(54) Title: AUTOMATIC VEHICLE SEAT BELT RELEASE SYSTEM

(57) Abstract

An automatic vehicle seat belt release system has a fastening arrangement (12, 18) for coupling with a seat belt fastening element (20) and for engaging the fastening element (20) in association with an anchor location; event sensing apparatus for sensing a predetermined emergency event and for providing an output signal in response thereto; release apparatus (43) associated with the socket arrangement, for releasing the seat belt fastening element (20) therefrom in response to receipt of a predetermined signal, thereby to disassociate the seat belt from the anchor location; and time delay apparatus arranged between the event sensing apparatus and the release apparatus (43), operative to receive the output signal from the event sensing apparatus and, after a predetermined time interval, to provide the predetermined signal to the release apparatus (43), thereby to cause activation thereof and release of the seat belt.
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AUTOMATIC VEHICLE SEAT BELT RELEASE SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to safety devices for use in vehicles, and, in particular, to seat belt arrangements.

BACKGROUND OF THE INVENTION

Since the development of the motor vehicle and aircraft, various safety arrangements have been developed for securing passengers, drivers and pilots in their seats so as to avoid injuries caused by their being thrown therefrom during crash situations. This problem has become more acute as vehicles have become more technologically advanced, and as the speed of travel has increased accordingly. The most common solution to this problem has been to provide various seat belt systems, which, in many vehicles, may also be combined with air bag arrangements.

In the area of seat belts various improvements have been made recently. These improvements include provision of a belt with a spring reel which keeps the belt continuously tensioned and which locks at the time of a crash, thereby preventing the driver or passenger from being thrown suddenly from his seat.

It has been found that, in the seconds following a crash, the passengers and driver of a vehicle may be in a traumatic condition. This condition affects each person differently, and may vary between complete disorientation or unconsciousness, to partial function and control.

The degree of traumatization is affected by any of several factors, including:

a. loss of consciousness/disorientation,
b. fractures of the sternum, ribs, and other body parts.
c. tearing of tendons and ligaments, and
d. psychological trauma of being trapped in the wreckage of the vehicle or seat belt.

Situations in which people are trapped in their seats and are not able to release the seat belt without help from rescue personnel may be caused by:

a. side collision - when the seats are next to each other and it is not possible to reach the belt release button,
b. head-on collision - when the gear box is raised over the seats and causes access to the belt release button to be blocked,
c. mechanical damage to the seat belt release mechanism which may cause it to catch and lock, and

d. a diminished physical and psychological condition of people in the vehicle, which does not permit them to function even to the extent of doing the minimum necessary to release a seat belt.

There are, furthermore, extreme situations in which it is not possible for rescuers to release people trapped in a vehicle, such as when a vehicle catches fire. In such a case, due to the fact that the rescuers are unable to release the trapped people, and due to the fact that these people are unable to release themselves, they may be burned to death.

SUMMARY OF THE INVENTION

The present invention aims to provide a system for providing automatic release of a vehicle seat belt in the event of a crash situation.

In particular, the system of the present invention aims to provide automatic release of the seat belt after a predetermined interval has elapsed from the occurrence of the crash, thereby to prevent persons being trapped in a crashed vehicle, but only after the initial protection provided by the seat belts is no longer required.

There is thus provided, in accordance with a preferred embodiment of the invention, an automatic vehicle seat belt release system which includes a fastening arrangement for coupling with a seat belt fastening element and for engaging the fastening element in association with an anchor location; event sensing apparatus for sensing a predetermined emergency event and for providing an output signal in response thereto; release apparatus associated with the fastening arrangement, for releasing the seat belt fastening element therefrom in response to receipt of a predetermined signal, thereby to disassociate the seat belt from the anchor location; and time delay apparatus arranged between the event sensing apparatus and the release apparatus, operative to receive the output signal from the event sensing apparatus and, after a predetermined time interval, to provide the predetermined
signal to the release apparatus, thereby to cause activation thereof and release of the seat belt.

