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(71) Applicant *(for all designated States except US)*: **OWENS CORNING INTELLECTUAL CAPITAL, LLC** [US/US]; One Owens Corning Parkway, Toledo, Ohio 43659 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **GAVIN, Patrick, M.** [US/US]; 1599 Krebs Court, Newark, OH 43055 (US). **PELLEGRIN, Michael, T.** [US/US]; 505 Marion Manor Woods, Newark, OH 43055 (US). **BELT, James, S.** [US/US]; 19290 Utica Road, Utica, OH 43080 (US). **LATORRE, Carmen, A.** [US/US]; 115 E. College St., Apt D., Granville, OH 43023 (US). **LUCAS, Marc, A.** [US/US]; 1612 W. Cleveland Avenue, East Point, GA 30344 (US).

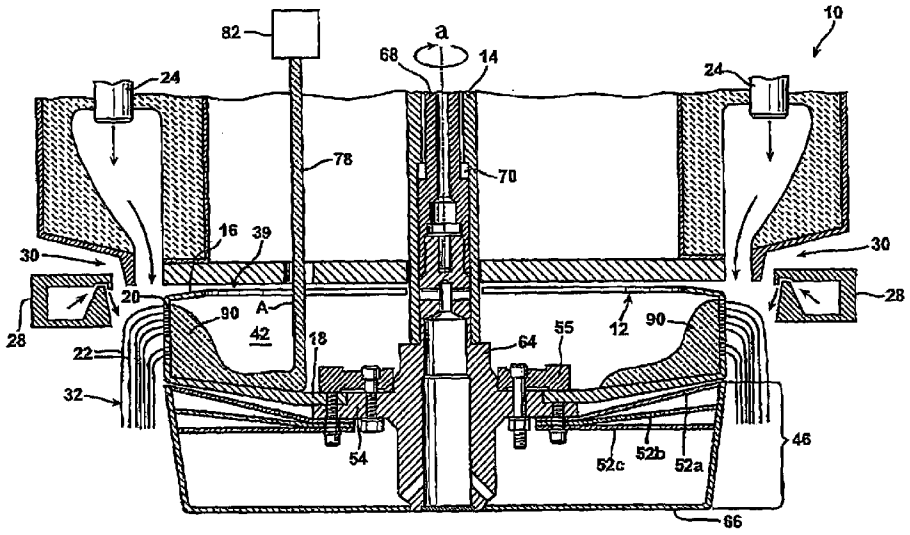
(74) Agents: **DOTTAVIO, James, J.** et al.; 2790 Columbus Road, Bldg 21-0, Granville, Ohio 43023 (US).

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(54) **Title:** FIBERIZING SPINNER INCLUDING A RADIATION SHIELD FOR THE MANUFACTURE OF HIGH QUALITY FIBERS



(57) **Abstract:** An apparatus for manufacturing high quality glass wool fibers, and more particularly to a spinner (12) including a radiation shield (46) is disclosed. The spinner includes a number of radiation shield positioned beneath the spinner base and decreases the temperature gradient along the peripheral sidewall (18) of the spinner and improves the quality of the glass fibers (22). One suitable material for the radiation shield is a high temperature nickel alloy.

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FIBERIZING SPINNER INCLUDING A RADIATION SHIELD FOR THE MANUFACTURE OF HIGH QUALITY FIBERS

TECHNICAL FIELD AND INDUSTRIAL APPLICABILITY OF THE INVENTION

The present invention relates to a fiberizer and spinner for use in the manufacture of high quality glass wool fibers, and more particularly to an improved radiation shield for insulating spinners used in the rotary fiberizing process.

BACKGROUND OF THE INVENTION

Fibers of glass and other thermoplastic materials are useful in a variety of applications including acoustical and thermal insulation materials. Common prior art methods for producing fiberglass insulation products involve producing glass fibers from a rotary process. In a rotary process, glass composition is melted and forced through orifices in the outer peripheral wall of a centrifuge, commonly known as a centrifugal spinner, to produce the fibers. One commonly used spinner is generally cup-shaped that has a base wall with a central hole, a top opening and an outer peripheral sidewall that curves upward from the base wall, forming the top opening. Another commonly used spinner uses a slinger cup to propel the glass composition to the sidewall for fiberization. A drive shaft is used to rotate the spinner and is typically fixed to the spinner with a quill.

