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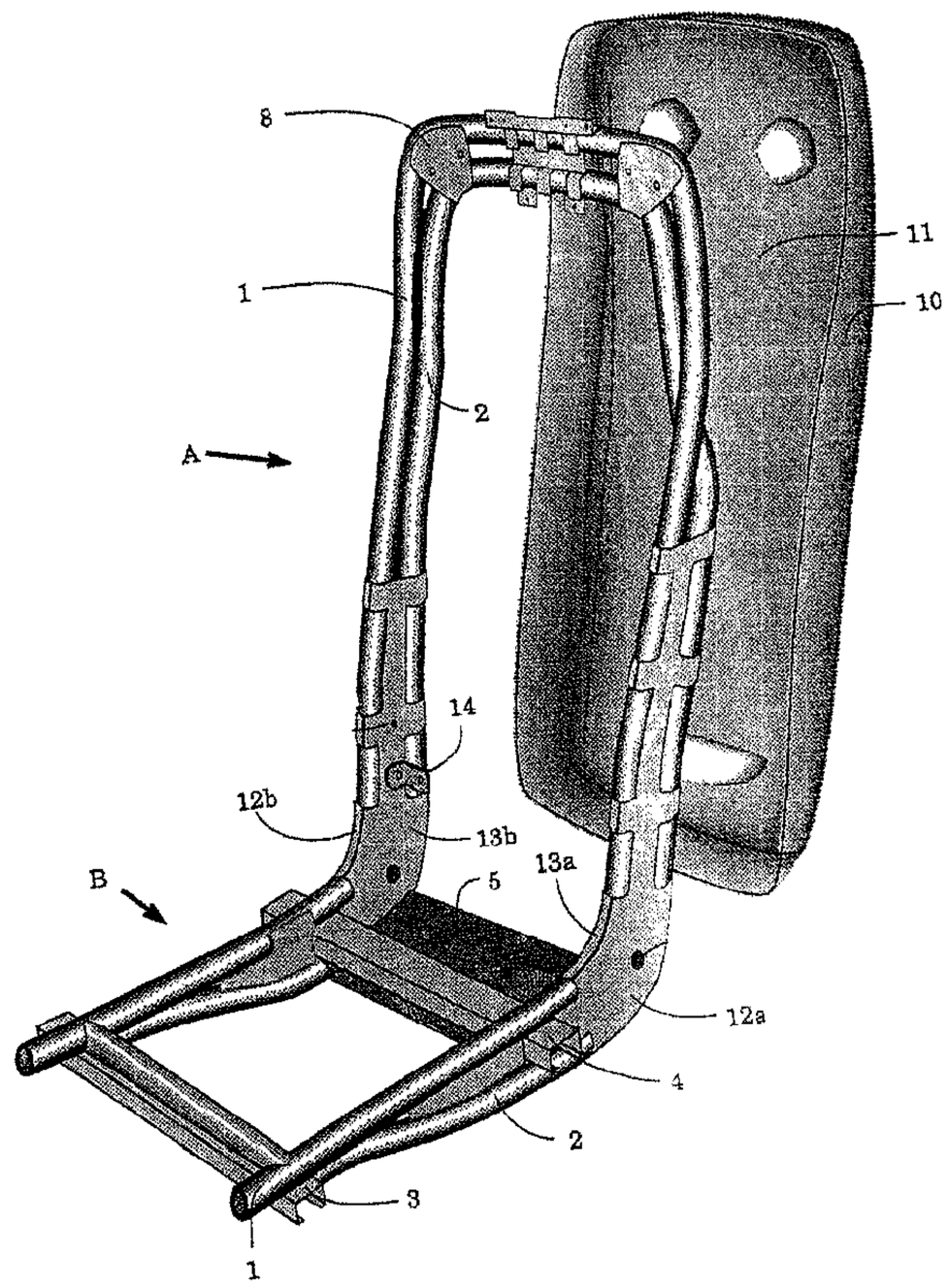
(54) Title: A METHOD TO SAFELY RESTRAIN OCCUPANTS IN A CRASHING VEHICLE AND A SEAT CONSTRUCTED TO PERFORM SAID METHOD



(57) Abrégé/Abstract:
The present invention relates to a method for a safe restrainment of occupants in a crashing vehicle using safety belts, and a double tube frame construction at the same time being a supporting body of the vehicle seat. The method is 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

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(57) Abrégé(suite)/Abstract(continued):
construction in such a way that, at a moderate load, the upper portion of this double tube frame construction will move resiliently, but with a bigger load a permanent deformation will be the result in said 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. The device is characterized in a seat frame with a seat portion and a back rest portion (B; A) being made of a parallell tube frame having two tubes (1, 2) 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 height to a position side by side, and in reinforcing, deformable form plates (12) rigidly arranged between the parallel tubes (1, 2), at least at the seat portion (B) and at the lower portion of the back rest portion (A).