Additionally in accordance with a preferred embodiment of the invention, the fastening arrangement includes an upper portion which includes a socket for fastenably receiving the seat belt fastening element, and which further includes locking element; and a lower portion anchored to the anchor location, and having apparatus for lockably engaging the locking element of the upper portion, wherein the release apparatus includes apparatus for detaching the upper portion from the lower portion, thereby to release the seat belt from the lower portion of the fastening arrangement, and thus to disassociate the seat belt from the anchor location.

Further in accordance with a preferred embodiment of the invention, the release apparatus includes apparatus which is operative, after the predetermined time interval, to generate a high pressure so as to forcibly separate the upper portion of the fastening arrangement from the lower portion thereof.

Additionally in accordance with a preferred embodiment of the invention, the release apparatus includes a mechanism associated with the lower portion and normally having a first position in which the mechanism lockably engages the locking element of the upper portion, and apparatus for forcing the mechanism to move to a second position, thereby to permit disengagement thereof of the locking element of the upper portion.

Further in accordance with a preferred embodiment of the invention, there is also provided resilient apparatus arranged to normally urge the locking element out of engagement with the mechanism, wherein, when the mechanism moves into the second position, the resilient apparatus is operative to cause the locking pin to withdraw from engagement with the mechanism of the locking pin, and thus to cause detachment of the upper portion of the fastening arrangement from the lower portion thereof.

Additionally in accordance with a preferred embodiment of the invention, the mechanism includes a cylinder containing a quantity of a combustible material; piston apparatus located within the cylinder and having an actuating portion extending therefrom so as to protrude externally of the cylinder, and operative to move from a first position such that the locking element of the upper portion is locked, to a second position such that the locking element of the upper portion is released; and apparatus for igniting the combustible material so as to cause an rapid increase in pressure inside the cylinder, thereby to drive the piston
apparatus within the cylinder, and thereby to move the piston apparatus from the first position to the second position.

Further in accordance with a preferred embodiment of the invention, the actuating portion is operative to lockably engage the locking element when the piston is in the first position, and wherein movement of the piston to the second position causes disengagement of the actuating portion from the locking element and thus release thereby of the actuating portion.

In accordance with an alternative embodiment of the invention, the mechanism also includes additional apparatus for lockably engaging the locking element, and wherein, when the piston apparatus is in the first position, the apparatus for lockably engaging is operative to lockably engage the locking element, and wherein, when the piston apparatus is moved to the second position, it is operative to activate the apparatus for lockably engaging so as to disengage and release the locking element.

In accordance with yet a further embodiment of the invention, the fastening arrangement includes a housing; spring-biased locking apparatus for selectively locking the seat belt fastening element; and manual apparatus for selectively disengaging the spring-biased locking apparatus from the seat belt fastening element,

and the release apparatus automatically activates the spring-biased apparatus so as to disengage from the seat belt fastening element.
BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood and appreciated from the following detailed description, taken in conjunction with the drawings, in which:

Fig. 1A is a front view illustration of the anchoring of a pair of vehicle seat belt fastening arrangements, including associated webbing portions and associated fastening elements releasably fastened in the fastening arrangements;

Fig. 1B is a side view of the apparatus of Fig. 1A, taken in the direction of arrow B therein;

Fig. 2 is a schematic block diagram showing the sensory, delay, ignition and pressure portions of the present invention;

Fig. 3A is an enlarged, detailed, partially cut away view of a single fastening arrangement of Figs. 1A and 1B, constructed in accordance with a preferred embodiment of the invention, and including an automatic emergency release mechanism, seen in an ‘at rest’ state;

Fig. 3B shows the construction of Fig. 3A after initial actuation of the release mechanism thereof;

Fig. 3C shows the construction of Figs. 3A and 3B after full actuation of the release mechanism thereof, and release of a detachable portion thereof;

Fig. 4A is an enlarged, detailed, partially cut away view of a single fastening arrangement of Figs. 1A and 1B constructed in accordance with an alternative embodiment of the invention, and including an automatic emergency release mechanism, seen in an ‘at rest’ state;

