PUSH BUTTON BUCKLE

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ABSTRACT

A push button buckle for use in a safety restraint system in combination with a mating tongue plate connector whereby only a small force is required to release the buckle from the mating connector even when the restraint system is in tension through the application of a load. The buckle comprises the conventional base, pivotally mounted latch lever, spring for biasing the latch lever to the locking position, and with the improvement comprising a first push button lever pivotally mounted adjacent one end and in contact with the latch member at its opposite end and a second push button lever also pivotally mounted at one end at a spaced apart location from the pivotal mounting of the first push button lever and overlaying the first push button lever, whereby the application of force on the second push button lever which is exposed through a cover of the buckle engages and pivots the first push button lever which moves the latch member to a release position and in which the first and second push button levers are so arranged and proportioned so as to provide a mechanical advantage to reduce the force required to release the buckle from the mating connector.

10 Claims, 10 Drawing Figures
PUSH BUTTON BUCKLE

BACKGROUND AND PRIOR ART

Push button buckles used in safety restraint systems, such as in automobiles, are entirely conventional and are now well known in the art. Many types of such push button buckles are in commercial application and use and function relatively satisfactorily. However, one problem involved with the prior art push button buckles is the release force required in order to disengage the mating connector, such as a metal tongue plate, from the buckle when the entire system is under load.

For example, the connectors of the safety restraint system are engaged to prevent an occupant of a vehicle from being thrown forward in the event of an emergency or a collision. As a result of such emergency, the vehicle may be turned upside down such that the entire weight of the occupant restrained by the system places all of the safety strap in considerable tension. It will be apparent that such tension creates a high frictional load between the latch member and the complementary metallic tongue plate such that the tongue plate is not easily released from the buckle. It will be obvious that subsequent to an accident as described above, it is highly desirable that the occupant may immediately release himself from the restraint system so that he may exit from the vehicle. To do so, it is necessary that the push button can be operated so as to effect the release and the force required to operate such push button cannot be excessive even when the entire system is under load since the physical condition of the occupant will not readily admit of his application of considerable force to effect the release.

It will be apparent that conditions may also arise subsequent to a collision in which the safety restraint system is under load, other than when the vehicle is inverted, such as when the vehicle seat has been forced forward relative to the safety belt fixed anchors, etc. The present invention is thus concerned with the not unusual problem of providing an easy release for a safety restraint system subsequent to an accident when the system is under load while still permitting a positive, secure, metal-to-metal connection between the buckle and the mating connector.

Under Motor Vehicle Safety Standard No. 209 of the National Traffic and Motor Vehicle Safety Act of 1966, the Federal government has promulgated certain regulations with respect to the maximum permissible release force of a push button type buckle used in a safety restraint system. This regulation, in effect, requires that release can be effected when the buckle is engaged to a mating connector and attached to safety belts while the loop is subjected to a tensile force of 75 pounds during application of the release load. The release load is applied on the buckle in a manner and direction typical of those which would be employed by a seat belt occupant. The force shall be applied at least 0.125 inch from the edge of the push button access opening of the buckle in a direction that produces maximum releasing effect.

This requirement, when considered in connection with the other requirements of the Federal government with respect to the tensile load that the buckle must be able to withstand during the emergency condition and with the other requirements with respect to providing a positive and secure locking engagement between the buckle and the mating connector, requires that the push button assembly be provided with considerable mechanical advantage in order to meet the standard.

SUMMARY OF THE INVENTION

In view of the above-stated requirements for the release capability of a push button type of safety restraint system buckle, it is an object of the present invention to provide a push button buckle for a safety restraint system having an improved push button assembly which permits release of the buckle and mating connector when the system is under load, with a low applied release force. It is another object to provide an improved buckle in which the push button assembly incorporates a mechanical advantage that permits the low release force requirement to be met while maintaining the structural integrity of the safety restraint system during operation.

