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 (72) Inventors HAROLD RICHARD SCIBBE and EDWARD JOHN SMITH



(54) BELT RETRACTOR

(71) We, REPA FEINSTANZWERK GMBH, a corporation of Germany, of 7071 Aldorf, Industriegebiet, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to belt retractors.

10 Belt retractors having a reel normally biased in a direction tending to wind a belt around the reel are presently being widely used in connection with automobile seat belts.

15 Many well known types of automobile seat belt systems employ belt retractors in which torsion springs continually bias the reel in a direction tending to wind the belt around the reel. These types of retractors are desirable because when the seat belt is unbuckled and released the belt is automatically wound about the reel. The belt remains in the wound condition until it is protracted and buckled about a wearer. When the belt has been extended about the wearer and buckled the belt is continually biased into a snug fit about the wearer.

20 Experience has shown, however, that many people object to continually feeling the rewind force exerted on the belt, and such people may be reluctant to make use of such a seat belt. Therefore, various types of mechanisms have been designed for placing the seat belt system in a "tensionless" condition, a condition in which the rewinding of the belt under the bias of the spring is resisted. Many people find this a more comfortable type of seat belt since they are not constantly subjected to the rewind force exerted on the belt. Consequently, such people are more likely to make use of seat belts having this feature.

25 The present invention provides a belt retractor comprising a reel supported for rotation about a central axis thereof, means on said reel for connecting a belt thereto, means for biasing said reel in a first direction for winding the belt about the reel, locking surface means fixedly connected to the reel, a

locking member biased for movement toward a position in which it engages the locking surface means and resists rotation of said reel in said first direction, a control member movable relative to the locking member and comprising a first portion engageable with said locking member to hold the locking member out of engagement with said locking surface means and a second portion for allowing said locking member to move into engagement with said locking surface means, gate means mounted on said control member and movable relative thereto to a first position holding said locking member from movement into engagement with said locking surface means during a preselected range of movement of said control member relative to said locking member, said gate means being movable to a second position allowing the second portion of the control member to co-operate with the locking member such as to permit the locking member to move into engagement with said locking surface means during a preselected sequence of movements of said control member relative to said locking member.

30 In order that the invention may be well understood an embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, in which:

35 Fig. 1 is a perspective exploded view of a seat belt retractor with portions omitted;

40 Fig. 2 is a cross sectional view of the retractor of Fig. 1, in one rotational position of the reel;

45 Fig. 3 is a cross sectional end view of the retractor of Fig. 2, taken from the direction 3—3;

50 Figs. 4, 5 and 6 are end views of a retractor viewed from directions similar to Fig 3, with portions omitted, and illustrating the respective positions of the elements of the retractor during various rotational positions of the reel.

55 Referring to the drawings the elements of the retractor are enclosed within a housing 10. Spaced wall elements 12, 14 enclosed within

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the housing 10 support an axially extending cylindrical reel 16 for rotation about a central axis 17 thereof. The reel includes conventional means (not shown) for securing an end of an 5 automotive seat belt 18 to the reel so that the belt is disposed to be either wound or unwound from the reel as the reel is rotated about its central axis 17. One end of the reel has an integral portion 19 extending outwardly of the wall element 12 and a torsion 10 spring 20 is connected to the portion 19 and wound thereabout in a known manner. Torsion spring 20 provides means for biasing the reel in a known manner in a first rotational direction 15 tending to wind the belt about the reel.

The other end of the reel includes the apparatus for placing the reel in a tensionless condition. Fixedly secured to the reel for rotation therewith is a locking surface which 20 is shown as a disc 24 having a plurality of teeth 26. The reel 16 includes an integral portion 22 extending outwardly of the wall portion 14 and the disc 24 is fixedly connected to the reel portion 22. The disc 24 may be 25 connected to the reel portion 22 in any suitable manner, such as by mechanical fastening means, by a suitable cement, or by any other comparable fastening means. It is also contemplated that the teeth 26 can be integrally formed in the reel portion 22.

