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(54) **SAFETY BELT WINDER COMPRISING A POWER LIMITATION SYSTEM WHICH CAN BE ACTUATED ACCORDING TO THE STRIP OF BELT PULLED OUT**

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(57) **ABSTRACT**

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A safety belt roll-up mechanism is provided, and includes a force limitation device that operates in a multi-stage manner and has a two-stage torque rod and a pyrotechnically operating switching device that couples the torque rod, in various clamping lengths, with a belt shaft. The extent of the belt strap unwound from the belt shaft is utilized for actuation of the force limitation device. A ratchet wheel is connected to the belt shaft via a reduction gear mechanism. A portion of the periphery of the ratchet wheel has a tothing for engaging the reduction gear mechanism. A further portion of the periphery of the ratchet wheel has a switching contour that rests against a contact pin of an electric switch. The switching contour has a profile that effects the connection or disconnection of the switching device for the torque rod.

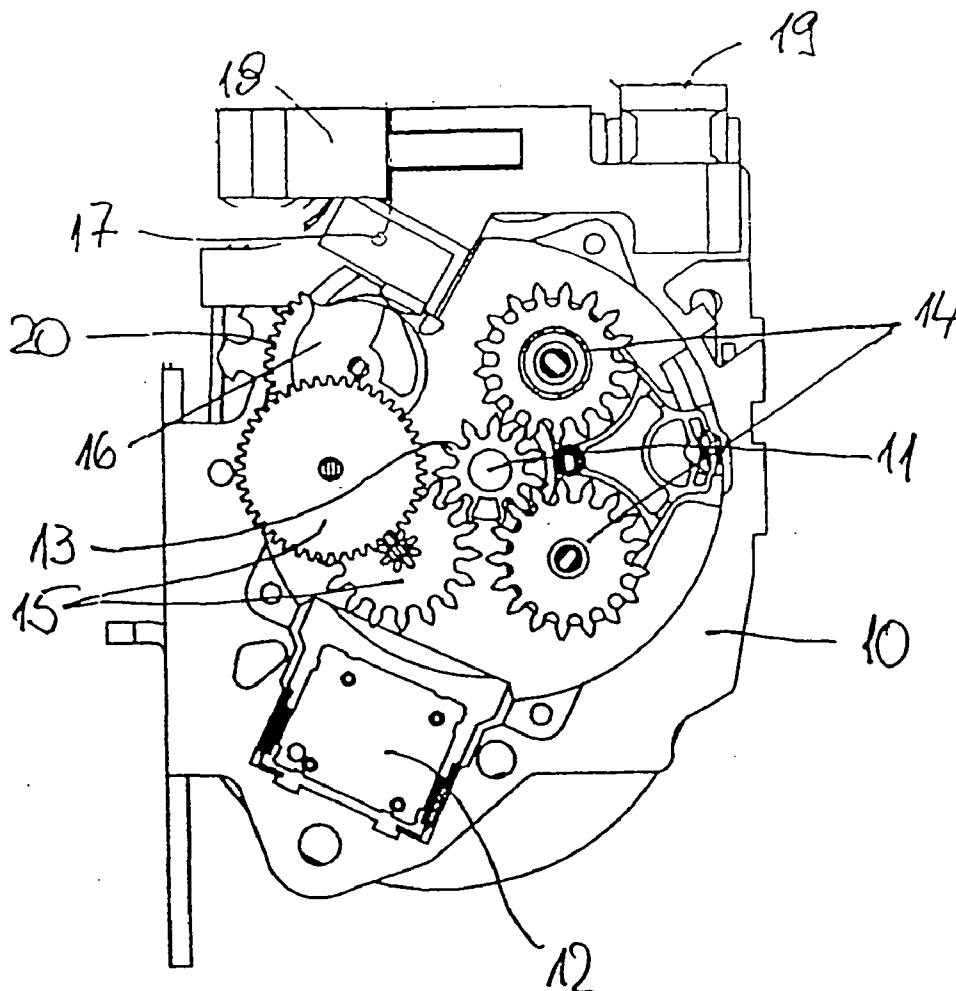
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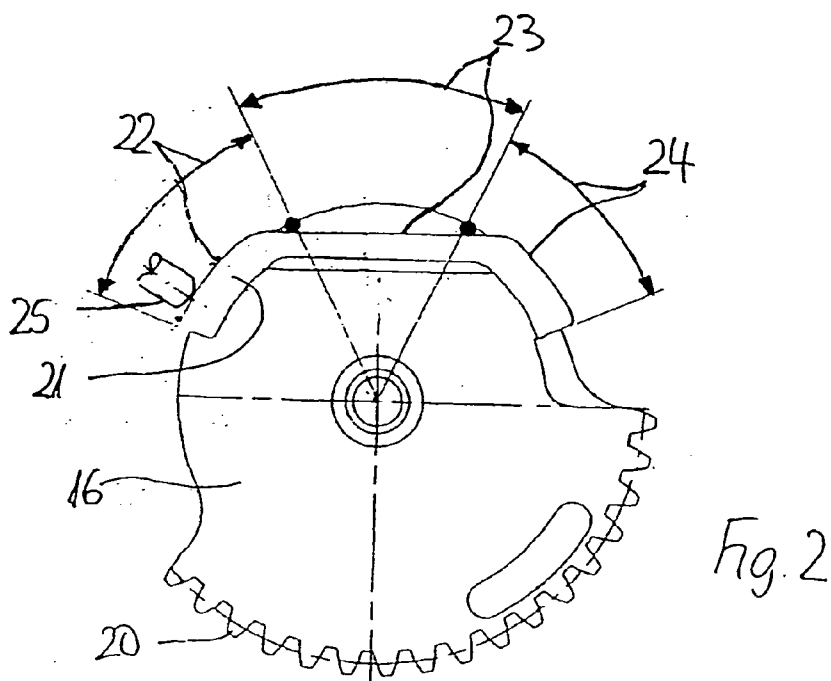
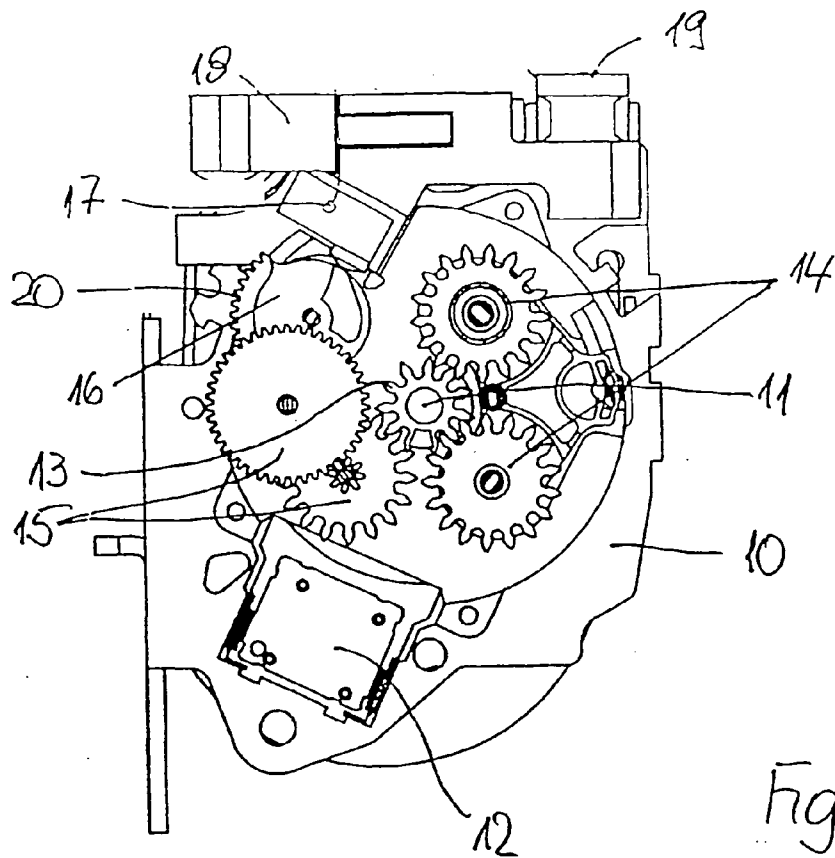
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**SAFETY BELT WINDER COMPRISING A POWER
LIMITATION SYSTEM WHICH CAN BE
ACTUATED ACCORDING TO THE STRIP OF
BELT PULLED OUT**