Fig. 4B is a cross-sectional detail of a locking pin forming part of the release mechanism of Fig. 4A, taken along line B-B therein; and

Fig. 5 shows the fastening arrangement after full actuation of the release mechanism thereof, and release of a detachable portion thereof;

Figs. 6A, 6B and 6C are schematic side-sectional views showing an at rest position of a seat belt fastener and a socket arrangement, normal release of the seat belt fastener, and emergency release of the seat belt fastener, respectively, in accordance with a further embodiment of the invention.
DETAILED DESCRIPTION OF THE INVENTION

The present invention seeks to provide a system for automatically releasing vehicle seat belts in the event of an emergency situation. An emergency situation is any situation which may arise and as a result of which it may be necessary to automatically release vehicle seat belts, including, for example, a vehicle crash, or the advent of a fire in the engine compartment. The invention is based on the sensing of an emergency situation, such as by any known ‘event’ sensor, typically a crash sensor such as may be known to be employed for triggering actuation of an air bag, or a fire and/or smoke sensor; the provision of a time delay device, which is operative to provide its own output signal after a predetermined time has elapsed from receiving an input signal from the crash sensor, which, in the present invention, may be in the range 10-30 seconds, for example; and actuating a seat belt release mechanism.

Referring now to Fig. 1A, there is seen a pair of seat belt sockets arrangements, each referenced generally 10, constructed in accordance with a preferred embodiment of the invention. As seen also in Fig. 1B, each socket arrangement 10 is aligned along a longitudinal axis 11, and is formed of a lower portion 12, which is anchored, via a suitable anchor cable 14, to a suitable anchor location, shown generally at 16, such as a portion of the vehicle chassis. Socket arrangement 10 is further formed of an upper portion 18 which has an upward-facing, typically female, socket portion 19 which is constructed in any suitable manner so as to receive therein the tongue of the fastening element 20 of a seat belt 22. The fastening element 20, socket portion 19, and seat belt 22 may be of any known, suitable construction, and are thus not described in detail herein. A spring-biased release button 24, for enabling normal release of the fastening element 20 from socket portion 19, is also provided, as seen in Fig. 1B.

In accordance with the present invention, upper portion 18 of socket construction 10 is constructed so as to be automatically detached from lower portion 12 after a predetermined time delay following a crash.

Referring now additionally to Fig. 2, there is provided a crash sensor and time delay unit 67, which is operative to electronically actuate a release mechanism 43 which, as described below in more detail, is operative to cause detachment of upper portion 18 of fastening arrangement 10 from the lower portion 12, thereby to release the associated seat belt 22.

In more detail, unit 67 includes an event sensor 72 and a delay device 70, which prevents activation of the release mechanism 43 until an initial time interval of, for example,
10-30 seconds, has passed, thereby causing release of the seat belt only after it has finished its task of protecting its user. Event sensor 72 may be any type of sensor which is operative to provide an electrical output signal in response to a predetermined emergency occurring, which would require automatic release of a seat belt, such as described herein. Accordingly, event sensor 72 is preferably a crash sensor, although it may alternatively be a fire and/or smoke sensor, for example.

An example of a suitable crash sensor is that described in US Patent No. 5,396,424, entitled Crash Sensor, the contents of which are incorporated herein by reference. The described crash sensor provides a trigger signal in response to sensing a crash, thereby to inflate an air bag. In the present invention, the trigger signal is provided not to an air bag, but to delay device 70. Delay device 70 may be any suitable capacitive delay device which, after a predetermined time interval, is operative to discharge, thereby to provide an output signal, via an electrical cable 74, to an electrical ignition device forming part of the release mechanism 43, thereby to cause release of the seat belt.

Release mechanism 43 may include any suitable known pressure device, such as those described in any of the following US patents in conjunction with air bag inflation, the contents of which are incorporated herein by reference: USP 5,398,964 entitled Starting Device for Air Bag; USP 5,429,387 entitled Low Pressure Switch/Initiator/Gas Generator, USP 5,422,965 entitled Air Bag Operating Device; and USP 5,403,036 entitled Igniter for an Air Bag Inflator.

