BLOW PIN AND METHOD FOR PRODUCTION OF A PINCH LINE FREE LINER

Abstract: Method of blow moulding a container from a parison of a thermoplastic material comprising at least one opening, wherein the method comprises - placing at least one opening of the parison on a blow pin - arranging a moulding cavity surrounding the parison, - simultaneously blowing pressurised gas from the blow pin into the parison and expanding the outer cross sectional diameter of the blow pin and a blow moulding pin for performing the method is disclosed.
Blow pin and method for production of a pinch line free liner

The present invention relates to a pinch line free liner for a composite pressure container, a method for producing such a liner as well as equipment adapted to perform the method.

Background

A common type of composite pressure containers consist of an internal gas tight liner, at least one boss connected thereto for installation of a valve or similar connection devices for filling or emptying of the container. On the outside of the liner one or more enforcement layers are arranged to provide the container with the necessary strength to store fluid under a desired pressure. These types of containers are for instance disclosed in WO00/66939 and WO98/34063.

Prior art

The liner for the pressure containers have traditionally been produced by blow moulding. The process of blow moulding is well known in the art. The material to form a hollow or partly hollow article is provided in the form of a parison. A blow pin is inserted in the parison which is arranged in a mould cavity. Pressurized gas is fed into the parison through the blow pin forcing the parison to expand until it reaches the walls of the mould cavity.

For the blow moulding of generally bottle shaped containers with an elongated shape and an opening for filling and discharging arranged at one end thereof the parison normally has the form of a tube which is open at both ends. This parison is arranged over the blow pin and the mould cavity is closed around parison so that the parison at both ends thereof is sealed gas tight by the closing of the mould cavity. The parison is accordingly squeezed or pinched by the closing edges of the mould cavity. This area of the blow moulded object will after the moulding process is completed result in a so called pinch line in the moulded object. The material properties such as the thickness of the material will vary in the pinch line area compared to the areas remote from the pinch line. This uneven thickness may influence the reliability of the container to store fluid under pressure. Further the pinch line in the area surrounding the opening makes the outer surface of the moulded object uneven and non-smooth often with dents at the ends of the pinch line.

When blow moulding liners for composite gas containers the boss is normally arranged around the opening remaining in the liner where the blow pin was inserted. Accordingly the boss is fastened to the liner by welding or gluing in the area comprising the pinch line. The unevenness of the pinch line makes the securing of
the boss to the liner difficult and providing a smoother outer surface surrounding
the opening would be desirable to make the installation of the boss more efficient.

US4,578,028 describes a radially expandable core pin for blow molding of a
container. Here core pin is expanded radially to compression mold internal
attachment means in the neck-portion of the container comprising a dispensing
orifice. The body portion of the container is blow molded by supplying a gas
pressure trough the core pin.

**Objectives of the invention**

The objective of the present invention is to provide a method for blow moulding a
liner reducing or eliminating the presence of one or more pinch lines.

A further objective is to provide a method and system that reduces or eliminates the
pinch line at both ends of a cylindrical liner.

A further objective is to provide a blow pin adapted to perform the method
according to the present invention.

This and other objectives are obtained by a method of blow moulding a container
from a parison of a thermoplastic material comprising at least one opening, wherein
the method comprises

- placing the at least one opening of the parison on a blow pin
- arranging a moulding cavity surrounding the parison,
- simultaneously blowing pressurised gas from the blow pin into the parison
  and expanding the outer cross sectional diameter of the blow pin.

In one aspect of the method according to the present invention the parison is
pinched between a contact area of the moulding cavity and the blow pin when the
outer diameter of the blow pin is expanded. The parison will accordingly be pinched
in a circular line or cross section of the parison, where the parison has a generally
equal thickness along the circular line and in the areas on each side of the circular
line. The remaining parison extending out of the moulding cavity during the
moulding process can be removed from the container by cutting along the circular
line forming an opening in the container. The thereby obtained container will
comprise no or very limited pinch lines across the area surrounding the opening.

In a further aspect of the method the parison is cylindrical and comprises a first and
a second opening internally connected, wherein the moulding cavity comprises a
first and a second opening comprising respectively first and second contact areas,
wherein the blow pin comprises first and second surface areas and wherein the
method comprises simultaneously expanding the outer cross sectional diameter of
the first and the second surface areas, such that the parison is pinched between the first contact area and the first surface area and the second contact area and the second surface area. This aspect of the method provides a container with two openings both prepared without the forming of pinch lines or areas with variations in material thickness in the areas surrounding the openings. The smooth surface and even thickness enhances the possibility for securely fastening of a boss to each opening.

