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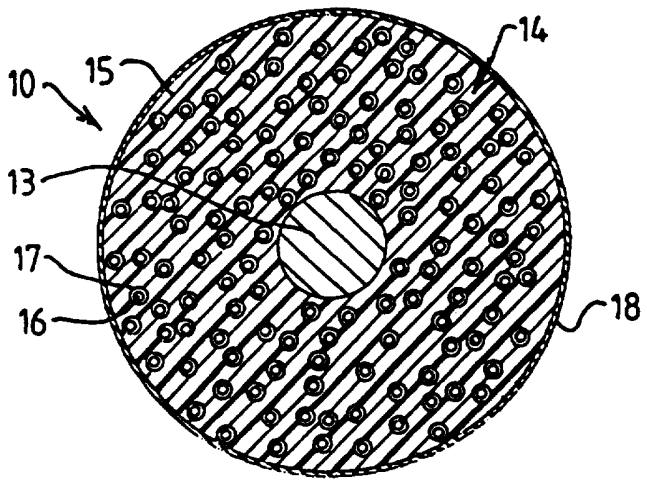
(54) Title: PADDING ELEMENT PROVIDED WITH GAS-FILLED CELLS FOR IMPACT ABSORPTION

(57) Abstract

A padding element (14) for use in a vehicle may comprise an item such as a dashboard cover, sun visor or the like, but is preferably the outer part of a steering wheel (10). The element (14) is injection moulded from a plasticised thermoplastic material (15) which incorporates microspheres (16), the microspheres being formed of a plastic material. The microspheres expand to make the moulded material a "foam". The individual cells in the foam are surrounded by the material (17) that formed the microspheres. The process leads to a minimum of "flashing". The thermoplastic material may be recycled when the vehicle is scrapped at the end of its useful life.



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PADDING ELEMENT PROVIDED WITH GAS-FILLED CELLS FOR IMPACT ABSORPTION

THE PRESENT INVENTION relates to a padding element and to a method of manufacturing a padding element for an interior component in a motor vehicle. The padding element may comprise a dash-board cover, which may incorporate an air-bag cover, a padding element for a pillar, such as a B-pillar, and, in particular, the outer part of a steering wheel. Alternatively, the padding element may comprise a knee protection pad, sun visor gear lever knob or arm-rest.

Interior components of vehicles, such as motor cars, which are positioned such that an occupant of the vehicle may hit them during an accident, are often made of a plastic material, or are at least covered with such a material. Typical materials are polyurethane foam, soft polyvinyl chloride, expanded polyvinyl chloride, or expanded polypropylene. Sometimes a solid thermoelastomer is used. A thermoelastomer is a thermoplastic material which has elastic properties (i.e. if it is stretched so that one dimension is increased by up to 100%, it returns to its original shape).

A typical steering wheel for use in a motor vehicle comprises a metal frame defining the rim of the steering wheel and one or more spokes extending from the rim towards a hub. The metal frame is covered with a padding element. It has been proposed to utilise a polyurethane foam as the principal part of a padding element which is moulded to the metal frame of a steering wheel. Such polyurethane foam

has also been proposed for use as a padding element for a dashboard cover, that may incorporate an air-bag, and as a padding element for a pillar, such as a B-pillar.

A polyurethane foam is made from a liquid polyurethane material where gas "bubbles" (closed gas cells) are generated by a chemical foam agent. The material may be moulded to form an appropriate padding element, but it has been found that this leads to a substantial amount of "flashing" with the liquid material flowing from the mould cavity between the two mould parts. "Flashing", when it occurs in this context, has to be cut off from the steering wheel. This is labour-intensive. Polyurethane is also difficult to recycle, and leads to a long production time due to long time for curing.

A thermoplastic material can easily be recycled, but prior attempts to utilise a foamed thermoplastic material forming a padding element, for example for use as part of a steering wheel, have not proved to be very successful. If a foam agent is introduced late so that the gas cells are generated mainly in the mould more and larger cells will be created in the centre of the mould because close to the surface the plastic material will be cooled very quickly. This will result in a very thick "skin" and a fairly high average density. On the other hand if the foam agent is introduced at an early stage the gas cells will reach the surface where they will "burst" creating a rough structure of the surface.