Generally, the present invention provides a push button buckle for use in a safety restraint system comprising a buckle frame including a base and a pair of standing sidewalls, a latch member including a dog element for operative engagement with an opening in a mating tongue plate supported above the base and movable toward and away from the base from an operative to a release position, respectively, a spring biasing the latch member dog element toward said base, and an improved push button means including a first push button lever pivotally mounted to the buckle frame at one end and in operative engagement with the latch member at its opposite end, a second push button lever pivotally mounted at its end at a spaced apart location from the pivotal mounting of the first push button lever and overlying the first push button lever, the first and second levers being arranged and proportioned so as to provide a greater mechanical leverage than the mechanical leverage of the first push button lever alone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a push button buckle constructed in accordance with the present invention;
FIG. 2 is a top plan view of the push button buckle shown in FIG. 1 with the cover shown in phantom lines;
FIG. 3 is a side elevation view of the buckle as shown in FIG. 2;
FIG. 4 is a cross sectional view of the buckle showing the mating tongue plate in engagement;
FIG. 5 is a view as in FIG. 4 showing the push button depressed;
FIG. 6 is a perspective view of the second push button lever;
FIG. 7 is a cross sectional view taken along the plane VII—VII of FIG. 4;
FIG. 8 is a cross sectional view taken along the plane VIII—VIII of FIG. 4;
FIG. 9 is a diagrammatic illustration of the forces involved in a single push button lever buckle; and
FIG. 10 is a diagrammatic illustration of the forces involved in a push button buckle constructed in accordance with the present invention.
BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, an exemplary embodiment of a safety belt buckle according to the present invention, shown generally at 20, and its mode of operation, will be explained in detail. The buckle is to be employed with a safety belt or strap of conventional form including a first strap 21 connected to the buckle (see FIG. 2) and a second strap 22 secured to a tongue plate 23 of conventional construction having shoulders 24 to provide an insertion stop limit for the tongue plate into the buckle and a tongue plate opening 25 having an abutting wall 26 for purposes to be explained more fully hereinafter. The seat straps 21, 22 are attached to the floor or frame of a vehicle in any well known manner so as to be positioned on each side of a passenger or occupant riding in a vehicle, when used as a conventional seat belt that circumscribes the lap of the occupant. Of course, the present invention may also be used in a three-point safety restraint system that is well known in the art. It would also be understood that the tongue plate 23 is merely exemplary and other types of tongue plates, fabricated of metal, having an abutment wall may be used in conjunction with the push button buckle of the present invention.

The exemplary form of the push button buckle, indicated generally at 20, comprises a frame indicated generally at 30, a latch member indicated generally at 40, spring means indicated generally at 60, improved push button means indicated generally at 70, and a cover indicated generally at 90.

The buckle frame 30 includes a base 31 having an opening 32 through which the safety strap 21 may be inserted into the buckle. The frame 30 also includes a pair of upstanding sidewalls 33, 34 each of which has an elongated opening, such as openings 35 shown in sidewall 34 positioned above he opening 32 in base 31. The safety strap 21 passing through the opening 32 is provided with an adjustable loop that receives a knurled bar 36 having end portions which are received in the openings, such as opening 35, in the sidewalls 33, 34 and thus interconnect the strap 21 with the buckle 20. Such construction is entirely conventional and other frame constructions may be employed to perform the same function.

Latch means 40 is pivotally supported in the frame 30 for securing the tongue plate 23 within the buckle. In the exemplary embodiment, such latch means comprises a latch member having a first planar portion 41 (see FIGS. 4 and 7) and a second planar portion 42 integral with the first portion and disposed at an obtuse angle to the first planar portion 41. The second planar portion 42 includes a dog element 43 which projects downwardly toward the base 31 of the frame 30 for locking engagement with the abutment wall 26 of the tongue plate 23. At the junction of the two planar portions 41, 42 the latch member is provided with stub axles 45, 46 (see FIG. 8) which are received in openings 45, 46 in the sidewalls 33, 34 of the frame 30 for pivotal movement of the latch member. As may be seen in FIG. 4, when the tongue plate 23 is engaged through the forward end of the buckle frame, the rearward edge of the dog element 43 will be in abutting contact with wall 26 on the tongue plate to prevent the tongue plate from being withdrawn when the belt is under tension. It will also be apparent that when the tongue plate is forced to the right, as viewed in FIG. 4, as when the belt is under tension due to the presence of a load such as in the aforesaid described inverted vehicle condition, there will be metal-to-metal contact between the abutment wall 26 and the dog element 43 rearward edge. To withdraw the tongue plate allowing the passenger to release himself from the safety restraint system, the latch member 40 must be pivoted to the release position as shown in FIG. 5 by the push button means 70 in a manner to be described. To pivot the latch member 40 to the release position, the frictional force between the abutment wall 26 and the edge of the dog element 43 must be overcome. The required release force for the buckle is thus determined by the frictional force which resists pivotal movement of the latch member and the mechanical advantage of the buckle.

