

GRAPHITE GUIDE RINGS

**Field of the Invention**

This invention relates to devices and processes to make glass articles. More specifically, the invention is concerned with
5 providing a guide ring useful in glass container fabrication processes.

Background of the Invention

In the manufacturing of glass articles, such as glass bottles or other containers, various molds and forms are
10 used to shape, guide, size, and hold hot glass as it is being formed into container shapes. In a typical process for manufacturing glass containers, a gob of molten glass is transferred (most typically, by dropping) to a "blank" or pre-form mold. A bottom portion of the blank mold includes a neck
15 ring to form a neck portion of the eventual glass container. The neck-ring is made in two halves which are opened to allow removal of the glass preform, called a parison, and continue the container fabrication process operating on the parison. The neck-ring is also typically used to pick up the parison
20 from the (opened) blank mold, invert the parison, and position the parison over a second or "blow" mold prior to opening. The second mold closes around the parison, e.g., as the parison is dropped from the opening neck ring. Further parison shaping occurs within the blow mold to produce the
25 glass container.

In order to support the neck-ring halves, assure proper alignment during neck ring operations, and form a top portion of the parison, a guide ring adjoining the neck ring halves is typically used. The neck ring halves are supported
30 by and slide on the guide ring. The neck ring halves and the guide ring are typically made of a metal, e.g., bronze, steel, or nickel alloys. Lubricant is applied to metal ring surfaces to facilitate sliding during ring opening and closing operations.

35 The lubrication is typically applied by "swabbing" the guide ring and/or neck ring halves with a swab stick. Swabbing is accomplished by dipping the swab stick into a

bucket containing a swabbing compound and contacting the parts to be lubricated with the dipped swab stick. The swabbing operation presents problems of contamination (of the swabbing compound, molds, and glass containers) and inadequate/unreliable lubrication, causing operational failures and loss. In addition, swabbing is labor intensive in a glass fabrication process that is otherwise mostly automated.

Summary of the Invention

10 These lubrication and other problems may be avoided in the present invention by providing a guide-ring (or other high temperature slidably contacting component) comprising a graphite body, preferably having a metal insert mechanically attached to the graphite body. The self-lubricating properties of the graphite body preferably avoids the need for swabbing or other separate lubricating steps. A preferred two-piece construction and fine grain graphite composition of at least a portion of the guide ring provide the structural integrity needed to resist chipping and other damage during glass container or other manufacturing operations.

20 The preferred fine grain graphite also allows the insert to be threaded, press fit, shrink fit, or otherwise mechanically attached to the graphite body. The mechanical attachment is sufficient to retain the insert even under the harsh conditions of glass fabrication or other difficult applications.

Brief Description of the Drawings

Figure 1 shows a perspective view of a prior art guide ring and a neck ring half;

30 Figure 2 shows a front cross sectional view of a prior art glass fabrication step;

Figure 3 shows a perspective view of a neck ring element and a guide ring assembled according to the invention;

35 Figure 4 shows a cross-sectional perspective view of an alternative guide ring assembly; and

Figure 5 shows an expanded, cross-sectional side view of a threaded guide ring assembly.



In these Figures, it is to be understood that like reference numerals refer to like elements or features.

Detailed Description of the Invention

Several different fabrication processes are typically used to fabricate glass containers, e.g., a "blow and blow" process (i.e., where gas pressures are primarily used to form glass containers in a two-step process) and a "press and blow" process where a plunger is used in the first step of a two-step process. Figure 1 shows a perspective view of prior art equipment used in a "press and blow" process, including a guide ring 2 supporting a split neck ring 3. These rings form a portion of the bottom of a blank or preform mold (not full shown for clarity) which periodically contact hot glass gobs. Although "press and blow" neck and guide rings are shown, similar rings are used in the "blow and blow" process.

A cross-sectional view of prior art fabrication equipment during a "press and blow" process step is shown in Figure 2. The blank mold assembly 4 includes a split mold portion 5, a split neck ring 3, and a guide ring 2 through which a plunger 6 can be inserted or "pressed" upward.

The "press and blow" process begins with the plunger 6 retracted in a lower position, leaving an empty preform or blank cavity 9. A glass gob 7 is dropped through a funnel 8 into the preform cavity 9 of the blank mold assembly 4. A portion of equipment 10 is shown dotted for clarity as it supports the blank mold assembly 4 (including neck ring 3) and actuates the plunger 6 upward into the cavity 9.

