

Dec. 13, 1955

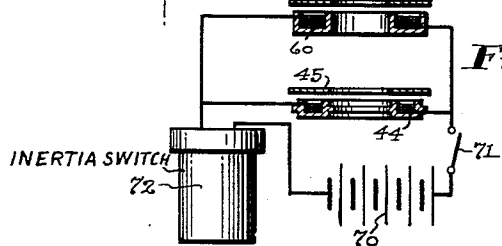
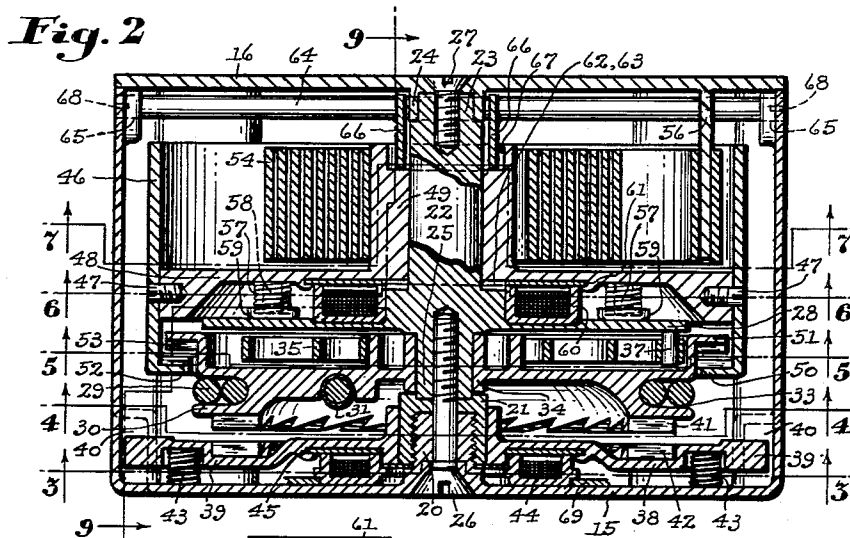
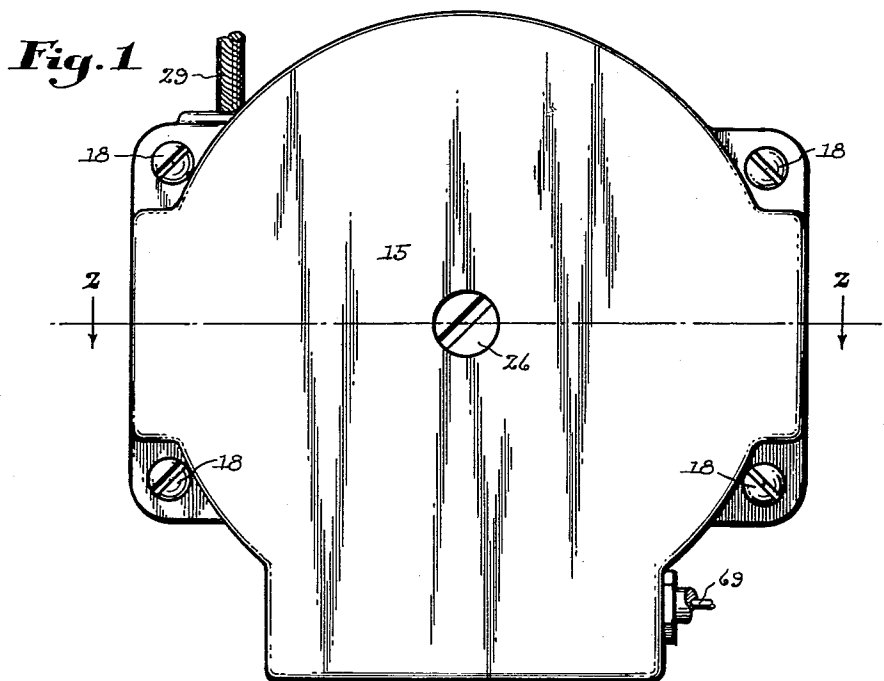
A. C. HOVEN ET AL