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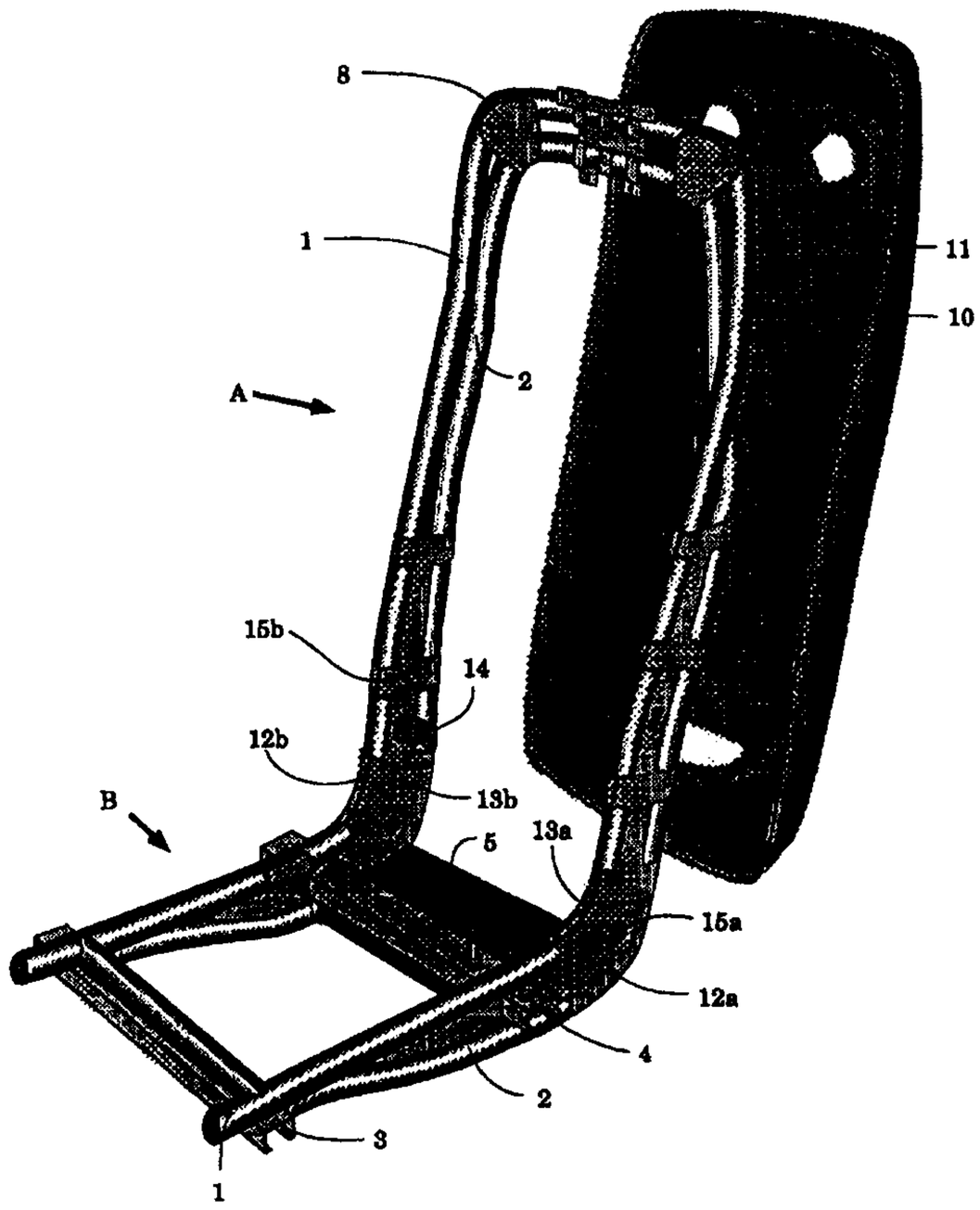
(57) Abstract

The present invention relates to a method for a safe restrainment of occupants in a crashing vehicle using safety belts, and a double tube frame construction at the same time being a supporting body of the vehicle seat. The method is 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, but with a bigger load a permanent deformation will be the result in said 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. The device is characterized in a seat frame with a seat portion and a back rest portion (B; A) being made of a parallell tube frame having two tubes (1, 2) 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 height to a position side by side, and in reinforcing, deformable form plates (12) rigidly arranged between the parallel tubes (1, 2), at least at the seat portion (B) and at the lower portion of the back rest portion (A).



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 restrainment 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 saftey 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 today 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 collapsable while bending in its transverse direction. This construction cannot absorb any greater

loads and seems 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 restrainment 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 restrainment of the occupant. Surprisingly the existing deformations contribute to decrease the injuries from a wip lash effect on the occupants.

According to the present invention this is obtained by a method and by a seat 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 wip lash injuries, will be decreased compared to the same restrainment 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, depending on 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 it 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 in 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 seat frame comprising two generally inverted-U-shaped tubes that are immediately adjacent to each other, said two tubes at a closed end of the inverted-U-shape defining an upper back portion of the seat, at a downwardly depending middle portion of the inverted-U-shape said two tubes defining a lower back portion of the seat, and at an open end of the inverted-U-shape said two tubes being bent relative to the middle portion so as to define a seat portion of the seat,

in said lower back portion, axes of said tubes being generally parallel to each other in a plane perpendicular to a plane of said lower back portion,

in said upper back portion, axes of said tubes being generally parallel to each other in a plane parallel to the plane of said lower back portion; and

at least two reinforcing, deformable plates, each of said plates holding said two tubes parallel to each other in said lower back portion.

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.

According to the present invention, there is also provided a seat for a vehicle, comprising:

a first continuous tube bent in an inverted-U-shape with a closed end that forms an upper back portion of the seat and with sides downwardly depending from the closed end that form a lower back portion of the seat, each end of said tube at an open end of the inverted-U-shape being further bent forward to form a seat portion of the seat;

a second continuous tube that is also bent into an inverted-U-shape and bent forward at each end to form the seat portion and that is immediately adjacent said first tube substantially throughout their lengths, said second tube being parallel to said first tube and directly behind said first tube at the lower back portion of the seat, said second tube being further bent forward above the lower back portion so that said second tube is directly

beneath said first tube and parallel to said first tube at the upper back portion of the seat; and

reinforcing, deformable plates holding said second tube directly behind and parallel to said first tube in the lower back portion,

whereby the upper back portion of the seat is elastically movable relative to the lower back portion by virtue of said second tube being directly beneath and parallel to said first tube at the upper back portion and the lower back portion of the seat resists elastic deformation by virtue of said second tube being directly behind and parallel to said first tube in the lower back portion.

