PRODUCT

Field of Invention

This invention relates to a moulding apparatus and a method of forming a moulded foam article using said moulding apparatus.

Background

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A foam component of a garment or clothing is very often an important aspect of the garment in providing support and comfort to the wearers. Fabric layers which are not incorporated with a foam are usually thin and lack the sturdiness necessary for supporting body parts. In order for the foam component to perform its function, it needs to be moulded into a desired shape profile to complement and support the shape of body parts. Typically, this can be done *via* a thermal moulding process which requires the use of a moulding apparatus, heat and pressure to mould the foam into a desired shape.

While the foam provides structural support to the garment, the fabric layers or liners lining the foam component determines the texture or hand-feel of such garments. An example of such foam-based garment is a brassiere. Most of the designs for brassiere cup use polyester fabrics as fabric liners over the foam component. Although polyester fabrics are usually strong, they lack the superior hand-feel of nylon fabrics. In the past, people have tried to use white or light colour nylon fabrics as brassiere cup liners. However, this led to undesirable results in which the nylon-lined brassiere cups turned yellow during the thermal moulding process. This is due to the fumes produced during the moulding process which caused yellowing of the nylon fabrics.

Given the above, there is a need to develop new moulding apparatus and method that address one or more of the problems as mentioned.

Summary of Invention

According to a first aspect of the invention, there is provided a moulding apparatus for producing a moulded article, comprising:

a male mould component; and

a female mould component configured to receive the male mould component;

wherein at least one of the male and female mould components comprises one or more vents; and

wherein the vents are co-operable with a suction mechanism for extracting fluid through the vents.

According to a second aspect of the invention, there is provided a method for producing a moulded article, the method comprising the steps of:

disposing a foam article between a male mould component and a female mould component, at least one of the male and female mould components comprising one or more vents;

moulding the foam article under a pre-determined set of physical conditions to thereby form the moulded article; and

extracting fluid released from said moulding through the vents.

Brief Description of Drawings

Certain embodiments of the present disclosure are described more fully hereinafter with reference to the accompanying drawings.

Figure 1 depicts a side view of male and female mould components of the invention for moulding brassiere cup.

Figure 2 depicts top views of an aluminium female mould component for moulding a pair of brassiere cups, having: (a) a vent at one moulding receptacle; and (b) four vents at each moulding receptacle.

Figure 3 depicts the cross-section of a moulded brassiere cup which comprises a foam component in between an inner and outer fabric layers.

Description

The present invention provides a moulding apparatus that is particularly suited for producing a moulded article from a foam article without causing, or that at least reduces or minimises,

yellowing (or other colour variations) of the moulded article. The moulding apparatus allows the moulded articles to form their expected moulded shape and at the same time retain their colours. These advantages are achieved by having vents that operate with a suction mechanism to remove fluid (i.e. fumes, steam and other hot gases) that are produced during the moulding process. This minimises the reaction of such fluid with the moulded articles, therefore preventing or reducing the yellowing of these articles. As such, according to a first aspect of the invention, there is provided a moulding apparatus for producing a moulded article, comprising:

a male mould component; and

a female mould component configured to receive the male mould component;

wherein at least one of the male and female mould components comprises one or more vents; and

wherein the vents are co-operable with a suction mechanism for extracting fluid through the vents.

Additionally, according to a second aspect of the invention, there is a method of making the moulded article from the foam article using the moulding apparatus of the invention as described. The method for producing a moulded article comprises the steps of:

disposing a foam article between a male mould component and a female mould component, at least one of the male and female mould components comprising one or more vents;

moulding the foam article under a pre-determined set of physical conditions to thereby form the moulded article; and

extracting fluid released from said moulding through the vents.

In embodiments herein, the word "comprising" may be interpreted as requiring the features mentioned, but not limiting the presence of other features. Alternatively, the word "comprising" may also relate to the situation where only the components/features listed are intended to be present (e.g. the word "comprising" may be replaced by the phrases "consists of" or "consists essentially of"). It is explicitly contemplated that both the broader and narrower interpretations can be applied to all aspects and embodiments of the present invention. In other words, the word "comprising" and synonyms thereof may be replaced by the phrase "consisting of" or the phrase "consists essentially of" or synonyms thereof and *vice versa*.