2,726,826

INERTIA REEL WITH RETRACTING MECHANISM

Filed Dec. 28, 1954

5 Sheets-Sheet 1



INVENTORS

Alfred C. Hoven
Walter E. Nordmark
 BY *John S. Braddock*

ATTORNEY

Dec. 13, 1955

A. C. HOVEN ET AL

2,726,826

INERTIA REEL WITH RETRACTING MECHANISM

Filed Dec. 28, 1954

5 Sheets-Sheet 3

Fig. 5

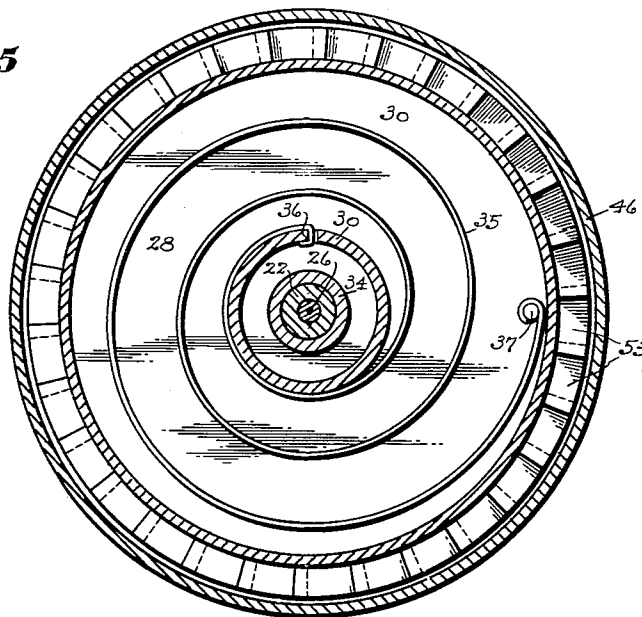
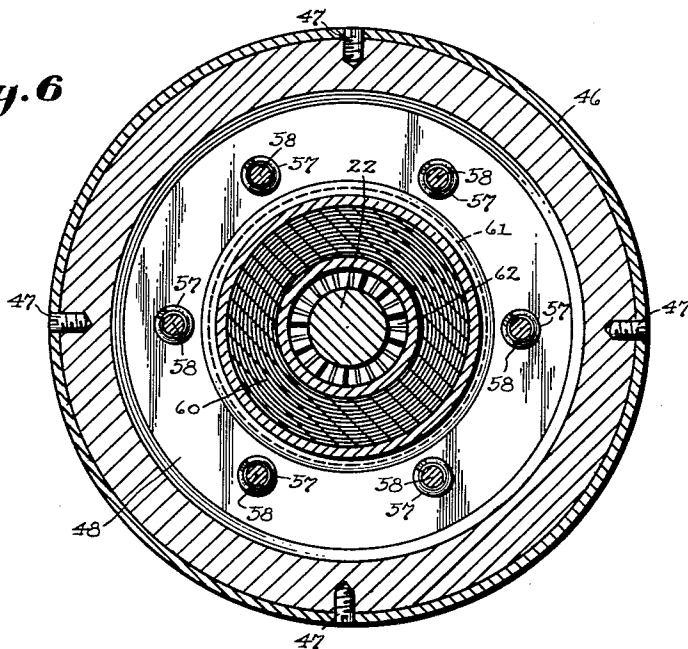


