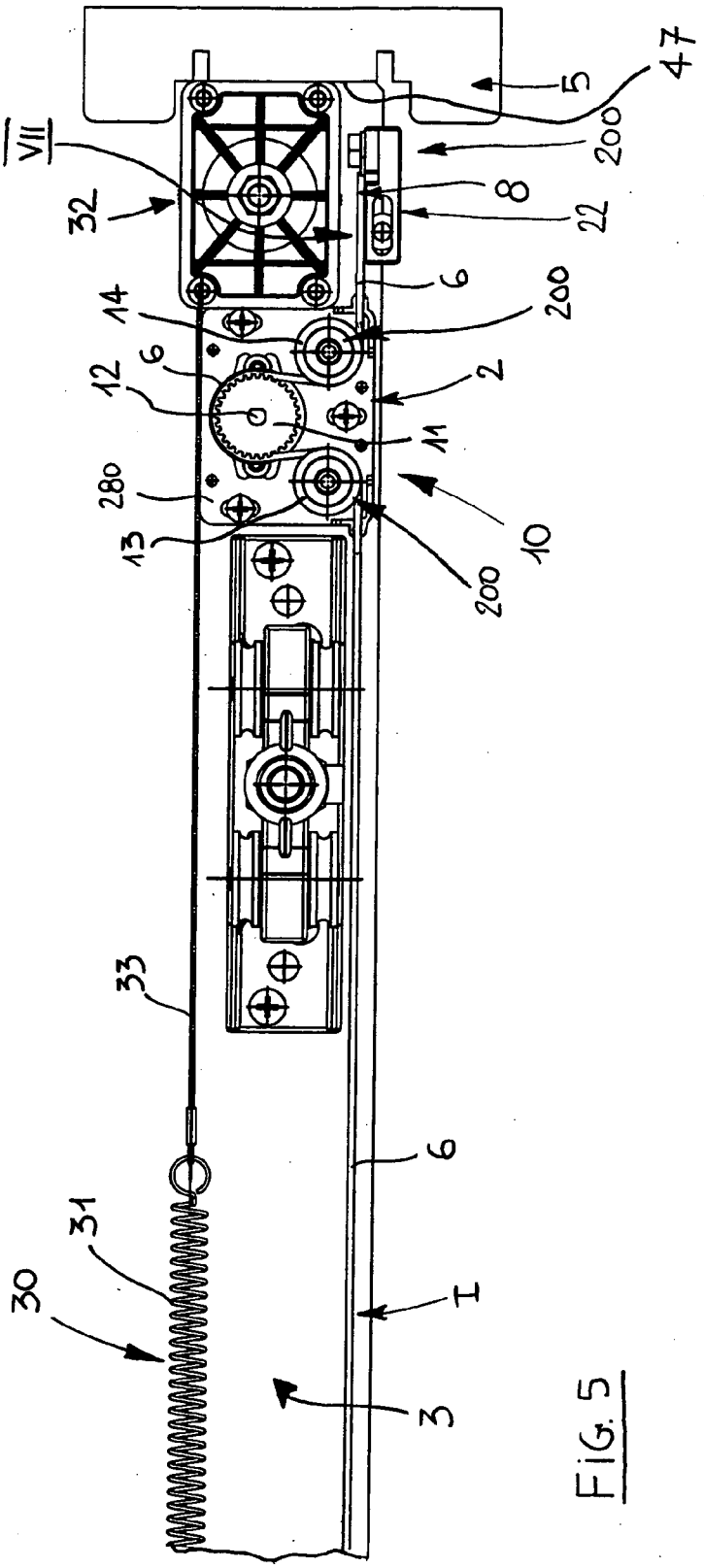

FIG. 5

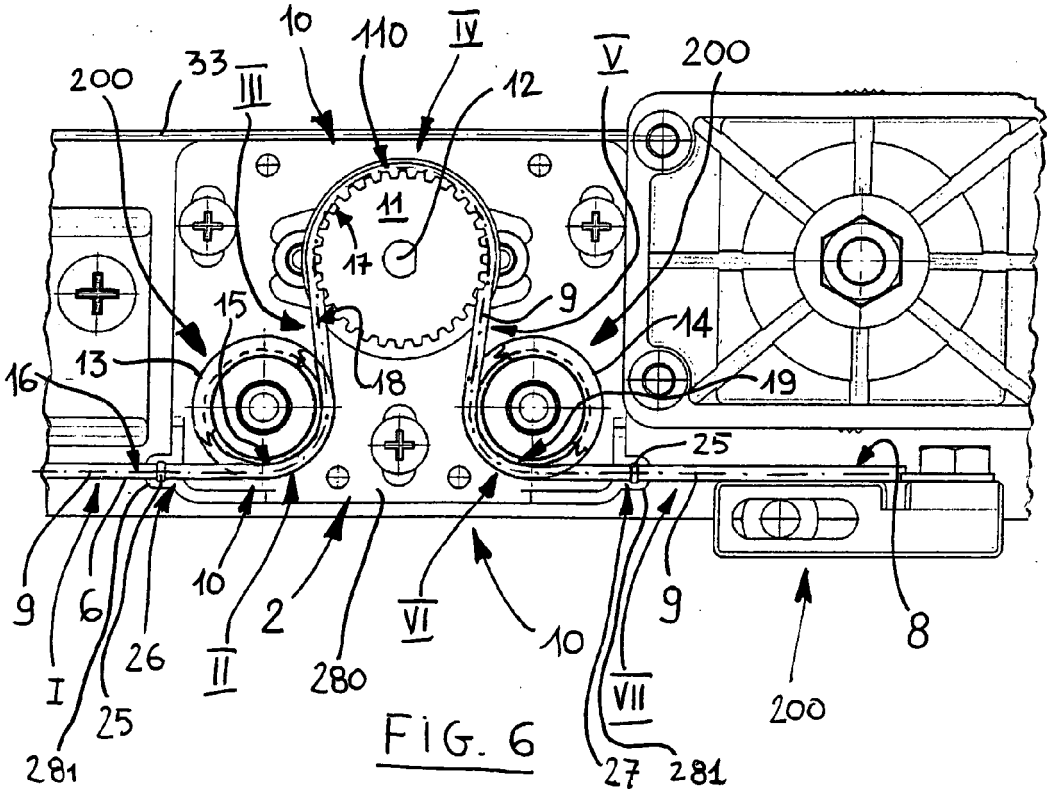
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