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(56) Related Art

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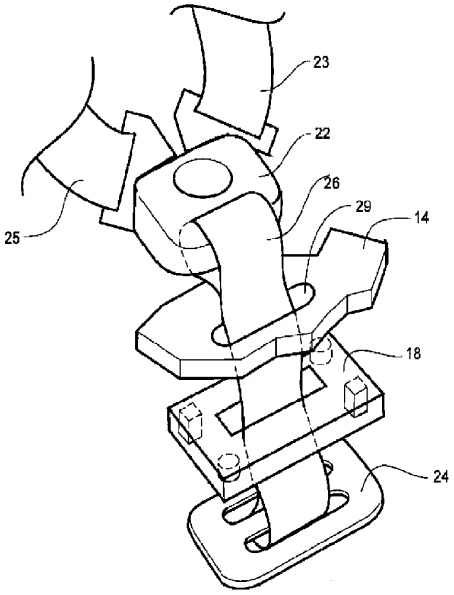
(54) Title: HARNESS TENSION SENSOR AND CRASH OCCURRENCE SENSOR



(57) Abstract: A child safety device for a vehicle including a seat including a shell (14), a harness including at least one strap (23,25,26) for retaining an occupant in the seat, and a sensor (18) between a device on the strap and the seat sheLI indicating a tension status of the harness.

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HARNESS TENSION SENSOR AND CRASH OCCURRENCE SENSOR

TECHNICAL FIELD AND BACKGROUND OF THE INVENTION

[0001] This invention relates to a harness tension sensor and related apparatus for a child safety seat. Child safety seats have a harness that includes a pair of shoulder straps that extend from the back rest of the seat across the shoulders of the seat occupant and a crotch strap that extends upwardly from the seat bottom to a point between the legs of the seat occupant. The shoulder straps extend downwardly and have latch members that interconnect with a latch affixed to the crotch strap that extends upwardly through a slot from below the seating surface. A tensioning strap extends through an opening in the front of the seating surface. When the shoulder straps are latched into the latch, the tensioning strap is pulled to place the shoulder straps in tension so that they fit securely against the anterior aspect of the upper torso of the seat occupant. Any significant slack in the shoulder straps can increase the risk of injury by subjecting the seat occupant to an initial rapid, unrestrained acceleration before the shoulder straps are tensioned by the forward movement of the seat occupant and bring the seat occupant to an almost instantaneous stop.

[0002] At present, child safety seats do not incorporate a reliable means to determine whether the shoulder straps have been properly tensioned. Some proposals for placing tension sensors in the latch or elsewhere require wiring in the crotch strap or in other locations in the seating area. This wiring may be subject to wear or exposure to moisture during use or cleaning, and thus may be less than fully desirable for use in situations, such as child safety seats, that should be cleaned periodically, or are subject to wetting from spilled drinks or other liquids.

[0003] Also, it may not be fully apparent in all cases that the shoulder straps have not been fully latched. Thus, inadequate tension on the shoulder straps may be the result of simple failure to sufficiently tighten the shoulder straps, or because the shoulder straps have not been properly latched. In the case of improper latching, the seat occupant is essentially unprotected in the event of an impact, since the latch members will exit the latch and prevent any significant tension at all on the straps during the initial phase of the impact.

[0004] In addition, present child safety seats to not provide a positive means of indicating that the seat has been subjected to a load of sufficient severity to require that the seat not be further used. A severe impact may stretch the shoulder straps beyond their elastic limit, warp or damage plastic seat parts, or otherwise render the seat unsafe for further use. In many cases the damage will not be readily visible and, in any event, it may not be apparent to the user that the damage is severe enough to require seat replacement.

SUMMARY OF THE INVENTION

[0005] Therefore, it is an object of the invention to provide a harness tension sensor and related apparatus for a child safety seat.

[0006] It is another object to provide a child safety seat that has a sensor that detects both that the seat is properly latched and that the shoulder straps have been properly tensioned.