According to the present invention, there is also provided a method of restraining an occupant in a seat in a decelerating vehicle, the method comprising the steps, during vehicle deceleration, of:

restraining an occupant facing forward in a seat in a decelerating vehicle with a seat belt attached to the seat at an upper back portion of the seat and to a seat portion of the seat, the seat having two generally inverted-U-shaped tubes that are immediately adjacent to each other, the two tubes at a closed end of the inverted-U-shape defining the upper back portion of the seat, at a downwardly depending middle portion of the inverted-U-shape the two tubes defining the lower back portion of the seat, wherein the two tubes are parallel to each other with one of the tubes being directly behind the other of the tubes at the lower back portion of the seat, and wherein the two tubes are parallel to each other with the one of the tubes

being directly beneath the other tube at the upper back portion of the seat;

elastically deforming the two tubes in the upper back portion of the seat under a strain of the attached seat belt on the upper back portion;

resisting permanent deformation of the two tubes in the lower back portion of the seat by holding the two tubes parallel to each other with the one of the tubes directly behind the other of the tubes with a reinforcing, deformable plate attached to the two tubes in the lower back portion of the seat.

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 parallel 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 parallel 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 portion 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 7a. These bent portions will connect to the oval cross section of the tube and will, together with a 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. 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.

WHAT IS CLAIMED IS:

1. A seat for a vehicle, comprising:

a seat frame comprising two generally inverted-U-shaped tubes that are immediately adjacent to each other, said two tubes at a closed end of the inverted-U-shape defining an upper back portion of the seat, at a downwardly depending middle portion of the inverted-U-shape said two tubes defining a lower back portion of the seat, and at an open end of the inverted-U-shape said two tubes being bent relative to the middle portion so as to define a seat portion of the seat,

in said lower back portion, axes of said tubes being generally parallel to each other in a plane perpendicular to a plane of said lower back portion,

in said upper back portion, axes of said tubes being generally parallel to each other in a plane parallel to the plane of said lower back portion; and

at least two reinforcing, deformable plates, each of said plates holding said two tubes parallel to each other in said lower back portion.

2. The seat of claim 1, further comprising at least one fastener joining said two tubes to each other in said upper back portion.

3. The seat of claim 1, wherein said two tubes have oval cross-sections.

4. The seat of claim 1, comprising two pairs of said plates, each of said pairs of plates holding said tubes.

5. The seat of claim 1, further comprising a seat belt fixedly attached to the seat at two places and removably attached to the seat at one place.

6. A seat for a vehicle, comprising:

a first continuous tube bent in an inverted-U-shape with a closed end that forms an upper back portion of the seat and with sides downwardly depending from the closed end that form a lower back portion of the seat, each end of said tube at an open end of the inverted-U-shape being further bent forward to form a seat portion of the seat;

a second continuous tube that is also bent into an inverted-U-shape and bent forward at each end to form the seat portion and that is immediately adjacent said first tube substantially throughout their lengths, said second tube being parallel to said first tube and directly behind said first tube at the lower back portion of the seat, said second tube being further bent forward above the lower back portion so that said second tube is directly beneath said first tube and parallel to said first tube at the upper back portion of the seat; and

reinforcing, deformable plates holding said second tube directly behind and parallel to said first tube in the lower back portion,

whereby the upper back portion of the seat is elastically movable relative to the lower back portion by virtue of said second tube being directly beneath and

parallel to said first tube at the upper back portion and the lower back portion of the seat resists elastic deformation by virtue of said second tube being directly behind and parallel to said first tube in the lower back portion.

7. The seat of claim 6, further comprising plural fasteners joining said first and second tubes at the upper back portion.

8. The seat of claim 6, further comprising a stabilizing plate fixedly connecting one portion of said first and second tubes to another portion of said first and second tubes across the seat portion of the seat.

9. The seat of claim 8, further comprising a cross bar fixedly connecting one end of said first tube to another end of said first tube across the seat portion of the seat.

10. A method of restraining an occupant in a seat in a decelerating vehicle, the method comprising the steps, during vehicle deceleration, of:

restraining an occupant facing forward in a seat in a decelerating vehicle with a seat belt attached to the seat at an upper back portion of the seat and to a seat portion of the seat, the seat having two generally inverted-U-shaped tubes that are immediately adjacent to each other, the two tubes at a closed end of the inverted-U-shape defining the upper back portion of the seat, at a downwardly depending middle portion of the inverted-U-shape the two tubes defining the lower back portion of the seat,

wherein the two tubes are parallel to each other with one of the tubes being directly behind the other of the tubes at the lower back portion of the seat, and wherein the two tubes are parallel to each other with the one of the tubes being directly beneath the other tube at the upper back portion of the seat;

elastically deforming the two tubes in the upper back portion of the seat under a strain of the attached seat belt on the upper back portion;

resisting permanent deformation of the two tubes in the lower back portion of the seat by holding the two tubes parallel to each other with the one of the tubes directly behind the other of the tubes with a reinforcing, deformable plate attached to the two tubes in the lower back portion of the seat.