FIG. 6

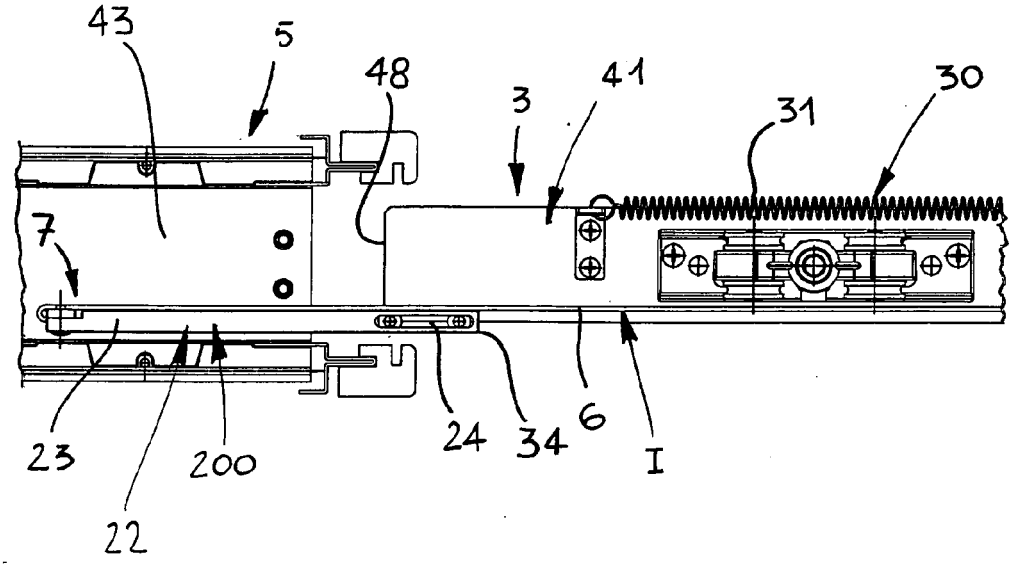
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FIG. 7

