

A method to safely restrain occupants in a crashing vehicle and a seat constructed to perform said method.

The present invention relates to a method to safely restrain occupants in a crashing vehicle, and a seat constructed to perform said method. In a closer aspect the invention relates to a technique to obtain a safe and gentle restraintment of passengers/driver by using a safety belt integrally with the chair.

The advantages of being restrained by a safety belt to avoid injuries in a crashing car are well known. However there are a few problems how the safety belts protect the occupants. There are also problems to arrange an attachment of the safety belts in a limited space, e.g. in mini buses and in public transportation.

The use of safety belts when going by public transportation involves problems regarding a safe attachment of the safety belts in the vehicle/the seat. An attachment in the seat of the type used to-day must involve a rigid and voluminous construction which will occupy some of the useful space in the vehicle. An attachment outside the chair must have rigid points of attachment also occupying some of the useful space in the vehicle and postulate a great strength of the vehicle's walls and floor. Other claims to the attachment of the safety belts in the vehicle are that they by no means shall increase the risk of injuries on other passengers.

DE-A-2 546 157 discloses a back rest at a vehicle seat with a built in safety belt, the back rest being resiliently collapsible while bending in its transverse direction. This construction cannot absorb any greater loads and is seemed to be very dangerous at crashes over 30 km/h. Thus at greater loads the resiliency being obtained comes suddenly to an end and the created shock is believed to be fatal for an occupant using the belt.

US-A-4 993 778 discloses a seat construction with an integral safety belt. The attachment of the belt is secured outside the seat. This construction is not made to accumulate the loads in a crash.

WO 9014245 is one example of a seat construction being extremely solid. In a crash with this construction there is nothing making a gentle, progressive restraintment of the occupant possible. This document is one example of a voluminous and heavy construction without refinements. The same can be said about EP-0 590 237 in which an effort has been made to get a slim construction. However the construction is very complex and probably rather heavy.

The object of the present invention is to obtain a technique admitting the arrangement of a safety roll belt integrally with a seat in a vehicle, wherein a light and not voluminous seat body is capable of accumulating great loads in a crash by

a beneficial distribution of the actual load from the belt, and at the same time with a resiliency and maybe a permanent deformation, at first at the back rest of the seat, and later at its passage to the lower seat portion. In the load from a crash there is also a 5 to 10 % extension of the belt, and this extension can, together with the deformation of the back rest of the seat, contribute to a gentle restraint of the occupant. Surprisingly the existing deformations contribute to decrease the injuries from a whip lash effect on the occupants.

According to the present invention this is obtained by a method and by a device having the characterizing clauses mentioned in the claims.

In a crash the kinetic energy of the occupants is restrained by the safety belts and by a cooperating resiliently deformable double tube frame construction in such a way that during a modest load the upper portion of the double tube frame construction will move resiliently, but at a greater impact or load a permanent deformation of the double tube frame construction will occur at the same time as the resilient movability, also at a permanent deformation, will contribute in bringing the occupant back towards the back rest of the seat by a resilient back transfer of an upper portion of the double tube frame construction. Surprisingly it has been shown that the loads on the neck portion of the occupant, and whip-lash injuries, will be decreased compared to the same restraint of an occupant in a conventional safety belt in a seat having the belt attached outside of the seat. To some extent this beneficial effect can be explained by the braking effect on the occupant being dynamic in such a way that at first the belt is stretched during a simultaneous progressive dampening by the resiliency in the upper portion of the tube frame at the back rest. When this happens the permanent deformation will occur, but not at that part of the double tube frame construction where the resilient movability takes place. Thus this resiliency is still there and can meet the occupant at a jerk backwards to slow down the speed of the head.

At higher speeds there will be a phase where a deformation of the bent portion of the parallel tube construction (at the passage from the back rest to the seat). At the same time, or a little later (in dependence of the type of the vehicle - e.g. a city bus or a tourist bus - it is possible to start an energy accumulating deformation of the brackets on the floor usually used to attach the seat construction to the floor of the vehicle. By a suitable dimensioning and choice of material a very gentle slowing down of the occupants can occur during a maximal resilient and permanent deformation of all the deformation zones.

Thus according to the present invention there is possible to manufacture seats being specially adapted to children and school-buses in such a way that some of the seats are made for children with a weight up to e.g. 20 kg; other seats for

children up to e.g. 20 - 30 kg; etc. Hereby the safety for all the occupants can be increased. It is of course possible to use a technique according to the invention at family cars too. Thus the dimensioning and form of the seat is not made only with regard to the weight of the body, but also to the length, the corpulence, and to the length ratio between body/legs.

Accordingly the present invention discloses a device to perform a gentle restraintment of the occupants/driver by a safety belt being attached at the seat of the vehicle. This device is characterized in

a seat frame with a seat portion and a back rest portion (B;A) being made of a parallell tube arrangement where two tubes (1, 2) are arranged above/under and forward/behind eachother at the seat portion (B) and at the back rest portion (A) respectively up to a position at the breast (D) of an occupant, above said position the tubes are twisted to a position side by side, and in

reinforcing, deformable form plates (12) rigidly arranged between the parallell tubes (1, 2), at least at the seat portion (B) and at the lower portion of the back rest (A).

This construction saves valuable space, preferably at public transport vehicles having several rows of seats in front of each other, at the same time as the weight can be kept rather low.