Fig. 6



INVENTORS

Alfred C. Hoven &
Walter E. Nordmark

BY *John S. Braddock*

ATTORNEY

Dec. 13, 1955

A. C. HOVEN ET AL

2,726,826

INERTIA REEL WITH RETRACTING MECHANISM

Filed Dec. 28, 1954

5 Sheets-Sheet 4

Fig. 7

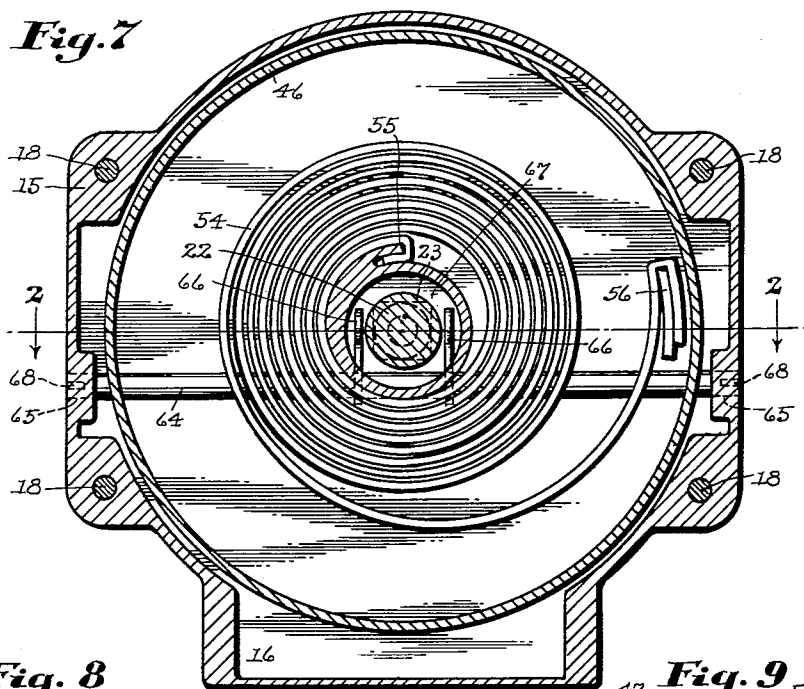


Fig. 8

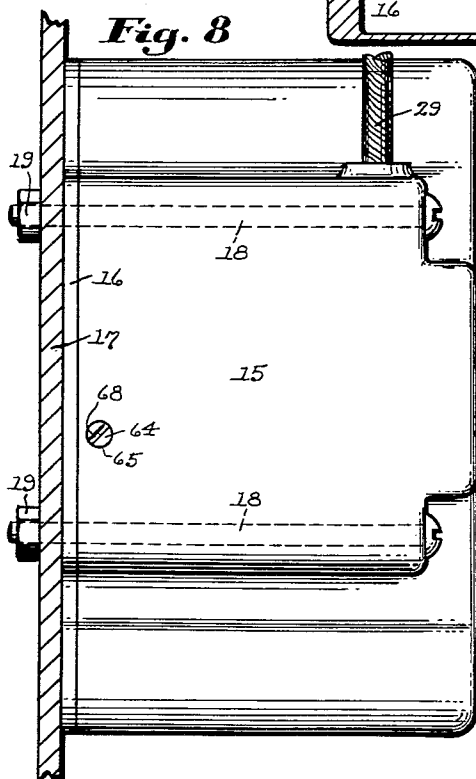
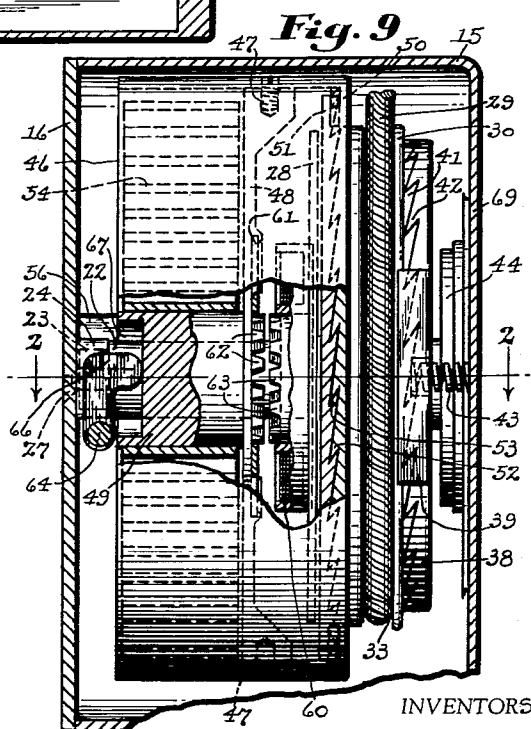