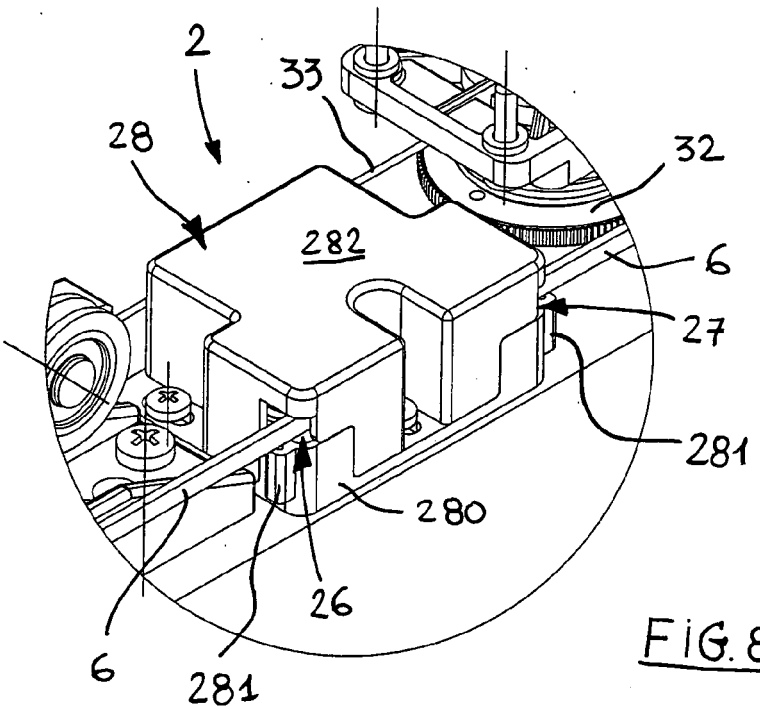
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FIG. 8

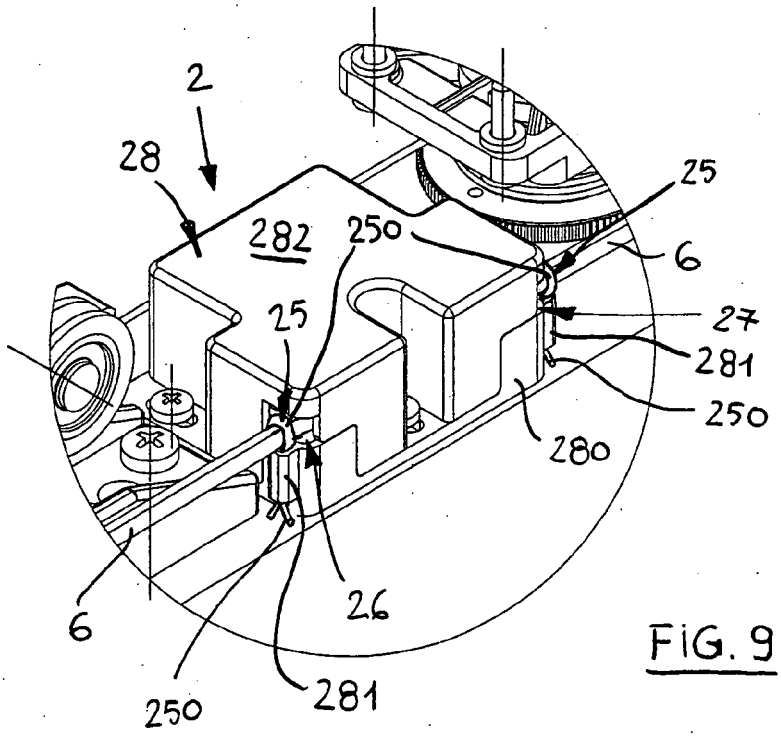
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FIG. 9

