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(58) Field of search
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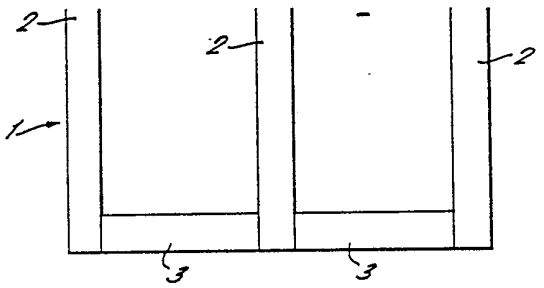
SPECIFICATION NO. 2201670A

The following corrections were allowed under Section 117 on 20 June 1989

Front page Heading (72) Inventor
below Trevor Farrell
insert Robert William Blundy
William Jones

THE PATENT OFFICE
21 July 1989



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The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

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(54) Glass forming apparatus

(57) In a glass forming apparatus in which a sheet of glass (100) is supported (2) at spaced locations beneath a heat source (4) whereby an unsupported portion of the sheet (100) can sag on application of heat thereto, a body (8) of thermally insulating material, and in particular, microporous insulating board, is located beneath the portion of the sheet (100) that is to sag, to serve as a reflector/scatterer and produce a non-specular distribution of heat energy whereby the necessary non-uniform temperature distribution is obtained in the sheet (100).

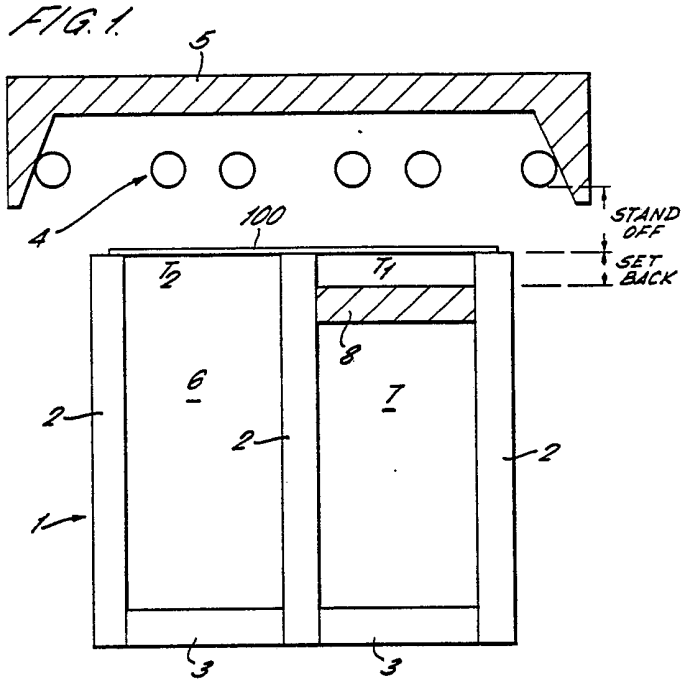

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FIG. 1.