The latch member 40 and the dog element 43 is normally biased into the engaging position by spring means 60, which in the exemplary embodiment, may comprise a pair of flat leaf springs 61, 62. The forward ends of the springs 61, 62, as seen best in FIGS. 4 and 5, are bent into an arcuate shape about a spring pin 63 that is connected at its opposite end in suitable openings at the forward edge of the frame sidewalks 33, 34, as seen in FIG. 3. It will be apparent to those having skill in the art that the spring herein disclosed is exemplary and other spring or biasing means may be employed to urge the dog element 43 on the latch member 40 towards the base and into the operative position. The improvement of the present invention is particularly directed to the push button means 70. In the exemplary embodiment, and with particular attention to FIGS. 4 and 5, it will be seen that the push button means 70 comprises a first push button lever 71 which is pivotally mounted adjacent one end on a lever pin 72 that is transversely supported between the sidewalks 33, 34 of the buckle base. The lever pin 72 is mounted intermediate the fore and aft ends of the buckle 20. The end 73 of the lever 71 opposite the end which is pivotally mounted, as seen best in FIGS. 4 and 5, is in engagement with the forward end of the first planar portion 41 of the latch member 40. The first push button lever 71 is also provided with a central opening for reasons to be explained more fully hereinafter. Intermediate the ends of the first push button lever 71 there is provided a transversely extending upwardly directed projection 75 for reasons that will also become clear. It should also be noted that the spring pin 63 provides a stop limit for upward pivotal movement of the lever 71.

The push button means 70 also includes a second push button lever 80, seen best in FIG. 6, having a pair of arcuately shaped ears 81 at one end for mounting on the spring pin 63 as seen best in FIGS. 4 and 5. The push button lever 80 includes a singular raised portion 82 and is provided at the end opposite its pivotal end with a pair of stop tabs 83 which project transversely of the buckle longitudinal axis and which extend into the opening 74 in the first lever and beneath such lever as to limit the upward pivotal movement of the second lever. As seen best in FIG. 5, an intermediate portion 84 of the second push button lever 80 engages the upwardly extending projection 75 on the first push button lever.
It should also be noted that the springs 61, 62 which bias the latch member into the operative position also bias the first and second push button levers 71, 80 to their fully raised position. Upon depression of the levers so as to actuate the latch means and release the tongue plate, the bias of the springs are overcome and the levers will be returned to their normal position when the force is withdrawn from the second push button lever.

The push button buckle of the present invention also includes the cover 90 which includes a top wall 91 having an opening 92 which overlies the finger engaging portion 98 of second push button lever 80. The cover also includes a rear wall 93 and a front wall 94 having a slot 95 through which the tongue plate 23 is inserted. The cover also includes sidewalls 96, 97 and thus the operating elements of the buckle are entirely enclosed except for the finger engaging portion of the uppermost push button lever. It will be apparent to those skilled in the art that various types of covers may be employed with the push button buckle of the present invention.

Referring now to FIGS. 9 and 10, the advantages to the construction of the present invention may be appreciated by comparison of a single lever push button buckle with the construction of the present invention. FIGS. 9 and 10 comprise force diagrams of an exemplary buckle such as that illustrated; FIG. 9 represents the forces with a single push button lever 71 and the latch 40 and FIG. 10 represents the forces with a first push button lever 71, a second push button lever 80, and the latch 40. In the figures:

- \( F_1 \) = application force
- \( F_2 \) = force applied to latch member
- \( F_3 \) = force at end of latch member engaging tongue plate
- \( F_4 \) = force applied to second push button lever by first push button lever

The dimension \( a \) represents the distance between the pivotal axis of the first push button lever 71 and the free end thereof which engages one end of latch member 40. The dimension \( c \) represents the distance between the pivotal axis of latch member 40 and the end thereof which engages the abutment wall 26 of the tongue plate 23. The dimension \( d \) represents the distance between the pivotal axis of the latch member and the end of the latch member which engages the free end of the first push button lever 71. The dimension \( b \) represents the distance between the pivotal axis of the first push button lever 71 and the point of application of force which may be no closer to the edge of the opening 92 in the buckle cover 90 than 0.125 inches from the edge that will afford the maximum leverage. The dimension \( x \) is the distance between the pivotal axis of the second push button lever 80 and the point of application of force, such point being determined in the same manner as above explained. The dimension \( y \) represents the distance between the pivotal axis of the second push button lever 80 and the point of engagement between the first and second push button levers. The dimension \( z \) represents the distance between the pivotal axis of the first push button lever 71 and the point of engagement between the first and second push button levers. In a typical buckle construction having the proportions represented in the drawings of the present application which are approximately to scale, the dimensions referred to above are:

\[
\begin{align*}
  a &= 1.10 \\
  b &= 0.77 \\
  c &= 0.23 \\
  d &= 0.65
\end{align*}
\]

\[
\begin{align*}
  x &= 0.84 \\
  y &= 0.43 \\
  z &= 0.66
\end{align*}
\]