Fig. 9



INVENTORS

Alfred C. Hoven
Walter E. Nordmark

BY *John S. Braddock*

ATTORNEY

Dec. 13, 1955

A. C. HOVEN ET AL

2,726,826

INERTIA REEL WITH RETRACTING MECHANISM

Filed Dec. 28, 1954

5 Sheets-Sheet 5

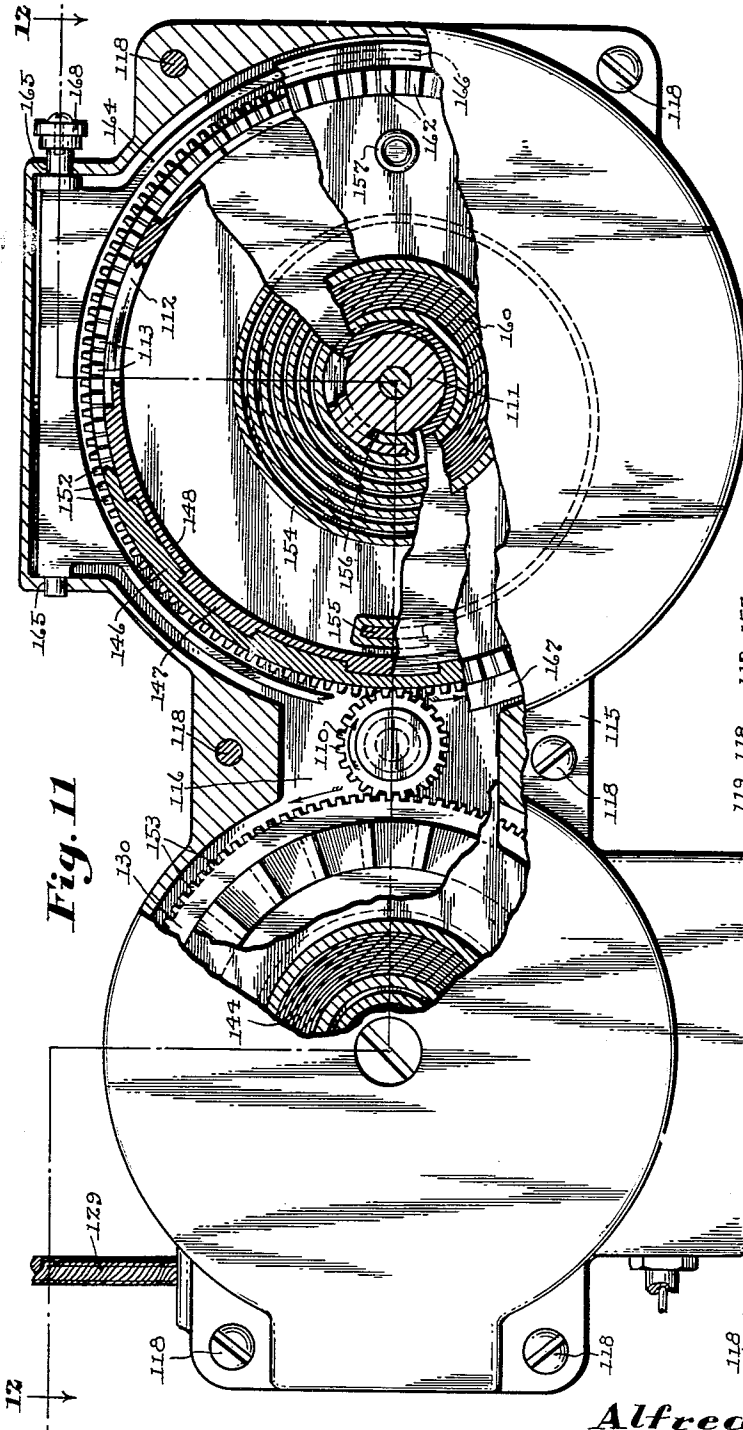


Fig. 11

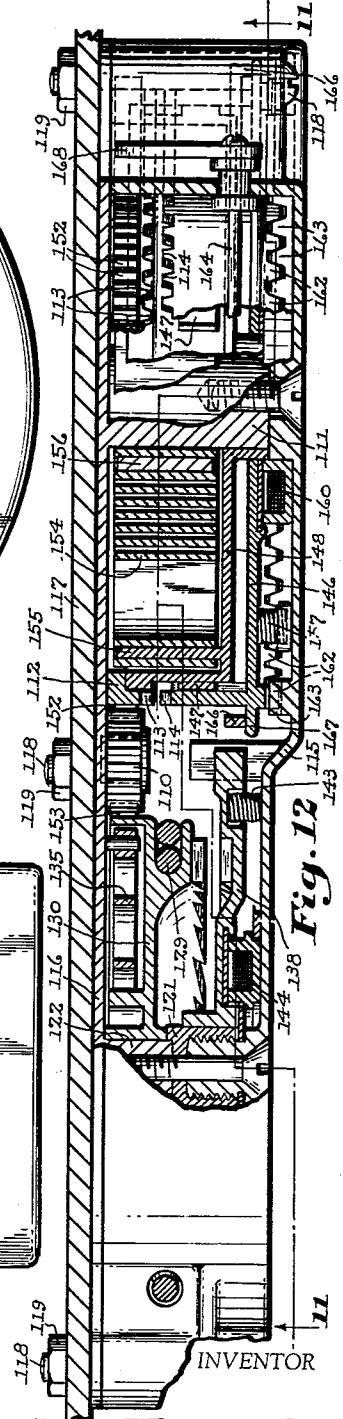


Fig. 12

INVENTOR
Alfred C. Hoven
Walter E. Nordmark
BY *John S. Braddock*
ATTORNEY

1

2,726,826

INERTIA REEL WITH RETRACTING MECHANISM

Alfred C. Hoven and Walter E. Nordmark, Grand Rapids, Mich., assignors to American Seating Company, Grand Rapids, Mich., a corporation of New Jersey

Application December 28, 1954, Serial No. 478,074

8 Claims. (Cl. 242—107)

The present invention relates to inertia-locking safety shoulder harness takeup reels.

The primary objects of the invention are to provide an improved automatic inertia-operated reel for taking up the cable on a shoulder harness by means of which an occupant of an airplane or other vehicle—and particularly an airplane pilot—is secured in his chair in the event of a crash; to provide an improved safety reel of the same general type as that disclosed in our co-pending application Serial No. 211,076 filed February 15, 1951, now Patent No. 2,701,693; to provide such a takeup reel which takes up any slack in the chair occupant's shoulder harness cable and which is normally yielding to permit full freedom of movement but which in the event of a crash will lock by inertia to prevent the chair occupant from being thrown farther forwardly and injured by striking parts of the vehicle which are in front of him; and more particularly to provide such a takeup reel which in the event that the chair occupant is in a forward-leaning position at the time of an initial crash will not only prevent his being thrown farther forwardly at that time, but will also operate immediately after the initial crash to forcefully retract the occupant to a rearwardmost position against the chair back thus providing additional safety for the occupant of the chair in the event of subsequent rebounding crashes.

Inertia-locking takeup reels of the same general type as that disclosed in our co-pending application above identified, have been credited by the armed services for saving the lives of many airplane pilots; however many of the pilots so saved have suffered broken backs and many of these it is thought were incurred in rebounding second and third crashes of the airplane due to the fact that the pilot, though locked against farther forward movement, was still in a forward-leaning position at the time of such subsequent crashes. It is thought that many such injuries might be prevented if the pilot were pulled all of the way back into his chair immediately after the initial crash, and the present invention is designed to fill that requirement.

Illustrative embodiments of the invention are shown in the accompanying drawings, wherein:

Figure 1 is a rear elevational view of the reel as it would appear when installed on the rear of a vehicle seat such as the pilot's seat in an airplane, the cable which connects the reel to the pilot's shoulder harness being shown fragmentarily;

Figure 2 is a horizontal sectional view of the same taken on lines 2—2 of Figures 1, 7 and 9;

Figure 3 is a vertical sectional view thereof taken on line 3—3 of Figure 2;

Figure 4 is a vertical sectional view of parts thereof taken on line 4—4 of Figure 2;

Figure 5 is a vertical sectional view of parts thereof taken on line 5—5 of Figure 2;

Figure 6 is a vertical sectional view of parts thereof taken on line 6—6 of Figure 2;

2

Figure 7 is a vertical sectional view thereof taken on line 7—7 of Figure 2;

Figure 8 is a side elevational view thereof;

Figure 9 is a vertical sectional view thereof taken on line 9—9 of Figure 2, certain parts being broken away;

Figure 10 is a wiring diagram illustrating an electrical circuit including parts of the reel;

Figure 11 is a view partly in rear elevation and partly in vertical section taken on line 11—11 of Figure 12, of a modified form of the invention; and

Figure 12 is a fragmentary view of the same shown partly in top plan and partly in horizontal section taken on line 12—12 of Figure 11.

