March 15, 1966 E. H. SPOUGE 3,240,510

SAFETY HARNESS

Filed June 11, 1963 8 Sheets-Sheet 1

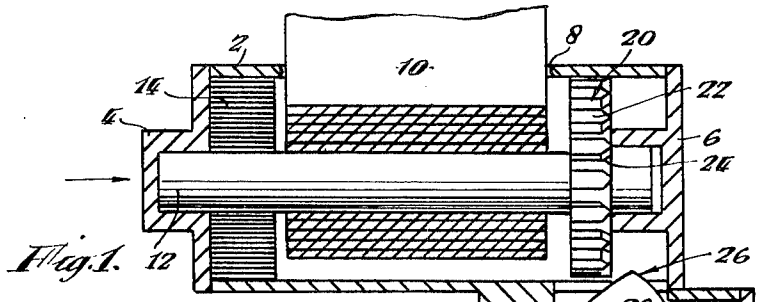

Fig. 1.

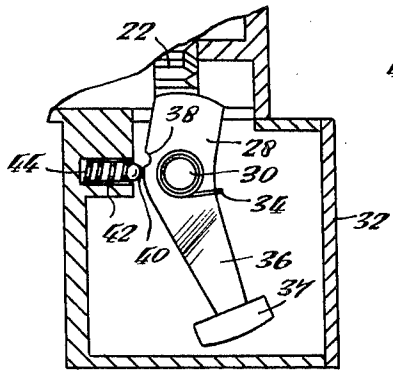

Fig. 2.

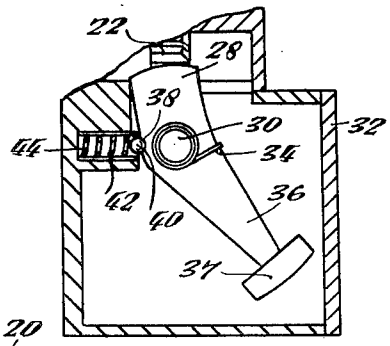

Fig. 3.

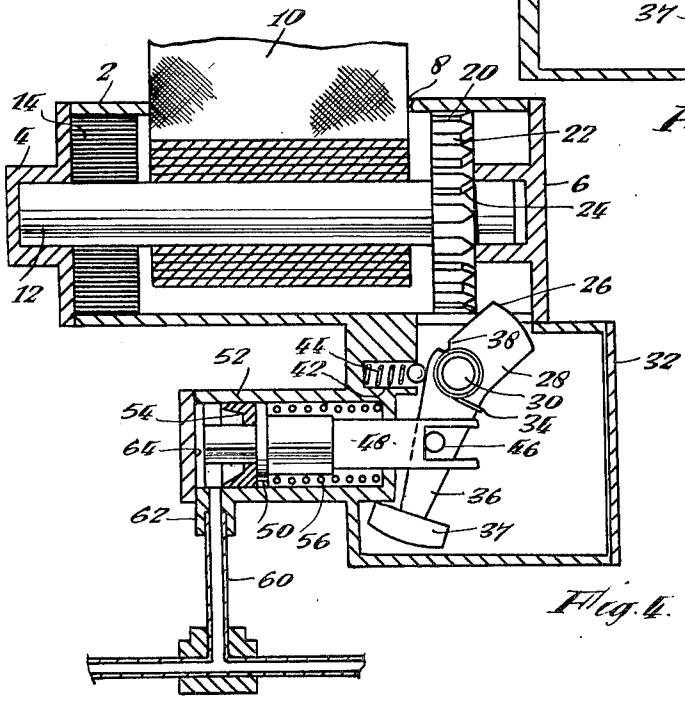

Fig. 4.

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SAFETY HARNESS

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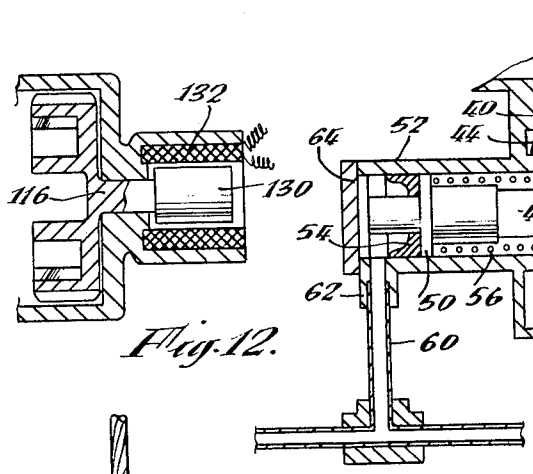

Fig. 12.

Fig. 5.

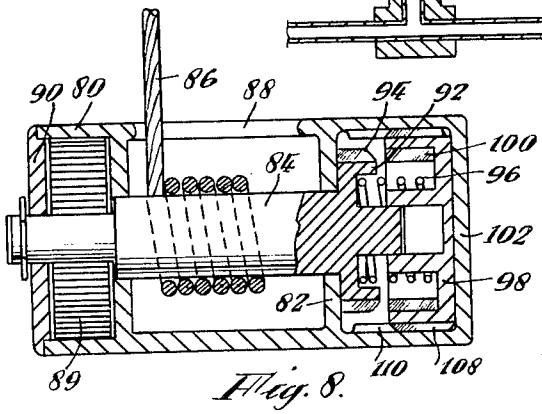

Fig. 8.

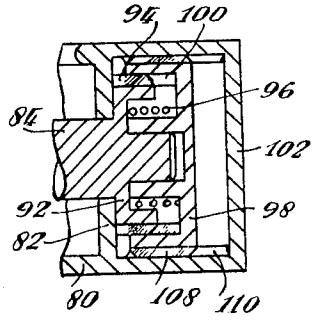

Fig. 9.