[0001] The invention relates to a safety belt roll-up mechanism having a belt shaft that is mounted in a housing and serves as a carrier for a belt strap that can be wound onto and unwound from the belt shaft, whereby the belt roll-up mechanism is provided with a force limitation device that operates in a multi-stage manner and has a torque rod and a switching device that couples the torque rod, in various clamping lengths, with the belt shaft, and whereby the extent of the belt strap unwound from the belt shaft is utilized for the actuation of the force limitation device.

[0002] A safety belt roll-up mechanism having the aforementioned features is known from DE 27 27 470 A1. The known safety belt roll-up mechanism has a torque rod as a force limitation device that at its one end is fixedly connected to the shaft blocking mechanism, and at its other end is coupled to the belt shaft in such a way that even when the shaft blocking mechanism is triggered, the belt shaft, upon torsion of the torque rod, can still rotate further by a certain amount. Since the adjustment of the force limitation level should be effected as a function of, in particular, the size of a vehicle occupant, the known belt roll-up mechanism has a device for the continuous alteration of the clamping length of the torque rod, which clamping length, in one embodiment of the known belt roll-up mechanism, is to be controllable as a function of the length of the belt strap withdrawn by connecting a sliding sleeve, which fixes the clamping length, with the belt shaft via a gear mechanism.

[0003] The known safety belt roll-up mechanism has the drawback that the sliding sleeve does not represent an adequate reliability for the fixing of the clamping length of the torque rod, and in addition, the mechanics for a continuous adaptation of the clamping length of the torque rod to the rotational speed of the belt shaft, and hence to the respectively existing belt strap withdrawal, is complicated.

[0004] It is therefore an object of the invention to simplify the construction of a safety belt roll-up mechanism having the aforementioned features, while providing a high operational reliability.

[0005] The realization of this object, including advantageous embodiments and further developments of the invention, are provided in the content of the patent claims, which follow this description.

[0006] In detail, the invention provides for a two-stage torque rod having a pyrotechnically operating switching device, and a ratchet wheel that is connected to the belt shaft via a reduction gear mechanism, whereby the ratchet wheel is provided over a portion of its periphery with a toothing for engagement with the reduction gear mechanism, and over a further portion of its periphery is provided with a switching contour that rests against a contact pin of an electric switch that is connected to the switching device for the torque rod, and the switching device is formed with a profile that effects a connection or disconnection of the switching device for the torque rod.

[0007] The invention is, above all, advantageously characterized in that merely one two-stage torque rod is proposed as a force limitation device, because therewith the

