

The invention relates to a heat-shrinkable, uncoated fabric of synthetic filament yarn for producing an air bag.

Coated fabrics have until now been used for air bags in most cases. It has become apparent that the use of these fabrics for producing air bags has considerable disadvantages. In addition to the relatively high production costs entailed by the coating process, the folded volume of coated fabrics is at least 10% higher than that of uncoated ones. The space required to accommodate the air bag, for example in the steering wheel, is therefore greater in the case of coated fabrics than when uncoated ones are used. Moreover, air bags produced from a coated fabric give rise to a greater imbalance in the steering wheel than those produced from an uncoated one. A further disadvantage arises from the necessity of dusting the coating with talc in order to prevent the coatings which rest against one another in the folded air bag from sticking together. When the air bag is rendered operative the talc emerging from the latter causes the occupants a considerable amount of inconvenience.

It is therefore desirable to develop uncoated fabrics for producing air bags which do not have the described disadvantages of the coating.

A fabric of this kind is described in EP-A 314 867, which proposes the use of a yarn with a titre of 470 dtex in a fabric of an asymmetrical construction. The low air permeability required for this fabric is obtained through heat-setting combined with calendering. A significant disadvantage of the fabric described here, which is of an asymmetrical construction, is, inter alia, that the same strength is not achieved in both thread directions. Moreover, the titre of 470 dtex has proved to have drawbacks in terms of foldability.

US-PS 3 842 583 describes an asymmetrical fabric in a titre range of 110 - 900 dtex. However the yarn which is used here is not strong enough and has high elongation values. The specifications currently required by European car manufacturers cannot be met by yarns of this type. Moreover, this asymmetrical fabric also has the disadvantage of different warp and weft strengths.

JP-A 01-104 848 describes fabrics for air bags which are produced from yarns having titres of 235 dtex (210 denier) and 470 dtex (420 denier) (see embodiments). While the titre of 235 dtex does not enable the desired strengths to be achieved, that of 470 dtex entails the above-mentioned disadvantages regarding the unacceptably high folded volume.

The object is therefore to develop a more suitable uncoated air bag fabric which can in addition be produced inexpensively.

It has surprisingly been found that a more suitable uncoated air bag fabric can be produced if a synthetic filament yarn in a titre range of 300 - 400 dtex is used, yarn counts of 23 - 28/cm warpwise and weftwise are selected and the fabric has an at least substantially symmetrical construction.

A fabric construction which is at least substantially symmetrical, has the same or almost the same yarn counts warpwise and weftwise and in which yarns of the same titre and the same technological properties (strength, etc.) are used in both thread directions advantageously results in a fabric of the same strength in both thread directions. This property of the fabric is of great advantage, as the radially symmetrical air bag component is not stressed to a greater degree in one direction than in another.

Other conceivable methods for obtaining the same strength in both thread directions have a highly adverse effect on other

properties of the fabric, e.g. air permeability and foldability, and are therefore hardly suitable.

Further advantages such as a thin fabric, low folded volume and therefore small space required for accommodating the air bag in the steering wheel as well as good folding properties can thus be achieved in a particularly simple manner by means of the yarn titre 300 - 400 dtex while maintaining a high strength.

Although yarn titres of 470 decitex which have been used until now meet requirements in terms of strength, they have proved to be highly unfavourable on account of the resulting thick fabric and consequent high folded volume. Although the titre of 235 dtex also proposed for air bags produces a fabric which is less thick, this does not meet the strength requirements with sufficient constancy and reliability - if at all.

However the desired high strength is achieved according to the invention while maintaining the lowest possible mass per unit area by using a yarn in a titre range of 300 - 400 dtex which has not until now been known for producing air bags. The following table shows a comparison between the titres 470, 350 and 235 dtex.

Table

Yarn titre (dtex)	470 f 72	350 f 72	235 f 36
Thickness (mm)	0.38	0.31	0.23
Mass per unit area (g/m ²)	243	200	179
Strength (N)			
Warp	3300	2900	2300
Weft	3100	2900	2400
Tear propagation strength (N) according to Schenkel			
Warp	130	94	67
Weft	133	93	62
Air permeability (l/dm ² ·min) 500 Pa	4.9	3.4	3.5

The above table shows that although a fabric of a slight thickness can be obtained with the titre 235 dtex, this does not apply to the strength required by car manufacturers. Although the titre 470 dtex results in a strength which is even greater than that desired, the fabric is too thick here. However a favourable fabric thickness with the required strength of >2400 N is achieved according to the invention with the titre 350 dtex.