Reference is now made to Figs. 3A, 3B and 3C, in which is shown fastening arrangement 10, constructed and operative in accordance with a preferred embodiment of the invention. It is seen that upper portion 18, in addition to upward-facing socket portion 19, further has a downwardly extending locking element 26, which is formed so as to be in normally locked engagement by lower portion 12 of socket arrangement 10. Release of locking element 26 permits upper portion 18 to be totally separated from lower portion 12 of socket arrangement 10 along axis 11, thereby releasing seat belt 22 while fastening element 20 thereof is still engaged in socket portion 19 of upper portion 18.

Lower socket portion 12 is formed of an outer housing 27 which has a pair of outwardly angled opposing side walls 28 which extend generally upwardly, along axis 11, from a base 29. Anchor cable 14 is fastened to housing 28 by any suitable fastening means (not shown).
Release mechanism 43 includes an inner housing 30 which has a pair of wall members 32 aligned along axis 11, and which are held together by a resilient gasket member 34, or the like. Each wall member 32 has formed thereon a first inwardly extending flange 38 formed at an upper end thereof, and an intermediate, second inwardly extending flange 40. A lower chamber 42, housing pressure device 44, is formed between the base 29 and the second flanges 40, and an upper chamber 46 is formed between the first and second flanges 38 and 40.

First flanges 38 define therebetween an end opening 48. When the release mechanism 43 is in an at rest position, as seen in Fig. 3A, a notched portion 50 of locking element 26 extends through opening 48 into upper chamber 46 so as to be fastenably engaged by the first flanges 38, thereby to fasten the detachable upper portion 18 of fastening arrangement 10 to the lower portion 12 thereof.

Lower chamber 42 contains the pressure device 44 which, as described above, may be formed in accordance with any known pressure pyrotechnical/mechanical device such as known for use in conjunction, for example, with air bags. The general, construction of pressure device includes, however, a cylinder 52, a piston 54, a predetermined volume of a pyrotechnic charge material 55, and an ignition device 68. Piston 54 has a piston plate 56 and a generally upwardly extending tapered protrusion 58, which widens from a generally narrow upper end 60 to a generally wide lower portion 62. Second flanges 40 have inward-facing edges which define therebetween an opening which is configured to seat therebetween tapered protrusion 58, when release mechanism 43 is in the at rest position.

Pressure device 44 is operative, when the pyrotechnic material therein is detonated by ignition device 68, to cause an instantaneous pressure increase in cylinder 52, thereby to force piston 54 in a generally upward, axial direction, as shown by arrows 66 in Fig. 3B. As piston 54 moves upwards, tapered protrusion 58 thereof forces second flanges 40 apart, as shown by arrows 76, so as to cause splaying of side walls 28, against the urging of gasket member 34, transversely to axis 11.

The illustrated splaying apart of side walls 28 also causes an increased separation between first flanges 38, thereby to release locking element 26. Simultaneously, upper end 60 of the tapered piston protrusion 58 engages an opposing end surface 80 of locking element 26.

As seen in Fig. 3C, as piston 54 reaches the end of its travel within cylinder 52, the entire upper portion 18 of the seat belt fastening arrangement 10 is seen to be completely
released from lower portion 12, while still attached to seat belt fastening element 20, thereby to release the seat belt 22, and thus to release a vehicle passenger who might otherwise have been trapped in his seat by the seat belt, as described above in the Background of the Invention.

Referring now to Figs. 4A-5, there is provided a seat belt fastening arrangement, referenced generally 110, constructed and operative in accordance with an alternative embodiment of the invention. Arrangement 110 is generally similar to arrangement 10, shown and described above in conjunction with Figs. 1-3C, and is thus only described herein with regard to the differences between the present arrangement 110 and arrangement 10. Components of arrangement 110 are indicated in Figs. 4A and 5 by numbers corresponding to their counterpart components in Figs. 3A-3C, but with the addition of a prefix "1", and are not described again herein, except as may be necessary for understanding of the present embodiment.