A locking member is biased towards a position in which it engages with the teeth 26 to hold the reel against rotation in a rewind direction. In the illustrated embodiment the locking member includes a locking pawl 28 having a first end 46 pivotally connected to a portion of the housing. The other end of the pawl is biased toward engagement with the teeth 26 of the disc 24. If the pawl 28 is disposed above the teeth, as shown in Fig. 3, the pawl is biased toward engagement with the teeth by means of gravity. As shown in Fig. 1 the pawl 28 is also biased by torsion spring 29 toward engagement with the teeth 26. A spring bias is particularly necessary if the pawl is not disposed above the teeth 26.

A control member is provided, and includes a portion disposed in the path of movement of the locking member. The control member 50 preferably includes a disc member 30 frictionally engaging a portion of the reel. In the illustrated embodiment, the disc member 30 is rotatably mounted on the hub 32 of the disc 24 and is urged into frictional engagement with a surface 34 of the disc 24 by means of a spring washer 36 held in place by a retaining ring 38. The disc member 30 includes an annular extension 40 (Fig. 2) which frictionally engages the surface 34 of disc 24. The surface area of the annular extension 40 is designed so that a predetermined amount of frictional engagement exists between the disc member 30 and the reel portion 22. The frictional engagement 60 of the disc member 30 and the disc 24 means

that rotation of the reel 16 in either direction rotates the disc member 30 in the same direction.

The disc member 30 includes a first annular surface portion 42 disposed in the path of movement of a portion of the pawl 28. The radius of the first annular surface portion 42 is greater than the outer radius of disc 24 so that first surface portion 42 engages the pawl and holds it out of engagement with the teeth 26 of disc 24. The disc member 30 also includes a slot 44. A pin 46 is fixed to housing wall 47 and extends into the slot 44 to limit the range of rotation of the disc member 30. Thus a predetermined arcuate portion of the disc member 30 is designed to cooperate with the pawl 28. Formed within this arcuate portion of the disc member 30 is a second portion or recess 48. The recess 48 is designed so that when the pawl 28 is allowed to drop into it the pawl can also engage the teeth 26 on the disc 24.

Gate means are mounted on the disc member 30 and are movable relative to the disc member 30 to selectively open and close the recess 48 during selected ranges of rotation of the disc relative to the pawl 28. The gate means preferably takes the form of an elongated member 50 pivotally connected to a pin 52 which extends from the surface of the disc member 30 in a direction parallel to central axis 17. During a preselected range of rotational movements of the disc member 30 the elongated member 50 hangs freely from the pivot pin 52 in the manner shown in Figs. 4 through 6. During another preselected range of movements of the disc member 30 the elongated member 50 is moved to a first or closed position in which a surface 54 of the elongated member 50 engages the pawl 28 and holds it out of engagement with the teeth 26 as the recess 48 moves past the pawl 28, as shown in Fig. 3. The elongated member 50 is pivoted to the latter position by engagement of surface 55 of the elongated member with a pin 56 which is fixed to housing wall 47.

The manner in which the reel is placed in a tensionless condition may be appreciated by reference to Figs 3 through 6. When the belt is fully wound on the reel the relative positions of the elements are substantially as shown in Fig. 5. The pawl 28 engages a first portion of annular surface 42 and the gate member 50 hangs freely from the pivot pin 52. During initial protraction (unwinding) of the belt (in a counterclockwise direction when viewing Figs. 3 through 6) the disc member 30 is also rotated counterclockwise by its frictional engagement with the reel. The pawl 28 rides over the annular surface 42 and ratchets over the recess 48 and teeth 26 until the pin 46 engages one end of the slot 44. The disc member 30 is then in the position

shown in Fig. 4 and remains in that position during further rotation of the reel as the belt is fully protracted to the desired extent.

Once the belt has been so protracted and then allowed to retract (rewind) the disc member 30 is rotated clockwise by its frictional engagement with the reel. During a portion of this retraction the surface 55 of the elongated member 50 engages pin 56 and pivots to a first position (Fig. 3) in which its surface 54 engages the pawl 28 and prevents the pawl from dropping into the recess 48 as the recess 48 moves past the pawl. This means that after the initial protraction and during the initial retraction the pawl cannot drop into the recess and engage teeth 28 to resist further retraction of the belt under the influence of spring 29. The disc member 30 rotates with the reel in the clockwise direction until the pin 46 engages the opposite end of the slot 44 (Fig. 5). At this point the pawl 28 is held away from the teeth 26 by the annular surface 42, and the elongated member 50 hangs freely in a second position from pin 52. The disc member 30 remains in that position until the reel 16 has been rewound (by spring 20) to a position in which it snugly fits the wearer.