The present invention seeks to provide an improved padding element and a new method of manufacturing a padding element.

According to one aspect of this invention there is provided a method of manufacturing a padding element for an interior component of a motor vehicle, the method comprising the step of moulding the padding element from a mixture of microspheres and a plasticised thermoplastic or thermoelastomer material, the microspheres being formed of a plastic or polymer material.

Preferably the moulding comprises injection moulding.

Conveniently the microspheres are added to the matrix material after it has been plasticised.

Alternatively the microspheres are added to the matrix material in a plasticiser in which the matrix material is plasticised.

In another embodiment the microspheres are added to the matrix material in a mixer prior to the matrix material being plasticised.

Advantageously the microspheres are added to the matrix granules in a quantity of between 2 and 5%, most preferably substantially 3% by weight based on the weight of the matrix material.

Conveniently wherein the plastic material forming the microspheres is a different material to the material of the matrix.

Preferably the melting point of the material forming the microspheres is higher than the melting point of the material of the matrix. This is however not

necessary because the microspheres are cooled by the expansion.

Advantageously thermoelastomer material is utilised, such as a matrix material, being based on styrene, ester, urethane, amide or olefin. Preferably the thermoelastomer material is an styrene-ethylene-butane-styrene material or a styrene-ethylene-propylene-styrene.

Conveniently the padding element is moulded on to the component. The component may comprise a steering wheel, a dashboard, a pillar, such as a B-pillar, an air-bag cover, knee protection pad, sun visor, gear lever knob or arm-rest.

The invention also relates to a padding element formed by a method as described above.

According to another aspect of this invention there is provided a padding element for an interior component of a motor vehicle, the padding element comprising a moulded element, the element being moulded from a matrix of thermoplastic material, the element having, within the matrix material a plurality of closed gas filled cells, each cell being bounded by a material which is different from the material of the matrix.

Preferably the diameter of each "bubble" or cell is approximately 100 - 150 microns.

Conveniently the volume contained within the said bubbles comprises between 30 and 60% of the total volume of the said element.

Advantageously the element has an unfoamed skin adjacent its surface having a thickness of the order of tenths of a millimetre.

The element may be in the form of an element moulded to the core of a steering wheel, or a dashboard, knee protection pad, sun visor, gear lever knob or arm-rest, or alternatively, a pillar such as a B-pillar.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a block diagram of a method for making a padding element,

FIGURE 2 is a perspective view of a steering wheel incorporating a padding element, and

FIGURE 3 is a sectional view taken on the line III-III of Figure 2.

Referring to Figure 1, in a method of fabricating a padding element, an initial step is to take thermoplastic granules 1. Suitable non-elastomer thermoplastic materials may comprise polyolefins, or polyvinyl chloride. Suitable thermoelastomer materials are based on styrene, esters, urethanes, amides or olefins. The preferred thermoplastic materials are styrene-ethylene-butane-styrene or styrene-ethylene-propylene-styrene.

The thermoplastic granules 1 may optionally be passed to a mixer 2. Here the granules may be mixed with

an appropriate dye 3, if the granules are not already coloured.

The granules subsequently passed to a plasticiser 4. Within the plasticiser the granules are heated until the material is liquid or has a suitable consistency for injection moulding. The thermoplastic or material may have a high temperature approaching 200°C. The material is then passed from the plasticiser 3 to an injection moulding apparatus 5.

A source 6 of microspheres is provided. The microspheres are preferably spheres of a copolymer based on polyacrilonitrile and with an unexpanded diameter of 30 to 40 microns, the spheres having a hollow centre, which contains liquified isoprene or isopentane. When heated, the spheres expand to 120 - 140 microns as the isopentane is gasified. Microspheres of this type are commercially available.

If needed the microspheres for use in connection with the present invention could be formed from a plastics material which has a melting point which is higher than the melting point of the thermoplastic granules 1.