It is seen that detachable upper portion 118 of fastening arrangement 110 has a rod-like locking element 126 which extends downwardly generally parallel to or along axis 11. Locking element 126 is arranged in a generally axial bore 160 and is formed so as to be in normally locked engagement by lower portion 112 of fastening arrangement 10. Release of locking element 126 permits upper portion 118 to be totally separated from lower portion 112 of fastening arrangement 110, thereby releasing the seat belt while fastening element 120 thereof is still engaged in socket portion 119.

It is seen that lower socket portion 112 is formed of a housing 128 which has a transverse recess 130 formed therein. A release mechanism 143, located in transverse opening 130, is constituted by a pressure device 144 which, similarly to pressure device 44 of arrangement 10, employs a pyrotechnic or other similar charge material. When the release mechanism is in an at rest position, as seen in Fig. 4A, locking element 126 is located fully in bore 160.

Pressure device 144 is formed of a cylinder 152 and a piston 154. Piston 154 has a piston plate 156 and a locking pin 158 which extends through an opening 159 formed in a closed, inward-facing end portion 162 of cylinder 164, and extending transversely across bore 160.

Referring now also to Fig. 4B, elongate locking element 126 has a transverse bore 164 extending therethrough. Bore 164 is located such that when locking element 126 is fully located within elongate opening 160, locking pin 158 extends through the bore 164, thereby
to fasten the locking element 126, and thus upper portion 118, to lower portion 112. It is seen that a resilient compression member 166 is located in the bottom of opening 160 and, in the position shown in Fig. 4A, is seen to be compressed between the locking element 126 and housing 128.

As in seat belt fastening arrangement 10, described above in conjunction with Figs. 1A-3C, pressure device 144 may be any suitable gas discharge or other pyrotechnic device which, when detonated, as by an electrical ignition device 168 causes a predetermined pressure increase within cylinder 152 so as to transversely displace piston 154. Examples of known pressure devices which may be useful in the present invention are listed above.

In operation, there is provided an electrical signal from the delay device to ignition device 168 of pressure device 144, via an electrical wire 174.

Ignition of the pyrotechnic material, or other equivalent, typically combustible material located in cylinder 152, causes a rapid increase in pressure within the cylinder, in front of piston 154. As illustrated in Fig. 5, this increase in pressure forces piston 154 laterally outwards, as shown by arrows 176. As piston 154 moves outwards, thereby to withdraw locking pin 158 from bore 164 of locking element 126, and thus to release locking element 126, resilient compression member 166 urges it upwards, thereby to permit release of the upper portion 118 of the seat belt fastening arrangement 10 from lower portion 112, while still attached to seat belt fastening element 120, thereby to release the seat belt, and thus to release a vehicle passenger who might otherwise have been trapped in his seat by the seat belt, as described above.

Referring now to Figs. 6A, 6B and 6C, there is provided, in accordance with yet a further embodiment of the invention, a seat belt fastening arrangement, referenced generally 210. Similarly to arrangements 10 (Figs. 1A-3C) and 110 (Figs. 4A-5), arrangement 210 employs a pressure device, referenced 244, in order to cause release of a seat belt fastener 220 from a seat belt socket 218. In the present embodiment, however, the pressure device is employed so as to automatically operate the release mechanism which is used for normal, repeated release of the seat belt fastener. This will be appreciated from the following description. It will also be appreciated that arrangement 210 is operated by event sensor and time delay unit 67 (Fig. 2), which is not described herein again in detail, and is connected thereto by an electrical conductor 74.

Socket 218 has a housing 212 which is formed with inner walls 213 and 214 which define therebetween a slit 215. An engagement member 216 is connected via a lower portion
thereof 218 and via a compression spring 220 to an exterior wall portion 222 of housing 212. It is seen that engagement member 216 further has an upper end 224 which is held behind inner wall 213, such that when lower portion 218 of the engagement member 216 is pushed outwardly, it pivots about its upper end 224. Engagement member 216 further has a locking tongue 226 which extends generally inwardly, such that, when a seat belt fastener 220 is inserted into slit 215, a lower edge 230 of the seat belt fastener 220 engages locking tongue 226 so as to cause pivoting of engagement member 216, and a consequent sideways retraction of locking tongue 226, thereby enabling seat belt fastener 220 to be fully inserted until an opening 231 formed therein is engaged by tongue 226, thereby to lock the seat belt fastener 220 in housing 212.