During fiberization, the spinner is subjected to high temperatures and high rotational speeds that exert substantial force on the spinner. An external burner forces a jet of hot gas onto the fibers as they are extruded through the orifices of the sidewall to heat the fibers, and an external blower is used to stretch the fibers. During fiberization, it is important to maintain the glass at a predetermined temperature to improve the quality of fiberization. While the preferred temperature varies based on equipment and manufacture, it is typically the temperature at which the molten glass has a viscosity of 1000 poise (also referred to as the log 3 viscosity).

Spinners are formed of metal alloys and typically include a base wall and a foraminous sidewall. The molten glass is dropped onto the base surface of the spinner and is propelled against the sidewall by the rotation of the spinner. The base surface of the spinner radiates and convects heat from the molten glass and spinner sidewall. The orifices at the lower edge of the sidewall cool to a temperature lower than that of the higher orifices. The cooling of the orifices cools the glass and increases viscosity of the

glass and leads to thicker stiffer primary fibers. Allowing the glass to cool may allow for devitrification of the glass, which may lead to plugging of the lower orifices.

Thus, there exists a need in the art for a spinner that maintains the spinner base and peripheral sidewall as well as the molten glass, while in the spinner prior to fiberizing, at a preferred temperature and that confers improved properties to the fiberglass insulation product.

SUMMARY OF THE INVENTION

The need to control glass temperature in the spinner and improve glasswool quality is met by a spinner according to the present invention. The spinner of the present invention is adapted to control the temperature of the molten glass by including a radiation shield mounted beneath the spinner. The radiation shield is positioned beneath the spinner and typically includes a multi-layer structure. The objectives, features, and advantages of the present invention will become apparent upon consideration of the description herein and the appended claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages of this invention will be apparent upon consideration of the following detailed disclosure of the invention, especially when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a partially schematic cross-sectional view in elevation of a fiberizer with a radiation shield according to the principles of the present invention.

FIG. 2 is a partially schematic cross-sectional view in elevation of a fiberizer with a radiation shield according to the principles of the present invention.

FIG. 3 is a partially schematic cross-sectional view in elevation of a fiberizer with a radiation shield according to the principles of the present invention.

FIG. 4 is a box plot graph comparing the temperatures of the bottom corner of a spinner including a radiation shield of the present invention and bottom corner of a spinner without a radiation shield.

FIG. 4 is a box plot graph comparing the percentage of fused fibers generated from a spinner including a radiation shield of the present invention and a spinner without a radiation shield.

FIG. 5 is a graph of thermal data from spinners including the radiation shield of the present invention and spinners without radiation shields.

DETAILED DESCRIPTION AND PREFERRED EMBODIMENTS OF THE INVENTION

Although the present invention is herein described in terms of specific embodiments, it will be readily apparent to those skilled in this art that various modifications, rearrangements, and substitutions can be made without departing from the spirit or scope of the invention. The scope of the present invention is thus only limited by the claims appended hereto.

Referring to FIG. 1, the fiberizer 10 includes a spinner 12 fixed to a hub 54 of quill 64 at the lower end of a rotatable shaft or spindle 14. Rotating the spinner 12 by rotating spindle 14 is known in the art. The spinner 12 includes a base 16 extending from hub 54 to the peripheral wall 18. Disposed around the outer periphery of the peripheral wall 18 is a plurality of orifices 20 for centrifuging fibers 22 of a molten thermoplastic material, for example, glass.

The spinner 12 is supplied with a stream 78 of a molten thermoplastic material. Conventional supply equipment 82 can be used to supply stream 78 of molten glass. Such molten glass supply equipment is well known in the industry and, therefore, will not be discussed in detail herein. The glass in stream 78 drops into the chamber 42 of spinner 12 and through centripetal force is directed against the peripheral wall 18 and flows outwardly to form a build-up or head 90 of glass. The glass then flows through the orifices 20 to form primary fibers 22, which are heated and stretched by burners 24 and annular blower 28.