The invention will now be described in connection to embodiments shown in the drawings, where;

Fig. 1 is an oblique front pictorial view of a seat body principally comprising a parallell tube frame arrangement according to the invention;

Fig. 2 is an oblique front pictorial view from above of the seat body according to fig. 1;

Fig. 3 is an oblique front pictorial view from above of the seat body with reinforcing plates and with a covering back;

Fig. 4a and Fig. 4b show diagrammatically how the seat body, comprising a parallell tube frame arrangement, will act during influence from a load;

Fig. 5a and Fig. 5b is an oblique front pictorial view and an oblique back pictorial view, respectively of a complete vehicle seat built on a seat body/-construction according to the invention.

Fig. 1 discloses an oblique front pictorial view of a seat body principally comprising two parallel tube frame portions 1 and 2. The portions 1 and 2 are parallel from the lower seat member B to the back member A via a bent portion C. U-girders 3 and 4 are used for attaching in a bracket portion (not shown) being locked to the floor of the vehicle. A stabilizing plate 5 at the seat is attached to the tube frame portion 2. Approximately at the breast height - the position D in fig. 1 - the tube frame portions 1 and 2 are transferred - seen from below - from a position forward/behind each other to a position side by side (see also fig. 2). Two fastening means 8 and 9 connect the tube frame portions at the uppermost part of the seat body. In fig. 2 is shown how the tube frame portions 1 and 2 are separated from each other at said bent portion C.

A reinforcing plate 7 is arranged at the lower seat portion and will stiffen the seat body and increase its resistance to breaking. This is also the reason for using tubes with an oval cross section in the body. At the plates 6 and 7 there are also bent portions 6a (not visible) and 7a. These bent portions will connect to the oval cross section of the tube and will, together with an adjacent tube portion, form an arrangement for attaching a seat member.

In fig. 3 is shown how the space between the tube frame portions in connection to the bent portion C have been complemented with form plates 12 and 13. These form plates will form pairs 12a, 13a and 12b, 13b, respectively, said pairs being connected close to the tube frame portions 1 and 2. Preferably said pairs are clamped in a fit position. By having the form plates 12a, 12b at both sides - both from the outside and the inside - they can be connected by welding, or in a simpler way by bolts and nuts and/or by screws. A rear cover 10, e.g. glass fiber reinforced with a covering rear 11 will make the back rest of the seat. To said back rest the cushioned lower seat member (shown in fig. 5) will complete the seat.

Fig. 4a shows the position of the upper resilient elastic portion of the parallel tube arrangement in a not loaded position, while fig. 4b shows the same portion of the arrangement during load from a force F (from the safety belt in a crash). Here it is clearly shown how the tube portions cooperate when being placed side by side and also being exposed to a torsion at the passage from the lower position where the tube portions being placed behind each other. This torsion will probably contribute to the excellent characteristics helping to create a "soft" progressivity in restraining the occupant.

Finally fig. 5a and fig. 5b show an oblique front pictorial view and an oblique back pictorial view, respectively of a complete vehicle seat built on a seat body/-construction according to the invention.

The invention is not restricted to the shown embodiments but modifications can be made within the scope of the following claims.

**CLAIMS**

1. A method to obtain a safe and gentle restraintment of an occupant in a crashing vehicle by using a safety belt and a double tube frame construction forming the supporting body of the vehicle seat,

characterized in

that in a crash the kinetic energy of the occupant is restrained by said belt and by the cooperating resiliently deformable double tube frame construction in such a way that, at a moderate load, the upper portion of this double tube frame construction will move resiliently, and with a bigger load a permanent deformation will be the result in this double tube frame construction at the same time as the resilient movability in a phase of permanent deformation also can cooperate in bringing the occupant back to the back rest of the seat by a resetting elasticity of the upper portion of the double tube frame construction.

2. A method according to claim 1, characterized in

that the dimensioning and the choice of material for the components forming part of and connecting the parallel tube frame construction, and for the attachment of a bracket between the seat and the floor are made in such a way that a soft and gentle restraint is obtained for a probable crashing speed considering the weight of the body of the occupant.

3. A device to perform a gentle restraintment of the occupants/driver by a safety belt being attached to the seat of the vehicle, and to perform the method according to claim 1, characterized in

a seat frame with a seat portion and a back rest portion (B; A) being made of a parallell tube frame where two tubes (1, 2) are arranged above/under and forward/behind, at the seat portion (B) and at the back rest portion (A) respectively up to a height at the breast (D) of the occupant, and that the tubes are twisted above said position to a position side by side, and in

reinforcing, deformable form plates (12) rigidly arranged between the parallell tubes (1, 2), at least at the seat portion (B) and at the lower portion of the back rest portion (A).

4. Device according to claim 3, characterized in

that the deformable form plates (12) is so preshaped that they will make a close connection to the parallel tubes (1, 2) at the passage from the seat portion (B) to the back rest portion (A).



5. Device according to claim 3, characterized in that the tubes has an oval cross section to increase the bending resistance in a forward direction.

6. Device according to claims 3 - 5, characterized in that the deformable plates (12) two and two and from two sides are bearing on the parallel tubes (1, 2) and that the form plates are mutually attached to each other.

7. Device according to claim 3, characterized in that the safety belt is a three point belt, the upper attachment of which is made at the parallel tubes (1, 2).