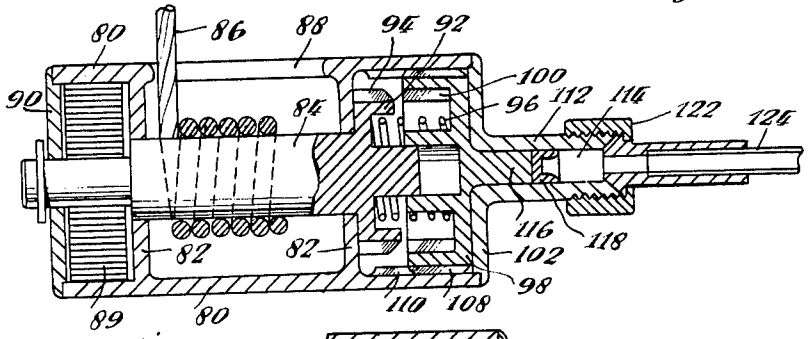

Fig. 10.

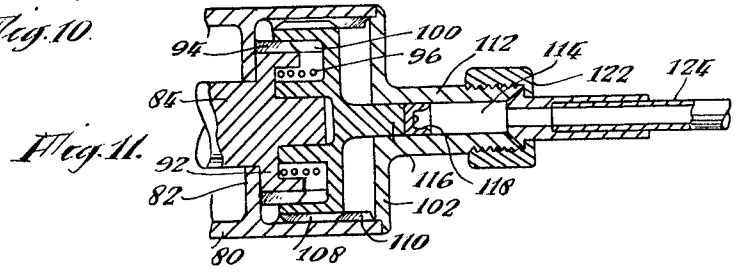

Fig. 11.

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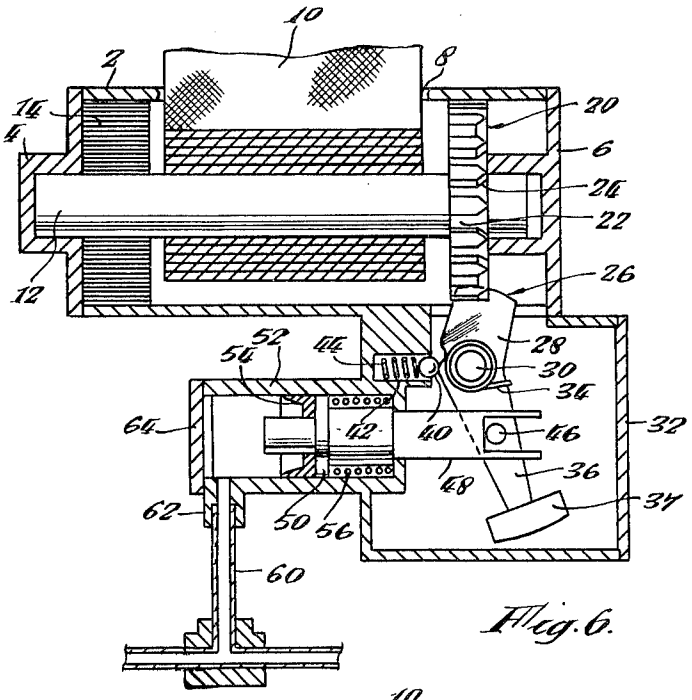

Fig. 6.

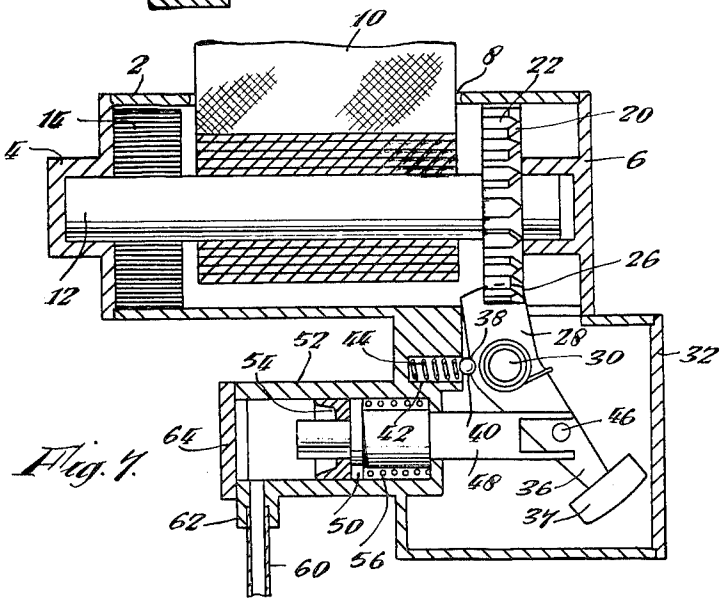

Fig. 7.

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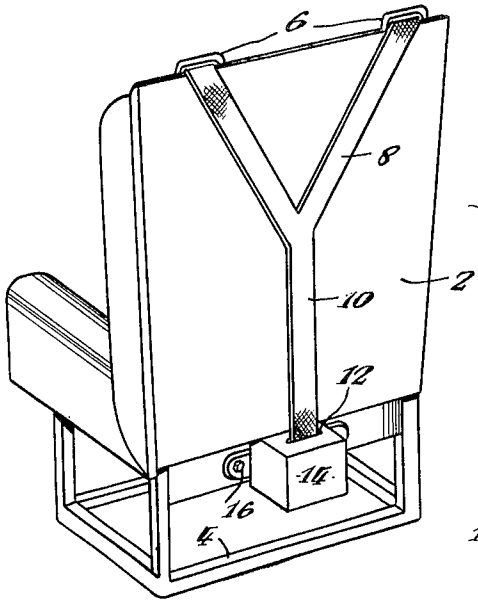


Fig. 13.