The rotation of the spinner 12 (as depicted by the circular arrow (α) in FIG. 1) centrifuges molten glass through orifices 20 in spinner peripheral wall 18 to form primary fibers 22. The primary fibers 22 are maintained in a soft, attenuable condition by the heat of an annular burner 24. The annular blower 28 uses induced air through passage 30 to pull primary fibers 22 and further attenuate them into secondary fibers 32 suitable for use in a product, such as wool insulating materials. The secondary fibers 32 are then collected on a conveyor (not shown) for formation into a product, such as a glass wool pack.

A hollow quill 64 is press fit in a borehole formed through the center of hub 54 and locked in place with three circumferentially spaced locking pins 66. The upper end of the quill 64 is threaded into the lower end of a hollow drawbar 68. The quill 64 is preferably cooled further with water circulated through an annular cooling jacket 70 disposed around spindle 14 and quill 64 and above hub 54. The quill 64 and hub 54 are preferably

fabricated from a low thermal expansion alloy to minimize differential thermal expansion between them.

The radiation shield 46 may include one plate 52a, two plates 52a, 52b or a plurality (more than one) of individual plates 52a, 52b, 52c. Optionally, the radiation shield 46 may contain more than three plates. The plates may be connected to the hub 54 of quill 64. Quill pan 66 is attached to one or more of the plates via welding, clamping or any other means of attachment. As shown in Fig. 3, quill pan 66 may be bolted via bolts 75, 76 to the bottom section 63 of quill 64. Alternatively, the quill pan may be welded, clamped or attached to the bottom section 63 by any other means of attachment. The plates inhibit convection from the base of the spinner and inhibit the infrared energy from escaping from the base of spinner 12 and decreases the thermal gradient along the height of the peripheral sidewall 18 thus inhibit devitrification within the glass head 90 and controls the temperature of the glass as it passes through the orifices 20 at the lower edge of peripheral sidewall 18. The primary plate 52a is preferably frustoconical to follow the base wall 16 of spinner 12. The secondary and tertiary plates 52b, 52c may be frustoconical or planar to allow space between the plates. The plates 52a, 52b, 52c may be formed of stainless steel or a refractory metal, such as Hastelloy –a transition metal nickel based high temperature alloy. On especially suitable material for the shields is Hastelloy X, which is available from Haines International of Kokomo, Indiana, USA. Hastelloy X includes 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo, 1.5 weight % W, 0.1 weight % C, 1 weight % Mn (maximum), 1 weight % Si (maximum) and 0.008 weight % B (maximum).

Similarly, the fiberizer 10 of FIG. 2 includes a spinner 12 clamped to the hub 54 on quill 64 that is mounted at the lower end of spindle 14 by clamping ring 55. The spinner 12 includes a base 16 extending to the peripheral wall 18, which contains a plurality of orifices 20 for centrifuging fibers 22. A stream 78 of a molten thermoplastic is supplied to the chamber 42 material spinner 12 by conventional supply equipment 82. The molten thermoplastic flows outwardly to form a build-up or head 90 of glass. The glass then flows through the orifices 20 to form primary fibers 22, which are heated and stretched by burners 24 and annular blower 28. The annular blower 28 uses induced air through passage 30 to pull primary fibers 22 and further attenuate them into secondary fibers 32. The circular arrow (α) shows the rotation of the spinner 12.

Spinners are manufactured in a variety of geometries depending upon the fiberization process used. Typically, major manufacturers of glass fiber have their own fiberization process, which varies from manufacturer to manufacturer; however, the principles of the present invention are equally suitable for use in any rotary fiberization process.

Fig. 4 shows a box plot graph comparing the temperatures of the bottom corner of a spinner including a radiation shield of the present invention and the bottom corner of a spinner without a radiation shield. As shown in the graph, the radiation shield insulator significantly increased the average temperature around the spinner bottom corner (+70°F) (21.1°C).

