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**Item of lingerie made from a knitted tube having
retaining features**

The present invention relates to an item of support lingerie having at least one moulded region to create a retaining and support volume for at least one protuberant part of the human body.

5 The articles in question are primarily brassieres and briefs, in which the cups and the part covering the buttocks respectively may incorporate substantially mechanical features designed to impart to them a support function and even to lift the breasts and buttocks of the
10 users.

Manufacturers in the lingerie sector are constantly faced with a dual challenge: that of ensuring maximum comfort on the one hand whilst providing an optimum support and retaining function on the other.
15 Historically, the problem initially cropped up with brassieres, whilst the idea of moulding and hence supporting the buttocks by means of the actual structure of the briefs in a manner similar to that applied to the breasts is a more recent phenomenon.

20 Traditionally, items of lingerie have been made using cut pieces which are then sewn together, particularly in the zones intended to form a three-dimensional capacity such as the cups of brassieres. In order to improve wearing comfort, the idea was posited
25 that stitching should be reduced as far as possible, especially since stitched seams form extra thicknesses which can be irritating where they come into contact with the skin. Bonding and even welding techniques were therefore developed and applied in this field with a view

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to reducing or even eliminating the presence of these stitched seams.

Patent document EP 0 809 945, for example, discloses a brassiere manufactured from a material incorporating
5 heat-weldable fibres, the various components of the brassiere made from this material being assembled with one another by heat-welding in order to impart the final shape to said brassiere.

Although stitching is eliminated, the plurality of
10 welded zones, particularly in the bottom part of the brassiere surrounding the bust, nevertheless involves the use of some relief areas which are elastically supported against the skin and have a perceptible effect on wearing comfort.

15 In order to overcome this drawback, brassieres have been developed in which the periphery is made in a single piece from a tubular knitted fabric. In reality, these brassieres tend not to have cups for the breasts and are designed for women with a small chest or for sporting
20 purposes and compress the breasts rather than support them. Similarly, briefs made from tubular knitted fabric do not have any means of supporting or lifting the buttocks, although they do afford good peripheral compression.

25 In situations where several pieces are not stitched together to impart a three-dimensional shape to the cups, it is necessary to use textile fibres that are both elastic and whose elongation can be modified in order to provide the support characteristics and adapt to
30 different bust sizes. For example, heat-deformable fibres are used to enable the cups or buttock regions to be heat-moulded, thereby imparting a three-dimensional configuration to accommodate the breasts or buttocks.

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However, the ability to mould fibres is not enough on its own because it is also vital to impart mechanical strength in order to support and hold these parts of the body. Generally speaking, this mechanical strength is not
5 needed merely in the region supporting the buttocks or breasts but also needs to be imparted to the article of lingerie generally in order to take account of the day-to-day strain to which different parts of the item are subjected. Accordingly, it is necessary to preserve a
10 certain degree of strength in the back tabs of a brassiere, which is also subjected to strain as the bust of the user moves.

Another necessary feature is the ability to withstand washing, sometimes at a high temperature, which
15 may affect the durability of the mechanical characteristics of the fibres.

For this reason, it is preferable to provide a fabric lining, at least in certain zones, this lining naturally also being subject to the above-mentioned
20 criteria/limitations, especially resistance and elasticity, whilst it is particularly important for it not to be secured to the outer fabric by stitching, yet exhibit a capacity for controlled extension as applicable, etc.

25 This is essentially the objective of the invention.

Generally speaking, it relates, as mentioned above, to an item of support lingerie incorporating at least one region moulded to create a three-dimensional retaining and support volume for at least one protuberant part of
30 the human body, manufactured from a tubular knitted fabric made from a first extensible and heat-deformable material, provided with a ribbing constituting one of the edges of said article elastically enclosing the body, the

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final shape of the item of lingerie being made by cuts made in the knitted tube starting from the free edge opposite the ribbing, characterised in that each moulded three-dimensional region is lined by at least one
5 internally bonded lining made from a second extensible and heat-deformable material, one face of which is coated with a heat-activatable adhesive, the knitted fabric and lining materials on the one hand having a modulus of elongation, either by heat deformation or elastic, and
10 the adhesive on the other hand having an activation temperature such that they enable deformation to be induced by hot-moulding the moulded regions to impart a three-dimensional aspect to them without affecting the heat-bonded join, said first and second materials
15 conserving their capacity to support and hold after moulding.