A release member 232 is mounted within a recess 234 formed in the side of housing 212, and is employed such that an end portion thereof, referenced 236, is arranged to engage a first end 238 of an intermediate pivot element 240. As seen in Fig. 6B, pivot element 240 is arranged to pivot such that a second end thereof, referenced 242, pushes against lower portion 218 of engagement member 216, thereby to push it generally sideways, and thus to cause retraction of locking tongue 226. Seat belt fastener 220 may now be removed from slit 215 without encountering resistance from locking tongue 226.

Engagement member 216 has a bottom extension 246 which is cranked outwardly, thereby to define a sloped surface 248. Pressure device 244, which may be similar to pressure device 44, shown and described above in conjunction with Figs. 1A-3C, and is thus not described herein in detail, has a cylinder 250 which contains a pyrotechnic charge material 252, of the sort described above, and a piston 254. Preferably, piston 254 protrudes through the end of cylinder 250, and has a slanted contact surface 255 (Fig. 6B) which is arranged to be in full touching contact with sloped surface 248 of engagement member when in the at rest position illustrated in Fig. 6A.

Upon detonation of the charge material 252, piston 254 is forced in a generally upward direction, shown by arrow 256 in Fig. 6C. This upwards movement of piston 254 causes slanted contact surface 255 of the piston to push upwardly and outwardly against sloped surface 248 of engagement member 216, shown by arrow 258, thereby causing the entire engagement member 216 to pivot about its upper end 224. This causes retraction of locking tongue 226, so as to enable removal of seat belt fastener 220 from socket arrangement 210, thereby to release the seat belt, and thus to release a vehicle passenger who might otherwise have been trapped in his seat by the seat belt, as described above.
It will be appreciated by persons skilled in the art that the scope of the present invention is not limited to what has been specifically shown and described hereinabove, merely by way of example. Rather, the scope of the invention is limited solely by the claims, which follow.
CLAIMS

1. An automatic vehicle seat belt release system which comprises:
   a fastening arrangement for coupling with a seat belt fastening element and for engaging the fastening element in association with an anchor location;
   event sensing means for sensing a predetermined emergency event and for providing an output signal in response thereto;
   release means associated with said fastening arrangement, for releasing the seat belt fastening element therefrom in response to receipt of a predetermined signal, thereby to disassociate the seat belt from the anchor location; and
   time delay means arranged between said event sensing means and said release means, operative to receive said output signal from said event sensing means and, after a predetermined time interval, to provide said predetermined signal to said release means, thereby to cause activation thereof and release of the seat belt.

2. An automatic vehicle seat belt release system according to claim 1, wherein said fastening arrangement comprises:
   an upper portion which comprises means for coupling with the seat belt fastening element, and which further comprises locking element; and
   a lower portion anchored to the anchor location, and having means for lockably engaging said locking element of said upper portion,
   wherein said release means comprises means for detaching said upper portion from said lower portion, thereby to release said seat belt from said lower portion of said fastening arrangement, and thus to disassociate the seat belt from the anchor location.

3. An automatic vehicle seat belt release system according to claim 2, wherein said release means comprises means which is operative, after said predetermined time interval, to generate a high pressure so as to forcibly separate said upper portion of said fastening arrangement from said lower portion thereof.

4. An automatic vehicle seat belt release system according to claim 3, wherein said release means comprises:
   a mechanism associated with said lower portion and normally having a first position in which said mechanism lockably engages said locking element of said upper portion, and
means for forcing said mechanism to move to a second position, thereby to permit disengagement therefrom of said locking element of said upper portion.