Fig. 5 is a box plot graph comparing the percentage of fused fibers generated from a spinner including a radiation shield of the present invention and a spinner without a radiation shield.

Fig. 6 is a graph of showing K-values for spinners without the radiation shield of the present invention (prior to January 6, 2006) and the K-values for spinners including the radiation shield (January 6, 2006 and thereafter). K-value is a measure of heat conductivity. Specifically, it is the measure of the amount of heat, in BTUs per hour, that will be transmitted through one square foot of material that is one inch thick to cause a temperature change of one degree Fahrenheit from one side of the material to the other. The lower the K-value for a material, the better it insulates.

The invention of this application has been described above both generically and with regard to specific embodiments. Although the invention has been set forth in what is believed to be the preferred embodiments, a wide variety of alternatives known to those of skill in the art can be selected within the generic disclosure. The invention is not otherwise limited, except for the recitation of the claims set forth below.

CLAIMS

I Claim:

1.) A radiation shield (46) for use in the manufacture of glass fibers, comprising:
a primary plate (52a) mounted on a rotatable hub (54); and
at least one secondary plate (52b) mounted on a rotatable hub.

2.) The radiation shield for use in the manufacture of glass fibers of claim 1, further comprising a quill pan (66) mounted beneath said primary plate and said at least one secondary plate.

3.) The radiation shield for use in the manufacture of glass fibers of claim 1, wherein said primary plate is formed of stainless steel.

4.) The radiation shield for use in the manufacture of glass fibers of claim 1, wherein said primary plate is formed of a nickel based alloy.

5.) The radiation shield for use in the manufacture of glass fibers of claim 1, wherein said primary plate is formed of a nickel based alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo, 1.5 weight % W, 0.1 weight % C, 1 weight % Mn, 1 weight % Si and 0.008 weight % B.

6.) The radiation shield for use in the manufacture of glass fibers of claim 1, wherein said primary plate is formed of a nickel based alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo.

7.) The radiation shield for use in the manufacture of glass fibers of claim 1, further comprising a secondary plate and a tertiary plate (52c) mounted below said primary radiation shield.

8.) A shielded spinner for the manufacture of glass fiber insulation, comprising:
at least one spinner (12), said spinner being rotated to extrude glass fibers;
a radiation shield (46)comprising:
a primary plate (52a) mounted on a rotatable hub (54);
at least one secondary plate (52b) mounted on a rotatable hub; and
a quill pan (66) mounted beneath said primary plate and said at least one secondary plate (52b).

9.) The shielded spinner for the manufacture of glass fiber insulation of claim 8, wherein said primary plate is formed of stainless steel.

10.) The shielded spinner for the manufacture of glass fiber insulation of claim 8, wherein said primary plate is formed of a nickel based alloy.

11.) The shielded spinner for the manufacture of glass fiber insulation of claim 8, wherein said primary plate is formed of a nickel based alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo, 1.5 weight % W, 0.1 weight % C, 1 weight % Mn , 1 weight % Si and 0.008 weight % B.

12.) The shielded spinner for the manufacture of glass fiber insulation of claim 8, wherein said primary plate is formed of a nickel based alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo.

13.) The shielded spinner for the manufacture of glass fiber insulation of claim 8, further comprising a secondary plate and a tertiary plate (52c) mounted below said primary plate.

14.) A fiberizer (10) for the manufacture of glasswool, comprising:

a rotatable quill (64);

a spinner (12) mounted to said quill having a base wall (16) and a foraminous peripheral sidewall (18); a radiation shield (46) comprising at least one plate (52a) mounted beneath the base wall of said spinner; and a quill pan (66) mounted beneath said plate.

15.) The fiberizer for the manufacture of glasswool of claim 14, wherein said plate is frustoconical proximate to the base wall of said spinner.

16.) The fiberizer for the manufacture of glasswool of claim 15, wherein said plate is formed of a high temperature nickel alloy.

17.) The fiberizer for the manufacture of glasswool of claim 14, wherein the radiation shield further comprises a secondary plate (52b) distal to the base wall of said spinner.