Not only do the articles proposed by the invention afford maximum comfort due to the fact of using a knitted tube and bonded seams, they also exhibit bust supporting
20 properties which enable brassieres to be made for every chest size, for example, including the largest requiring E or F size cups.

Whilst the support features are naturally linked to the double thickness of textile fabric, they are also due
25 primarily to a judicious choice of materials for both the two layers of textile and for the adhesive, meeting the imperatives of mechanical strength over time and in space as well as the problems inherent in manufacture.

Accordingly, it is of vital importance during the
30 heat-forming process that the two layers of textile react compatibly in terms of elongation whilst remaining bonded to one another. The same may be said with regard to the elastic and hence rebound elongation during day-to-day

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use of the product.

Tests have shown that the modulus of elongation of the materials used for the knitted fabric and the lining must exhibit a differential ranging between 0 and 140% and each fabric must be capable of undergoing an elongation greater than or equal to 40%. This is the requirement for good mechanical strength, particularly with regard to moulding. In this respect, elongation is defined as being the percentage elongation and deformation of the material relative to its non-elongated state, caused by a linear force of 3N per centimetre.

If the above values are not complied with, there is a risk that one of the materials will slip relative to the other, thereby rupturing the adhesive/textile cohesion during moulding, which will cause the two materials to come unstuck.

As regards the criteria for selecting appropriate materials, it should be pointed out that materials which permit too great an elongation must be ruled out because although they will permit perfect moulding, they will not provide the subsequent mechanical strength needed to hold the breasts or buttocks.

In fact, the results of an experiment show that the first and the second materials should be made of a mixture of fibres containing at least 7% synthetic fibres. Polyester fibres, in particular, are suitable.

Synthetic fibres having a modulus of elongation can be perfectly mixed with natural fibres such as cotton which are not at all or not very extensible: it is the links created by the knitting stitches which permit elongation of the fabric if the extensible fibres are correctly disposed or aligned in said stitches.

By preference, said first and second materials are

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made of a mixture of polyamide and elastane.

This mixture permits suitable elastic elongation and heat-forming whilst affording a mechanical strength that will impart a proper stability to the product both over
5 time and in space.

One of the key technical developments of the invention is in fact the adhesive, without which a lining could not be fixed. The cohesion of the two textile layers must be maintained under heat during the moulding
10 process, which in principle leads to a definitive stretching of certain fibres, and when cold when the product is not elastically stretched. Furthermore, this cohesion must not be altered by successive washes, even at high temperature.

15 A large amount of research and numerous tests have shown that the adhesive material may be selected from among the polyamides or from polyurethane adhesives. The criterion governing selection is the activation temperature of the adhesive, which must not in principle
20 be detrimentally affected by the hot moulding operation, conducted at a temperature of between 175°C and 195°C.

More specifically, one possibility is to use an adhesive comprising a mixture of copolyamides whose activation temperature is between 165°C and 195°C.

25 If using a polyurethane, the activation temperature will be between 185°C and 195°C.

Tests on materials with a lower activation temperature, for example in the order of 140°C to 150°C, even up to 165°C, have led to problems due to unsticking
30 because the adhesive comes apart from the substrates during moulding.

Apart from these problems of temperature, the choice of adhesive material will depend on the capacity of

whatever materials are used to cohere with the textile layers. The chosen copolyamide mixture as well as polyurethane are effective in this respect.

It should also be pointed out that the adhesive with a copolyamide base is disposed on one face of the lining in the form of dots laid out in repetitive patterns. This mode of application has a double advantage in that it avoids making the lining thicker and it allows it to retain its breathability. If using a polyurethane adhesive, which is better suited to a more refined moulding process, the adhesive is disposed on the face of the lining in the form of a continuous film.

In a preferred application, the invention relates to a brassiere and is thus made from a tubular knitted fabric as described above wherein the ribbing forms the bottom edge that elastically surrounds the body at the level of the bust, the region of the cups being lined with one of said internally bonded lining moulded to the shape of the breasts.

Clearly, by the region of the cups is meant the interior thereof as well as their immediate periphery and preferably the region linking them.