various body sizes of large occupants or of small women, teenagers and children are adequately taken into consideration in the respectively fixed response range. With the reduction to one two-stage torque rod, one, known pyrotechnical switching device for the two applicable clamping lengths of the torque rod is also usable, by means of which, in a very operationally reliable manner, the respective clamping lengths of the torque rod can be fixed, whereby when an accident is sensed, the pyrotechnical switching device is triggered or not depending upon the extent of the belt strap that is unwound from the belt shaft. If the pyrotechnical switching device is not triggered, the load level, which is set appropriately high as is expedient for large vehicle occupants, is effective, whereas when the switching device is triggered, the clamping length of the torque rod is altered, and an appropriately low force limitation level is set. With reference to this, the control of the triggering readiness of the pyrotechnical switching device is inventively effected in that the ratchet wheel, which is brought into a position in conformity with the prevailing belt strap withdrawal, acts via a switching contour formed thereon upon the contact pin of an electric switch, whereby the electric switch fixes the triggering readiness of the pyrotechnical switching device in the sense previously described. In so doing, a straightforward construction and a reliable operation of the inventively equipped belt roll-up mechanism is ensured.

[0008] In detail, to fix the response readiness, one embodiment of the invention provides that, proceeding from the position of the ratchet wheel that is provided when the belt strap is fully wound up, the switching contour has a first portion for the contact of the contact pin, which in this position effects the deactivation of the triggering of the pyrotechnical switching device, and a second portion that adjoins the first portion and that, upon rotation of the belt shaft, is traveled over by the contact pin, whereby in the position of the contact pin where it rests against the second portion of the switching contour, the pyrotechnical switching device can be triggered, and has a third portion of the switching contour that adjoins the second portion for contacting the contact pin, and the contact pin, in its position where it rests against the third portion of the switching contour, deactivates the triggering of the pyrotechnical switching device. By dividing the switching contour into three portions, consideration is given to the circumstance that where the belt strap is entirely removed or withdrawn only slightly, no triggering of the pyrotechnical switching device is to be effected. If the belt strap is withdrawn to an extent that is customary for smaller vehicle occupants, then, via the appropriate position of the contact pin that rests against the switching contour, the triggering readiness of the pyrotechnical switching device is brought about, so that when an accident is sensed, the switching device becomes operative. If the belt strap is withdrawn further by large vehicle occupants, the contact pin moves along the third portion of the switching contour, and in this position the triggering readiness of the pyrotechnical switching device is again deactivated, so that the force limitation level, which is set high, becomes effective.

[0009] One embodiment of the invention is shown in the drawing, and will be described subsequently. In the drawing:

[0010] FIG. 1 shows in a side view the system side of a safety belt roll-up mechanism with control of the force limitation device,

[0011] FIG. 2, in an enlarged view, shows the ratchet wheel as a component of the control.

[0012] A known belt winder or roll-up mechanism is provided with a U-shaped housing, in the lateral housing plates of which, of which one housing plate 10 can be seen in FIG. 1, there is mounted a belt shaft 11. As can be seen from FIG. 1, the belt shaft 11 is provided with a shaft gear wheel 13 that is fixedly connected therewith. Disposed on the lateral housing plate 10 is a sensor 12 that reacts to the vehicle, and the function of which, for self-blocking belt roll-up mechanisms, is adequately known from the state of the art.

[0013] Connected to the externally toothed shaft gear wheel 13 is a gear mechanism 14 that is comprised of a plurality of gears and by means of which the ALR-ELR changeover of a belt roll-up mechanism can be controlled, whereby this function also is not of importance for the explanation of the present invention, and can be selectively realized or not on an inventively embodied, self-blocking, roll-up mechanism.

[0014] Important for the realization of the invention is that a reduction gear mechanism 15, that comprises two further gears, be connected to the shaft gear wheel 13; the reduction gear mechanism acts upon a ratchet wheel 16 that is rotatably mounted on the housing plate 10. For this purpose, the ratchet wheel 16 is provided with an external toothing 20 over a portion of its outer periphery. Associated with the ratchet wheel 16 is an electric switch 17, out of which projects a switching pin 25 that is illustrated in FIG. 2 and is guided on a switching contour 21 formed on the ratchet wheel 16, whereby the electric switch 17 is coupled with a switch housing 18 for the pyrotechnically operated switching device for adjusting the clamping length of the torque rod, which forms the force limitation device and is not illustrated in detail. The belt roll-up mechanism is furthermore provided with a connector 19 for an energy supply line coming from the vehicle.