18.) The fiberizer for the manufacture of glasswool of claim 17, wherein the radiation shield further comprises a tertiary plate (52c) distal to the base wall of said spinner.

19.) The fiberizer for the manufacture of glasswool of claim 15, wherein the plate is formed of a high temperature nickel alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo, 1.5 weight % W, 0.1 weight % C, 1 weight % Mn , 1 weight % Si and 0.008 weight % B.

20.) The fiberizer for the manufacture of glasswool of claim 15, wherein the plate is formed of a high temperature nickel alloy comprising approximately 47 weight % Ni, 22 weight % Cr, 18 weight % Fe, 9 weight % Mo.

FIG. 1

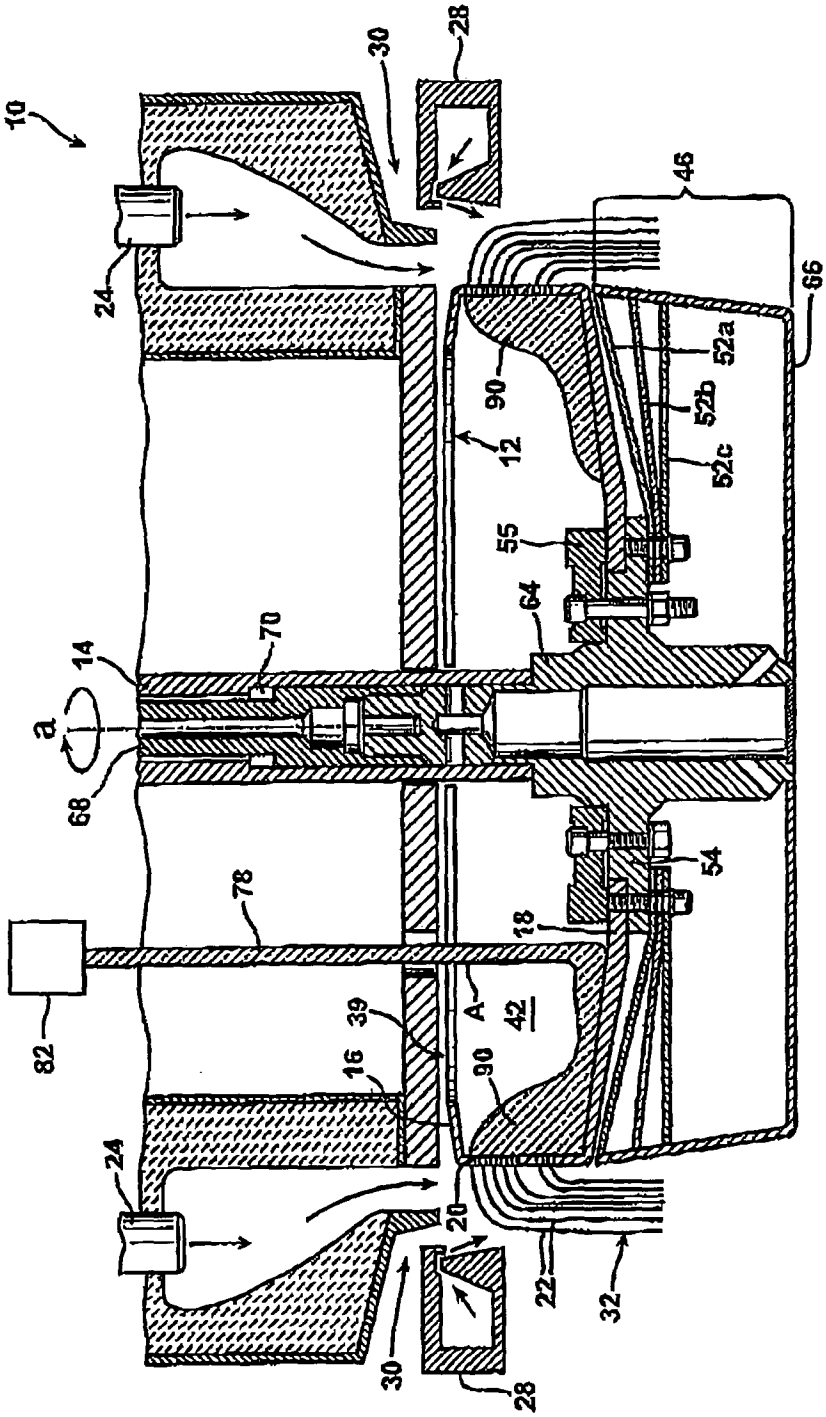
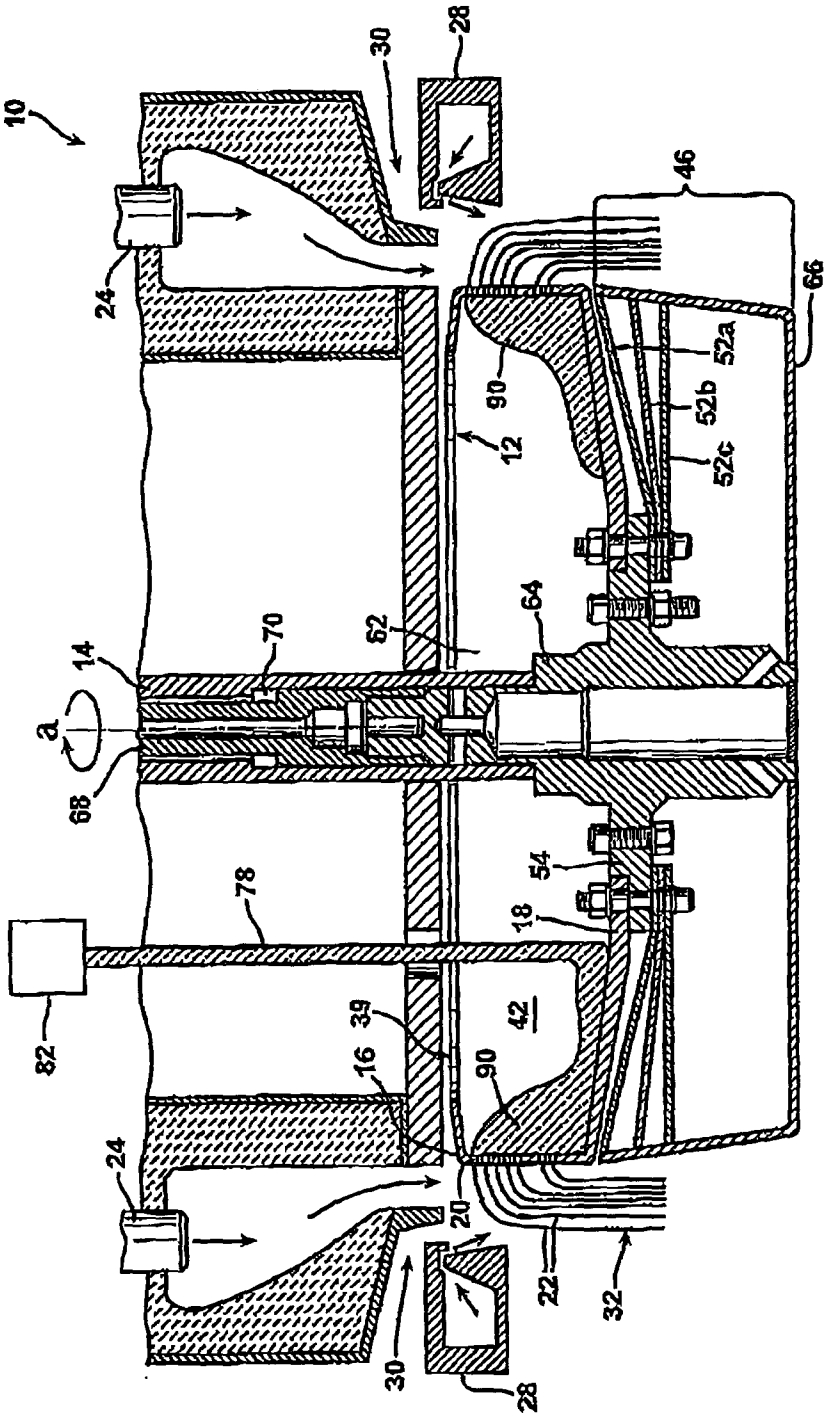