Thus far, the reel is in a position in which it is snugly held against the body of the wearer under the action of the torsion spring 20. In order to place the reel in a tensionless condition the belt must be protracted slightly further, such as with a simple shrug of the wearer's shoulders. This would rotate the reel 16 from the position of Fig. 5 slightly counterclockwise. The slight rotation must be far enough that the pawl 28 comes into alignment with the recess 48 and must not be far enough to bring the elongated gate member 50 past the pin 56 and into the Fig. 4 position. With this small amount of protraction the reel and the disc member 30 are disposed so that when the belt is allowed to retract the recess 48 is not covered by the elongated member 50. During the latter retraction the pawl 28 is free to move into the recess and thereby into engagement with the teeth 26 on the disc 24. This position is shown in Fig. 6. The rewind bias of the torsion spring 20 is blocked and the belt is in a tensionless condition.

In order to release the belt from the tensionless condition the belt need only be protracted to rotate the reel far enough so that upon subsequent release the elongated gate member 50 pivots to the position of Fig. 3 to engage the pawl as the recess 48 moves past the pawl. The belt then rewinds under the influence of the torsion spring.

Once the belt has been protracted and then allowed to retract to the Fig. 5 position, if the wearer, in attempting to place the reel in a tensionless condition, were to subsequently protract the belt too far, the elongated gate member 50 would block engagement of the

pawl 28 with the teeth of the disc member 30 after the belt is released. This would again bring the elements into the Fig. 5 position. The belt need then be only protracted slightly further in the manner set forth above and then released to place the system in a tensionless condition.

In the illustrated embodiment the elongated gate member is mounted to the control member in a preselected positional relationship to the recess, and the pin 56 is disposed to cooperate with the elongated member to place the reel in a tensionless condition in the manner described above. However, it is contemplated that the length of the elongated gate member 50 and its position relative to the recess 48, and the position of the pin 56 may vary in accordance with the selected type of reel motions which are desired, to place the system in a tensionless condition. Also, while the preferred embodiment contemplates a gate means in the form of an elongated member pivotally connected to the control member, other forms of gate means which operate in accordance with the same principles will be readily apparent to those of ordinary skill in the art. Similarly, while the preferred embodiment contemplates a fixed pin for engaging the gate means and moving it to a closed position in response to selected reel movements, other means for moving the gate means into its various positions will become readily apparent to those of ordinary skill in the art.

WHAT WE CLAIM IS:—

1. A belt retractor comprising a reel supported for rotation about a central axis thereof, means on said reel for connecting a belt thereto, means for biasing said reel in a first direction for winding the belt about the reel, locking surface means fixedly connected to the reel, a locking member biased for movement toward a position in which it engages the locking surface means and resists rotation of said reel in said first direction, a control member movable relative to the locking member and comprising a first portion engageable with said locking member to hold the locking member out of engagement with said locking surface means and a second portion for allowing said locking member to move into engagement with said locking surface means, gate means mounted on said control member and moveable relative thereto to a first position holding said locking member from movement into engagement with said locking surface means during a preselected range of movement of said control member relative to said locking member, said gate means being moveable to a second position allowing the second portion of the control member to cooperate with the locking member such as to permit the locking member to move into engagement with said locking surface means during a pre-

selected sequence of movements of said control member relative to said locking member. 35

2. A retractor as claimed in claim 1, wherein said gate means comprises an elongated member pivotally mounted to said control member, and means for pivoting said elongated member into engagement with said locking member during a preselected range of movement of said control member relative to said locking member. 40

10 3. A retractor as claimed in claim 2, wherein said means for pivoting said elongated member comprises a member mounted in a fixed positional relationship to said locking member and operative to engage said elongated member and pivot it to said first position during said preselected range of movement of said control member relative to said locking member. 45