A particularly suitable yarn with a titre of 350 dtex exhibits a strength of at least 60 cN/tex, an elongation value of 15 - 30% and a hot-air shrinkage of at least 6% (measured at 190°C). The specifications issued by car manufacturers can

hereby be met entirely for the first time by uncoated fabrics in a particularly advantageous manner.

The air permeability is of particular importance for the operation of the air bag. According to fairly recent specifications, car manufacturers require a value of

$$\leq 10 \frac{l}{dm^2 \cdot min}$$

at a test pressure $\Delta p = 500$ Pa. This value can only be achieved by means of an additional coating or a calendering treatment when using the known air bag fabrics.

The air permeability of the fabric according to the invention was tested in accordance with DIN 53 887. However, departing from this DIN, the differential test pressure was raised to 500 Pa so that an unambiguous test signal could also be obtained for the fabrics produced according to the invention.

A fabric construction which is at least substantially symmetrical is particularly advantageous for producing the standard values required by car manufacturers.

A fabric construction which is at least substantially symmetrical is understood to mean, within the scope of the invention, both constructions which have the same yarn counts warpwise and weftwise and are therefore symmetrical and those with almost the same yarn counts. Tests have shown that yarn count differences of, for example, approximately 10% between the warp and the weft still produce the advantageous properties and effects of a symmetrical fabric.

The fabric construction must be selected so as to produce a fabric which is as closely woven as possible. Yarn counts of 23 - 28/cm warpwise and weftwise have proved necessary to produce the fabric according to the invention, as the low air

permeability which is required can only be achieved with these yarn counts. All looms which are generally used in the weaving trade are suitable for producing the fabric.

The number of monofilaments in the filament yarn is of vital importance to achieve the desired properties. It is particularly advantageous to work with 72 monofilaments when the yarn titre is 300 - 400 dtex. The filament titre, which is then lower than in the case of a 470 f 72 or 235 f 36 yarn, has a positive and particularly advantageous effect on the stiffness of the fabric, i.e. this is reduced, and improves its folding property. A lower air permeability of the fabric is, moreover, achieved with a lower filament titre.

The air bag fabric can be produced with any synthetic filament yarn having the above-mentioned strength, elongation and shrinkage values. However yarns consisting of polyamide 66 have proved to be particularly favourable. A polyamide 66 into which a heat stabilizer has been introduced during the polymer production process is particularly preferred. These yarns can be produced both according to a conventional production process with winding taking place between spinning and stretching and according to a continuous spinning/stretching process. The yarns may be used either twisted or untwisted.

If the fabric which is produced with an at least substantially symmetrical fabric construction is subjected to a desizing and/or washing process, this wet treatment causes shrinkage. Further shrinkage may then be brought about in a heat-setting unit. A reduction in air permeability may be achieved by means of a sanforizing or calendering process.

Fabrics which are treated in this way have the required low air permeability.

The advantages of the fabric according to the invention result in a more reliable air bag system which meets the

specifications of car manufacturers and is therefore more marketable. The air bag system covers the actual air bag, the air bag accommodation in the motor vehicle as well as the control system for rendering the air bag operative.

Embodiment

A polyamide 66 yarn having a titre of 350 f 32 was used to produce a fabric in plain weave. The yarn count was 27/cm warpwise and 26/cm weftwise. The fabric was subjected to a washing treatment in a jigger and then heat-set on the stenter frame at 190°C. This was followed by a treatment in a sanforizing unit. The air bag fabric thus produced has a mass per unit area of 200 g/m² with a thickness of 0.31 mm. The strength, being 2900 N in both thread directions, was in the desired range, as was the value of 3.4 l/dm²·min which was determined for the air permeability.

Claims:

1. Heat-shrinkable, uncoated fabric of synthetic filament yarn for producing an air bag, characterised in that the fabric has an at least substantially symmetrical construction with yarn counts of 23 - 28/cm warpwise and weftwise and the yarn has a titre of 300 - 400 dtex.
2. Fabric according to claim 1, characterised in that the yarn has a titre of 320 - 380 dtex.
3. Fabric according to claim 1, characterised in that the yarn has a titre of 340 - 360 dtex.
4. Fabric according to claim 1, characterised in that the yarn has a titre of 350 dtex.
5. Use of a fabric according to at least one of claims 1 - 4 for producing an air bag.
6. Use of a fabric according to at least one of claims 1 - 4 in an air bag system.