The release force, \( F_3 \), may be found as follows:

\[
F_3 = \frac{F_1 \times (d)}{c}
\]

Since \( F_2 = \frac{F_1 \times (b)}{a} \)

Then, \( F_3 = \frac{F_1 \times (d)}{c} \times \frac{1}{(a) \times (c)} \)

Substituting, \( F_3 = (F_1 \times 0.77 \times 0.65) / (1.10 \times 0.23) = \frac{0.5005}{0.2530} F_1 \)

Thus, the release force, \( F_3 \), is approximately equal to twice the application force \( F_1 \). Turning now to FIG. 10, it will be seen that:

\[
F_3 = \frac{F_1 \times (d)}{c}
\]

\[
F_4 = \frac{F_1 \times (x)}{y}
\]

Then, \( F_5 = \frac{F_1 \times (x) \times (z) \times (d)}{(a) \times (y) \times (c)} \)

Substituting, \( F_5 = F_1 (0.84 \times 0.66 \times 0.65) / (1.10 \times 0.43 \times 0.123) = F_1 (3.6036) / (0.10879) \)

Thus, it will be seen that the release force, \( F_3 \), is more than three times greater than the application force \( F_1 \). It will be apparent to those having skill in the art how the buckle of the present invention operates and it will be seen that through the arrangement of the first and second push button levers in the proportions which are represented approximately to scale in the drawings, there is provided a greater mechanical advantage or leverage with the push button construction of the present invention compared with a single push button lever construction. Various modifications and amendments will also be apparent to those having skill in the art without departing from the scope of the invention.

I claim:

1. A push button buckle for use in a safety restraint system comprising:
   a frame including a base and upstanding sidewalls,
   a latch member including a dog element supported above said base and movable toward and away from said base,
   a spring biasing said latch member dog element toward said base,
   a first push button lever pivotally mounted to said frame at one end and in operative engagement with said latch member at its opposite end, and
   a second push button lever pivotally mounted at one end at a spaced apart location from the pivotal mounting of said first push button lever and overlying said first push button lever,
   said first and second levers being arranged and proportioned so as to provide a greater mechanical advantage than the mechanical advantage of said first push button lever alone.

2. The buckle of claim 1 wherein said latch member is pivotally mounted adjacent one end, said dog element being positioned away from said pivotal mounting toward said adjacent end, the other end of said latch member engaging said first button lever whereby depression of said first lever pivots said latch member so as to move said dog element away from said base to a release position.
3. The buckle of claim 2 wherein said second push button lever is pivotally mounted adjacent the engaging ends of said latch member and said first push button lever.

4. The buckle of claim 3 wherein said spring biases said push button levers to the raised normal position.

5. The buckle of claim 1 wherein an intermediate portion of said first push button lever engages an intermediate portion of the second push button lever.

6. The buckle of claim 5 wherein said first push button lever includes an upwardly extending projection for engagement with said second push button lever.

7. The buckle of claim 1 wherein said first lever is pivotally mounted intermediate the ends of said frame and said second lever is pivotally mounted at the end of said frame.

8. The buckle of claim 7 wherein said second lever is pivotally mounted on a pin transversely supported by said frame upstanding sidewalls, said pin providing a stop for upward pivotal movement of said first push button lever.

9. The buckle of claim 8 additionally including a buckle cover releasably secured over said frame and having an opening for access to said second push button lever, said second push button lever having a tab extension for engagement with the lower surface of said first push button lever.

10. In a push button buckle for use in a safety restraint system including a frame having a base and upstanding sidewalls, a latch member having a dog element for locking engagement in an opening of a mating tongue plate, said latch member being pivotally mounted between said sidewalls for movement of said dog element toward and away from said base, a spring biasing said latch member dog element toward said base, and a cover over said frame having an opening, the improvement comprising: a first push button lever pivotally mounted adjacent one end and in engagement with said latch member at its opposite end, and a second push button lever pivotally mounted adjacent one end at a spaced apart location from the pivotal movement of said first lever, overlying said first lever and beneath said cover opening, the intermediate portions of said first and second levers being in engagement.

* * * * *