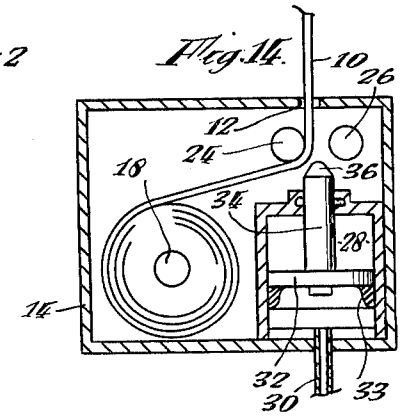


Fig. 14.

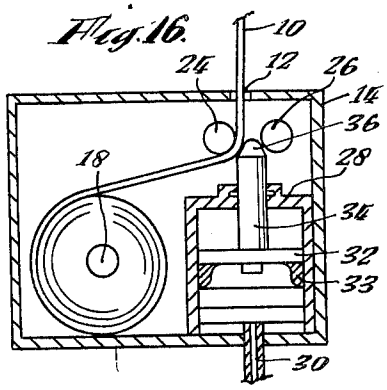


Fig. 16.

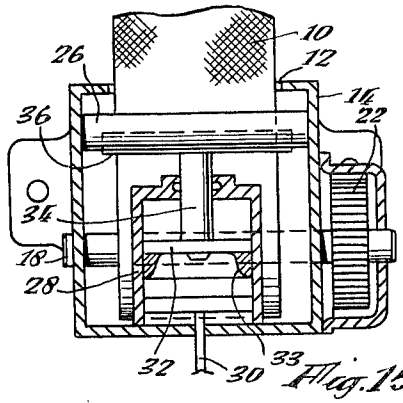


Fig. 15.

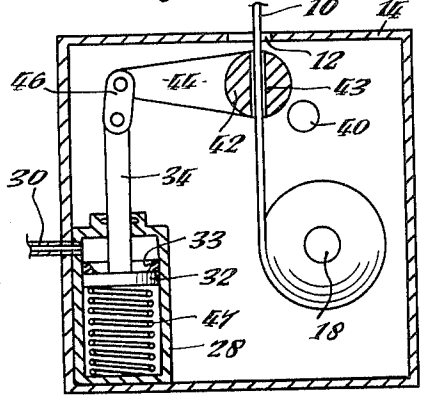


Fig. 17.

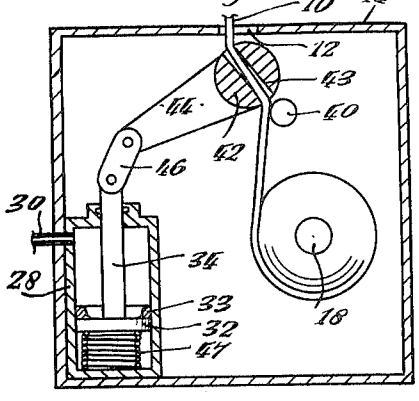
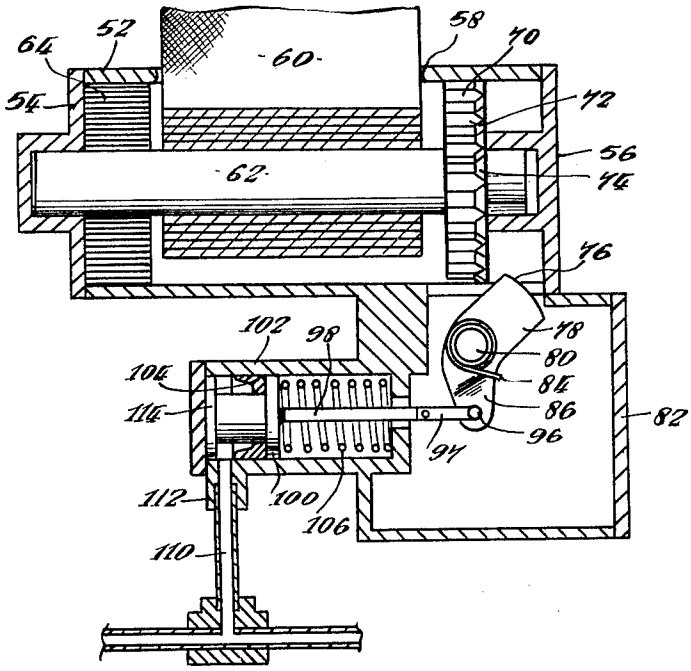


Fig. 18.

Fig. 19.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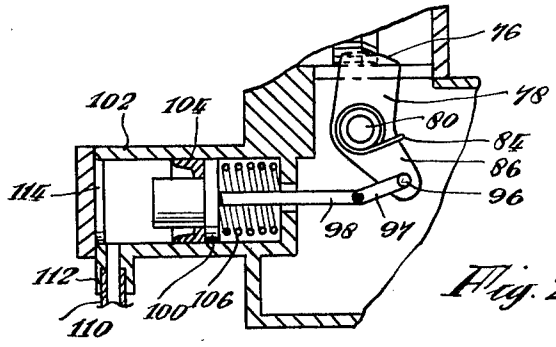
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Fig. 20.

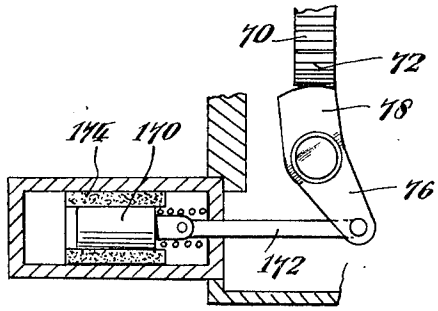
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Fig. 21.