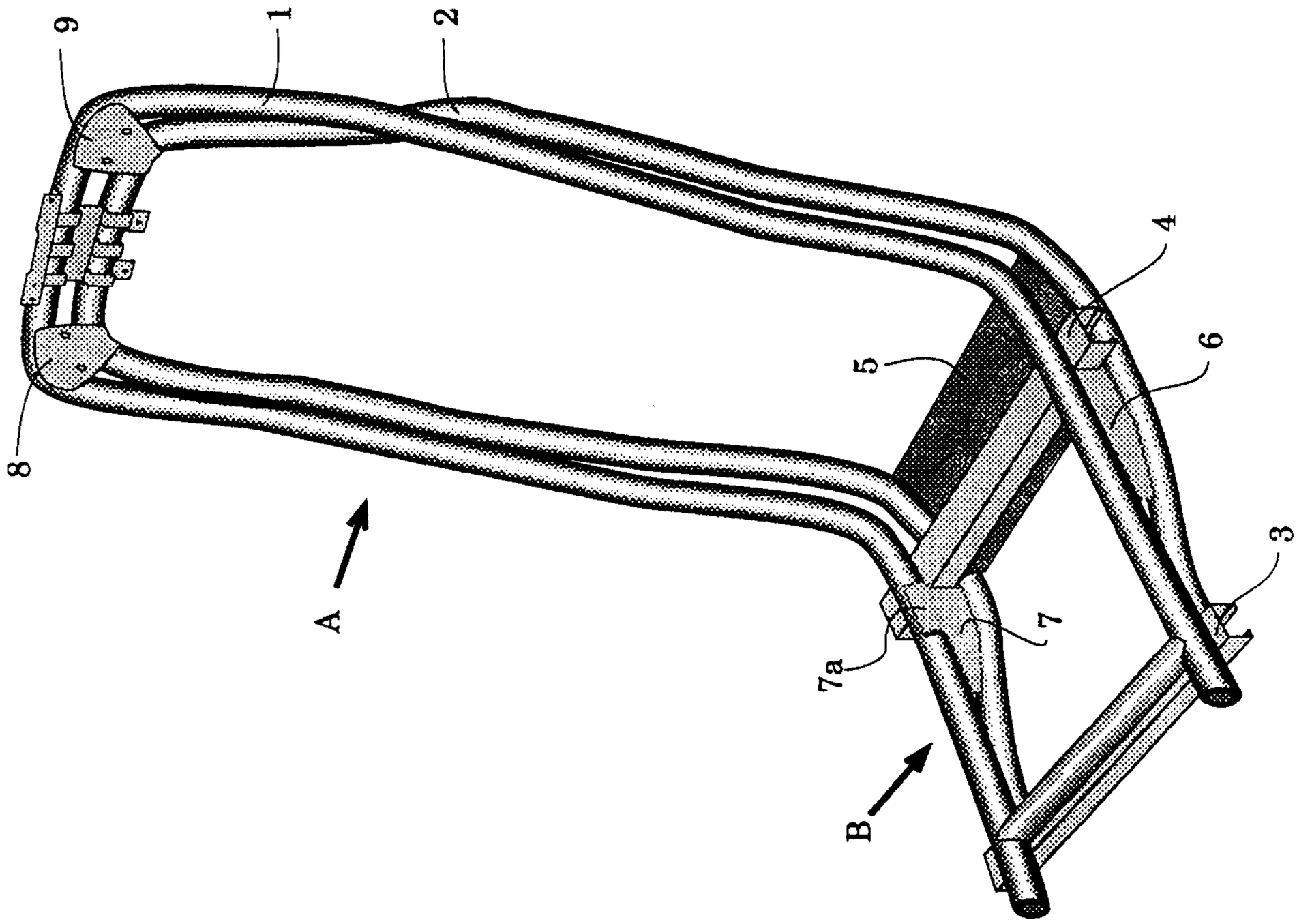


Fig.2