The term "male mould component" when used herein refers to a mould component having one or more protrusions or convex portions on a surface. On the other hand, the term

"female mould component" refers to a mould component having one or more receptacles or concave portions on a surface. As will be appreciated, the female mould component is configured to receive the male mould component, such that the mating surfaces of each component are complementary to each other to provide a good fitting. Figure 1 shows an embodiment of the moulding apparatus comprising both the male and the female mould components which are used for moulding a brassiere cup.

The foam article may comprise a first fabric layer, a second fabric layer, and a foam component disposed between the first fabric layer and the second fabric layer. The foam component may be bonded between the first and second fabric layers with a bonding agent between the foam component and the fabric layers. The bonding agent may be an adhesive for bonding the foam component and the fabric layers directly, or may be used for bonding the foam component and the fabric layers prior to the moulding process. The bonding of the foam component and the fabric layers may occur during the moulding process. On the other hand, a laminated foam article, which comprises a foam component which had already been bonded to the fabric layers prior to moulding, may be used with the moulding apparatus. The bonding agent may comprise one or more of polyurethane, polyester and silicone, but may not be limited to such materials. The bonding agent may be applied to the foam component and/or fabric layers by spraying, printing, layering, heat transfer or using a hot glue gun.

The foam component may be made of polyurethane, or any other foam materials which may be suitable for use in garments or fabric. The term "fabric" when used herein includes woven fabrics, knit fabrics, non-woven fabrics, multilayer fabrics, and the like. Any suitable types of fabric materials may be used to form the first and second fabric layers. Suitable fabrics include synthetic and natural fabrics. For example, each of the first and second fabric layers may be made from one or more of nylon, polyester, spandex and cotton, or a combination thereof, but may not be limited to such materials. As will be appreciated, the first and second fabric layers may not necessary be made of the same fabric material. Furthermore, the fabric layers may be made of a single fabric material or a blend of different fabric materials. The choice of foam component and fabric layers depends on the moulded article to be produced. Suitable moulded articles that may be produced using said method of the current invention include a brassiere cup, brassiere wing, brassiere strap, butt enhancer, shoulder pad, impact protection or industrial wear like a shin guard, an elbow guard and a head guard.

During the moulding of the foam article (for example, comprising a polyurethane foam component), hot fluid may be produced. Such fluid may include fume, smoke, hot gases (e.g. hot air or steam), and dispersion of liquid particles in gas (e.g. aerosol). The fluid may

interact with the first and second fabric layers, liners or finishes on the foam article, thereby causing the fabric layers, liners or finishes to turn yellow. This is particularly prominent for nylon and spandex fabric liners which may undergo discolouration easily. Therefore, it is important that such fluid is removed promptly to minimise their contact with the moulded articles.

One or both of the male and female mould components comprises one or more vents which are co-operable with a suction mechanism to extract and remove fluid produced during the moulding process. Such suction mechanism may comprise a vacuum pump, a Venturi system, and any other devices capable of drawing fluid away, or producing a suction or low pressure may be used. The vents may be referred to as vacuum channels for communicating the fluid away from the components. At least one vent in either or both of the male and female components is needed for the invention to work. However, it may be advantageous to have more than one vent to allow a quicker removal of fluid produced during the moulding process. Preferably, the vents may be found at least on the female mould component. Embodiments of the female mould components having vents are as shown in Figure 2. Such female mould components have two receptacles and are used for moulding a pair of brasserie cups. Figure 2a shows a female mould component with one vent at one receptacle, while Figure 2b shows a female mould component having four vents at each receptacle. The vents may be formed as perforations in the female mould component. As will be appreciated, the vents may be positioned at any suitable parts of the mould components. For example, the vents may be positioned at the side of the moulding receptacles (in Figure 2b), or at the center portion of the moulding receptacles.

The male and female mould components may be made of materials which are durable, and are able to withstand high temperature and pressure. Preferably, the male and female mould components are made of metal, and more preferably, aluminium or steel.