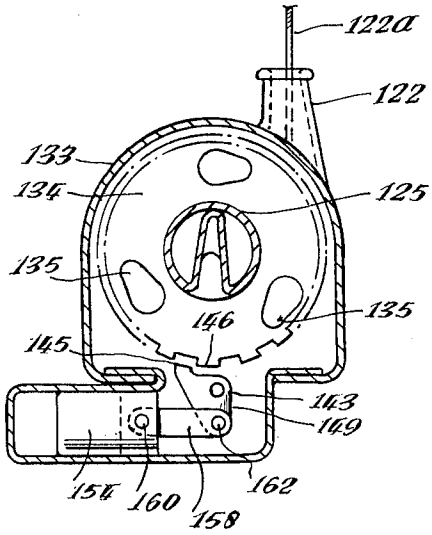
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Fig. 24.

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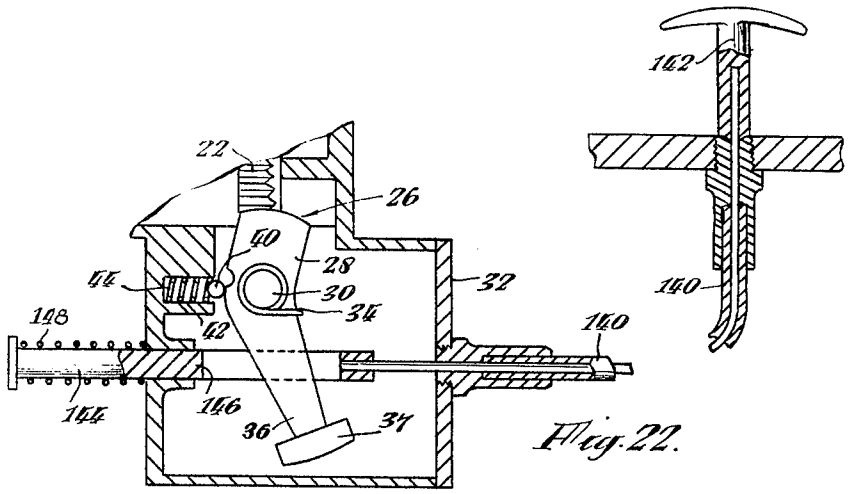

Fig. 22.

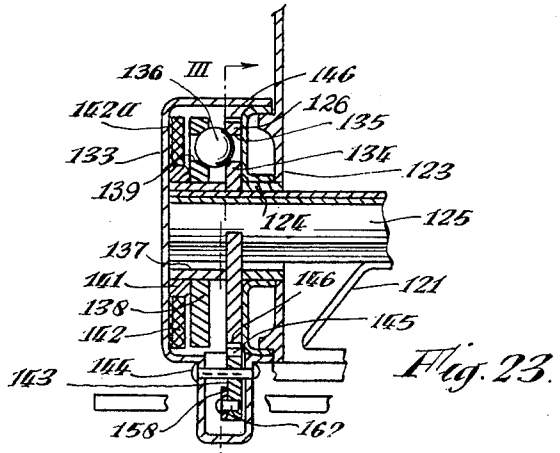

Fig. 23.

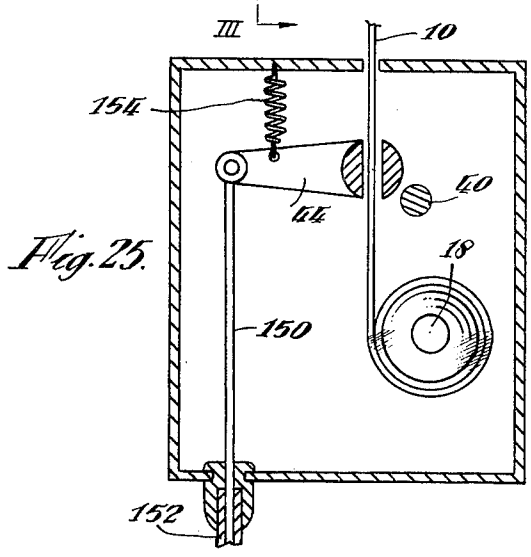

Fig. 25.

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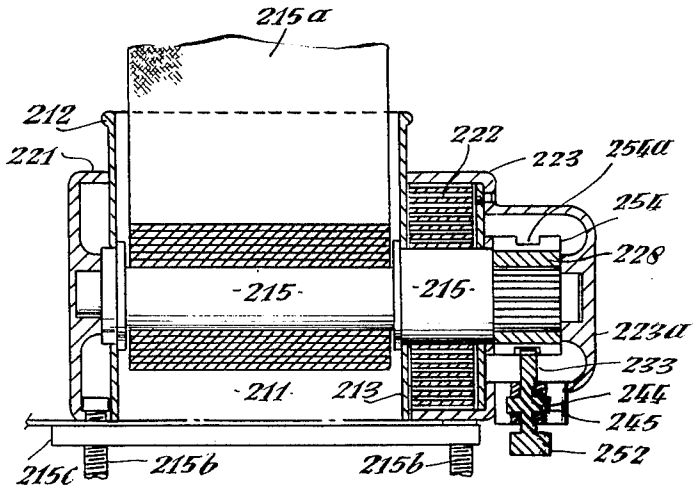

Fig. 26.

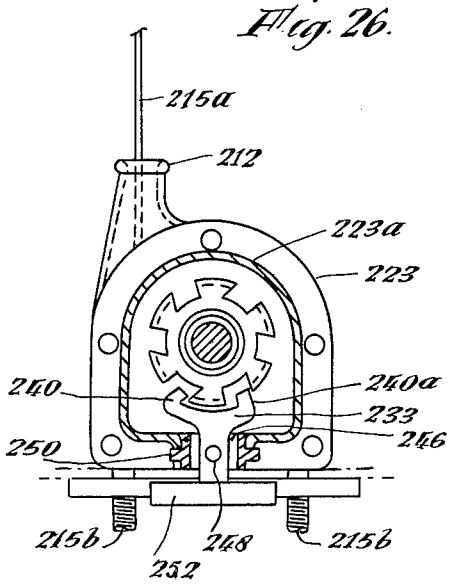

Fig. 27.