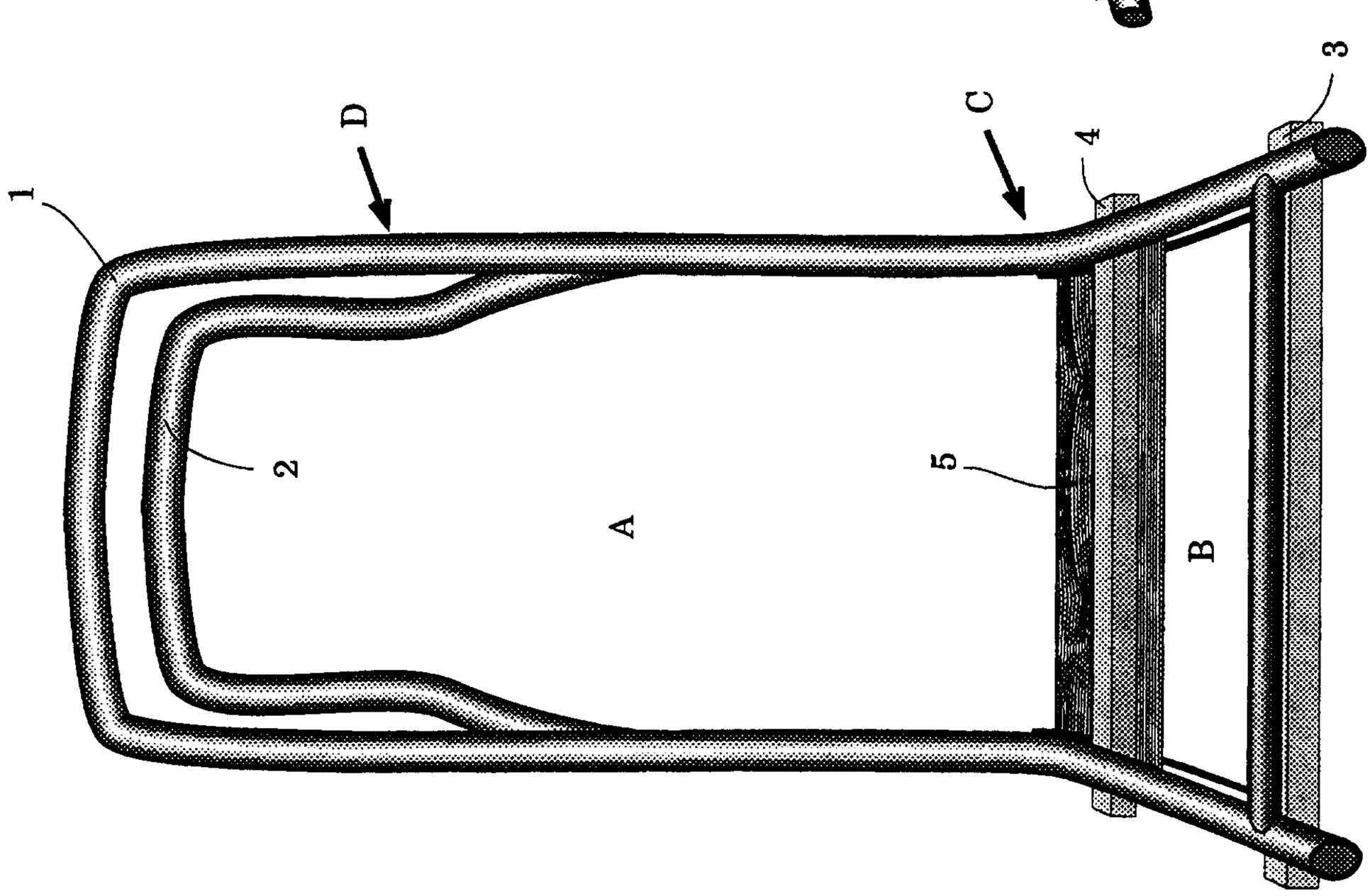
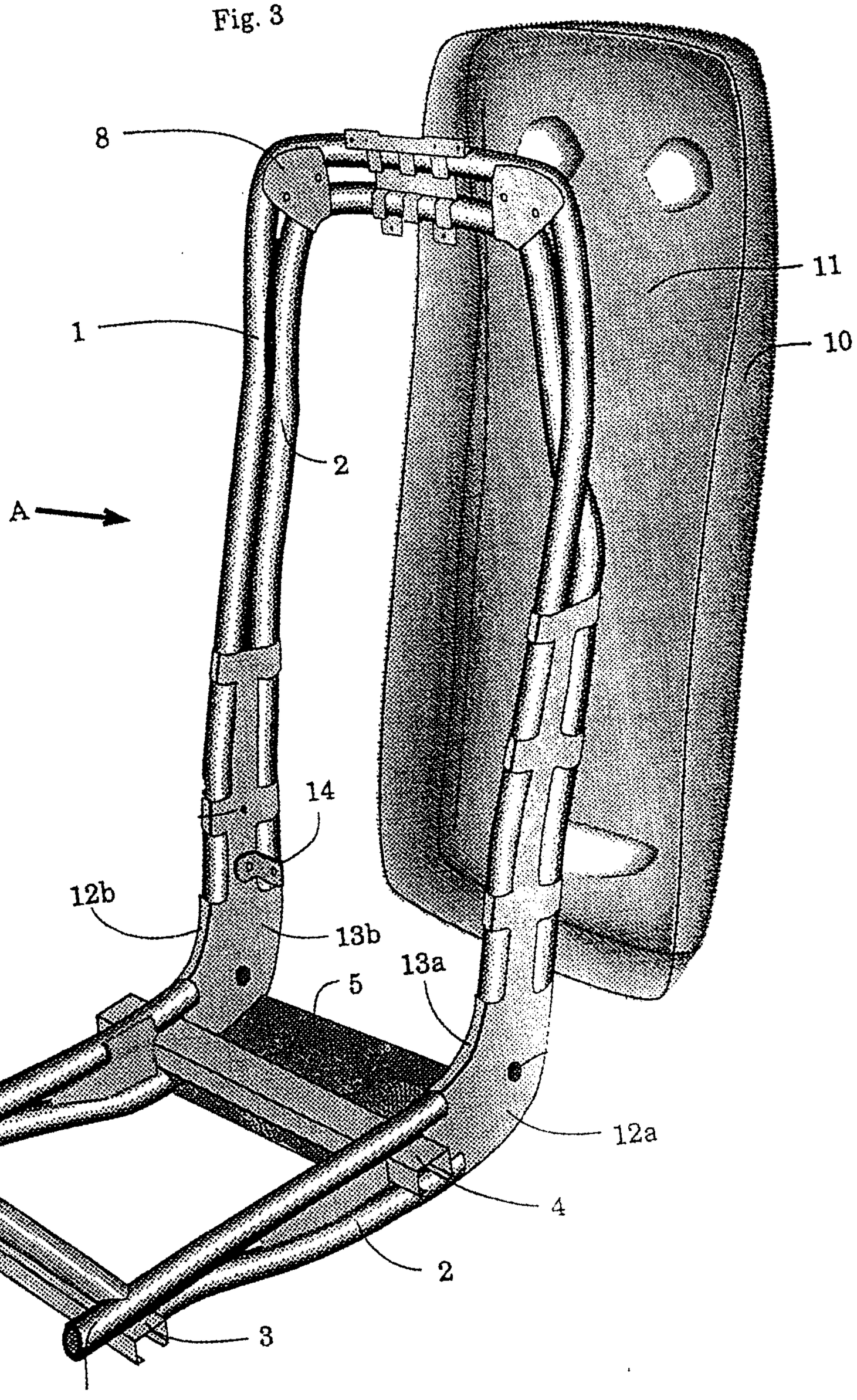