In a preferred embodiment the container is a liner for a composite pressure container.

In another aspect the present invention provides a blow moulding pin comprising an outer surface arranged to engage with an opening in a parison, wherein the blow moulding pin comprises controllable and reversible expansion means for expanding the outer cross sectional diameter of the outer surface of the blow pin, wherein the expansion means can be controllable expanded simultaneously as gas is supplied to the interior of the parison from one or more gas supplying openings in the blow moulding pin.

In a further aspect the outer surface arranged to engage with an opening in a parison is cylindrical or conical with a circular cross section before and after the expansion.

The blow moulding pin may be arranged to receive the opening of a tube shaped parison.

Further the expansion means can preferably be controllable expanded simultaneously as gas is supplied to the interior of the parison from one or more gas supplying openings in the blow moulding pin.

The blow moulding pin may further comprise a shaft separating the controllable and reversible expansion means for expanding the outer cross sectional diameter of the outer surface of the blow pin in first and second expansion means for simultaneous expansion of the tube shaped parison at a first and second end thereof. This aspect of the blow moulding pin is applicable for providing a container with two openings arranged along the central axis of the blow pin at each end of the container.

The expansion of the cross sectional diameter of the blow moulding pin is in one aspect of the present invention between 25 and 150% preferably between 50 and 100%.

The present invention further provides for use of the method according to the present invention for obtaining a liner for a composite pressure container, where the liner comprises no pinch line in the area adjacent to the at least one opening.
Also the present invention provides for use of a blow pin according to the present invention for producing a liner for a composite pressure container, where the liner comprises no pinch line in the area adjacent to the at least one opening.

Brief description of the drawings

The present invention will be described in further detail with reference to the enclosed figures illustrating embodiments thereof.

Figure 1a illustrates a first embodiment of a blow pin according to the present invention.

Figure 1b illustrates the blow pin of figure 1b in an expanded position.

Figure 2a illustrates the situation prior to the onset of the blow moulding, with half of the moulding cavity removed for illustrative purposes.

Figure 2b illustrates the situation during the blow moulding process, with half of the moulding cavity removed for illustrative purposes.

Figure 3a is a cross sectional schematic view of the position and state of the blow pin prior to the onset of the blow moulding process.

Figure 3b is a cross sectional schematic view of the position and state of the blow pin during the blow moulding process.

Figure 3c is a sketch of a top view of the blow pin and the mould prior to the onset of the blow moulding process.

Figure 4 is a cross sectional schematic view of the position and state of the liner during the blow moulding process.

Figure 5a is a cross sectional view which schematically illustrates a second embodiment of the present invention comprising an elongated blow pin for obtaining a pinch line free liner at both ends of a cylindrical liner.

Figure 5b is a detailed sketch of the extended end of the blow pin and the mould cavity enclosing it.

Figure 6a is a cross sectional view which schematically illustrates the second embodiment of the present invention during the blow moulding process.

Figure 6b is a detailed sketch of the extended end of the blow pin and the mould cavity enclosing it during the blow moulding process.
A person skilled in the art will appreciate that an expandable blow pin as disclosed here may be constructed in different ways, including different systems for providing the expansion, such as different mechanical expansion means, including a flexible balloon which can be filed inflated and deflated by controlling the gas flow in and out of the balloon.

Principal description of the invention

The present invention is explained in further detail with reference to the enclosed figures illustrating an embodiment of the invention. Figure 1a and 1b show a sketch of a first embodiment a blow pin 10 according to the present invention. The blow pin 10 comprises adjustment means 20 comprising a controllable shaft 22 in connection with an inner blow needle 18 comprising orifices 12 for supplying gas to blow up a parison. The adjustment means are arranged to regulate the movement of the shaft 22 in and out of the adjustment means. This movement is transferred to the blow needle 18. Figure 1a illustrates the blow needle 18 and the shaft 22 in a retracted position whereas figure 1b illustrates the blow needle and the shaft in an extended position. The blow needle 18 comprises a conical section and the diameter of the free end of the blow needle is smaller than the diameter at the end of the blow needle connected to the shaft 22. The blow pin further comprises a number of hinged surface elements 15. The surface elements 15 describe the circumference of the blow pin and when the blow needle 18 is in the extended position the diameter defined by the surface elements 15 is extended compared to the diameter described by the surface elements 15 when the blow needle 18 is in the retracted position. When in use a parison is arranged on the blow pin in the retracted position. During the moulding process the inner diameter of the parison is extended by the extension of the shaft 22, the blow needle 18 and thereby the diameter described by the surface elements 15.