United States Patent Office 3,240,510 Patented Mar. 15, 1966

3,240,510

SAFETY HARNESS

Eric Herbert Spouge, Harold Hill, Essex, England, assignor to Pacific Scientific Company, San Francisco, Calif., a company of California

Filed June 11, 1963, Ser. No. 287,060
Claims priority, application Great Britain, June 13, 1962, 22,796/62, 22,797/62
4 Claims. (Cl. 280—150)

This invention relates to a safety harness assembly of the kind in which a strap (which word shall where the context so admits include a belt, cord, cable or the like) coupled to or constituting the harness is connected by one end to a take up reel.

Various forms of take up reels are known which embody inertia operated locking means which locks said reel on angular acceleration thereof. Such devices are often complicated and costly to construct and one of the objects of the present invention is to provide an improved and simplified construction of safety harness assembly (hereinafter referred to as a safety harness assembly of the kind described) wherein the assembly does not embody a take up reel having inertia operated locking means which locks the reel on angular acceleration thereof, but is sensitive to acceleration, deceleration or tilt of the vehicle.

According to the present invention there is provided a safety harness assembly of the kind described wherein locking means are provided and directly associated with said strap or with the take up reel to lock same. Said locking means may be remote controlled and may be hydraulically, pneumatically, electrically or manually operable and may include a member which itself may be inertia operated and may for example be constructed as a pendulum weight or actuated by a pendulum device or a sliding mass so as to be less sensitive to gravity and the locking means may include a latch member operatively associated with a toothed member carried by said reel. A locking means may be provided for locking the inertia member against release if a certain value is exceeded and hydraulically actuated means such as a piston and cylinder assembly may be provided for coupling in the hydraulic brake system of a vehicle so that said inertia locking member is moved to the locking position when the vehicle brake is applied.

In the drawings filed herewith:

FIG. 1 is a diagrammatic longitudinal section through one form of take up reel made in accordance with the present invention and suitable for use in a motor road vehicle.

FIGS. 2 and 3 are fragmentary views of the device shown in FIG. 1 with the parts moved to different positions.

FIG. 4 shows the device seen in FIGS. 1 to 3 modified to incorporate hydraulic actuation.

FIGS. 5 to 7 are fragmentary views of the device shown in FIG. 4 with the parts seen in different positions.

FIG. 8 is a diagrammatic longitudinal section through a modified form of inertia reel made in accordance with the invention but not incoroprating a pendulum weight.

FIG. 9 is a fragmentary view of the device shown in FIG. 8 with the locking means shown in the locked position.

FIG. 10 shows the device seen in FIG. 8 modified to incorporate hydraulic actuation.

FIG. 11 is a fragmentary view of the device seen in FIG. 10 with the locking means in the locked position.

FIG. 12 is a fragmentary view of a still further modification which is electrically operated.

FIG. 13 is a perspective rear view of a vehicle seat fitted with a hydraulically or pneumatically actuated strap locking device made in accordance with the present invention.

FIG. 14 is a detail view of the locking mechanism embodied in FIG. 13.

FIG. 15 is a side elevation of FIG. 14.

FIG. 16 is a view similar to FIG. 14 showing the parts in the locking position.

FIG. 17 is a detail view of a modified form of locking mechanism for use with the chain shown in FIG. 13.

FIG. 18 is a view of the mechanism shown in FIG. 17 with the parts in the locking position.

FIG. 19 is a diagrammatic sectional elevation of a take up device embodying a take up reel and pneumatically or hydraulically actuated locking means which acts directly on the take up reel.

FIG. 20 is a fragmentary view of the device shown in FIG. 19 with the parts shown in the locked position.

FIG. 21 is a diagrammatic fragmentary view showing the piston and cylinder of FIG. 20 substituted by a solenoid.

FIG. 22 is a fragmentary view of the arrangement shown in FIGS. 1 to 3 modified for manual remote control by cable.

FIGS. 23 and 24 are longitudinal and transverse views of a further modified form of the invention.

FIG. 25 is a diagrammatic fragmentary view of the arrangement shown in FIGS. 17 and 18 modified for manual control.

FIGS. 26 and 27 are a longitudinal sectional elevation and end view respectively of a modified form of take up reel made in accordance with the present invention.

Turning first to the construction shown in FIGS. 1 to 3 it will be seen that the device comprises a reel housing 2 fitted with end caps 4 and 6 and slotted on the cylindrical periphery at 8 to pass a strap 10 shown partly wound on a spindle 12 which is supported by its ends in the caps 4 and 6. The spindle 12 carries at one end a torsion return spring 14 one end of which is secured to the spindle 12 whilst the other end is fastened in the end of the housing 2, said spring being tensioned to apply a pull on the strap 10. Also mounted on the spindle 12 and secured against rotation thereon is the locking wheel 20 the periphery of which is formed with a plurality of closely spaced notches or slots 22 having splayed mouths 24 for the easy action of a two armed locking lever 26 one arm 28 of which is a locking plate, said lever being supported on a pivot 30 in a casing extension 32 of the housing 2. The locking lever arm plate 28 is urged to the disengaging position by a spring 34 mounted on the pivot 30. The other arm 36 of the lever 26 carries a pendulum weight 37 and as will be seen this weight is positioned so as to gently urge the locking arm plate 28 to the engaging position but is held by the spring 34 in the position in which the weight 37 is pressed against the casing 32 constituting a stop therefor.