10
30
28
46
66
24
52a
52b
52c
90
12
55
64
70
14
a
68
54
78
18
82
39
A
42
16
90
24
20
22
32
30
28

FIG. 2


10
30
28
46
24
66
52a
52b
52c
90
12
64
62
70
14
a
68
78
54
18
82
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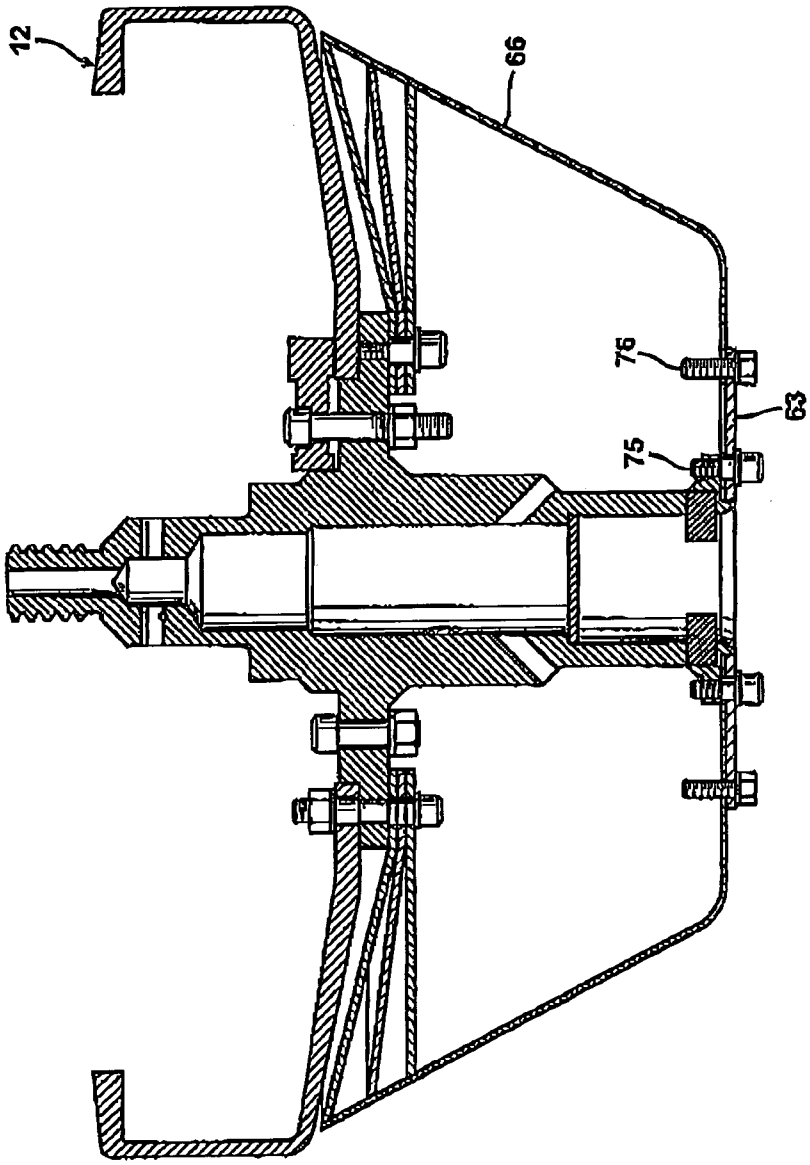