Referring now in detail to these drawings, the reel there shown is enclosed in a housing comprising a cup-shaped housing member 15 and a cover plate 16 therefor, this housing being adapted for mounting in the vehicle on the back of a chair, a back panel 17 of which chair is fragmentarily indicated in Figure 8, by means of bolts 18 passing through the housing and provided with nuts 19. The cup-shaped housing member 15 is provided with an inwardly extending, externally threaded central hub 20, and the center spindle of the reel comprises a spindle part 21 threadedly mounted on the hub 20 and a spindle part 22 having its squared forward end 23 non-rotatably seated in an internally squared boss 24 in the center of the cover plate 16 and having its reduced rearward end 25 seated in a recess in the forward end of spindle part 21. A screw 26 passes through the housing member 15 and its hub 20 and through spindle part 21 and is threaded into the rearward end of spindle part 22, and another screw 27 passes through the cover plate 16 and is threaded into the forward end of spindle part 22. Spindle part 22 has a portion thereof intermediate its ends of greatly enlarged diameter thus forming a fixed middle plate 28 the purpose of which will hereinafter become apparent. The parts of the reel described up to this point are all rigidly interconnected and secured in assembly by the screws 26 and 27.

That end of the reel's cable 29 which is not shown in the drawings is adapted for attachment to the chair occupant's shoulder harness or lapbelt, it being understood that the term "harness" as herein used is intended to include the more conventional lapbelt or any other suitable restraining device. The other end of the cable 29, which is shown in the drawings, is connected as best seen in Figure 4 to a drum 30 by means of a cylindrical slug 31 attached to the end of the cable and seated in a cavity 32 in the drum, and the cable 29 can be wound into the drum's peripheral groove 33 in a counter-clockwise direction as viewed in the drawings. The drum 30 is rotatably but non-slidably mounted on the rearward end 25 of spindle part 22, the drum's hub 34 being confined against longitudinal movement between the middle plate 28 of spindle part 22 and the forward end of spindle part 21. The drum 30 is normally yieldingly urged in a winding direction for taking up slack in the cable 29 by means of a relatively weak spiral spring 35 (see Figures 2 and 5) one end of which is attached to the drum at 36 and the other end of which is attached to a pin 37 extending rearwardly from the stationary middle plate 28.

A locking member 38 is slidably but non-rotatably mounted on the spindle part 21 rearwardly of the drum 30. This locking member 38 has opposite outwardly extending wing portions 39 extending into guides 40 in the housing member 15, and by this means the locking member is non-rotatably keyed to the housing. The rearward part of the drum 30 and the forward part of the locking member 38 are provided with cooperative ratchets 41, 42 respectively, which are adapted to engage when the locking member is in a forwardly slid position of engagement with the drum (see Figure 9) to prevent ro-

tation of the drum in a direction for unwinding the cable while permitting rotation of the drum in the opposite direction for taking up any slack in the cable. The locking member 38 is normally urged forwardly toward its position of engagement with the drum 30 by means of springs 43 interposed between the housing member 15 and the locking member's opposite wing portion 39.

An electromagnet 44 of annular coil form is mounted on the housing member 15 rearwardly of the locking member 38, and the locking member has a circular armature 45 set therein. (See Figure 2.) This electromagnet 44 is adapted when energized to maintain the locking member in a rearwardly slid position of disengagement from the drum 30.

A cylinder 46 is rotatably and longitudinally slidably mounted on the forward portion of spindle part 22, said cylinder 46 being secured as by means of screws 47 to the disk part 48 of an inner member which also has a hub part 49 rotatable and slidable on the spindle part 22. The cylinder 46 has a peripheral flange 50 on its rearward end which flange 50 extends inwardly behind an outwardly extending peripheral flange 51 on the drum 30. These flanges 50 and 51 have cooperative ratchets 52, 53 respectively which are adapted to engage when the cylinder 46 is slid forwardly into engagement with the drum 30. A relatively powerful spiral spring 54 (see Figures 2 and 7) is associated with the cylinder 46, said spring 54 having its inner end secured at 55 to the hub 49 of the cylinder's inner member and having its outer end secured to an arm 56 projecting inwardly from the housing's cover plate 16. The cylinder 46 is normally urged forwardly toward its position of engagement with the drum 30 by means of springs 57 (see Figures 2 and 6); surrounding pins 58 extending rearwardly from the disk 48 of the cylinder's inner member, and cups 59 are interposed between the rearward ends of the springs 57 and the stationary middle plate portion 28 of spindle part 22 so that when the cylinder rotates the cups 59 bear against the front surface of said middle plate 28.

A second electromagnet 60, also of annular coil form, is secured to the front surface of the stationary middle plate 28, and the cylinder's disk part 48 has a circular armature 61 set therein (see Figures 2 and 6). This electromagnet 60 is adapted when energized to maintain the cylinder 46 in a rearward position of disengagement from the drum 30 in which rearward position of the cylinder it is coupled to stationary spindle part 22 by the engagement of teeth 62 on the rearward end of the disk portion 48 of the cylinder's inner member with teeth 63 on the spindle part 22 (see Figures 2, 6 and 9). The cylinder 46 is thus keyed against rotation except when in ratchet engagement with the drum 30.