[0007] It is another object to provide a child safety seat that has a sensor that detects that the seat is properly latched and that the shoulder straps have been properly tensioned, wherein the operative elements of the sensor and related parts

are under the seat and away from wear and liquids.

[0008] It is another object to provide a child safety seat that has a sensor that detects that the seat has been subjected to a load of sufficient severity that further use of the seat should not be permitted.

[0009] These and other objects of the present invention are achieved in the preferred embodiments disclosed below by providing a child safety device for a vehicle including a seat including a shell, a harness including at least one strap for retaining an occupant in the seat, and a sensor between a device on the strap and the seat shell for indicating whether the harness is sufficiently tensioned.

[0010] According to another preferred embodiment of the invention, the harness includes shoulder straps and a crotch strap.

[0011] According to another preferred embodiment of the invention, the device on the strap includes a strap buckle or slide.

[0012] According to another preferred embodiment of the invention, the sensor is positioned on a shell bottom.

[0013] According to another preferred embodiment of the invention, a child safety device for a vehicle includes a seat including a shell, a harness including at least one strap for retaining an occupant in the seat, and a sensor including crushable members between a device on the strap and the seat shell for indicating whether the harness has been severely tensioned.

[0014] According to another preferred embodiment of the invention, the crushable members are calibrated to crush at 500–700 pounds of load.

[0015] According to another preferred embodiment of the invention, the crushable members comprise ribs or thin walls.

[0016] According to another preferred embodiment of the invention, the sensor is a one use, one way type.

[0017] According to another preferred embodiment of the invention, a child safety device for a vehicle includes a seat including a shell and a harness including a strap for retaining an occupant in the seat. The device further includes a sensor between a device on the strap and the seat shell for indicating whether the harness is sufficiently tensioned, and a sensor including crushable members between the device on the strap and the seat shell for indicating whether the harness has been severely tensioned.

[0018] According to another preferred embodiment of the invention, both sensors are positioned under the seat shell.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Embodiments of the invention may be best understood by reference to the following description in conjunction with the accompanying drawing figures in which:

[0020] Figure 1 is front perspective view of an embodiment of a child safety seat;

[0021] Figure 2 is side view of the embodiment of the child safety seat;

[0022] Figure 3 is an enlarged view of an embodiment of a crash occurrence assembly for the child safety seat;

[0023] Figure 4 is a top view of an embodiment of a sensor housing;

[0024] Figure 5 is a side view of the sensor housing of Figure 4 showing crash occurrence and belt tension sensors;

[0025] Figure 6 is an enlarged side view of an embodiment of a belt tension sensor in a closed state;

[0026] Figure 7 is an enlarged side view of an embodiment of a crash occurrence sensor in an open state;

[0027] Figure 8 is a side view of the crash occurrence sensor of Figure 7 in the closed state;

[0028] Figure 9 is an enlarged side view of an embodiment of a belt tension sensor in an open state;

[0029] Figure 10 is a side view of the belt tension sensor of Figure 9 in the closed state;

[0030] Figure 11 is an enlarged side view of an embodiment of a combined belt tension and crash occurrence sensor showing the belt tension sensor in a closed state; and

[0031] Figure 12 is a side view of the embodiment of Figure 11 showing the crash occurrence sensor in a closed state.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0032] Figures 1-3 show a child safety seat 12 and harness 20 including a pair of shoulder straps 23 and 25 for insertion into a buckle 22 fixed to a crotch strap 26 that passes through a slot 29 in a seat shell 14 and is fixed at a distal end to a three bar slide 27. A sensor housing 18 is positioned between the seat shell 14 and the three bar slide 24.

Tension Sensor

[0033] As shown in Figures 1-6 and 9-11, the tension sensor 10 is designed to insure that sufficient tension is present in a harness 20 for a child safety seat 12. The sensor 10 may be associated with a buckle 22 or three bar slide 24 that captures one end of the crotch strap 26. The buckle 22 or three bar slide 24 is sufficiently large to retain the crotch strap 26 in the correct position between the legs of the seat occupant by bearing against the underside or bottom of the plastic seat bottom shell 14 with the strap 26 itself extending through the slot 29 and into the crotch area of the seat occupant.