FIG. 3

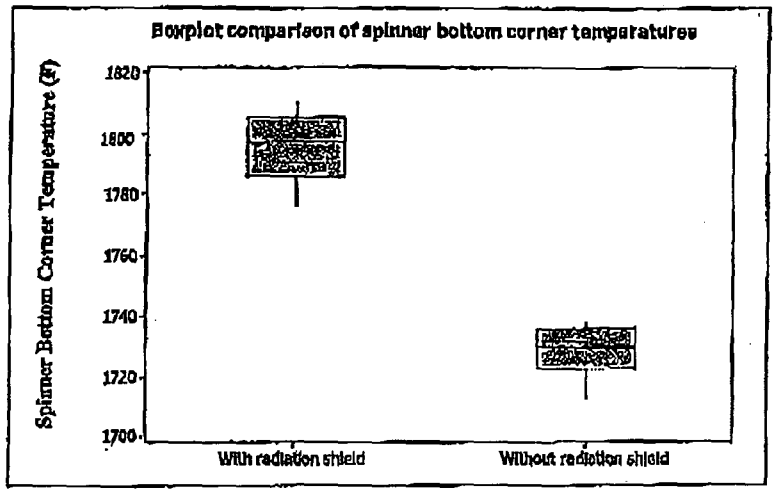

Boxplot comparison of spinner bottom corner temperatures
Spinner Bottom Corner Temperature (F)
1820
1800
1780
1760
1740
1720
1700
With radiation shield
Without radiation shield

FIG. 4

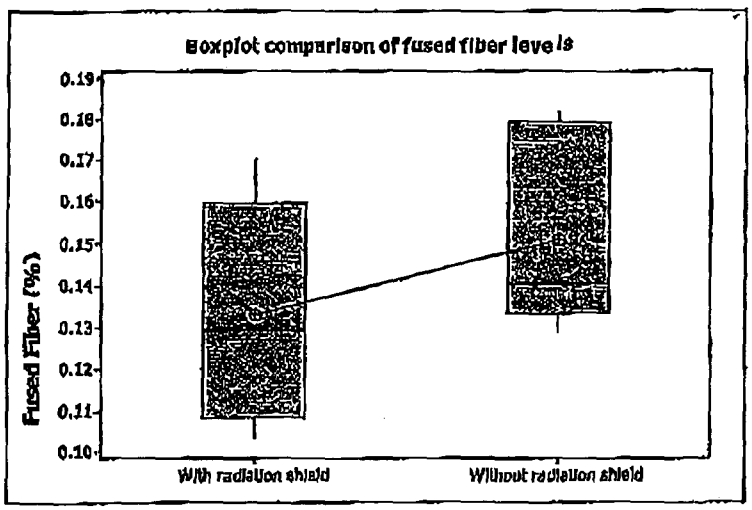

Boxplot comparison of fused fiber levels
Fused Fiber (%)
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
With radiation shield
Without radiation shield

FIG. 5

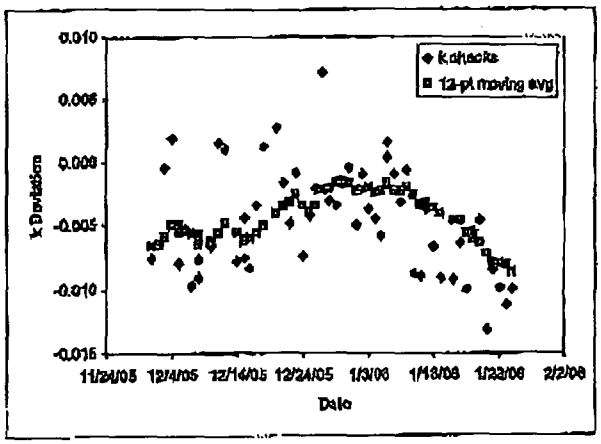

0.010
0.005
0.000
-0.005
-0.010
-0.015
k deviation
12-pt moving avg
11/24/05
12/4/05
12/14/05
12/24/05
1/3/06
1/13/06
1/23/06
2/2/06
Date

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/026302

A. CLASSIFICATION OF SUBJECT MATTER
INV. C03B37/04

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)
C03B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2008	29/05/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Marrec, Patrick

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 1 645 547 A (PARAMOUNT GLASS MFG CO LTD [JP]) 12 April 2006 (2006-04-12) paragraphs [0049] - [0051]; figure 4	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

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