Figures 2a and 2b illustrate this process. On figure 2a a parison 50 is arranged on the surface elements 15 of the blow pin. The adjustment means 20 hold the shaft 22 in a retracted position. Also illustrated is a part of the moulding cavity 30 adapted to provide the form of the finished mould blown container. The front part of the moulding cavity has been removed for illustrative purposes as the parison would otherwise not be visible. The moulding cavity comprises a contact area 32 adapted to engage with the outside of the parison at an entrance to the moulding cavity after the blow moulding process has been initiated. Figure 2b illustrates the situation after the blow moulding process has been initiated. The partly transformed parison 52 has obtained an enlarged inner diameter. In the lower part 54 in contact with the surface elements 15 of the blow pin the inner diameter of the parison has been increased due to the increased diameter of the surface elements 15. This has brought
the partly transformed parison 52 in direct contact with the contact area 32. The upper part of the parison 56 above the contact area 32 the diameter of the partly transformed parison 52 has increased due to gas blown into the interior of the parison through openings in the blow needle. After the contact in the contact area between the edge of the mould cavity and the outer surface of the parison part 54 extended by the extension of the diameter of the blow pin has been established no further extension is possible in the contact area. The upper part of the parison 56 will continue to increase in diameter when gas is supplied through the blow needle until the parison part 56 rests against the surface 30 of the moulding cavity.

A mould applicable for a blow moulding process consist of at least two parts that can be connected to form the moulding cavity and disconnected to remove the moulded object, where after the parts are reconnected to reform the moulding cavity to mould a further object and so on.

In the conventional process the closing of the mould and connection of the mould parts is combined with the pinching of the parison in that at least one connection line between two mould parts is arranged in direct contact with an opening in the mould cavity arranged to receive the blow needle and the parison. This structure is selected to ease the removal of the moulded object when the moulding process has been completed. The two or more parts forming the mould can be removed and the moulded object can thereafter be lifted of from the blow pin.

When closing the mould around the blow pin and the parison arranged thereon the parison is pinched a long at least part of the closure line between the two mould parts being brought together in the area surrounding the blow pin. The material thickness of the parison is necessarily larger than the desired material thickness of the completed blow moulded object. At the pinch line the blow moulding will to a more limited degree result in a reduction of the material thickness which results in uneven thickness distribution over the blow moulded object with a pinch line with increase thickness but also possible areas with lesser thickness.

According to the present invention the closing of the moulding cavity which normally consist of at least two elements that can be connected does not result in the pinching of the parison as the at least one opening in the mould cavity adapted to receive the blow pin has a diameter larger than the blow pin in the retracted position and larger than the diameter of the parison to be transformed. Prior to the beginning of the blow moulding the moulding cavity will comprise at least one connection line but without any material pinched therein.

Figures 3a and 3b illustrate respectively a cross-sectional view of the blow pin in a retracted (non-extended) and extended view. The parison is not included in these illustrations. The figures illustrate how the extension of the outer diameter of the blow pin by the extension of the shaft 22 and the there to connected at least
partly conical blow needle 18 results in the surface elements 15 being brought in contact or almost contact with the contact area 32 of the moulding cavity 30.

According to the present invention the diameter of the blow pin and thereby the diameter of the parison in direct contact therewith is increased when the blow moulding is initiated after the moulding cavity has been closed. The diameter of the cylindrical parison is increased evenly around the circumference in the area in contact with the blow pin as diameter described by the surface elements is increased evenly. The enlarged parison is brought in contact with the moulding cavity in the circular contact area 32 and pinching may accordingly take place in this circular area.

Figure 3c is a sketch of a top view of the blow pin with the needle 18 with gas supply openings and the surface elements 15 in a retracted state and the closed moulding cavity 30. The figure illustrates the circular contact area 32 and the contact line 35 where the at least two parts of the mould has bin brought in contact to form the moulding cavity.

On figure 4 the partly inflated parison 52 is illustrated during the blow moulding process. On figure 4 the blow needle 18 has extended the surface elements 15 to a maximum thereby pinching the parison 52 in the contact area 32. The parison 52 has not yet been fully inflated so that further blowing will take place to force the parison into full contact with the surface 30 of the moulding cavity. The part of the parison remaining outside the moulding cavity is marked with 50.