[0034] In one embodiment shown in Figures 1-3, the sensor 10 sits between the crotch strap buckle 22, or, a three-bar slide 24, and the plastic seat bottom shell 14. When sufficient tension is on the harness 20, the crotch strap 26 or three bar slide 24 is pulled upwardly thorough the slot 29 in the seat 12 bottom, and the buckle 22 or three bar slide 24 presses the sensor 10 against the seat bottom shell 14.

[0035] In one embodiment, a plunger 42 or other mechanism urges the sensor 10 from a normally open position to a closed position when there is too little tension on the harness 20. Closing the circuit allows a current to flow to a device such as a microprocessor that can activate any conventional alert means, such as a bell, buzzer, light, etc. that the harness needs to be further tightened. Latching the harness correctly and/or further tightening the harness 20 opens the circuit and deactivates the alert.

[0036] Conversely, the circuit can be designed so that the circuit is normally closed when the tension is correct, as shown in Figures 6 and 10, and in the open condition when the tension must be increased, as shown in Figures 5 and 9. The

open circuit is sensed and a microprocessor generates the alert, as described above.

[0037] The sensor may be any suitable pressure-sensitive on-off type switch, for example, spring-loaded contacts 13 that engage a complementary contact 15 in order to close the circuit, as shown in Figures 5 and 9-12.

Crash Occurrence Sensor

[0038] As shown in Figures 1-5, 7-8 and 11-12, in another aspect of the invention, the child safety seat 12 has a sensor 11 that detects that the seat 12 has been subjected to a load of sufficient severity that further use of the seat 12 should not be permitted. This crash occurrence sensor 11 may be used together with or separate from the tension sensor 10 described above. Figure 11 shows an embodiment of the invention wherein a plunger 42 indicates first that belt tension is sufficient and also indicates when the harness 20 has been subjected to a mor severe load.

[0039] In general, the crash occurrence sensor 11 is a "one use, one way" sensor. When it detects a severe load on a single occasion, it closes a circuit that provides an alert that the seat 12 has potentially been subjected to sufficient damage that the seat 12 should be discarded and not further used. The circuit is designed not to return to a normal state.

[0040] More specifically, the crash occurrence sensor 110 includes crushable members 77 that are calibrated to crush at, for example, 500-700 lbs. of load. Crushing of the crushable members 77, as shown in Figures 8 and 12, closes a circuit. The crushable members 77 may be ribs, thin walls, foam or honeycomb

materials, or any other suitable material that has the ability to resist crushing up to a predetermined point, and then reliably crush to a degree sufficient to close a circuit.

As also shown in the attached drawings, the crushable members 77 may be positioned on an upper surface of the crotch strap buckle 22, or a three-bar slide 24, so that in the event of a severe load, the buckle 22 or slide 24 is pulled upwardly against the plastic shell 14 of the seat by the crotch strap 26 so severely that the crushable members 77 are crushed against the plastic shell 14, engaging the contact 17 and 19 to close a circuit. With less severe loads, the crushable members 77 do not crush to any appreciable degree.

As is apparent from the foregoing, all of the electronic features of both the tension sensor 10 and the crash occurrence sensor 11 may be placed under the seat shell 14 away from the seat occupant and possible wear and damage.

Throughout the specification and the claims that follow, unless the context requires otherwise, the words "comprise" and "include" and variations such as "comprising" and "including" will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

It will be appreciated by those skilled in the art that the invention is not restricted in its use to the particular application described. Neither is the present invention restricted in its preferred embodiment with regard to the particular elements and/or features described or depicted herein. It will be appreciated that various modifications can be made without departing from the principles of the invention. Therefore, the invention should be understood to include all such modifications in its scope.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A child safety device for a vehicle, comprising:
   (a) a seat;
   (b) a harness comprising at least one strap for retaining an occupant in the seat; and
   (c) a sensor located between the at least one strap and the seat, wherein increasing the tension in the at least one strap exerts a force on the seat, and wherein the sensor measures the degree of the force exerted on the seat.