After the glass gob 7 is dropped, the funnel 8 is removed from the top of the mold assembly 4 and a baffle (not shown) is moved over the top of the mold assembly 5, sealing the mold cavity 9. The plunger 6 is pressed upward into the glass gob 7 through the neck ring halves 3 and guide ring 2 soon after the mold cavity 9 is sealed, forming a parison (preformed glass gob) having outside dimensions shaped by the cavity 9 and interior dimensions shaped by the plunger 6. When the plunger 6 is withdrawn downward and the blank mold portions 5 opened, the parison is in an upside-down position



held by the neck ring 3 and guide ring 2.

The neck ring 3 and held parison are then lifted, inverted, and placed into and/or above a blow mold (not shown for clarity). After placement of the parison at the blow mold, the split neck ring 3 opens, allowing the parison to drop into the blow mold. After reheating the parison, gas is typically allowed to enter through the neck of the parison to "blow" the parison into the shape of the blow mold. The blowing may also be accomplished or assisted by creating a vacuum within the blow mold external to the parison.

After forming the glass container in the blow mold, the mold is opened and the formed glass container is removed for further cooling and processing. The prior art "blow and blow" process is similar except that vacuum and/or gas pressures are primarily used to preshape the parison in a blank mold assembly instead of a large plunger 6. A small plunger may also be used to create a pilot cavity prior to vacuum and/or gas pressures preshaping the parison in a blank mold in the "blow and blow" process.

Figure 3 shows a perspective cross-sectional view of a graphite guide ring 11 and neck-ring half 12 of an embodiment of the present invention. In this embodiment, the neck ring 12 is preferably composed of metal similar to prior art neck ring 3 (shown in Figure 1), but the guide ring 11 preferably consists of a graphite body 13 and a metal insert 14. The dimensions of the graphite guide ring 11 are not substantially changed from the comparable metal guide ring 2 shown in Figure 1, but the preferred mechanical attachment and at least partial construction using graphite materials allow guide/neck ring sliding to be self lubricated while retaining the thermal and structural integrity of a metal insert to withstand the periodic hot glass contacting and operational loads.

The graphite body 13 has a planar (graphite) sliding surface 15 which is substantially coplanar with a planar insert surface 16. The graphite sliding surface 15 and the (coplanar) insert surface 16 form a sliding alignment surface. During parison forming, the alignment surface contacts an adjoining (metal) surface 17 of the neck ring element 12 as





shown. When the parison is to be dropped into a blow mold, the alignment surface slides relative to adjoining surface 17 as the neck ring elements are opened.

5 The neck ring element 12 has a (metal) neck-forming surface 18 and the guide ring insert has a (metal) top-forming surface 19. During a gob pressing step, the neck ring elements are actuated closed to form a (split) neck ring, and the neck-forming and top-forming surfaces 18 & 19 contact the hot glass gob 7 (see Figure 2) to form a portion of the
10 parison. After the neck ring elements 12 are opened and the parison dropped into a blow mold, the top- and neck-forming surfaces 18 & 19 are cooled by exposure to the ambient (air) environment, i.e., convection cooling of the top- and neck forming surfaces and rings occurs. Cooling of the top- and
15 neck-forming surfaces 18 & 19 is also accomplished by conduction of heat through the metal insert 14 and graphite body 13.

The metal insert 14 acts as a reinforcing ring and glass-contacting heat sink/conductor during glass container
20 fabrication steps. The insert 14 is attached to a recessed surface 20 of the graphite body 13. The recessed surface 20 is located to place the insert 14 in a position to form the top surface of the parison. This position also allows the metal insert to absorb impacts and loads that might otherwise
25 damage a single component guide ring, e.g., loads from non-aligned operation of plunger 6 as shown in Figure 2. The positioning of the insert 14 and body 14 to form a coplanar metal and graphite alignment surface also avoids the need for separate lubrication.

30 The guide ring 11 includes an inward-facing insert surface 21 of the insert 14 and an inward-facing body surface 22. The inward-facing surfaces 21 & 22 help to align the plunger 6 (see Figure 2) during plunger operation, absorbing impact and other loads. The preferred graphite composition
35 of the body surface 22 also minimizes the need for separate lubrication of the contacting plunger surfaces or the inward-facing insert surface 21.

The body 13 is preferably composed of a fine grain graphite, and the insert 14 is preferably composed of a

nickel-composition steel. The insert 14 may also be composed of a fine grain graphite or other metals. Because the insert 14 is press fit into the recess surface 20 of the graphite body 13 in this embodiment, the press fit insert is typically in compression. If the insert 14 is composed of a material having a significantly greater compressive strength than tensile strength, the compressed condition allows the insert to resist greater tensile loads or impacts even if the body 13 and insert are composed of the same material.