Figures 5a, 5b, 6a and 6b illustrate a second embodiment of the present invention wherein the equipment is adapted to produce a blow moulded cylindrical object such as a liner for a pressure container comprising two openings, one at each end thereof. A boss is intended to be secure to each end of the cylinder in connection with each of the openings, and to enhance and improve the process of securing each boss to the liner the presence of pinch lines in the areas for mounting the bosses is preferably reduced. The embodiment illustrated on these figures is provided to achieve this objective. The configuration of blow pin and blow needle at the lower end is similar to the configuration on the figures 1a, 1b, 3a and 3b. The blow pin comprises a blow needle 118 with a partly conical shape surrounded by surface elements 115; a cylindrical parison 150 is arranged thereon. Also indicated on the figures is the contact area 132. The embodiment further comprises an elongated shaft 119 centrally arranged and protruding from the blow needle 118 to the top of the mould 130. The free end of the shaft 119 comprises second surface elements 116. Details of the arrangement at the top section are disclosed in figure 5b. The second surface elements 116 are equally arranged with a possibility to controlled increase of the cross sectional diameter of the free end of the shaft. On figures 5a and 5b the second surface elements are in the retracted state. The parison 150 is in
the form of a cylinder arranged coaxially with the shaft 119 such that it expands the whole length of the moulding cavity 130. The second surface elements 116 are arranged within the top opening of the moulding cavity such that when the second surface elements are expanded the parison arranged thereon is pinched between the second surface elements and a second contact area 133 of the moulding cavity. This is illustrated on figure 6a.

Figure 6a and the details thereof illustrated on figure 6b show the situation after the cross sectional diameter of the first and second surface elements have been increased and the blow moulding has been initiated. One or more openings (not shown) are provided in the shaft 119 or the needle 118 to provide gas to the inside of the parison 152 causing it to inflate. In a preferred embodiment of the present invention the expansion of the first and second surface areas takes place simultaneously with the initiation of the blow moulding. On the figure the expansion has been completed but the blow moulding will be continued until the expansion of the parison 152 is stopped by the surface of the moulding cavity 130.

A person skilled in the art will appreciate that the present invention as defined by the enclosed claims can be utilized in a number of different ways without departing from the inventive concept.
CLAIMS

1. Method of blow moulding a container from a parison of a thermoplastic material comprising at least one opening, wherein the method comprises
   - placing the at least one opening of the parison on a blow pin
   - arranging a moulding cavity surrounding the parison,
   - simultaneously blowing pressurised gas from the blow pin into the parison and expanding the outer cross sectional diameter of the blow pin.

2. Method according to claim 1, wherein the parison is pinched between a contact area of the moulding cavity and the blow pin when the outer diameter of the blow pin is expanded.

3. Method according to claim 1 or 2, wherein the parison is cylindrical and comprises a first and a second opening internally connected, wherein the moulding cavity comprises a first and a second opening comprising respectively first and second contact areas, wherein the blow pin comprises first and second surface areas and wherein the method comprises simultaneously expanding the outer cross sectional diameter of the first and the second surface areas, such that the parison is pinched between the first contact area and the first surface area and the second contact area and the second surface area.

4. Method according to claim 1, 2 or 3, wherein the container is a liner for a composite pressure container.

5. Blow moulding pin (10) comprising an outer surface (15) arranged to engage with an opening in a parison (50), wherein the blow moulding pin comprises controllable and reversible expansion means (18, 20, 22) for expanding the outer cross sectional diameter of the outer surface of the blow pin, wherein the expansion means can be controllable expanded simultaneously as gas is supplied to the interior of the parison from one or more gas supplying openings (12) in the blow moulding pin.

6. Blow moulding pin according to claim 5, wherein the outer surface (15, 115, 116) is cylindrical or conical with a circular cross section before and after the expansion.

7. Blow moulding pin according to claim 5 or 6, wherein the blow moulding pin is arranged to receive the opening of a tube shaped parison (50).
8. Blow moulding pin according to any one of the claims 5 to 7, wherein the blow moulding pin further comprises a shaft (119) separating the controllable and reversible expansion means for expanding the outer cross sectional diameter of the outer surface of the blow pin in first (115) and second (116) expansion means for simultaneous expansion of the tube shaped parison at a first and second end thereof.

9. Blow moulding pin according to any one of the claims 5 to 8, wherein the expansion of the cross sectional diameter is between 25 and 150% preferably between 50 and 100%.

10. Use of the method according to any one of the claims 1-4 for obtaining a liner for a composite pressure container, where the liner comprises no pinch line in the area adjacent to the at least one opening.

11. Use of a blow pin according to any one of the claims 5-9 for producing a liner for a composite pressure container, where the liner comprises no pinch line in the area adjacent to the at least one opening.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. B29C49/04 B29C49/58 B29C49/60

**ADD.**

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)

B29C

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

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

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Name and mailing address of the ISA/

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