(54) Title: METHOD OF FOLDING AN AIRBAG

(57) Abstract: An airbag (20) is folded by: providing an airbag with a square configuration; folding four corners (70, 72, 74, 76) of the airbag toward the center (24) of the airbag resulting in a smaller square configuration; repeating said folding step to place the airbag in a smaller square configuration; folding a resulting left corner of the airbag toward the center of the airbag; folding a resulting right corner of the airbag toward the center of the airbag; and pinching lower and upper portions (90, 92) of the airbag while folding the lower and upper portions, respectively toward the center of the airbag.
METHOD OF FOLDING AN AIRBAG

The present invention relates to a method of folding an airbag for a vehicle occupant restraint system.

Airbags have been used for some time to provide impact protection to occupants of motor vehicles. The airbags are often stored in the dashboard or steering wheel of the vehicle. In the event of a crash the airbag is deployed. The characteristics of the airbag's deployment are determined by the method of folding the airbag.

Conventional airbag folds may create a thick airbag package. US 5 615 915 discloses a method of folding an airbag placed in a square configuration comprising repetitive folding of the four corners inward.

A method of folding an airbag in accordance with the present invention comprises providing an airbag in a substantially square configuration, folding four corners of the airbag toward the center of the airbag, folding a left corner toward the center of the airbag, folding a right corner toward the center of the airbag, and folding the lower and upper corners of the airbag, respectively, toward the center of the airbag.
Brief Description of the Drawings

FIG. 1 shows a round airbag in an initial unfolded and not inflated condition.

FIGS. 2-9 show the airbag in successively folded conditions.

FIG. 10 shows a square airbag in an initial unfolded and not inflated condition.
Detailed Description of the Invention

In one preferred embodiment, the airbag 20 is substantially circular along its outer circumference 22 as shown in FIG. 1 in an unfolded and not inflated condition. In this embodiment, the airbag is a driver's side airbag to be mounted in the steering wheel of a passenger vehicle. However, this method of folding could be used for driver side airbags placed in other locations in the vehicle and for other types of airbags, including side and passenger side airbags. Although, a round airbag is shown, the airbag may be other shapes. For example, a square airbag as shown in FIG. 10 may be used, eliminating the first folding step shown in FIG. 2.

Near the center 24 of the airbag is a sewn tether stitch 26 and an airbag ring 27. The airbag ring 27 is positioned between a front panel 30 and a back panel 32 of the airbag. In addition, the airbag has a top side 34, a bottom side 36, a left side 38, and a right side 40.

In accordance with the present invention, as shown in FIG. 2, the top, bottom, left and right sides, that is to say four arcuate sections of the circular edge, are folded toward the center are folded along first fold lines 60 toward the center of the airbag to create substantially a square shape. The four sides of the airbag 34, 36, 38 and 40 are folded toward the center 24 of the airbag so that the outside edges of the airbag 20 are tangent to the central tether stitch 26. The resulting airbag has four corners 70, 72, 74, 76. As shown in FIG. 3, the corners are folded into the center of the airbag.
Preferably, this step is repeated as shown in FIG. 4 and rotated so that a corner is facing up. Then, a left side of the folded bag 78 is folded along a second fold line 62 at the left edge of the bag ring as shown in FIG. 5. In the preferred embodiment, the bag is folded approximately 35 mm to the left of the center 24 of the airbag. The resulting right flap 80 is folded back along the right edge of the bag ring, along fold line 64, see FIG. 6. This step results in an overlapping tip 82. Next, as shown in FIG. 7, the overlapping tip 82 of the folded flap is folded back to the center 24 of the bag. Then, a lower portion 90 of the bag is pinched approximately 60 mm in width while folding the lower portion of the bag to the lower edge of the bag ring 27 as shown in Figure 8. This pinching and folding step is repeated for an upper portion 92 of the bag as shown in FIG. 9. Although pinching is used in the preferred method, an automated means may be used to accomplish the required width.

This method of folding an airbag is unique, in that the height, width and thickness of the resulting airbag pack are roughly one third smaller than a conventional fold. In addition, this folding technique results in very little dimensional variation from bag pack to bag pack.