The preferred material for the graphite body 13 is GLASSMATE-HT® fine grain graphite supplied by Poco Graphite, Inc. located in Decatur, Texas. Table 1 provides typical physical properties of the preferred GLASSMATE-HT® graphite material. This graphite material when combined with the assembly and shape of the graphite body 13 can also provide a smooth mold surface for controlling the shape of the parison without scratching the glass. The material and the design also provide good resistance to the harsh temperature and erosive environment without the need for forced air cooling. Alternative materials of construction include GLASSMATE®, GLASSMATE-SR®, and GLASSMATE-LT®, also supplied by Poco Graphite Inc.

TABLE 1

TYPICAL PHYSICAL PROPERTIES OF GLASSMATE-HT® GRAPHITE

Property (at room temperature)	Typical Value
Density (g/cc)	1.82
Hardness (Shore Scleroscope)	75
Flexural Strength (psi)	12,000
(Kg/cm ²)	845
Compressive Strength (psi)	20,000
(Kg/cm ²)	1,400
Thermal Conductivity (BTU-ft/ft ² -hr-°F)	60
(Cal-cm/cm ² -sec-°C)	0.21
Coefficient of Thermal Expansion	8.4

An important physical property of GLASSMATE-HT® graphite is high flexural strength, i.e. 12,000 psi flexural



strength is relatively high for graphite materials. A flexural strength of at least 8,000 psi, preferably at least 10,000 psi, allows the graphite body 13 to resist handling without damage, slide against the neck ring element 12, withstand plunger loads, and be mechanically attached to the insert 14. The preferred graphite materials of construction also retain most of their flexural strength at elevated temperatures typically encountered in glass fabrication processes.

Another important physical property of GLASSMATE-HT® graphite is its self-lubricating properties (i.e., non-galling) and low coefficient of friction of about 0.1 - 0.2 when in contact with machined metals such as steel. A coefficient of friction of no more than about 0.3 and the non-galling characteristics of the preferred graphite materials essentially avoids the need for separate lubrication process steps.

An alternative all-graphite embodiment of a guide ring assembly is shown in Figure 4. Alternative insert 23 and alternative body 24 are both substantially composed of a fine grain graphite, such as GLASSMATE-HT®. Upper body surface 25 (where upper refers to guide ring position during parison or preforming processes in a blank mold) and alternative insert surface 27 form a slidable surface and, along with lower body surface 26, allow the alternative guide ring assembly to guide the opening and closing of a split neck ring (not shown for clarity).

The alternative insert 23 is shown in Figure 4 as press fit into alternative body 24, but alternative means for attaching the insert to the body may also be used. For some applications, threaded attachment (similar to that shown in Figure 5) of the alternative insert 23 to the alternative body 24 is the preferred means for mechanically attaching the insert 23 to body 24. Alternative means for attaching inserts and body components include shrink fit and separate clamps or threaded fasteners.

For some applications, a coating (such as a hard ceramic) may be applied to surfaces of the alternative insert 23, providing added resistance to tensile or impact loads.



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Examples of hard ceramic materials for coating include titanium carbide and silicon carbide. Although the entire insert 23 can be coated, the coating may also be limited to the inward-facing surface 21.

5 The (alternative) all graphite embodiment shown in Figure 4 has disadvantages for some glass industry applications (when compared to the metal-graphite embodiment shown in Figure 3) and advantages for other glass industry applications. The glass temperature and contact times of an
10 application may exceed the oxidation temperature of the graphite, precluding the use of an all graphite embodiment. Plunger and other loads of an application may require metal reinforcement. If application temperatures and loadings allow, a smaller area of contacting surfaces for an all
15 graphite embodiment may reduce machining costs and machining material waste. Ready accessibility to components of the all graphite embodiment can also simplify replacement of components if damaged or worn.

Figure 5 shows an expanded, cross-sectional view of
20 another alternative embodiment which is the preferred embodiment. The assembly shown in Figure 5 comprises a threaded insert 28 and a threaded body 29. The threaded body 29 and insert 28 are similar to the alternative insert 23 and alternative body 24 shown in Figure 4 except for the mating
25 threaded means for (mechanically) attaching the alternative insert and body. In the preferred embodiment, the threaded insert 28 is substantially composed of nickel (NI-40) steel, and threaded body 29 is substantially composed of fine grain graphite. The (metal) threaded insert 28 has an alternative
30 top-forming surface 32 similar to the top-forming surface 19 of insert 14 shown in Figure 3.