The latter also has a centre piece, i.e. a triangular piece of fabric made from a non-extensible material inserted between said front piece and the knitted fabric in the region between the cups. This centre piece, which stiffens the part located between the breasts, contributes to the support function by specifically preventing any horizontal deformation between the breasts.

By preference, one face of said centre piece is coated with an adhesive enabling it to be bonded onto the knitted fabric. Even more preferably, said adhesive is the same as that used to bond the front piece and the

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knitted fabric.

In assembling this stiffening piece, the same benefits apply as those obtained by lining with the front piece, i.e. no over-thick stitched seams which can cause
5 irritation, adhesive applied so as to allow the material to breathe, etc.

In one possible embodiment, the brassiere proposed by the invention is also designed so that each cup incorporates a reinforcement inserted in a compartment
10 disposed between the front piece and the knitted fabric, said compartment bounding the bottom contour of the cup.

More specifically, said compartment is made from a textile tube without stitched seams, of a shape matching that of the reinforcement, having a very high density of
15 threads and sewn onto the front piece.

The fact that the support band made as above is sewn onto the bonded face of the front piece means that the stitching is not visible from the right side of the product. Consequently, there is less extra thickness on a
20 level with the support band, due to the lining proposed by the invention, and the reinforcement is less noticeable to the user. This design is therefore extremely advantageous because it significantly increases comfort whilst providing optimised support due to the
25 presence of the reinforcement.

In addition to the brassiere, the invention also relates to a method of manufacturing a brassiere from a tubular knitted fabric constituting a first extensible and heat-deformable material, provided with a ribbing
30 forming the bottom skirt of the brassiere, characterised by the following steps:

- tracing the upper contours of the brassiere as the tube is knitted using stitches of a different texture for

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said contours;

- bonding an internal lining of a second extensible and heat-deformable material in the region of the cups by hot-pressing at a temperature between 165°C and 195°C;

5 - hot-moulding the cups at a temperature between 175°C and 195°C;

- cutting out the brassiere along the outline contours on the knitted tube;

- joining front and rear portions of straps as cut.

10 The brassiere model is therefore designed on the basis of the tube knitted during the knitting process, which considerably facilitates the subsequent cutting operations enabling the final shape to be imparted to the product.

15 In one possible option, the upper contours of the brassiere are hemmed and stitched in an elasticating operation. These are essentially the contours of the straps, the width of which is therefore limited, conferring a more discrete appearance on said straps.

20 For practical reasons and to facilitate the manufacturing process, enabling said steps to be operated flat (bonding, moulding), the basic tube is cut on a level with the back join, back tabs being added and provided with a hooking system.

25 In the method proposed by the invention, in order to obtain a product as described above, the lining is a front piece, of which the face bonded to the knitted fabric is faced beforehand with a triangular centre piece of a non-extensible material, placed in the region
30 between the cups. This centre piece is itself coated beforehand with a layer of adhesive on its face that is not bonded to the front piece. Finally, in the case of reinforced brassieres, an additional step is integrated

in the method, which consists in stitching tubes of non-stitched tubular textile material against the face of the lining which is bonded to the knitted fabric, said tubes being provided in order to accommodate reinforcements delimiting the bottom contour of the cup.

The present invention does not only apply to brassieres; it additionally relates to briefs, which are therefore also made from a tubular knitted fabric as described above, wherein the ribbing forms the upper edge of the briefs and surrounds the waist of the body and characterised in that the region of the buttocks is lined with by at least one of the internally bonded lining and moulded to the shape of the buttocks.

The problems inherent in making briefs are generally the same as those intrinsic to brassieres, although the mechanical constraints are a priori not as great.

This being the case, the degree of moulding, which is often less than that required for brassieres with deep cups, requires a localised lining on a level with the buttocks, which may be selectively applied during moulding, and their immediate periphery.

The invention will now be described in more detail with specific reference to the appended drawings, of which:

- figure 1 depicts a perspective view of a knitted tube on which the outline of a brassiere has been traced;
- figure 2 shows a front piece to be bonded onto the knitted fabric illustrated in figure 1, on a level with the contour of the cups;
- figure 3 illustrates the bonding of said front piece in the region of the cups, on a knitted fabric cut along a directrix of the knitted tube and laid out flat;

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- figure 4 shows a finished brassiere; and
- figure 5 illustrates a knitted tube on which the outline of a pair of briefs has been traced.