Means manually operable from the exterior of the housing are provided for moving the cylinder 46 rearwardly out of ratchet engagement with the rotatable drum and into coupled engagement with the stationary spindle part 22. These means comprise a rod 64 extending through the housing and having bearings in apertures 65 through the opposite side walls of the housing member 15. Near the middle of the rod 64 are a pair of camming arms 66 which extend into a recess 67 in the forward end of the hub part 49 of the cylinder's inner member. Kerfs 68 are provided in the opposite ends of the rod 64, wherein may be inserted a screw driver or other tool for turning the rod. It will readily be seen that by turning the rod 64 clockwise as viewed in Figure 9 the cylinder 46 can be moved to the right from its position seen in Figure 9, to its position seen in Figure 2.

Other manually operable means may be provided for moving the locking member 38 rearwardly out of engagement with the drum 30, but since such means are old as disclosed in our above identified patent application they are not described herein and are merely indicated fragmentarily at 69 in the drawings.

An electric circuit which includes the electromagnets

44 and 60 is illustrated diagrammatically in Figure 10. The circuit also includes the battery 70, manual switch 71 and an inertia-operable electric switch 72. Such an inertia-operable switch is fully disclosed in Patent No. 2,596,427 issued May 13, 1952, to Nordmark et al., the switch being so constructed as to operate at between 2.0 and 3.0 G's of inertia force to interrupt the circuit.

Operation

The operation of the reel is as follows. With both the locking member 38 and the cylinder 46 in their rearwardmost positions of disengagement from the drum 30 (as seen in Figure 2), the manual switch 71 (Figure 10) is closed thus completing the electric circuit and energizing electromagnets 44 and 60, and the locking member 38 with its armature 45 and cylinder 46 with its armature 61 are maintained in their said rearward positions of disengagement from the drum 30 by the electromagnets. This circuit remains closed throughout all normal conditions of velocity of the vehicle. With the circuit closed and the locking member 38 and cylinder 46 out of engagement with the drum 30 the pilot is free to lean forward and otherwise move about in his chair as required, and the relatively weak spring 35 will automatically turn the drum 30 to take up any slack in the cable 29. If for some reason the chair occupant wishes to manually lock himself in the chair, he may do so with the manual control (not shown in detail but indicated only fragmentarily at 69) without interrupting the electric circuit.

When a crash occurs, manifesting itself in sudden deceleration of the vehicle and in a forward inertia load of more than 2 G's, inertia-switch 72 (Figure 10) operates automatically to interrupt the electric circuit. Electromagnets 44 and 60 are thus simultaneously deenergized. Springs 43 move the locking member 38 forwardly into ratchet engagement with the drum 30 thus preventing any paying out of the cable 29 and preventing the chair occupant from being thrown farther forwardly than he may be at the instant of the crash. At the same time springs 57 move cylinder 46 forwardly into ratchet engagement with the drum 30.

At the instant of the crash the load placed on the cable 29 by the chair occupant's own inertia force may be as high 4000 lbs. It would therefore be impractical to provide a device for overcoming such a load to retract the chair occupant at the instant of a crash, and such retraction might even be injurious to the occupant. Hence it is considered desirable to have such retraction commence when the load on the cable 29 decreases to about 125 lbs., which is the force exerted by the relatively strong spring 54, and which is the approximate force required to retract a forward-leaning occupant of average weight under normal conditions of velocity of the vehicle. It will thus be seen that when the load on the cable decreases to and below 125 lbs., spring 54 takes over with force increasing up to 125 lbs. to retract the chair occupant from a forward-leaning position rearwardly against the chair back thus providing an additional safety factor in the event of subsequent crashes of the vehicle.

Spring 54 can be preloaded by pulling outwardly on cable 29 when the cylinder 46 and drum 30 are in ratchet engagement, then manually disengaging the cylinder 46 from the drum 30 and coupling it to the spindle part 22 by turning rod 64 to slide the cylinder rearwardly. The cable 29 is then taken up by the drum 30 automatically, after which cylinder 46 may again be permitted to engage with the drum, and this spring-loading operation can be repeated as often as is necessary to preload spring 54 with the desired force of about 125 lbs.

The modified form of the invention shown in Figures 11 and 12 operates in much the same manner as the embodiment of the invention shown in Figures 1 through 9. The principal difference between the two forms of the invention resides in the juxtaposing of the relatively powerful spring means for retracting the chair occupant

5

6

which are shown at the right in Figures 11 and 12, with the other parts of the reel which are shown at the left in these views. The reel thus occupies less space to the rear of the chair, which is an important factor in some installations. In this modification the parts are mounted in an elongated housing 115 having a cover plate 116 and adapted for attachment to the back plate 117 of a vehicle chair by means of bolts 118 having nuts 119. The drum 130 for taking up the cable 129 is non-slidably and rotatably mounted on a spindle part 122 extending rearwardly from the cover plate 116, and the drum is normally urged in a direction for taking up any slack in the cable by the relatively weak spiral spring 135. The locking member 138 is slidably but non-rotatably mounted on spindle part 121 rearwardly of the drum 130 and is normally urged forwardly toward ratchet-engagement with the drum by springs 143. An electromagnet 144 is provided for maintaining the locking member 138 in a rearward position of disengagement from the drum 130 during normal travel conditions of the vehicle, and these parts all function the same as the corresponding parts of the reel shown in Figures 1 through 9.