The microspheres 5 are added to the thermoplastic granules 1. The microspheres are added to the thermoplastic or thermoelastomer granules in a quantity of between 2 and 5%, preferably 3%, by weight based on the weight of the thermoplastic material.

The microspheres 6 may be added to the thermoplastic granules 1 in the mixer 2, or, alternatively, may be added to the granules when in the plasticiser 4. However, it is preferred that the microspheres be added to

the plasticised thermoplastic or thermoelastomeric material as the material from the plasticiser 4 is introduced into the injection moulding tool 5.

When exposed to the relatively high temperature of the plasticised thermoplastic or thermoelastomer granules as they are introduced into the injection moulding apparatus 5, the polymer material forming the microspheres is softened and the liquified gas within the microspheres is heated to a temperature approaching that of the plasticised thermoplastic material. The liquified gas within the microspheres thus expands substantially as it is gasified.

The injection moulded elements are found to comprise a foam-like material. The gas spaces within the foam may comprise between 30 and 60% by volume. For a typical thermoplastic material, the density can decrease from about 0.9 kg/m^3 for the unfoamed material to about 0.6-0.4 kg/m^3 for the foamed material. The cellular structure of the foamed material is fine and very homogenous, as compared with the prior proposed foamed materials discussed above. The individual cells have a diameter of approximately 100 - 150 microns. A thin unfoamed skin some tenths of a millimetre thick at the outer surface of the moulded element.

Figure 2 illustrates a steering wheel comprising a rim 10 associated with spokes 11 and a central hub 12. The steering wheel has been formed by utilising the method described with reference to Figure 1 to mould a padding element comprising a foamed thermoplastic material on to a metal frame.

Figure 3 illustrates a sectional view of part of the rim 10. The metal frame 13 is clearly visible, being of circular section. The frame is surrounded by a padding element comprising a foamed material 14. The foamed material comprises the thermoplastic 15 as initially utilised, together with a plurality of individual cells 16 which are typically of 100 - 150 micron size in diameter. Each cell 16 is bounded by a thin layer 17 of the material forming the microspheres utilised.

It is found that there are no microspheres in an outer "skin" region 18 which has a thickness of some tenths of a millimetre.

The skin 18 provides the steering wheel with a comfortable "feel", although, if desired, an additional non-foamed skin could be added on to the exterior of the thin skin 18 discussed above.

The described process has been found to offer various advantages.

The padding has good energy-absorbing properties. The individual cells defined by the microspheres will collapse if subjected to a sufficiently high load, providing an energy-absorbing effect.

Only a minimum of "flashing" occurs, meaning that a minimum of time must be spent in de-flashing. Any material removed during flashing can be recycled.

The cycle time for the moulding process is relatively short. As the gas present in the microspheres expands, it provides a cooling effect, thus meaning that

the mould can be opened relatively swiftly after the injection process has been completed.

The moulding process is found to be "repeatable" in that the product is produced in a consistent manner. There is only a very low reject rate due to blisters and other surface defects. The material utilised, being a thermoplastic material, can be recycled, and consequently the material forming any faulty products may be recycled immediately. The material may be recycled at the end of the life of a motor vehicle.

Whilst the invention has been described with reference to a method of forming a padding element that forms an integral part of a steering wheel, it is to be understood that the invention relates to other padding elements for interior components of motor vehicles including dash-boards, pillars, such as B-pillars, air-bag covers, knee protection pads, sun visors, gear lever knobs, arm rests etc.

CLAIMS:

1. A method of manufacturing a padding element for an interior component of a motor vehicle, the method comprising the step of moulding the padding element from a mixture of microspheres and a matrix of plasticised thermoplastic material, the microspheres being formed of plastic shells filled with gas or liquified gas.

2. A method according to Claim 1 wherein the moulding comprises injection moulding.

3. A method according to Claim 1 or Claim 2 wherein the microspheres are added to the matrix material after it has been plasticised.