In the preferred folding method, the folding is performed with an inflator positioned in the center of the airbag. In addition, having the above folds not pulled tight to the inflator allows for easier installation of the airbag into the airbag module. To further reduce the bag pack size, the airbag pack may be wrapped with TYVEK, manufactured by DuPont, or
appropriate material before inserting the airbag into the pack area.

The present method of folding an airbag could also be used to fold a substantially square airbag as shown in FIG. 10. The steps for folding a square airbag would be the same as shown in FIGS. 3-9, skipping the initial step shown in FIG. 2.
CLAIMS:

1. A method of folding an airbag comprising the steps of:

   providing an airbag (20) in a substantially square configuration, the airbag having a center (24);
   folding four corners (70, 72, 74, 76) of the airbag toward the center (24) of the airbag to place the airbag in a smaller substantially square configuration;
   folding a resulting left corner of the airbag toward the center (24) of the airbag;
   folding another resulting right corner of the airbag toward the center (24) of the airbag; and
   folding lower (90) and upper (92) portions of the airbag, respectively, toward the center (24) of the airbag.

2. The method of folding an airbag according to claim 1 wherein the step of providing a airbag (20) in a substantially square configuration comprises the steps of:

   providing a round airbag having a circular edge;
   and

   folding four arcuate sections (34, 36, 38, 40) of said circular edge toward the center (24) of the airbag along fold lines (60) to place the airbag in a substantially square configuration.

3. The method of folding an airbag according to claim 1 wherein after folding four corners (70, 72, 74, 76) of the airbag (20), said method further comprises the step of: repeating said
folding step to place the airbag in a smaller square configuration.

4. The method of folding an airbag according to claim 2 wherein after folding four corners (70, 72, 74, 76) of the airbag (20), said method further comprises the step of: repeating said folding step to place the airbag in a smaller square configuration.

5. The method of folding an airbag according to claim 1 wherein the step of folding lower and upper portions (90, 92) of the airbag (20), respectively, toward the center (24) of the airbag comprises:

pinching the lower and upper portions of the airbag while folding the lower and upper corners of the airbag, respectively, toward the center of the airbag.

6. The method of folding an airbag according to claim 2 wherein the step of folding lower and upper portions (90, 92) of the airbag (20), respectively, toward the center (24) of the airbag comprises:

pinching the lower and upper portions of the airbag while folding the lower and upper corners of the airbag, respectively, toward the center of the airbag.

7. The method of folding an airbag according to claim 1 further comprising the step of: folding an overlapping tip of the airbag (20) toward the center of the airbag after folding the right corner of the airbag toward the center (24) of the airbag.
8. The method of folding an airbag according to claim 2 further comprising the step of: folding an overlapping tip of the airbag (20) toward the center of the airbag after folding the right corner of the airbag toward the center (24) of the airbag.

9. The method of folding an airbag according to claim 5 further comprising the step of: folding an overlapping tip of the airbag (20) toward the center of the airbag after folding the right corner of the airbag toward the center (24) of the airbag.

10. The method of folding an airbag according to claim 6 further comprising the step of: folding an overlapping tip of the airbag (20) toward the center of the airbag after folding the right corner of the airbag toward the center (24) of the airbag.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60R21/16

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)
IPC 7 B60R

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>US 6 092 839 A (NAGANO MAKOTO) 25 July 2000 (2000-07-25) abstract; figures 1,3-7</td>
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<td>US 5 425 552 A (LINDEL LEO) 20 June 1995 (1995-06-20) abstract; figures 1,3</td>
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Patent family members are listed in annex.

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17 December 2001

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Authorized officer
Wauters, J
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<td>&quot;AIR BAG FOLDING METHOD&quot; RESEARCH DISCLOSURE, KENNETH MASON PUBLICATIONS, HAMPSHIRE, GB, no. 413, September 1998 (1998-09), pages 1207-1208, XP000824882 ISSN: 0374-4353 the whole document</td>
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