[0015] As can be seen in the detailed view of FIG. 2, the switching contour 21, which is formed over a portion of the periphery of the ratchet wheel 16, has three zones, namely a first zone 22, a second zone 23 and a third zone 24, whereby when the ratchet wheel 16 is pivoted, the stationary switching or contact pin 25 that rests against the ratchet wheel travels over these zones 22, 23, 24. In this connection, the arrangement of the ratchet wheel 16 is such that in the first zone 22, a position of the switching pin 25 is effected in which the electric switch 17 establishes a deactivation of the pyrotechnical switching device, so that if an accident is sensed, the pyrotechnical switching device is not triggered. This first zone 22 corresponds to a position of the belt shaft 11 where the belt strap is entirely or nearly entirely wound up, in other words, where the safety belt is not being worn or where the belt strap is withdrawn only slightly, and in this belt withdrawal position a triggering of the switching device is not required or not desired.

[0016] If the belt strap is unwound from the belt shaft 11 to an extent that corresponds to the strapped-in length of belt strap for smaller persons, the switching pin, with a belt strap unwound in such a manner, rests against the second zone 23 of the switching contour 21 of the ratchet wheel 16, and in this position the position of the switching pin 25 effects an activation of the triggering readiness or operation in such a manner that when an accident is sensed, the pyrotechnical switching device is now triggered and thereby the clamping situation of the torque rod is altered in such a way that a lower force limitation level results.

[0017] Finally, if so much belt strap is unwound from the belt shaft 11 that corresponds to the strapped-in length of larger vehicle occupants, the third portion or zone 24 comes to rest against the switching pin, and as a result the switching pin is brought into a position corresponding to that when it rests against the first portion 22, in which the triggering of the pyrotechnical device is deactivated, so that in the absence of actuation of the pyrotechnical switching device, the high force limitation level is maintained.

[0018] The features of the subject matter of these documents disclosed in the preceding description, the patent claims, the abstract and the drawing can be important not only individually but also in any desired combination with one another for the realization of the various embodiments of the invention.

1 and 2: Cancelled

3. A safety belt roll-up mechanism comprising:

a housing;

a belt shaft that is mounted in said housing and serves as a carrier for a belt strap that can be wound onto and unwound from said belt shaft;

a force limitation device that operates in a multi-stage manner and has a 2-stage torque rod and a pyrotechnically operating switching device that couples the torque rod, in various clamping lengths, with said belt shaft, wherein an extent of belt strap unwound from said belt shaft is utilized for an actuation of said force limitation device;

a reduction gear mechanism;

a ratchet wheel that is connected to said belt shaft via said reduction gear mechanism, wherein said ratchet wheel is provided over a portion of a periphery thereof with a toothing for engagement with said reduction gear mechanism; and

an electric switch that is connected to said switching device for said torque rod, and that has a contact pin, wherein said ratchet wheel is provided over a further portion of its periphery with a switching contour that rests against said contact pin of said electric switch, and wherein said switching contour has a profile that effects a connection or disconnection of said switching device for said torque rod.

4. A safety belt roll-up mechanism according to claim 3, wherein said switching contour, proceeding from a position of said ratchet wheel that is provided when said belt strap is essentially entirely wound up, has a first portion for a contact of said contact pin, which in this position effects a deactivation of a triggering of said pyrotechnical switching device, has a second portion that adjoins said first portion and that, upon rotation of said belt shaft, is traveled over by said contact pin, whereby in a position of said contact pin where it rests against said second portion of said switching contour, said pyrotechnical switching device can be triggered, and has a third portion that adjoins said second portion and serves for contacting said contact pin, wherein said contact pin, when it is in its position where it rests against said third portion of said switching contour, deactivates the triggering of said pyrotechnical switching device.