Turning to figure 1, the knitted tube (1) has a
5 ribbing (2) that will subsequently form the skirt of the
brassiere (see figure 4), which is perfectly elastic
since it is a knit with a reverse stitch (false ribbing)
made directly by the knitting machine. This enables the
"tension" of the ribbing to be controlled, in other words
10 the give of the elasticity.

A specific knit may be used to trace the upper
contour of the brassiere with the cups (3, 4), the front
parts of the straps (5, 6) and their rear parts (7, 8)
which practically meet on a level with the ribbing (2).

15 Figure 2 illustrates the front piece (9) or lining
onto which textile tubes (10, 11) of a low thickness have
been stitched, said tubes (10, 11) themselves not being
provided with stitching so as to avoid any additional
thickness likely to irritate the skin of the breasts.
20 These tubes are made from a fine yarn with a very dense
mesh to prevent the reinforcement inserted therein (not
illustrated) from working out through the stitches. A
centre piece (12), being a piece of non-extensible
material of triangular shape, is bonded onto the face
25 having the textile tubes (10, 11) accommodating the
reinforcements, on a level with the mid-back.

In one option, the knitted fabric is cut at the
point at which the rear straps (7, 8) meet and is laid
out flat (figure 3) for the purpose of bonding the front
30 piece (9). The latter is bonded so that the textile tubes
(10, 11) accommodating the reinforcements on the one hand
and the centre piece (12) on the other are disposed
between the front piece (9) and the knitted fabric (1).

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Turning to figure 4, the finished brassiere has had the edges of the straps (5, 7; 6, 8) elasticated, having been joined at (13, 14) by any known means. Also, the back tabs (15, 16) with means enabling them to be fixed
5 to one another have been attached to the knitted fabric (1).

The fixing means may be bonding, welding, stitching, etc.

Finally, figure 5 shows a knitted tube (20) on which
10 a knitting stitch different from the rest of the knitwork (20) outlines the contours (21) of a pair of briefs. In this case, the ribbing (22) is at the top and encloses the waist of the user. Depending on the circumstances, the part located between the legs may also be made from a
15 different knitting stitch and/or from a different material for reasons pertaining to hygiene, comfort, etc.

The description above is given by way of example only and should not be construed as limiting the invention. On the contrary, all embodiments and designs
20 within the reach of the skilled person fall within its scope.

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CLAIMS

1. Item of support lingerie incorporating at least one region moulded to create a three-dimensional retaining and support volume for at least one protuberant part of the human body, manufactured from a tubular knitted fabric made from a first extensible and heat-deformable material, provided with a ribbing constituting one of the edges of said article elastically enclosing the body, the final shape of the item of lingerie being made by cuts made in the knitted tube starting from the free edge opposite the ribbing, characterised in that each moulded three-dimensional region is lined by at least one internally bonded lining made from a second extensible and heat-deformable material, one face of which is coated with a heat-activatable adhesive, the knitted fabric and lining materials on the one hand having a modulus of elongation, either by heat deformation or elastic, and the adhesive on the other hand having an activation temperature such that they enable deformation to be induced by hot-moulding the moulded regions to impart a three-dimensional aspect to them without affecting the heat-bonded join, said first and second materials conserving their capacity to support and hold after moulding.

2. Item of support lingerie made from a tubular knitted fabric as claimed in the preceding claim, characterised in that the modulus of elongation of the materials used for the knitted fabric and the lining exhibits a differential ranging between 0 and 140% and each fabric has an elongation greater than or equal to 40%.

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3. Item of support lingerie made from a tubular knitted fabric as claimed in the preceding claim, characterised in that the first and the second materials are made of a mixture of fibres containing at least 7% synthetic
5 fibres.

4. Item of support lingerie made from a tubular knitted fabric as claimed in the preceding claim, characterised in that said synthetic fibres are polyester.
10

5. Item of support lingerie made from a tubular knitted fabric as claimed in claim 3, characterised in that the first and the second material are made of a mixture of polyamide and elastane.
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6. Item of support lingerie made from a tubular knitted fabric as claimed in any one of the preceding claims, characterised in that the adhesive material is selected from the polyamides.
20

7. Item of support lingerie made from a tubular knitted fabric as claimed in the preceding claim, characterised in that said adhesive material is a mixture of copolyamides, the activation temperature of which is
25 between 165°C and 195°C.