Fig. 1

Fig. 3



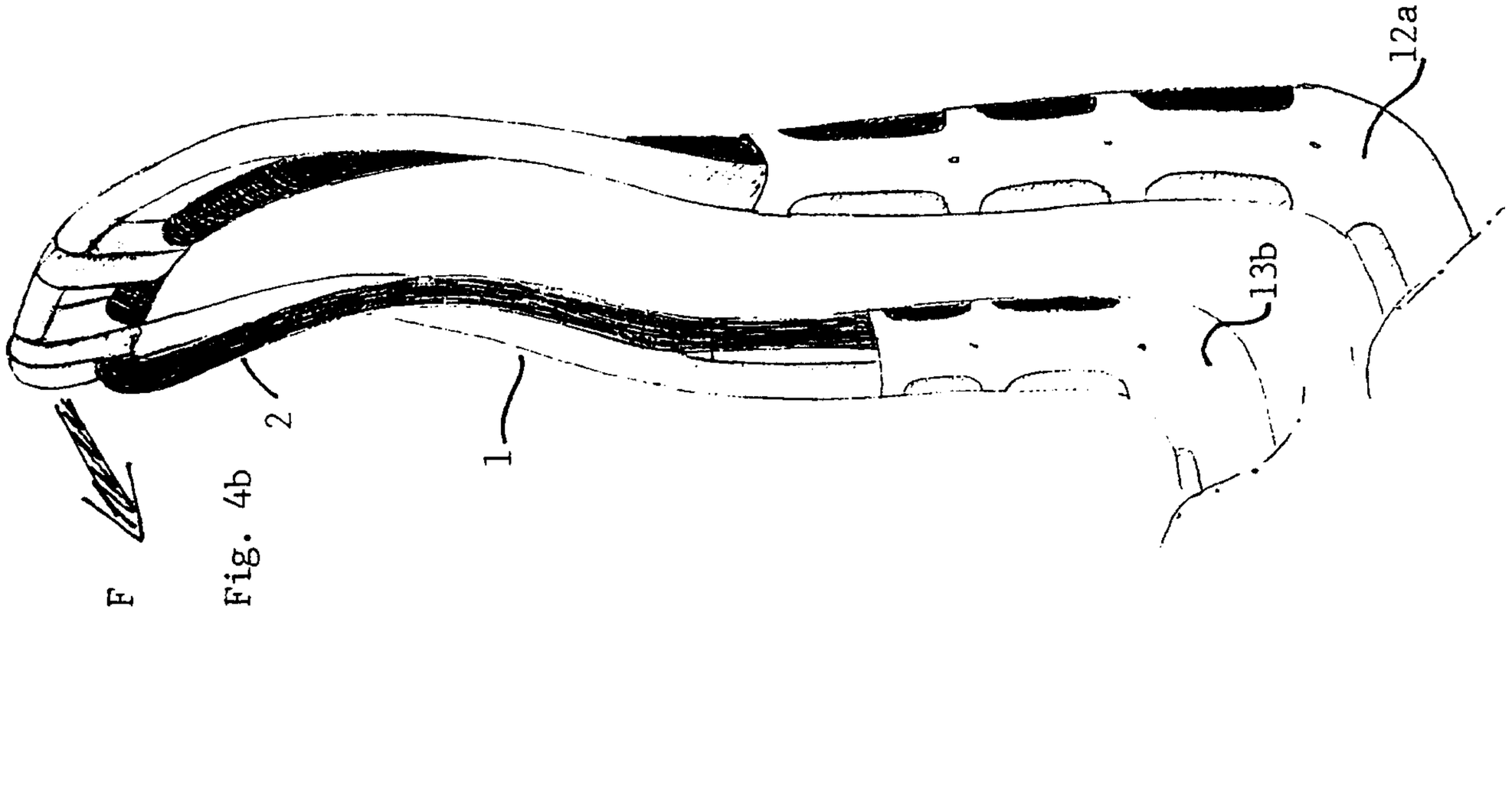


Fig. 4b

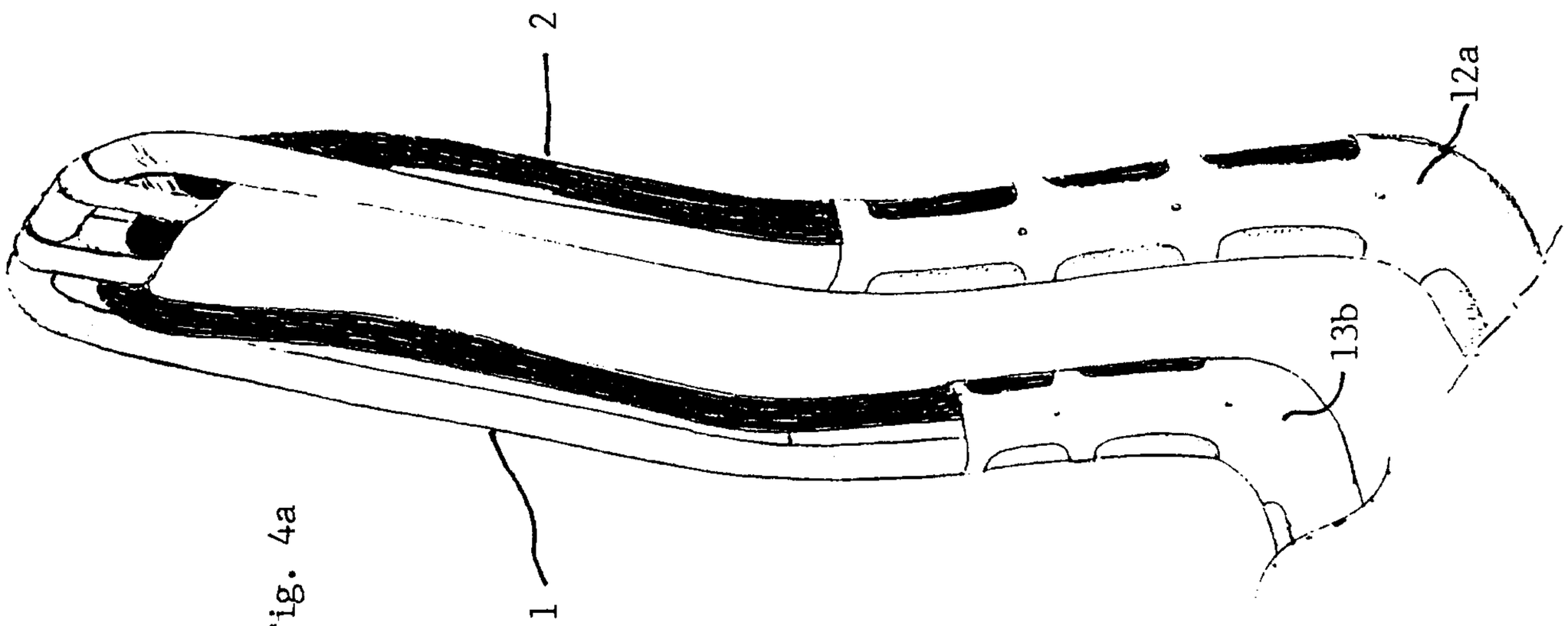