The foam article disposed in between the male and female components is moulded to the desired profile shape by bringing the mould components together. The foam article can be moulded with any orientation or arrangement of the mould components, as long as the moulding surfaces on the male and female components can be fitted together. Preferably, the male mould component is positioned below the female mould component, such that the female mould component moves downward towards the male mould component to perform the moulding. Advantageously, such positioning of the male mould component at the bottom ensures that the fluid generated during the moulding process moves upwards, and away from the male mould component where the foam article is positioned. The fluid is then

removed by the vents on the female mould component. Such arrangement of the mould components is different from the typical molding method in which the female mould component is positioned below the male mould component, and that the male mould component moves down from the top.

Such arrangement of the mould components allows the rising fumes to be quickly extracted through the vents above, reducing the reaction time the fumes have with the fabric layers, especially nylon-based fabrics. As the reaction time is reduced or even eliminated, the tendency for the fabric layers to turn yellow is diminished, thereby reducing, minimising, or even preventing yellowing of the moulded article. It will be appreciated that "yellowing" can mean other colour variations or changes of the fabric layers due to reactions with the fumes, without necessarily relating to the colour yellow or variations or shades thereof.

The moulding process has to be performed at a high temperature so that thermoforming of the foam article can occur. At the required temperature, the foam article becomes pliable and can be moulded into various shapes easily. To ensure that the foam article is not exposed to unnecessarily high temperature, the male and female mould components may be heated to different temperatures. A suitable pre-determined set of physical conditions may be applied to the foam article. For example, the suitable pre-determined set of physical conditions may be, but is not limited to a temperature of the male mould component at 170 to 200 °C, a temperature of the female mould component at 150 to 190 °C, a pressure of 29 to 116 psi and a moulding duration of 100 to 280 seconds. This prevents the foam article from exposing to excessive heat overall, as the female mould component may not need to be subjected to the heat requirements of the male mould component for example. This technique of differential mould heating reduces the overall heat in the mould components in the moulding process, thereby reducing the tendency of the foam article to emit fumes which can cause yellowing of the fabric layers, especially nylon-based fabrics. As will be appreciated, the pre-determined set of physical conditions (i.e. temperature of each mould component, moulding duration etc) may be adjusted accordingly to the type of foam component and fabrics used.

In an embodiment, the method for producing a moulded article may be applied to moulding a foam article comprising a foam component bonded to the first fabric layer and the second fabric layer, such as with a bonding agent. As such, the foam article may be a laminated composite, such that the foam component is sandwiched and bonded between the fabric layers prior to the moulding process. The laminated composite is subsequently moulded in the moulding apparatus having the vents to form the moulded article.

In a further embodiment, the foam article (i.e. laminated composite) may be in a non-moulded or moulded form prior to the moulding process. In the non-moulded form, the foam article may be flat or does not take any fixed shape. In the moulded form, the foam article may have a pre-moulded shape, and may be moulded using the same moulding apparatus as described herein, prior to the moulding process.

In an embodiment, the method for producing a moulded article may be applied to moulding a foam article comprising a foam component not bonded or not fully bonded to the first fabric layer and the second fabric layer with a bonding agent. As will be appreciated, the bonding agent may be disposed of between the foam component and the fabric layers, but may be partially or not bonding to the foam component and the fabric layers prior to the moulding process. The foam component may be fully bonded to the fabric layers after the moulding process to form the moulded article.

In a further embodiment, each of the foam component, first and second fabric layers may be in a non-moulded or moulded form prior to the moulding process. In the non-moulded form, each of the foam component, first and second fabric layers may be flat or does not take any fixed shape.

In the moulded form, each of the foam component, first and second fabric layers may have a pre-moulded shape (i.e. a brassiere shape), and may be moulded using the same moulding apparatus as described herein, prior to the moulding process. For example, this can be achieved *via* a multiple stage moulding process. In the first stage, the first and second fabric layers (i.e. in a flat form) may be deformed and moulded to form molded fabric layers. In the second stage, the foam component may be deformed and moulded (i.e. from a flat foam sheet) to form a moulded foam component. Thereafter, the third stage involves the assembling of the moulded foam component in between the moulded first and second fabric layers to form the foam article or laminated composite in moulded form. The assembling may further include bonding with a bonding agent. The foam article is subsequently further moulded in the moulding apparatus to form the final moulded article product.