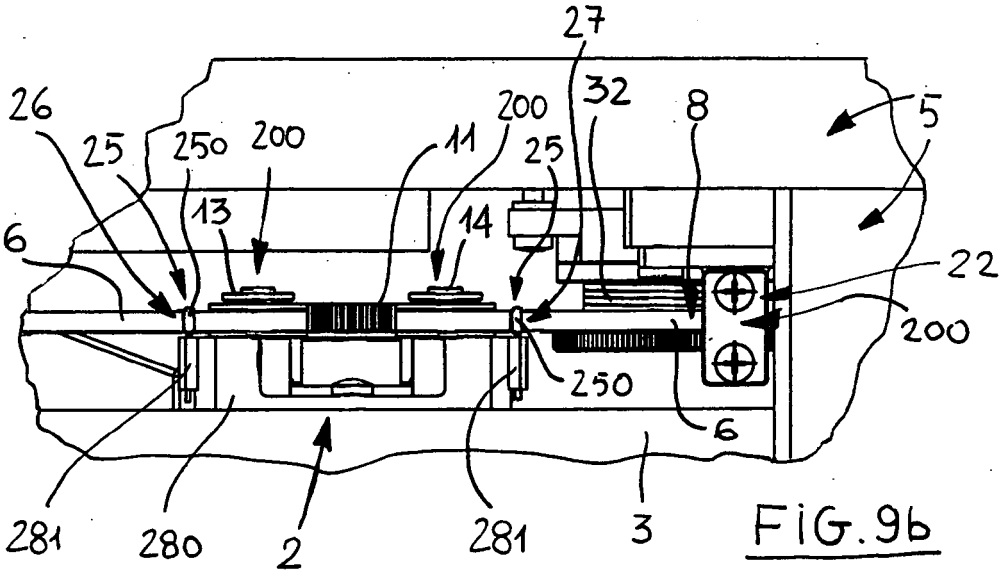
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FIG. 9b

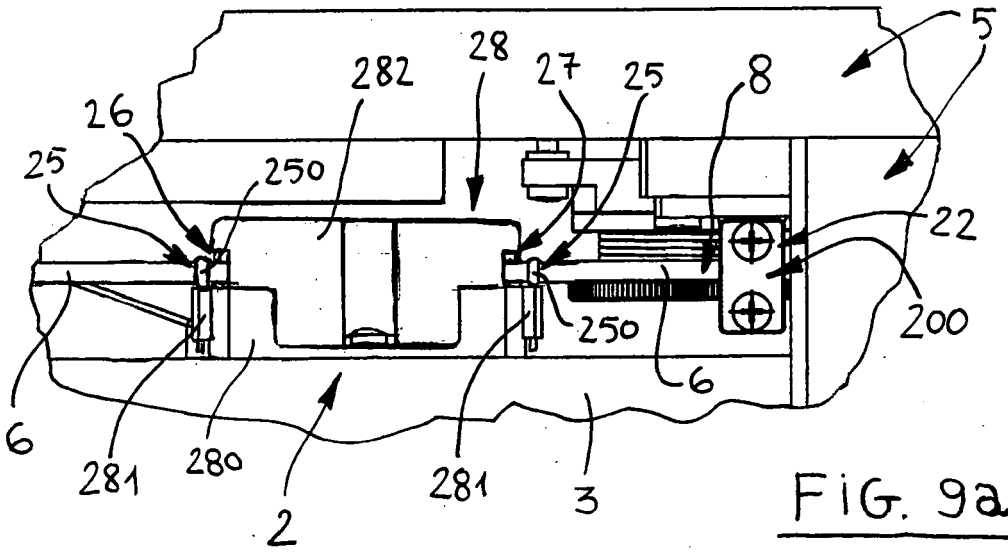
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FIG. 9a