The lever 26 is provided with a notch 38 adapted to be engaged by a ball 40 fitted in a drill hole 42 in the wall of the casing 32 and backed up by a compression spring 44. FIG. 1 shows the position of the parts at rest with the arm plate 28 in the unlocked position. The vehicle is assumed to to be moving in the direction of the arrow. If the vehicle is subjected to deceleration, the weight 37 by reason of its inertia will move to the position shown in FIG. 2 causing the arm plate 28 to engage with one of the notches 22 in the locking wheel 20 thereby locking the spindle 12 and preventing any pay out of the strap 10.

If the vehicle is involved in a collision resulting in a rapid deceleration of the vehicle the lever 26 will move to the extreme position shown in FIG. 3 in which the ball

40 becomes engaged in the notch 38 and the lever 26 is held locked. Release means (not shown) would normally be provided for resetting the lever 26.

Referring now to FIGS. 4 to 7 the same reference letters are used for the same parts as in FIGS. 1 to 3. In this modified construction the device incorporates a hydraulic piston and cylinder assembly adapted to be coupled to the hydraulic brake system of the vehicle. In this arrangement the arm 36 carries a pin 46 which is engaged by the piston rod 48 of a piston 50 housed in the cylinder 52 integral with the casing 32, said piston carrying a cup washer 54. A coil spring 56 on the piston rod 48 urged the piston away from the pin 46 on the arm 36. A pressure pipe line 60 is connected to an inlet 62 near the head 64 of the cylinder 52 and said pipe line 60 is coupled in the hydraulic brake system (not shown) of the vehicle. When the driver applies his hydraulic brakes then the piston 50 is moved to the position shown in FIG. 6 and once again the plate 28 is moved into the locking position, this time the inertia of the weight 37 being assisted by the hydraulic pressure in the brake system. The extreme position for the lever 26 can still be reached as shown in FIG. 7 independently of the foot brake action but cannot be achieved by foot brake action alone.

Turning now to FIGS. 8 and 9 a simplified construction is shown in which the use of a weighted lever is avoided. This has the advantage that the inertia locking means is less sensitive to gravity.

In this arrangement the device comprises a cylindrical housing 80 provided with intermediate partition walls 82 supporting a take up spindle 84 on which is wound a cable 86 which replaces the strap in the previous arrangement, said cable being connected at its free end to the harness (not shown) after leaving the casing 80 through the slot 88. At one end the spindle 84 carries a torsion spring 89 which is housed in the end of the casing 80 and is tensioned to exert a pull on the cable 86. The spring housing is closed by a cap 90 through which the end of the shaft 84 projects. The other end of the spindle 84 is formed with a cylindrical head 92 provided with radial teeth 94 on its periphery, said head 92 being hollow to accommodate a compression spring 96. Mounted on the spindle 84 on an extension thereof projecting beyond the head 92 is an inertia plate 98 slidable on said spindle, said inertia plate 98 being bored on one face to provide a collar for the spring 96 and formed with internal radial teeth 100 for co-operation with the radial teeth 94. The end of the housing 80 remote from the spring 96 is closed with a cap 102. The inertia plate 98 is also provided on its periphery with splines 108 which engage with complementary splines 110 provided on the inner periphery of the housing 80.

The operation of this device will be obvious. The inertia plate 98 can move into engagement with the radial teeth 94 to lock the spindle 84 by action of inertia.

FIG. 9 shows the inertia plate in the locking position.

In the modified form shown in FIGS. 10 and 11 the device illustrated in FIGS. 8 and 9 has been modified for hydraulic actuation when coupled to the hydraulic brake system of the vehicle. The same reference letters are used in these figures for the same parts seen in FIGS. 8 and 9. In this arrangement a cylindrical extension 112 on the cap 102 has a bore 114 to receive the piston like extension 116 on the inertia plate 98, said extension 116 carrying a cup washer 118. Finally the cylindrical extension 112 is closed by a union 122 securing a pipe line 124 in circuit with the hydraulic brake system of the vehicle.

Again the operation will be obvious and it will be clear that the locking can take place with or without the assistance of the hydraulic actuation.

In the form shown in FIG. 12 the piston like extension 116 is made in brass or other non-magnetic material and carries an armature 130 of a solenoid coil 132 the winding of which is adapted to be connected in circuit with a source of electric energy and a switch which may for example be the brake switch of a motor road vehicle or a switch on the pilot's control panel.

In the form shown in FIG. 22 of the drawings the cable 140 is flexible and its flexible core is connected by one end to a handle 142 and by its other end to a rod 144 slidably mounted in the casing extension 32 and carries an abutment 146 adapted to engage the arm 36 of the locking lever 26 when the handle 142 is pulled. A cable return spring 148 is provided.

Obviously, if pneumatic pressure is available the hydraulic cylinder and piston assembly can be replaced by a pneumatic assembly and either can be coupled to any other form of control or actuating means whether for operation independently or in conjunction with other mechanism, for example in an aircraft it could be coupled for operation by the pilot immediately before landing or take off. If desired the solenoid assembly can be replaced by any other electrically actuated means.

In the form shown in FIGS. 13 to 16 the chair 2 surmounting a frame 4 is provided at the top with strap guides 6 for shoulder straps 8 which are joined to a common strap 10 extending down the back of the chair 2 and seen entering a slot 12 in a casing 14 secured by bolts 16 to the frame 4, only one of said bolts being seen as the other is hidden by the casing. The casing could be secured to the floor or other convenient structural member.