15 4. A retractor as claimed in claim 1, 2 or 3, wherein said control member comprises a disc member rotatable about said central axis relative to said locking member, said first portion comprising a first surface portion of the disc member engageable with said locking member to hold said locking member out of engagement with said locking surface means, said second portion comprising a recess portion in the disc member normally co-operable with said locking member to permit the locking member to move into engagement with said locking surface means, said gate means including surface means which in said first position of the gate means engages said locking member and holds said locking member out of cooperation with said recess during a preselected range of movement of said disc member relative to said locking member and which in said second position of said gate means allows said recess to cooperate with said locking member in response to a predetermined sequence of rotational movements of said disc member relative to said locking member. 50

20 5. A retractor as claimed in claim 4 when dependent on claim 2 or 3, wherein said elongated member is pivotally mounted to said disc member in a selected positional relationship to said recess. 55

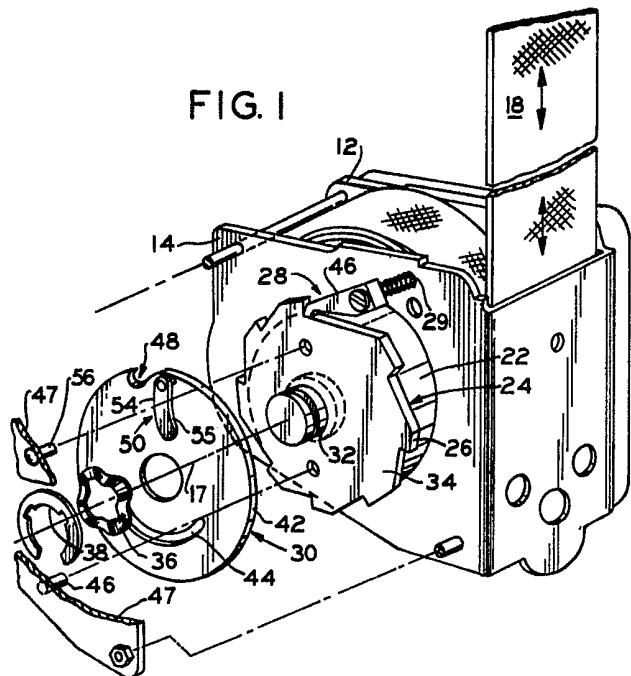
25 6. A retractor as claimed in claim 4 or 5, including means for urging said disc member into frictional engagement with said reel such that said disc member is rotated concurrently with said reel as said reel is rotated about its central axis, and means for limiting the range of rotation of said disc. 60

30 7. A retractor as claimed in any one of the preceding claims and having a belt connected to said reel by said connecting means.

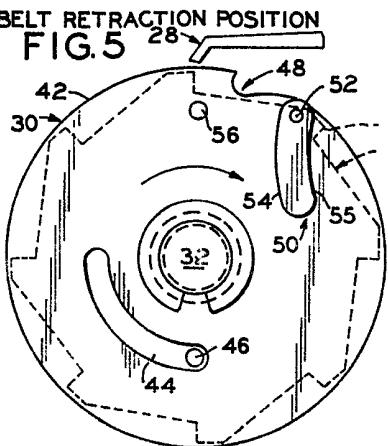
8. A belt retractor substantially as herein described with reference to the accompanying drawings.