2. The child safety device according to claim 1, wherein the harness comprises shoulder straps and a crotch strap.

3. The child safety device according to either of the preceding claims, wherein the seat comprises a shell and wherein the sensor is positioned on a shell bottom.

4. A child safety device for a vehicle, comprising:
   (a) a seat;
   (b) a harness comprising at least one strap for retaining an occupant in the seat; and
   (c) a sensor located between the at least one strap and the seat, wherein increasing the tension in the at least one strap exerts a force on the seat, and wherein the sensor indicates when the force exerted on the seat is severe.

5. The child safety device according to claim 4 wherein the sensor is a one use, one way type.

6. The child safety device according to any one of the preceding claims, wherein the sensor indicates when the degree of the force exerted on the seat corresponds to sufficient tension in the at least one strap.

7. The child safety device according to any one of the preceding claims, wherein the sensor activates an alert means when the degree of the force exerted on the seat corresponds to sufficient tension in the at least one strap.

8. The child safety device according to any one of the preceding claims, wherein the sensor comprises a spring that contracts when the force is exerted on the seat.

9. The child safety device according to claim 8, wherein the sensor indicates when the spring becomes a length that corresponds to sufficient tension in the at least one strap.

10. The child safety seat according to any one of the preceding claims further comprising a device located between the at least one strap and sensor such that when the tension in the at least one strap increases the device exerts a force on the seat.

11. The child safety seat according to claim 10, wherein the device comprises a strap buckle or slide.

12. The child safety device according to any one of the preceding claims further comprising a second sensor located between the at least one strap and the seat, wherein increasing the tension in the at least one strap exerts a force on the seat, and wherein the second sensor indicates when the force exerted on the seat is severe.

13. The child safety device according to claim 12, wherein the seat comprises a shell and wherein both sensors are positioned on the shell bottom.

14. The child safety device according to claim 4, wherein the sensor comprises at least one crushable member that is configured to crush when the force exerted on the seat is severe, and wherein the sensor indicates when the at least one crushable member is crushed.

15. The child safety device according to claim 4, wherein the sensor activates an alert means when the sensor indicates that the force exerted on the seat is severe.

16. The child safety device according to claim 14, wherein the crushable members are calibrated to crush at 500-700 pounds of load.

17. The child safety device according to either of claims 14 or 16, wherein the crushable members comprise ribs or thin walls.

18. A child safety device being as described in the specification with reference to and as illustrated in the accompanying drawings.