Fig. 4a

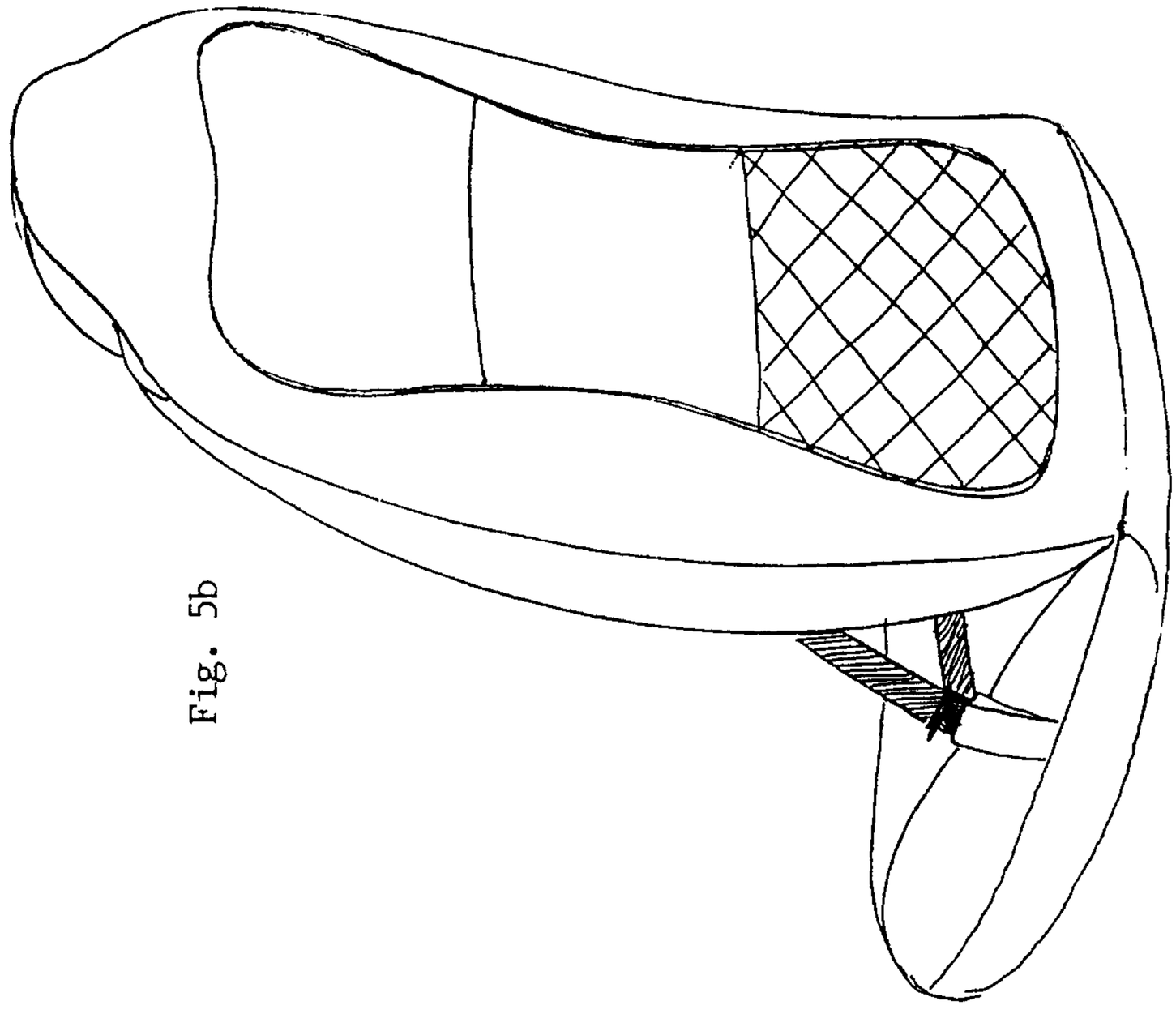


Fig. 5b

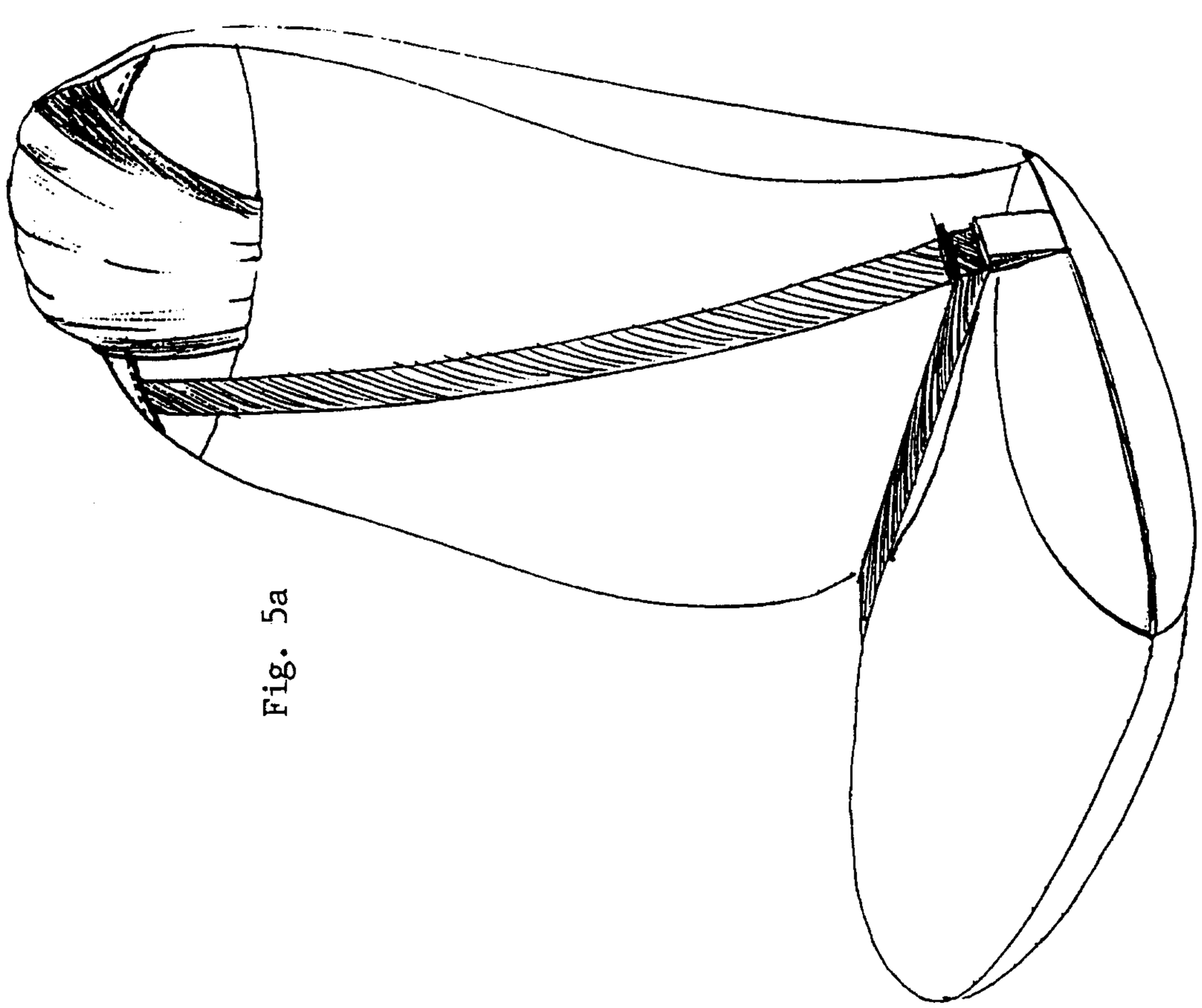