Within the casing 14 (see FIGS. 14 to 16) is mounted to take up reel spindle 18 around which the strap 10 is partly wound, its end being secured thereto. The take up reel spindle 18 is journalled in the casing 14, said spindle 18 carrying a torsion spring 22 one end of which is secured to the spindle 18 whilst the other end is secured to the casing 14. Also mounted in the casing 14 are two fixed pillars 24 and 26 respectively between which the strap 10 passes, being always in contact with the pillar 24. A hydraulic cylinder 28 mounted in the casing 14 is shown connected to a pipe 30 adapted to be coupled in the hydraulic system of the hydraulically operated brakes of the vehicle. Within the cylinder 28 is disposed a piston 32 fitted with a cup washer 33, the piston rod 34 of said piston carrying a wedge 36 positioned so as to enter the gap between the fixed pillars 24 and 26 when projected by the piston 32. It will be seen that the arrangement is such that a pull on the strap 10 after the wedge 36 has been engaged will only increase the wedging action against the strap 10.

The operation of the device is fairly obvious. When the driver applies the footbrake the hydraulic pressure in the pipe 30 will cause the piston 32 to rise and force the wedge 36 between the fixed pillars 24 and 26 clamping the strap 10 against the fixed pillar 24 whilst the back of the wedge 36 is in contact with the pillar 26 as shown in FIG. 16. As soon as the hydraulic pressure in the cylinder 28 is relaxed the wedge 36 will fall back releasing the strap 10. In the form shown the piston 32 is returned by gravity but a return spring may be provided. So long as the wedge 36 is in the position shown in FIG. 14 the strap 10 is free to be wound in by the spring 22 or to be drawn out by a pull on the strap if the wearer of the harness leans forward or makes any movement increasing the tension in the strap.

Turning now to FIGS. 17 and 18, in which the same numerals are used to indicate the same parts as those seen in FIGS. 14 to 16, it will be seen that the casing 14 in addition to having the take up reel spindle 18 has only a single fixed pillar 40 adjacent to which is a shaft 42 journalled in the casing 14, said shaft having a diametrical slot 43. The slotted shaft 42 carries a lever 44 at one end which is connected by a link 46 to the piston rod 34. A compression spring 47 is positioned beneath the piston 32 in the cylinder 28. The strap 10

is threaded through the slot 43 in the shaft 42 and as before passes out through the slot 12 in the casing 14.

In the rest position shown in FIG. 17 the slot 43 is vertically disposed so that the strap 10 is free to move in either direction. As soon as hydraulic pressure is applied to the cylinder 28 the slotted shaft 42 is turned bringing the strap against the fixed pillar 40 as shown in FIG. 18 in which position it is locked between said pillar 40 and the edge of the slot 43. On the release of the hydraulic pressure the piston 32 rises under the action of the spring 47 and the slotted shaft 42 returns to the position shown in FIG. 5.

In FIGS. 19 and 20, there is shown a take up reel provided with a locking device which can be actuated either hydraulically or pneumatically. The device comprises a reel housing 52 fitted with end caps 54 and 56 and slotted on the cylindrical periphery at 58 to pass a strap 60 shown partly wound on a spindle 62 which is supported by its end in the caps 54 and 56. The spindle 62 carries at one end a torsion return spring 64 one end of which is secured to the spindle 62 whilst the other end is fastened in the end of the housing 52, said spring being tensioned to apply a pull on the strap 60. Also mounted on the spindle 62 and secured against rotation thereon is the locking wheel 70 the periphery of which is formed with a plurality of closely spaced notches or slots 72 having splayed mouths 74 for the easy action of a two armed locking lever 76 one arm 78 of which is a locking plate, said lever being supported on a pivot 80 in a casing extension 82 of the housing 52. The locking lever plate 78 is urged to the disengaging position by a spring 84 mounted on the pivot 80. The other arm 86 of the lever 76 does not have the pendulum weight described. Said arm 86 carries a pin 96 which is coupled by a link 97 to the piston rod 98 of a piston 100 housed in the cylinder 102 integral with the casing 82, said piston carrying a cup washer 104. A compression coil spring 106 on the piston rod 98 urges the piston to the far end of the cylinder 102. A pressure pipe line 110 is connected to an inlet 112 near the head 114 of the cylinder 102 and said pipe line 110 is coupled in the hydraulic brake system (not shown) of the vehicle. The arrangement may be such that the piston 100, link 97 and locking lever 76 may be balanced about the pivot 80 so that the inertia forces, due to deceleration of the vehicle or other causes, do not affect the action.

When the driver applies his hydraulic brakes then the piston 110 is moved to the piston shown in FIG. 20 and the plate 78 is moved into the locking position.

When the hydraulic pressure falls and there is no pull on the strap the parts will return to the position shown in FIG. 19.

Referring to FIGS. 23 and 24 of the drawings which show longitudinal and transverse sections of a harness reel having an inertia member adjacent to said reel and mounted both for rotation therewith and relative rotational movement with respect thereto and means for locking said reel against rotation in the pay-out direction on occurrence of said relative movement, the device comprises a central casing 121 (FIG. 23) providing an entrance tunnel 122 (FIG. 24) for a strap 122*a* and a reel housing 123. The sides of the reel housing 123 are apertured and bearing sleeves 124 for the reel spindle 125 line the apertures. The bearing sleeves 124 are backed by annular members 126. The strap 122*a* passes into the reel housing 123 through the tunnel 122 and is wound onto the reel spindle 125. One end of the spindle 125 projects into an end housing 133 and carries a thrust plate 134 which is fast with the spindle 125. The thrust plate 134 has three equally spaced recesses 135 in it which provide seats for three ball bearings 136. Beyond the thrust plate 134 the spindle 125 carries a bearing sleeve 137 on which an inertia plate 138 is mounted. The inertia plate 138 is free to rotate about the spindle 125. The inertia plate 138 has three equally spaced recesses 139. The recesses 139 and 135 are part ovoid in shaped being arcuate in transverse cross section and deepening in opposite directions and so that the inertia plate is moved away from the thrust plate if it lags behind the thrust plate. The inertia plate 138 is urged by a resilient rubber ring 141 away from a friction pad 142 secured to a backing plate 142*a* held against rotation in the housing 133. The reel housing 123 has an enlargement at the base to accommodate a sear 143 pivotally mounted on a pintle 144 which is provided with a tooth 145 shaped to engage teeth 146 provided on the periphery of the thrust plate 134. The sear 143 has a downwardly depending arm 149. Within the enlarged base is a slidable mass 154 which is coupled by a connecting rod 158 to the arm 149 of the sear 143 by means of a gudgeon pin 160 and crank pin 162. The connecting rod and sear are balanced to eliminate the effect of inertia of these parts.