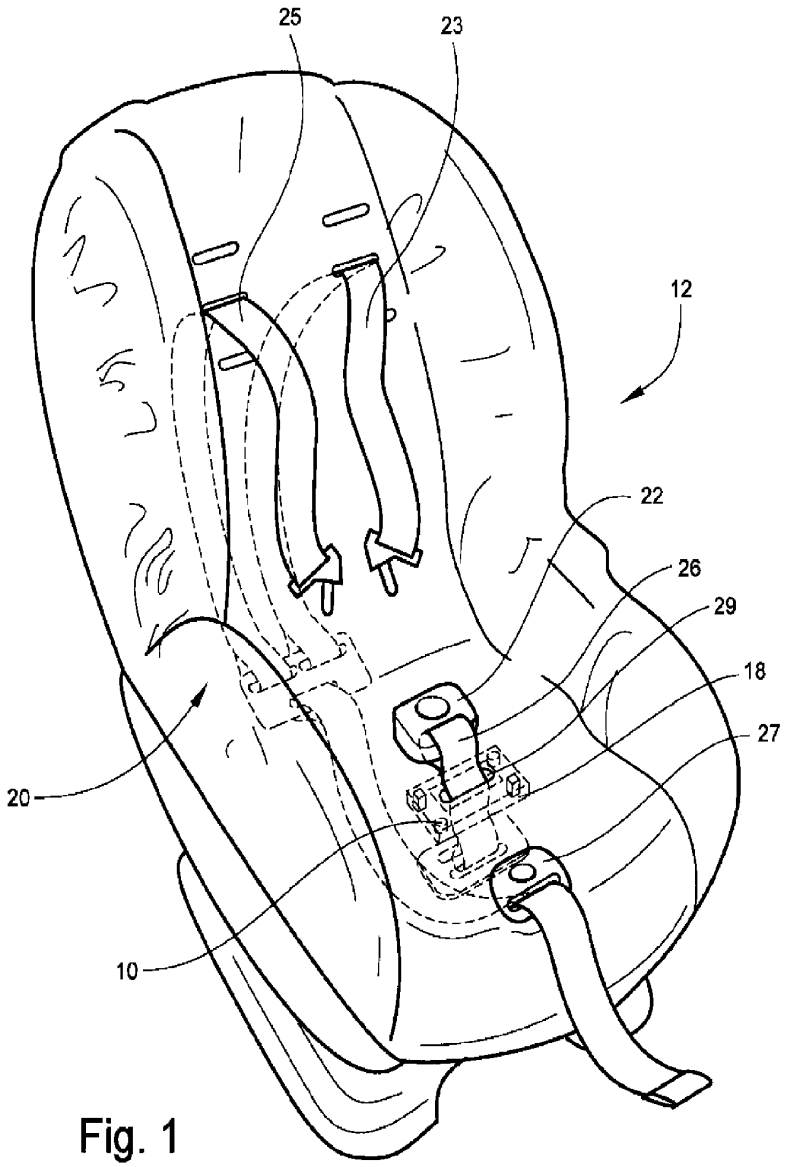


Fig. 1

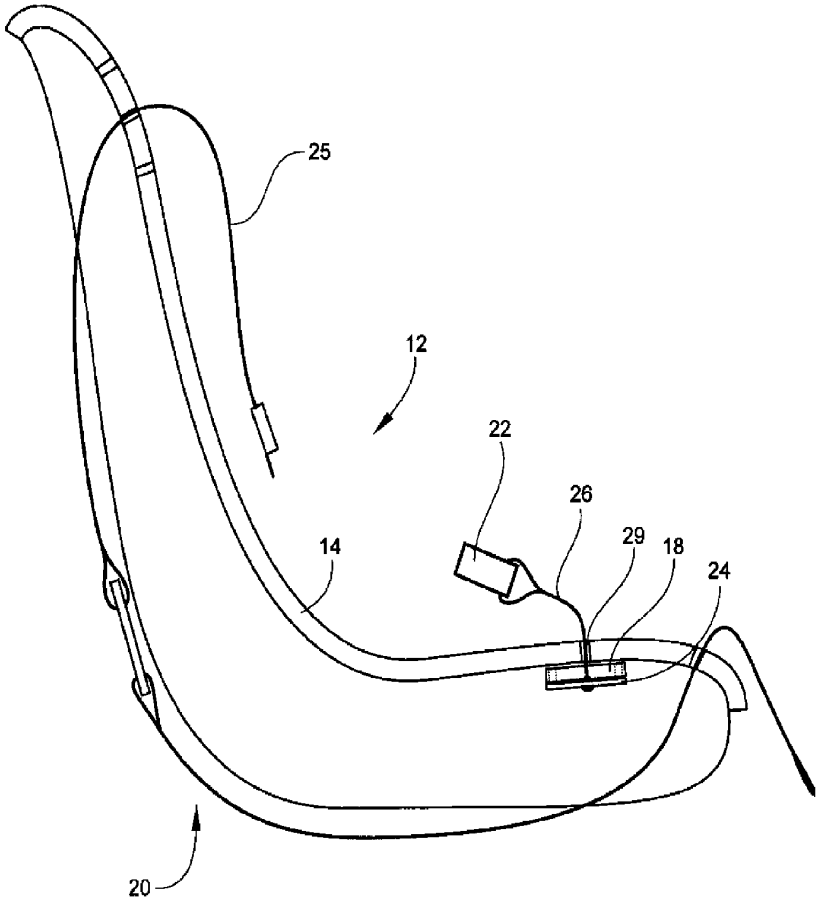
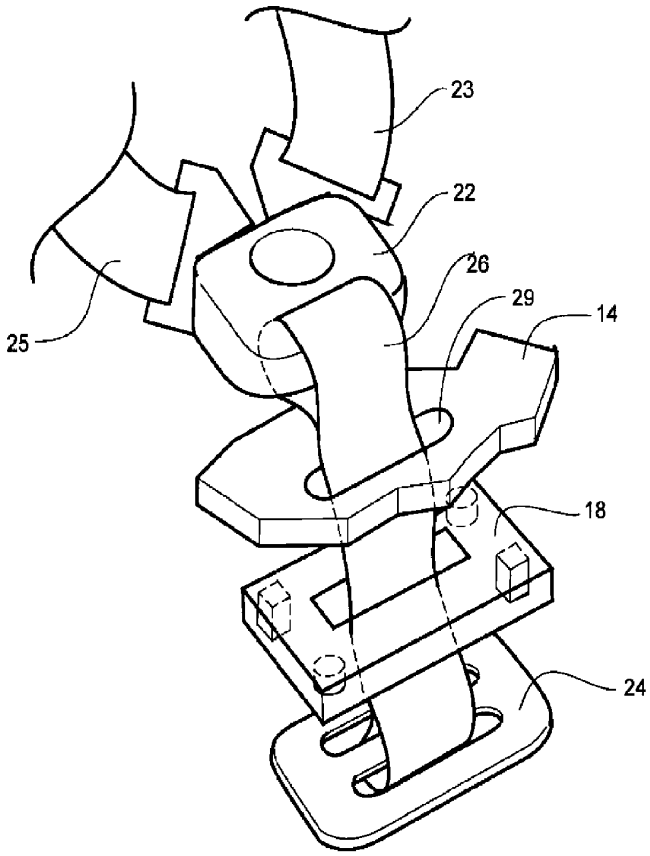