The threaded attachment of the graphite body 29 is made more feasible by the relatively high flexural strength of the preferred graphite materials, such as GLASSMATE-HT®. The
35 high flexural strength allows the threaded guide ring assembly to withstand significant loads which may be applied during glass fabrication processes.

The thickness "T" dimension of the threaded body 29 is similar to the depth "D" dimension of the threaded insert

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28. These dimensions allow the threaded body 29 to be supported by land 33 and create an alignment surface comprising substantially coplanar threaded body top surface 34 and threaded insert top surface 35.

5 While the preferred embodiment of the invention has been shown and described, and some alternative embodiments also shown and/or described, changes and modifications may be made thereto without departing from the invention. Accordingly, it is intended to embrace within the invention
10 all such changes, modifications and alternative embodiments as fall within the spirit and scope of the appended claims.

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CLAIMS

1. An apparatus for forming a portion of a glass container from a hot glass gob comprising:

a ring-shaped body having a substantially planar surface, said body substantially composed of graphite;

an insert mechanically attached to said body and having a surface for contacting said hot glass gob; and

a plurality of ring elements slidably contacting said planar surface.

2. The apparatus of Claim 1 wherein said insert comprises a ring-shaped insert having a planar insert surface which is substantially co-planar with a surface of said body.

3. The apparatus of Claim 2 wherein said insert is composed of a metal and said insert and body form a guide ring.

4. The apparatus of Claim 3 wherein said body and insert have centerline axes that are substantially co-axial.

5. The apparatus of Claim 4 wherein said body has a radially inward-facing surface relative to said co-axial centerline, wherein a portion of said surface for contacting said hot glass gob is closer to said coaxial centerline than substantially all of said inward-facing surface of said body.

6. The apparatus of Claim 5 wherein a portion of said surface for contacting said hot glass gob forms a top portion of a blank mold and said inward-facing surface of said ring elements forms a neck portion of said blank mold.

7. The apparatus of Claim 6 which also comprises:
means for sliding said ring elements relative to said guide ring; and

means for inverting said ring elements when said ring elements are in contact with said parison.



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8. The apparatus of Claim 7 wherein said graphite has a flexural strength of at least 8,000 psi.

9. An apparatus useful as a guide ring for fabricating glass containers from a hot glass gob comprising:

a ring-shaped body having a substantially planar surface and a substantially inward-facing surface, said body substantially composed of graphite; and

a ring-shaped insert mechanically attached to said inward-facing surface and having a contact surface for contacting said hot glass gob.

10. The apparatus of Claim 9 wherein said insert is mechanically attached by mating threaded surfaces on said body and said insert.

11. The apparatus of Claim 10 wherein said insert is substantially composed of a metal.

12. The apparatus of Claim 11 wherein said planar surface is substantially coplanar with a surface of said cylindrical insert.

13. A process for assembling an insert ring having an insert centerline to a graphite body ring having a body centerline for use in molding hot substances, said process comprising:

aligning said centerlines to be substantially coaxial; and

mechanically attaching said insert to said graphite body such that an inwardly-facing surface of said body contacts said insert.

14. The process of Claim 13 which also comprises the steps of:

locating a plurality of neck ring elements each having a ring planar surface such that said ring planar surfaces contact a planar surface of



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said body; and

sliding said neck ring elements relative to said body while substantially maintaining said contact in the absence of a separate lubricant.

15. An apparatus useful as a guide ring for fabricating glass articles comprising:

a ring-shaped graphite body having upper and lower substantially horizontal surfaces and inner and outer substantially vertical surfaces; and

a ring-shaped insert with an outer external surface in mechanically held contact with the inner surface of said graphite body and a surface for contacting a hot glass article.

16. The apparatus of Claim 15 wherein the upper horizontal surface of said graphite body is coplanar with a planar surface of said insert.

17. The apparatus of Claim 16 wherein the external surface of the insert and the internal surface of the graphite body are both substantially circular, with the internal surface of the graphite body entirely in contact with the external surface of the insert.

18. An apparatus useful as a guide ring for fabricating glass articles comprising:

a ring-shaped insert with an arcuate external surface and a surface for contacting a hot glass article; and

a ring-shaped graphite body with an arcuate inner surface in mechanically held contact with the arcuate external surface of said insert, said insert having a further surface for slidably contacting a third body.

19. The apparatus of Claim 18 wherein the insert has a further surface for contacting said third body.



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20. The apparatus of Claim 19 wherein the surfaces for contacting said third body are substantially coplanar and form a composite sliding surface.

21. The apparatus of Claim 21 wherein the third body and the insert are substantially composed of a metal.

22. The apparatus of Claim 22 wherein the composite sliding surface is a substantially horizontal surface.



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