8. Item of support lingerie made from a tubular knitted fabric as claimed in one of claims 6 and 7, characterised in that the adhesive material is disposed on one face of
30 the lining in the form of dots laid out in repetitive patterns.

9. Item of support lingerie made from a tubular knitted

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fabric as claimed in any one of the preceding claims, characterised in that the adhesive material is a polyurethane adhesive, the activation temperature of which is between 185°C and 195°C.

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10. Item of support lingerie made from a tubular knitted fabric as claimed in the preceding claim, characterised in that the adhesive material is disposed on one face of the lining in the form of a continuous film.

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11. Brassiere made from a tubular knitted fabric as claimed in any one of the preceding claims, wherein said ribbing forms the bottom edge that elastically surrounds the body at the level of the bust, characterised in that the region of the cups is lined with one of said internally bonded lining moulded to the shape of the breasts.

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12. Brassiere made from a tubular knitted fabric as claimed in the preceding claim, characterised in that a centre piece of non-extensible fabric is inserted between the front piece and the knitted fabric in the region between the cups.

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13. Brassiere made from a tubular knitted fabric as claimed in the preceding claim, characterised in that a face of said centre piece is coated with an adhesive material enabling it to be bonded to the knitted fabric.

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14. Brassiere made from a tubular knitted fabric as claimed in the preceding claim, characterised in that said adhesive material is the same as that used to bond the front piece and the knitted fabric.

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15. Brassiere made from a tubular knitted fabric as claimed in any one of claims 11 to 14, characterised in that each cup has a reinforcement inserted in a compartment disposed between the front piece and the knitted fabric, said compartment delimiting the bottom contour of the cup.

16. Brassiere made from a tubular knitted fabric as claimed in the preceding claim, characterised in that said compartment is made from a textile tube without stitching, of a shape matching that of the reinforcement, having a very high density of threads and sewn onto the front piece.

17. Method of manufacturing a brassiere from a tubular knitted fabric constituting a first extensible and heat-deformable material, provided with a ribbing forming the bottom skirt of the brassiere, characterised by the following steps:

- tracing the upper contours of the brassiere as the tube is knitted using stitches of a different texture for said contours;
- bonding an internal lining of a second extensible and heat-deformable material in the region of the cups by hot-pressing at a temperature between 165°C and 195°C;
- hot-moulding the cups at a temperature between 175°C and 195°C;
- cutting out the brassiere along the outline contours on the knitted tube;
- joining front and rear portions of straps as cut.

18. Method of manufacturing a brassiere from a tubular knitted fabric as claimed in the preceding claim,

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characterised in that the upper contours of the brassiere are hemmed and stitched in an elasticating operation.

19. Method of manufacturing a brassiere from a tubular
5 knitted fabric as claimed in one of claims 17 and 18, characterised in that the basic tube is cut on a level with the back join, after which the residual back tabs are provided with a hooking system.

10 20. Method of manufacturing a brassiere from a tubular knitted fabric as claimed in any one of claims 17 to 19, characterised in that the lining is a front piece, of which the face bonded to the knitted fabric is faced with a triangular centre piece of a non-extensible material
15 placed in the region between the cups.

21. Method of manufacturing a brassiere from a tubular knitted fabric as claimed in the preceding claim, characterised in that said centre piece is coated with a
20 layer of adhesive on its face that is not bonded to the front piece.

22. Method of manufacturing a brassiere from a tubular knitted fabric as claimed in any one of claims 17 to 21,
25 characterised in that tubes of non-stitched tubular textile are stitched onto the face of the lining which is bonded to the knitted fabric, said tubes being provided in order to accommodate reinforcements delimiting the bottom contour of the cup.

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23. Briefs made from a tubular knitted fabric as claimed in any one of claims 1 to 10, wherein said ribbing forms the upper edge of the briefs and surrounds the waist of the body, characterised in that the region of the buttocks is lined with at least one of said internally bonded lining and moulded to the shape of the buttocks.