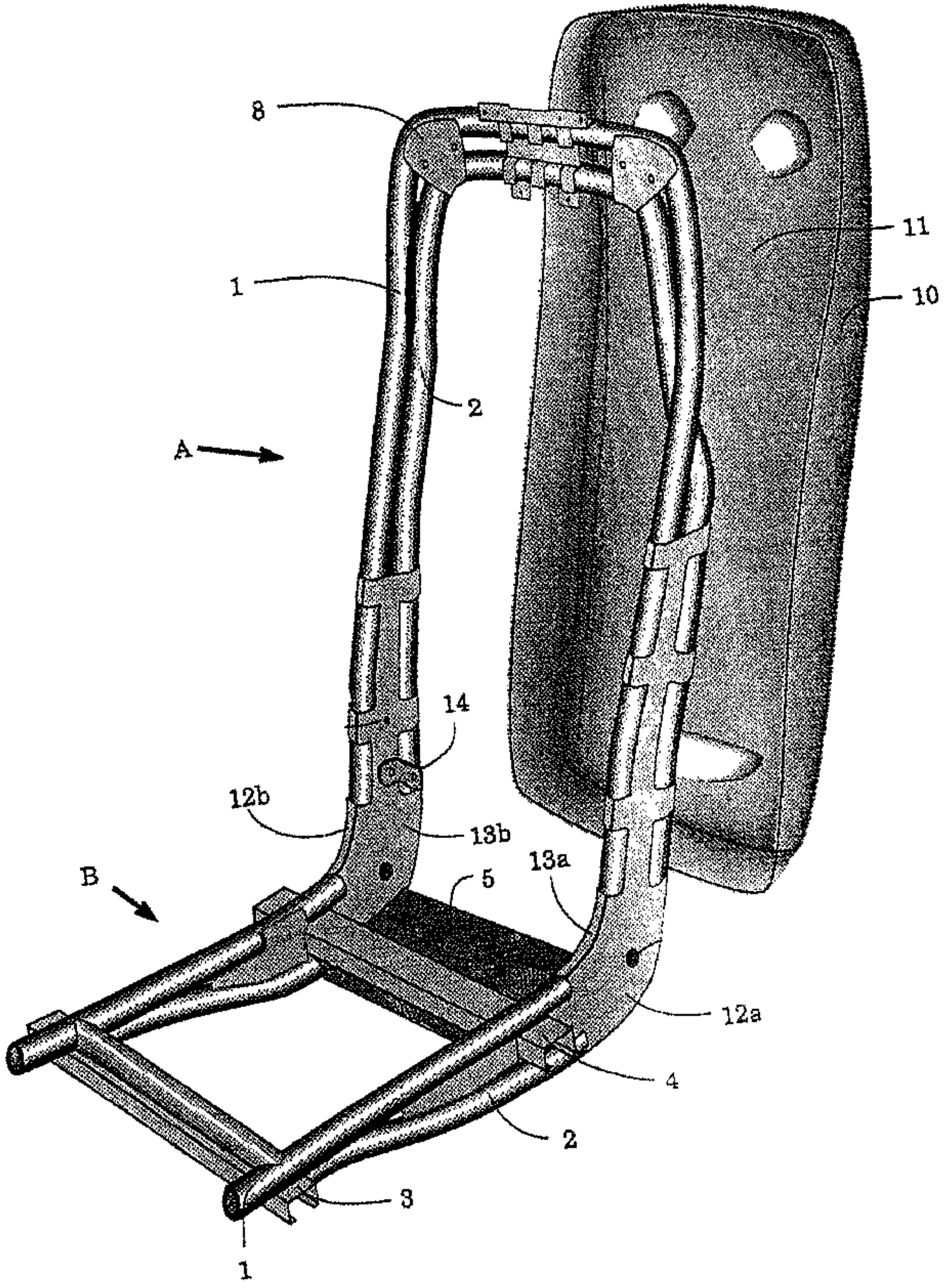


Fig. 5a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