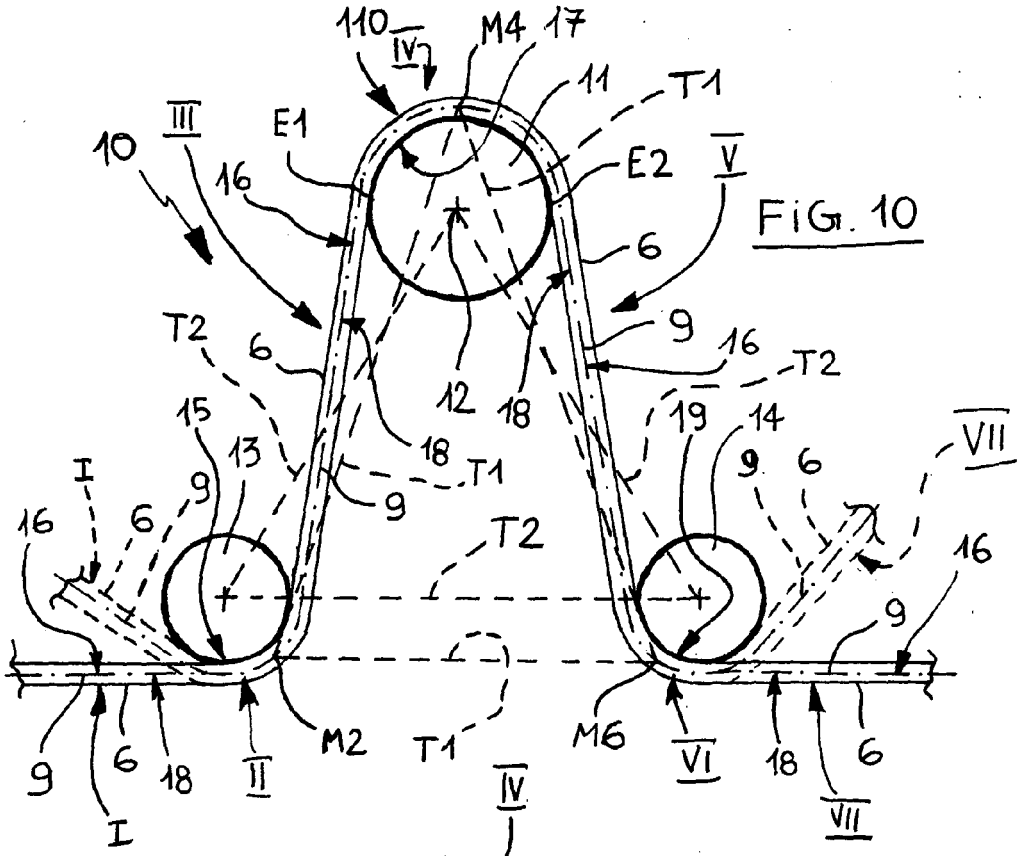
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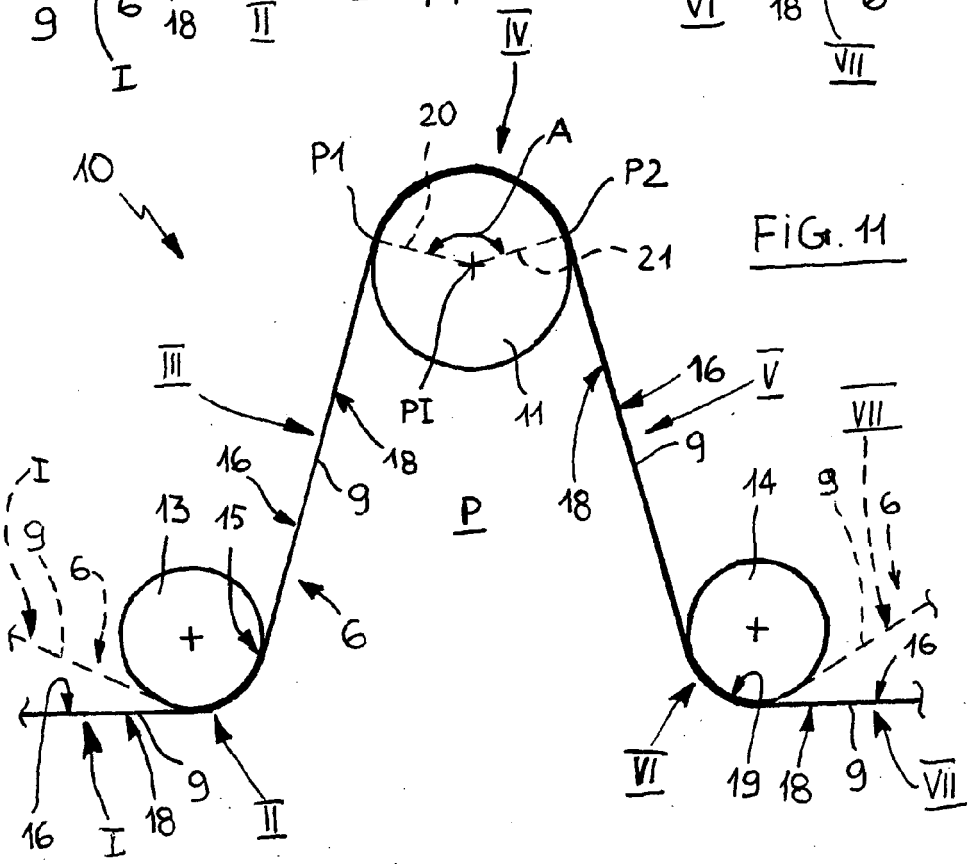
FIG. 10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VII

FIG. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5701

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Y	* paragraphs [0016] - [0018]; figures *	40	
A		4	

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	* page 4, lines 8-22; figures *		

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Y	* abstract; figures *	40	
A		45,46	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 February 2007	WITASSE-MOREAU, C

CATEGORY OF CITED DOCUMENTS

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27-02-2007

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