The final moulded article is illustrated in Figure 3. Specifically, the moulded article is a brassiere cup which comprises a foam component in between an inner and outer fabric layers. The fabric layers are made of nylon and the foam component is made of polyurethane.

Statements of Invention

1. A moulding apparatus for producing a moulded article, comprising:

a male mould component; and

a female mould component configured to receive the male mould component;

wherein at least one of the male and female mould components comprises one or more vents; and

wherein the vents are co-operable with a suction mechanism for extracting fluid through the vents.

2. The moulding apparatus according to Statement 1, wherein the suction mechanism comprises a vacuum pump or a Venturi system.

3. The moulding apparatus according to Statement 1 or 2, wherein the male mould component and the female mould component are made of aluminium or steel.

4. A method for producing a moulded article, the method comprising the steps of:

disposing a foam article between a male mould component and a female mould component, at least one of the male and female mould components comprising one or more vents;

moulding the foam article under a pre-determined set of physical conditions to thereby form the moulded article; and

extracting fluid released from said moulding through the vents.

5. The method according to Statement 4, wherein the male mould component is positioned below the female mould component.

6. The method according to Statement 5, wherein the female mould component moves downward towards the male mould component to perform said moulding.

7. The method according to any one of Statements 4 to 6, wherein the foam article comprises:

a first fabric layer;

a second fabric layer; and

a foam component disposed between the first fabric layer and the second fabric layer.8. The method according to Statement 7, wherein the foam component is bonded between the first fabric layer and the second fabric layer with a bonding agent.

9. The method according to Statement 8, wherein the bonding agent comprises one or more of polyurethane, polyester and silicone.

10. The method according to Statement 8 or 9, wherein the bonding agent is applied to the foam component and/or fabric layers by spraying, printing, layering, heat transfer or using a hot glue gun.

11. The method according to Statement 7, further comprising, prior to moulding the foam article, moulding each of the first fabric layer, second fabric layer, and foam component between the male and female mould components.

12. The method according to Statement 11, further comprising, prior to moulding the foam article, applying a bonding agent to bond the moulded foam component between the moulded first and second fabric layers.

13. The method according to Statement 12, wherein the bonding agent comprises one or more of polyurethane, polyester and silicone.

14. The method according to Statement 12 or 13, wherein the bonding agent is applied to the moulded foam component and/or moulded fabric layers by spraying, printing, layering, heat transfer or using a hot glue gun.

15. The method according to one of Statements 7 to 14, wherein the foam component is made of polyurethane.

16. The method according to one of Statements 7 to 15, wherein each of the first and second fabric layer are selected from one or more of nylon, polyester, spandex and cotton.

17. The method according to any one of Statements 4 to 16, wherein the pre-determined set of physical conditions comprises:

(i) a temperature of the male mould component at 170 to 200 °C;

(ii) a temperature of the female mould component at 150 to 190 °C;

(iii) a pressure of 29 to 116 psi; and

(iv) a moulding duration from 100 to 280 seconds.

18. The method according to any one of Statements 4 to 17, wherein the moulded article is a brassieres cup, a brassieres wing, a brassieres strap, a butt enhancer, a shoulder pad, a shin guard, an elbow guard, or a head guard.

Abstract

Disclosed herein is a moulding apparatus for producing a moulded article, comprising a male mould component and a female mould component configured to receive the male mould component, wherein: at least one of the male and female mould components comprises one or more of vents; and the vents are co-operable with a suction mechanism for extracting fluid through the vents.