Fig. 2

Fig. 3



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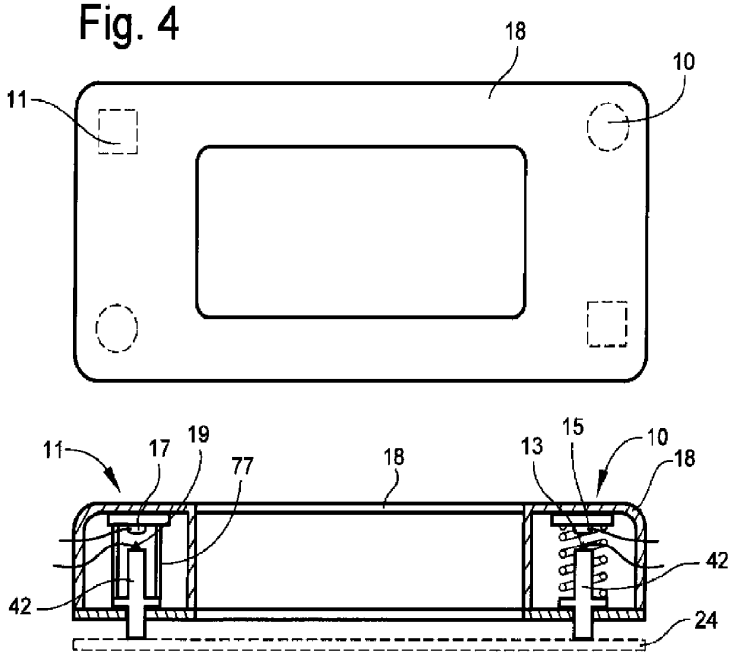
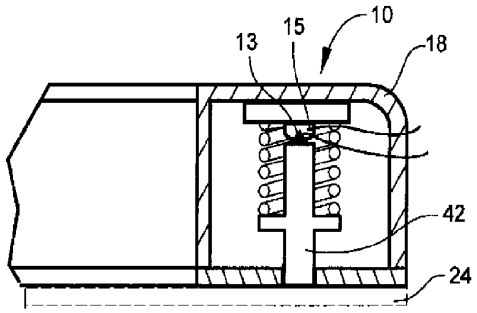