A. A. THORNTON & CO.,
Chartered Patent Agents,
Northumberland House,
303/306 High Holborn,
London W.C.1.

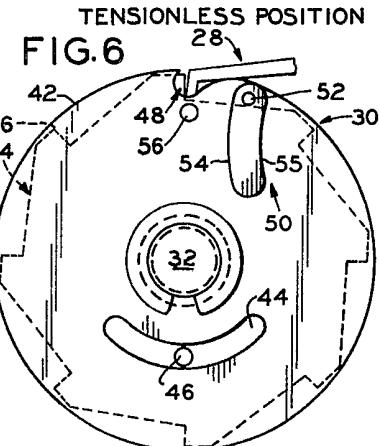
FIG. 1



BELT RETRACTION POSITION
FIG. 5



TENSIONLESS POSITION
FIG. 6



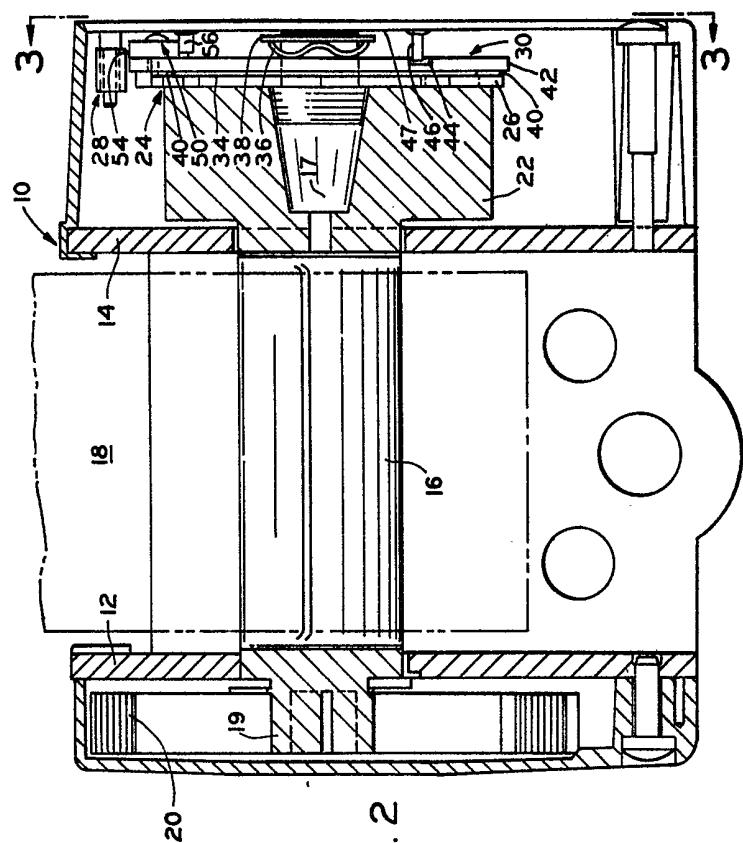


FIG. 2

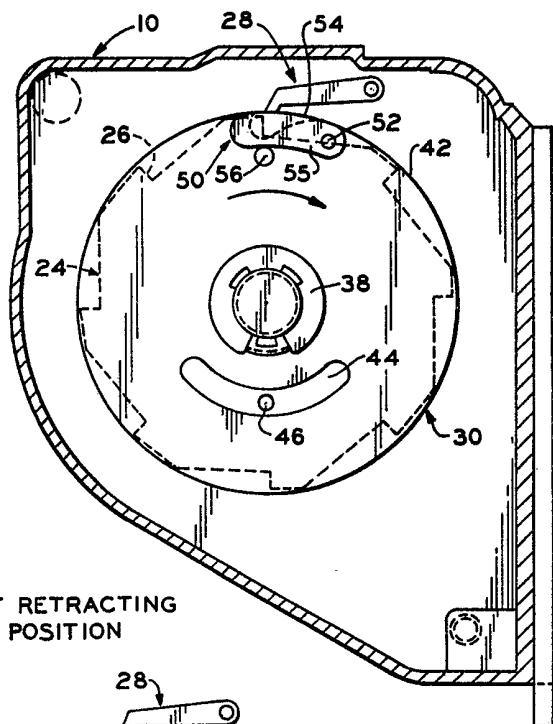


FIG.3

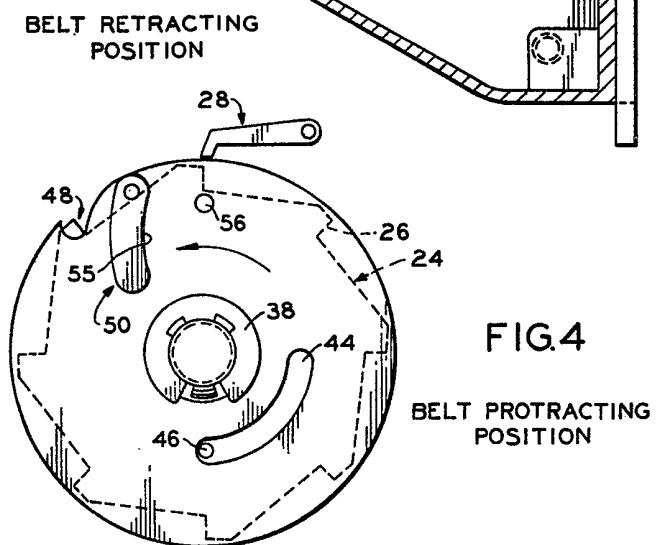


FIG.4