Figures

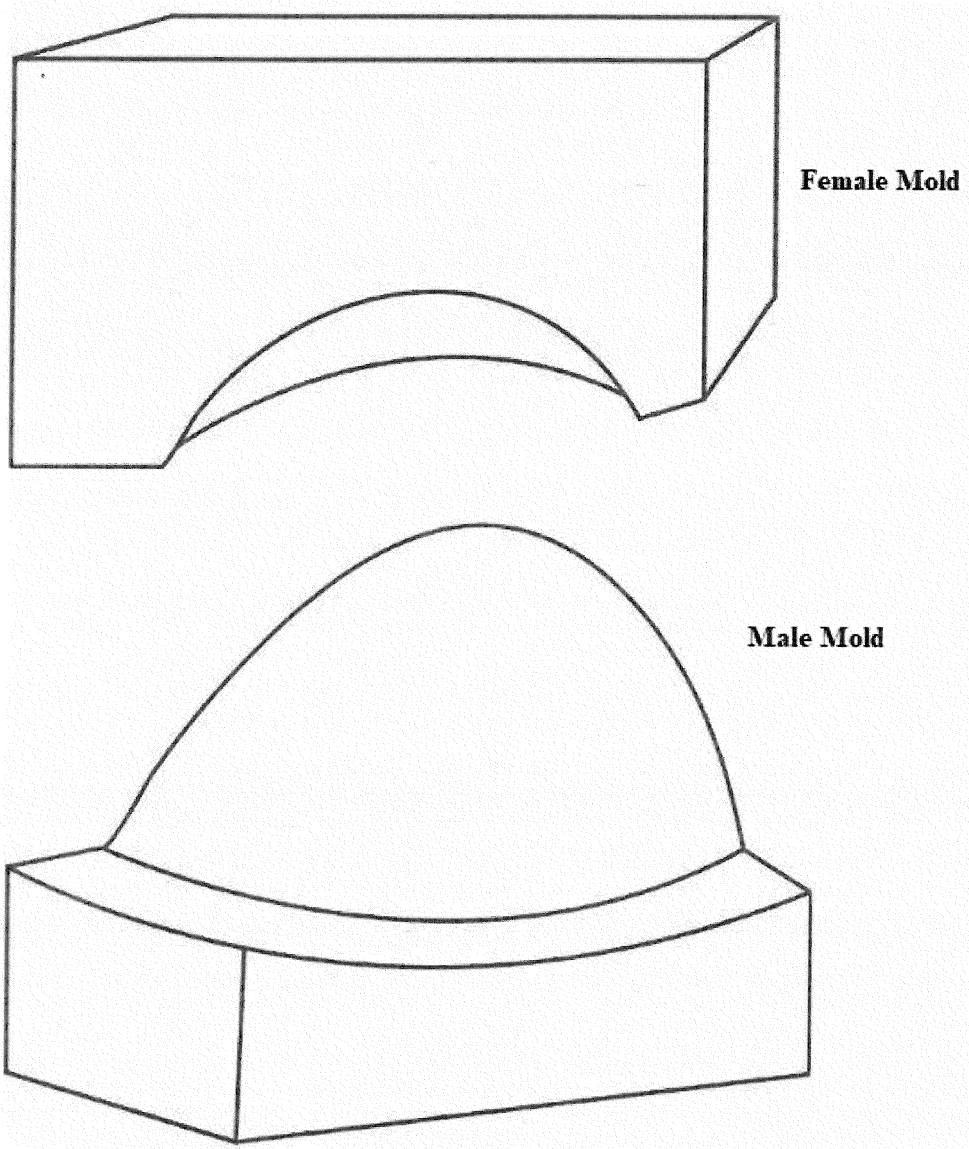


Figure 1

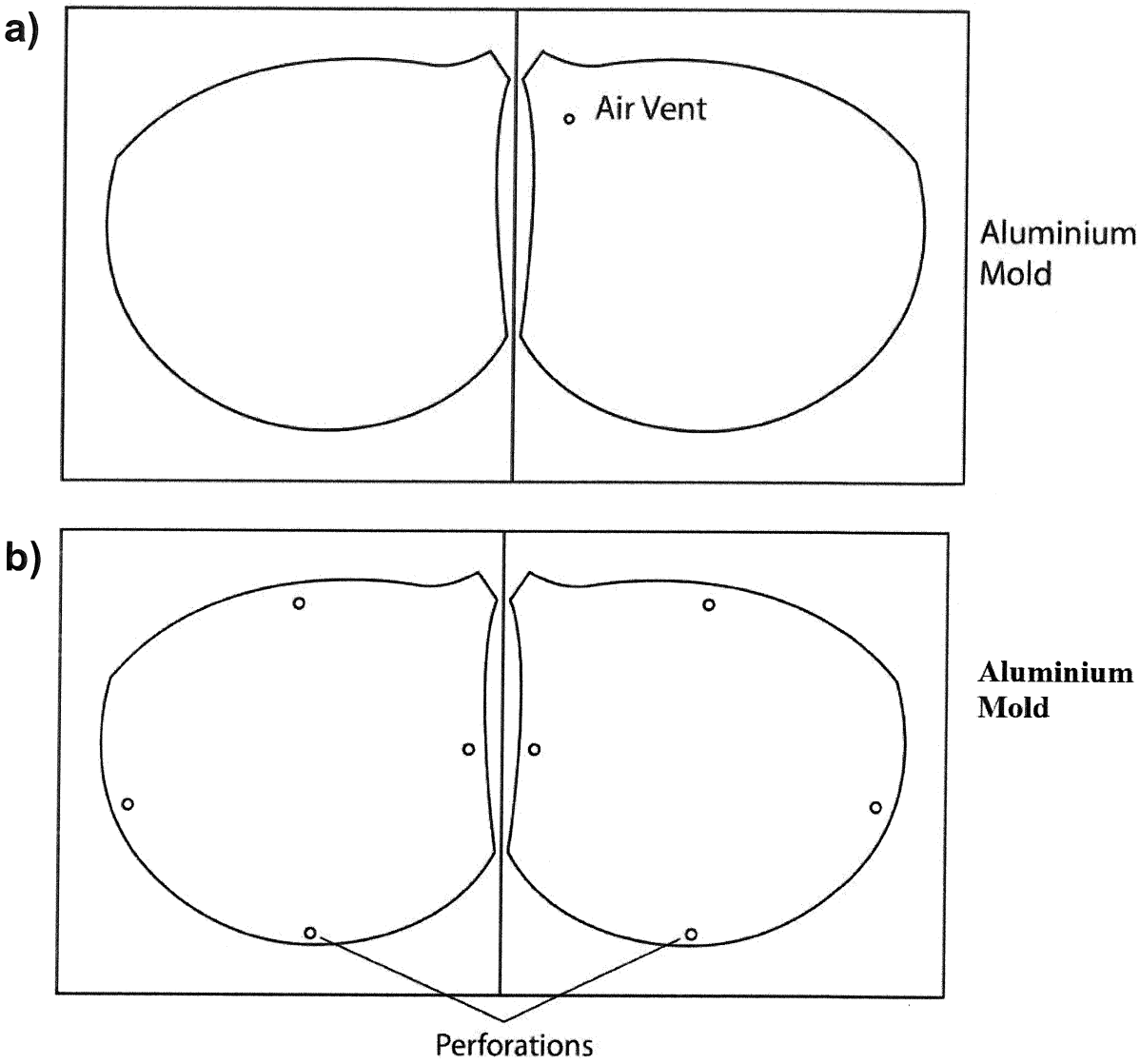


Figure 2

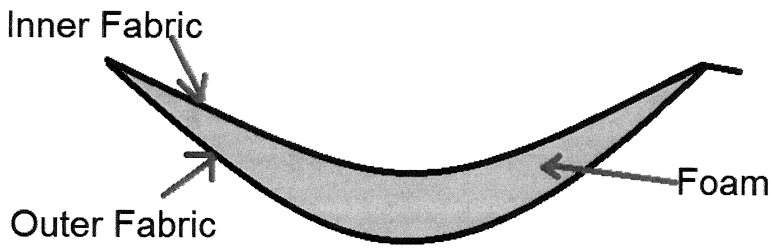


Figure 3