4. A method according to Claim 1 or Claim 2 wherein the microspheres are added to the matrix material in a plasticiser in which the matrix material is plasticised.

5. A method according to Claim 1 or Claim 2 wherein the microspheres are added to the matrix material in a mixer prior to the matrix material being plasticised.

6. A method according to any one of the preceding Claims wherein the microspheres are added to the matrix granules in a quantity of between 2 and 5% by weight based on the weight of the matrix material.

7. A method according to Claim 6 wherein the microspheres are added in a quantity of substantially 3% by weight.

8. A method according to any one of the preceding Claims wherein the plastic material forming the microspheres is a different material to the material of the matrix.

9. A method according to Claim 8 wherein the melting point of the material forming the microspheres is higher than the melting point of the material of the matrix.

10. A method according to any one of Claims 1 to 8 in which a thermoelastomer material is utilised as matrix material.

11. A method according to Claim 10 in which the thermoelastomer material is based on styrene, ester, urethane, amide or olefin.

12. A method according to Claim 10 in which the thermoelastomer material is a styrene-ethylene-butane-styrene material.

13. A method according to Claim 10 in which the thermoelastomer material is styrene-ethylene-propylene-styrene.

14. A method according to any one of the preceding Claims wherein the padding element is moulded on to the said component.

15. A method according to any one of the preceding Claims wherein the component comprises a steering wheel, dashboard or pillar, air-bag cover, knee protection pad, sun visor, gear lever knob or arm-rest.

16. A padding element formed by a method according to any one of Claims 1 to 15.

17. A padding element for an interior component of a motor vehicle, the padding element comprising a moulded element, the element being moulded from a matrix of thermoplastic material, the element having, within the matrix material a plurality of closed gas filled cells, each cell being bounded by a material which is different from the material of the matrix.

18. An element according to Claim 17 wherein the diameter of each cell is approximately 100 - 150 microns.

19. An element according to Claim 17 or 18 wherein the volume contained within the said cells comprises between 30 and 60% of the total volume of the said element.

20. An element according to any one of Claims 17 to 18 wherein the element has an unfoamed skin adjacent its surface having a thickness of the order of tenths of a millimetre. (0.1 - 1.0mm).

21. An element according to any one of Claims 17 to 20 in the form of an element moulded to the core of a steering wheel.

22. An element according to any one of Claims 17 to 20 in the form of an element moulded to or forming a dashboard, knee protection pad, sun visor, gear lever knob or arm-rest.