5. An automatic vehicle seat belt release system according to claim 4, further comprising resilient means arranged to normally urge said locking element out of engagement with said mechanism, wherein, when said mechanism moves into said second position, said resilient means is operative to cause said locking pin to withdraw from engagement with said mechanism of said locking pin, and thus to cause detachment of said upper portion of said fastening arrangement from said lower portion thereof.

6. An automatic vehicle seat belt release system according to claim 4, wherein said mechanism comprises:

   a cylinder containing a quantity of a combustible material;
   piston means located within said cylinder and having an actuating portion extending therefrom so as to protrude externally of said cylinder, and operative to move from a first position such that said locking element of said upper portion is locked, to a second position such that said locking element of said upper portion is released; and
   means for igniting said combustible material so as to cause an rapid increase in pressure inside said cylinder, thereby to drive said piston means within said cylinder, and thereby to move said piston means from said first position to said second position.

7. An automatic vehicle seat belt release system according to claim 6, wherein said actuating portion is operative to lockably engage said locking element when said piston is in said first position, and wherein movement of said piston to said second position causes disengagement of said actuating portion from said locking element and thus release thereby of said actuating portion.

8. An automatic vehicle seat belt release system according to claim 6, wherein said mechanism also includes additional means for lockably engaging said locking element, and wherein, when said piston means is in said first position, said means for lockably engaging is operative to lockably engage said locking element, and wherein, when said piston means is moved to said second position, it is operative to activate said means for lockably engaging so as to disengage and release said locking element.
9. An automatic vehicle seat belt release system according to claim 1, wherein said fastening arrangement comprises:

a housing;

spring-biased locking means for selectably locking the seat belt fastening element; and

manual means for selectably disengaging said spring-biased locking means from said seat belt fastening element,

wherein said release means comprises means for automatically activating said spring-biased means so as to disengage from said seat belt fastening element.

10. An automatic vehicle seat belt release system according to claim 9, wherein said spring-biased locking means comprises a seat belt fastener engagement member having a locking tongue protruding laterally therefrom which, when said engagement member is at rest position, is operative to be in a position of locking engagement with a portion of said seat belt fastener engagement element, and which, when subjected to a predetermined lateral force component such that said engagement member is forced to move laterally, said locking tongue is retracted from said position of locking engagement, thereby releasing said seat belt fastener engagement member.

11. An automatic vehicle seat belt release system according to claim 10, wherein said release means comprises:

a cylinder containing a quantity of a combustible material;

piston means located within said cylinder and having an actuating portion extending therefrom so as to protrude externally of said cylinder, and operative, in response to a pressure increase caused by ignition of said combustible material, to extend from said cylinder so as to act on said engagement element so as to cause retraction of said locking tongue from said position of locking engagement, thereby to release said seat belt fastener engagement member.

be driven against said spring-biased locking means, thereby to cause retraction of when to move from an at rest position to a position such that said locking element of said upper portion is locked, to a second position such that said locking element of said upper portion is released; and

means for igniting said combustible material so as to cause said increase in pressure inside said cylinder.
FIG. 2

RELEASE MECHANISM

CAPACITIVE DELAY DEVICE

EVENT SENSOR

SUBSTITUTE SHEET (RULE 26)
# INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

- **IPC(6):** B60R 22/32
- **US CL:** 280/801.1; 24/602, 603

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

- U.S.: 280/801.1, 806; 24/602, 603; 180/268, 282

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electro: data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>US 5,123,498 A (ALCIDI et al.) 23 JUNE 1992, see entire document.</td>
<td>1,9,10</td>
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<tr>
<td>X</td>
<td>US 4,920,619 A (BENDER et al.) 01 MAY 1990, see entire document.</td>
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<td>X</td>
<td>FR 2,366,030 A (MERLI et al.) 28 APRIL 1978, see the abstract and Figs. 1 &amp; 2.</td>
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<td>A</td>
<td>US 3,624,813 A (GAYLORD) 30 NOVEMBER 1971.</td>
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<td>US 3,963,090 A (HOLLINS) 15 JUNE 1976.</td>
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

<table>
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<th>Special categories of cited documents</th>
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<td>06 NOVEMBER 1996</td>
<td>19 NOV 1996</td>
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