In operation on deceleration the mass 154 moves and rocks the sear 143 to cause the tooth 145 to engage one of the teeth 146 and so lock the thrust plate 134 against rotation with the result that the reel is locked so that if any pull is applied to the strap the mechanism which is normally adapted to lock by the inertia plate 138 is already locked by the sear 143. Thus the two forms of locking are complementary and provide additional safety in the event of failure of either.

Turning now to FIG. 21 of the drawings it will be seen from this fragmentary view that the piston 100 shown in FIGS. 19 and 20 has been replaced by a solenoid armature 170 coupled by a connecting rod 172 to the locking lever 76. Within the cylinder is positioned the solenoid coil 174 adapted to be connected in circuit for example with the brake light switch of the vehicle so that the solenoid is energised when the brake is applied and the armature is moved to cause the locking plate 78 to engage one of the slots 72 in the locking wheel 70.

Referring to FIG. 25 of the drawings which shows a manually operable means embodied in an arrangement similar to FIG. 17, the arm 44 is connected to one end of the core 150 of a flexible cable 152 the other end of which is adapted to be connected to a handle such as the handle 142 shown in FIG. 22. A return spring 154 is provided to unlock the strap 10 when the handle is released.

In the modified form shown in FIGS. 26 and 27 the device comprises a central casing 211 providing an entrance tunnel 212 and a reel housing 213 in which is journalled the reel spindle 215 as hereinafter described. A strap 215*a* is shown entering the reel housing and partly wound onto the spindle 215. An end housing 221 provides a journal for one end of the spindle 215 and adapted to be secured by bolts 215*b*, passing through a plate 215*c*, to the floor of the vehicle. A take up spring 222 is housed in a second end housing 223 in which the other end of the spindle 215 is journalled which housing 223 has an extension 223*a* accommodating the locking mechanism now to be described. A sleeve 228 is secured to the spindle 215.

The extension 223*a* of the end housing 223 accommodates a pawl or sear 233 having a pair of arms 240 and 240*a* carried by a hub 244 which is gimbal mounted, said gimbal consisting of a ring 246, a pivot 248 and pintles 250, the ring 246 surrounding the hub 244. Extending downwardly from the hub 244 is a bob weight 252. The sleeve 228 is provided with teeth 254 adapted to be engaged by one of the arms 240 or 240*a* according to which way the bob weight 252 swings. In this arrangement the teeth 254 are provided with a central groove 254*a* so that when the bob weight 252 is in a central position or at rest the arms 240 and 240*a* are positioned centrally in the groove 254*a* out of engagement with the teeth 254.

In operation any inertia forces acting on the bob weight **252** in any direction will cause one of the arms **240** or **240***a* to engage one of the teeth **254** upon which happening the sleeve **228***a* is held aaginst rotation and any subsequent pull on the strap **215***a* will be resisted as the pawl **233** is engaged with the sleeve **228**, thus locking the spindle **215** against rotation.

With the arrangement above described the locking means is sensitive not only to velocity changes of the vehicle in any direction but also to positional changes when the bob weight **252** is displaced in any direction by gravitational forces.

What I claim and desire to secure by Letters Patent is:

1. A safety harness assembly comprising a casing, a spindle rotatable within said casing, a strap wound around said spindle and extending outwardly of said casing for connection to a seat occupant's harness strap, a torsion return spring within said casing having one end connected thereto and its other end connected to said spindle, and tending to draw said strap into said casing to retain a slight tension on the seat occupant's harness, a locking wheel fixed upon said spindle, a cooperating weighted locking lever pivoted adjacent said locking wheel and adapted to turn through a limited arc to engage the latter in locking relation upon rapid deceleration of a vehicle carrying the safety harness to thereby hold the occupant in his seat, and spring means engaging said locking lever for normally returning said lever to its unlocked position after said locking operation.

2. A safety harness assembly as defined in claim **1**, wherein a detent retaining means is provided within said casing for permanently locking said locking lever in engagement with said locking wheel in the event of excessive deceleration of the vehicle such as due to a collision causing said locking lever to turn through an excessive arc.

3. A safety harness assembly as defined in claim **1** comprising a hydraulic cylinder and piston movable therein, said cylinder being coupled to the hydraulic brake system of the vehicle carrying said safety harness assembly, said piston being actuated by brake fluid of the vehicle and being positioned for moving said locking lever into locking relationship with the locking wheel upon the application of the vehicle brakes, and spring means acting upon said piston for effecting the release of said locking lever from said locking wheel upon the release of the vehicle brakes.

4. A safety harness assembly according to claim **3** wherein said pivoted lever is a pendulum and itself constitutes an inertia member.

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MERVIN STEIN, *Primary Examiner.*

STANLEY N. GILREATH, *Examiner.*

W. S. BURDEN, *Assistant Examiner.*