Fig. 5

Fig. 6



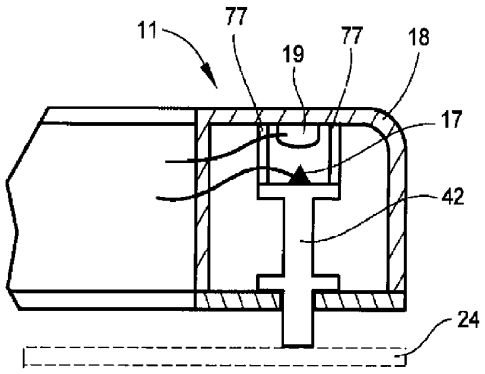


Fig. 7

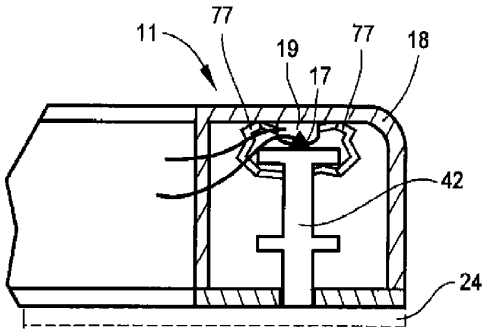


Fig. 8

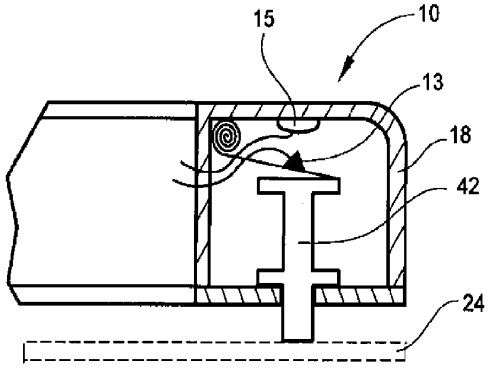


Fig. 9

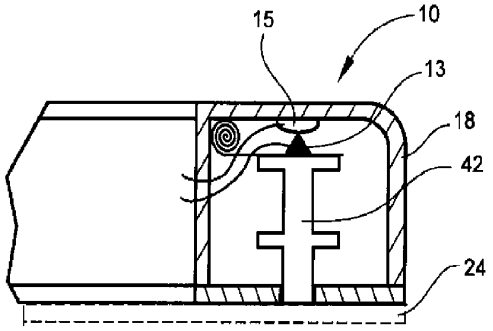


Fig. 10

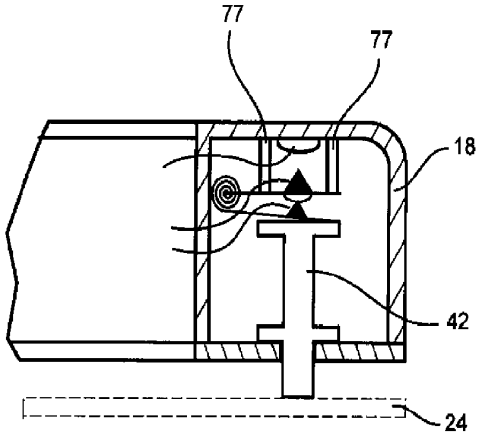


Fig. 11

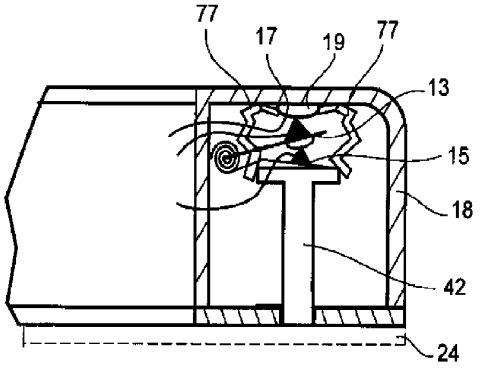


Fig. 12