23. An element according to any one of Claims 17 to 20 in the form of an element moulded to a pillar.

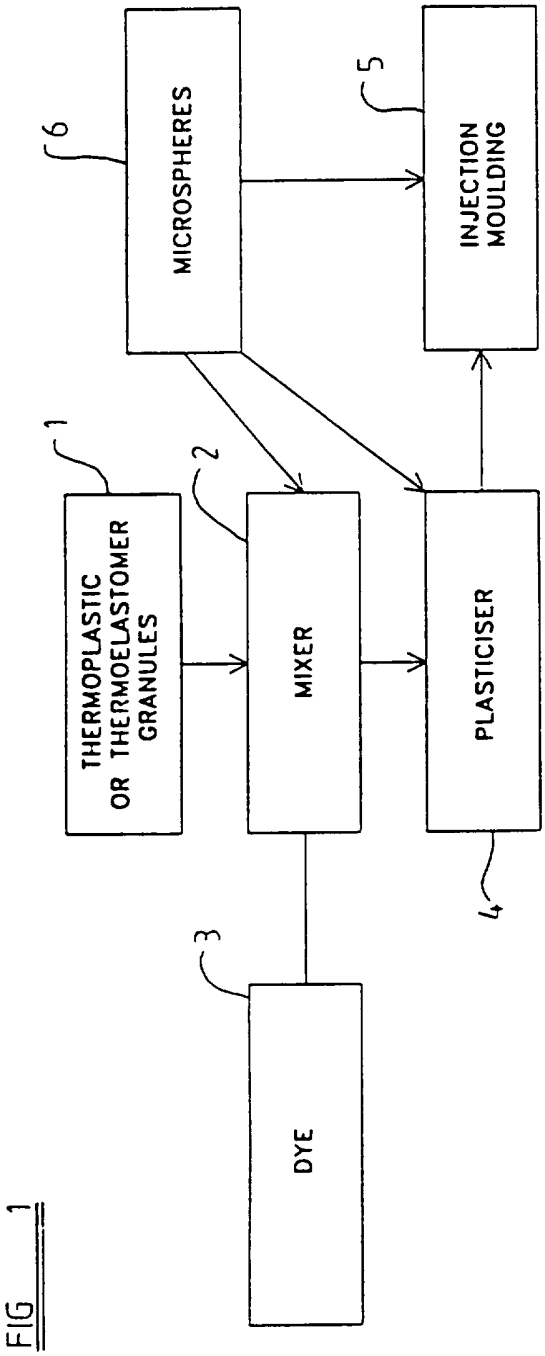

FIG 1

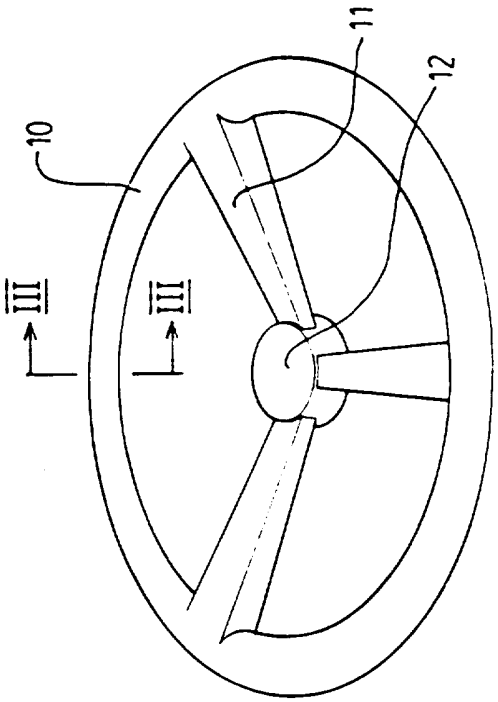

FIG 2

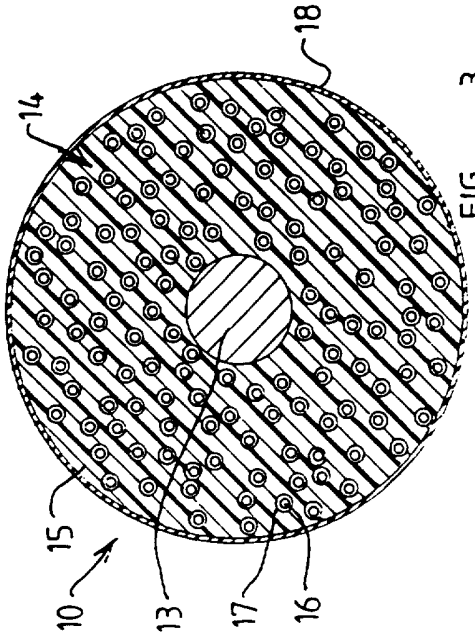

FIG 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/01195

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C08J 9/32
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)

IPC6: C08J, B62D

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5244613 A (MICHAEL F. HURLEY ET AL), 14 Sept 1993 (14.09.93), column 2, line 33 - line 63; column 3, line 26 - line 34; column 9, line 10 - line 56, abstract --	1-11,14-19, 21-23
A	US 5418257 A (MOREY WEISMAN), 23 May 1995 (23.05.95), abstract --	1-23
A	Derwent's abstract, No 92-222608/27, week 9227, ABSTRACT OF JP, 900271966 (KANTO SEIKI CO LTD), 9 October 1990 (09.10.90), abstract --	1-23

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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10 February 1997	13 -02- 1997
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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/96

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5244613	14/09/93	BR-A- 9400143	09/08/94
		CA-A- 2113502	22/07/94
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