The periphery of the drum 130 is provided with gear teeth 153 which mesh with the teeth of an idler gear 110 turnably mounted on the cover plate 116 of the housing. An inner cylinder 148 is rotatably and non-slidably mounted on a spindle 111 extending rearwardly from the cover plate 116 of the housing and has associated therewith a relatively powerful spiral spring 154, the inner end of said spring 154 being secured at 156 to the spindle 111 and the outer end of the spring being secured to an arm 155 on the inner cylinder 148. A gear ring 112 is freely turnably mounted on the outer periphery of the inner cylinder 148, and this gear ring 112 has gear teeth 152 on its outer periphery which mesh with the teeth on the idler gear 110 so that the gear ring is always geared to the drum 130 for movement therewith and independently of the inner cylinder 148 on which the gear ring is mounted. The gear ring 112 also has gear teeth 113 on its rear face. An outer cylinder 146 is rotatably and slidably mounted on the spindle 111 and is keyed to the inner cylinder 148 by means of splines 147. The outer cylinder 146 has gear teeth 114 on its front face which are adapted to engage with the teeth 113 on the gear ring 112 when the outer cylinder 146 is slid forwardly on the inner cylinder 148. Springs 157 normally urge the outer cylinder forwardly toward such position of engagement.

An electromagnet 160 is adapted when energized to maintain the outer cylinder 146 in a rearward position of disengagement from the gear ring 112 during normal travel conditions of the vehicle, in which rearward position the outer cylinder 146 is prevented from rotating by the meshing of coupling gear teeth 162 on the rear face of said outer cylinder 146 with coupling gear teeth 163 on the housing 115. A device is provided for manually moving the outer cylinder 146 rearwardly in order to "set" the reel, which device comprises a bail 164 swingably mounted in bearings 165 in the housing 115 and having arms 166 which gear against a peripheral flange 167 on the outer cylinder to move said outer cylinder rearwardly when the bail 164 is turned by means of its handle 168 on the exterior of the housing.

The reel shown in Figures 11 and 12 operates as follows. During normal travel of the vehicle electromagnets 144 and 160 are energized to maintain the locking member 138 and the outer cylinder 146 in their rearward positions. When a crash occurs, the electric circuit is interrupted as hereinbefore described thus deenergizing electromagnets 144 and 160. Springs 143 move locking member 138 forwardly into ratchet engagement with drum 130 thus to prevent any further paying out of the harness cable 129. Springs 157 move the outer cylinder 146 forwardly thus uncoupling it from the housing 115 and engaging it with the gear ring 112. The relatively powerful spiral spring 154 then rotates the inner cylinder 148,

outer cylinder 146, gear ring 112, idler gear 110 and drum 130 in the directions indicated by arrows in Figure 11, thus forcefully winding in the cable 129 and retracting the forward-leaning chair occupant rearwardly against the back of his chair.

It will thus be seen that the invention provides an efficient means for retracting the occupant of a vehicle chair rearwardly in his seat when a crash occurs, and while but two specific embodiments of the invention have been herein shown and described it will be understood that numerous details thereof may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

We claim:

1. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a drum rotatably mounted in the housing; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; other and more powerful means adapted for operable engagement with the drum to urge the drum in the winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; means for disengaging said powerful means from the drum; and means mounted in the vehicle and operatively connected to said disengaging means whereby sudden deceleration of the vehicle disables said disengaging means thereby operatively engaging said powerful means with the drum.

2. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a drum rotatably mounted in the housing; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; other and more powerful spring-operated means adapted for operable engagement with the drum to urge the drum in the winding direction with sufficient force positively to retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; means for disengaging said powerful spring-operated means from the drum; and means mounted in the vehicle and operatively connected to said disengaging means whereby sudden deceleration of the vehicle disables said disengaging means thereby operatively engaging said powerful spring-operated means with the drum.

3. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a drum rotatably mounted in the housing; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; other and more powerful spring-operated means adapted for operable engagement with the drum to urge the drum in the winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back

under normal conditions of velocity of the vehicle; spring means normally engaging said powerful spring-operated means with the drum; electromagnetic means for disengaging said powerful spring-operated means from the drum; and an inertia-operable electric switch included in an electric circuit which also includes said electromagnetic means whereby sudden deceleration of the vehicle opens the switch to interrupt said electric circuit.

4. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a drum rotatably and non-slidably mounted in the housing; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; a locking member non-rotatably slidable in the housing to and from a position wherein it engages the drum to prevent rotation of the drum in a direction for unwinding the cable while permitting rotation of the drum in the opposite direction; other and more powerful spring-operated means adapted for operable engagement with the drum to urge the drum in the winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; means for disengaging said powerful spring-operated means from the drum; and inertia-responsive means mounted in the vehicle and operatively connected to said disengaging means whereby sudden deceleration of the vehicle disables said disengaging means thereby operatively engaging said powerful spring-operated means with the drum.

5. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a drum rotatably and non-slidably mounted in the housing; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; a locking member non-rotatably slidable in the housing to and from a position wherein it engages the drum to prevent rotation of the drum in a direction for unwinding the cable while permitting rotation of the drum in the opposite direction; spring means normally urging said locking member toward its position of engagement with the drum; electromagnetic means for releasably maintaining said locking member out of engagement with the drum; and an inertia-operable electric switch included in an electric circuit which also includes said electromagnetic means whereby sudden deceleration of the vehicle opens the switch to interrupt said electric circuit.

6. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle; a spindle mounted in the housing and projecting rearwardly therein; a drum rotatably and non-slidably mounted on the spindle; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; a locking member non-rotatably slidable on the spindle rearwardly of the drum to and from a position wherein it engages the drum to prevent rotation of the drum in a direction for unwinding

the cable while permitting rotation of the drum in the opposite direction; spring means normally urging said locking member forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the locking member and adapted when energized to maintain the locking member in a rearward position of disengagement from the drum; a cylinder rotatably and slidably mounted on the spindle forwardly of the drum; interlocking means on the cylinder and the drum adapted to engage when the cylinder is slid in a forwardly direction; other and more powerful spring-operated means adapted to urge the cylinder and the drum, when engaged, in a cable-winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; spring means normally urging the cylinder forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the cylinder and adapted when energized to maintain the cylinder in a rearward position of disengagement from the drum; coupling means on the spindle and the cylinder adapted to prevent rotation of the cylinder when in its rearward position of disengagement from the drum and to permit rotation of the cylinder when in its forward position of engagement with the drum; and an inertia-operable electric switch included in an electric circuit which also includes the two aforesaid electromagnets whereby sudden deceleration of the vehicle opens the switch to interrupt said electric circuit.

7. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle and provided with rearwardly extending guides at the opposite interior sides thereof; a spindle mounted in the housing and projecting rearwardly therein between said guides; a drum rotatably and non-slidably mounted on the spindle; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in a winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; a locking member slidably mounted on the spindle rearwardly of the drum and having key means at opposite sides thereof forwardly-rearwardly movable in the housing's guides whereby the locking member is keyed against rotation, said locking member being slidable to and from a position wherein it engages the drum to prevent rotation of the drum in a direction for unwinding the cable while permitting rotation of the drum in the opposite direction; spring means normally urging the locking member forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the locking member and adapted when energized to maintain the locking member in a rearward position of disengagement from the drum; a cylinder rotatably and slidably mounted on the spindle forwardly of the drum; interlocking means on the cylinder and the drum adapted to engage when the cylinder is slid in a forwardly direction; other and more powerful spring-operated means adapted to urge the cylinder and the drum, when engaged, in a cable-winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; spring means normally urging the cylinder forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the cylinder and adapted when energized to maintain the cylinder in a rearward position of disengagement from the drum; coupling means on the spindle and the cylinder adapted to prevent rotation of the cylinder when in its rearward position of disengagement from the drum and to permit rotation of the cylinder when in its forward

position of engagement with the drum; and an inertia-operable electric switch included in an electric circuit which also includes the two aforesaid electromagnets whereby sudden deceleration of the vehicle opens the switch to interrupt said electric circuit.

8. A safety device for use on a vehicle having therein a chair and a safety harness for the chair occupant, said safety device comprising: a housing adapted for mounting in the vehicle and provided with rearwardly extending guides at the opposite interior sides thereof; a spindle mounted in the housing and projecting rearwardly therein between said guides; a drum rotatably and non-slidably mounted on the spindle; a cable connected to the harness and to the drum whereby rotation of the drum in one direction winds the cable thereon and opposite rotation of the drum unwinds the cable; spring-operated means for constantly yieldingly urging the drum in the winding direction with sufficient force to take up slack in the cable but not sufficient force to interfere with the occupant's freedom of movement; a locking member slidably mounted on the spindle rearwardly of the drum and having key means at opposite sides thereof forwardly-rearwardly movable in the housing's guides whereby the locking member is keyed against rotation; cooperative ratchet means on the rearward part of the drum and on the forward part of the locking member adapted to engage when the locking member is slid forwardly into engagement with the drum thus to prevent rotation of the drum in a direction for unwinding the cable while permitting rotation of the drum in a direction for winding the cable thereon; spring means normally urging the locking member forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the locking member and adapted when energ-

gized to maintain the locking member in a rearward position of disengagement from the drum; an outwardly extending peripheral flange on the forward part of the drum provided with ratchet means on its rearward face; a cylinder rotatably and slidably mounted on the spindle forwardly of the drum and provided with a peripheral flange extending inwardly behind the flange on the drum and provided with ratchet means adapted to engage the ratchet means on the drum's flange when the cylinder is slid in a forwardly direction; other and more powerful spring-operated means adapted to urge the cylinder and the drum, when engaged, in a cable-winding direction with sufficient force to positively retract the chair occupant from a forward-leaning position rearwardly against the chair back under normal conditions of velocity of the vehicle; spring means normally urging the cylinder forwardly toward its position of engagement with the drum; an electromagnet mounted in the housing rearwardly of the cylinder and adapted when energized to maintain the cylinder in a rearward position of disengagement from the drum; coupling means on the spindle and the cylinder adapted to prevent rotation of the cylinder when in its rearward position of disengagement from the drum and to permit rotation of the cylinder when in its forward position of engagement with the drum; and an inertia-operable electric switch included in an electric circuit which also includes the two aforesaid electromagnets whereby sudden deceleration of the vehicle opens the switch to interrupt said electric circuit.

References Cited in the file of this patent

UNITED STATES PATENTS

2,701,693 Nordmark et al. ----- Feb. 8, 1955