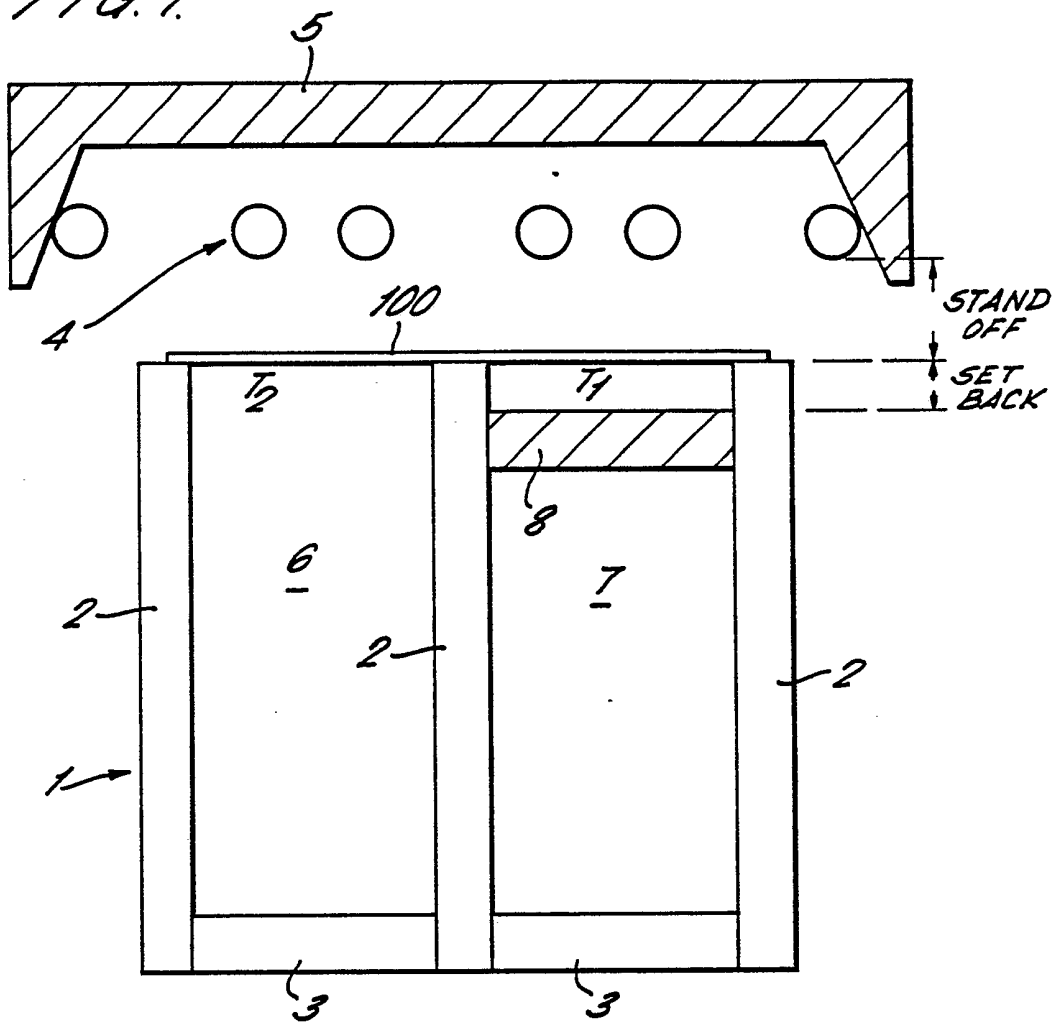
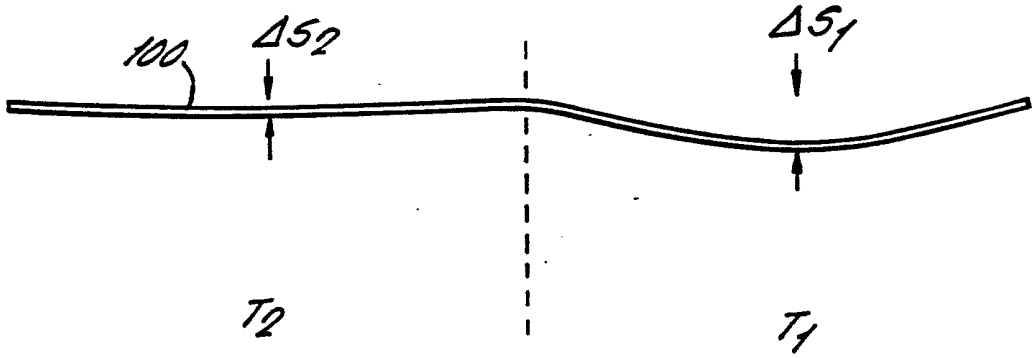


FIG. 2.



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GLASS FORMING APPARATUS

This invention relates to glass forming apparatus.

For the manufacture of curved glass items such as automobile windscreens, it is known to use apparatus comprising an enclosure, for example a muffle furnace, containing heaters, for example infra red emitters operating at about 850°C in the medium wavelength, under which a planar piece of glass in located supported at its periphery. When the temperature in the enclosure is at the correct level, the piece of glass undergoes two-dimensional catenary sagging, this resulting in the piece of glass assuming a required curved shape which it retains after cooling.

Such known apparatus is useful when only relatively large radii of curvature are required in the piece of glass, but difficulties arise when relatively tight curves are required as is often the case with new designs of automobile windscreens.

According to this invention there is provided glass forming apparatus comprising an enclosure; a heating element in the enclosure; means to support a piece of glass in the enclosure to receive heat energy from the heating element, a portion of the piece of glass being unsupported whereby said portion can sag relative to the supported portions of the piece of glass; and a body of thermally insulating material located adjacent to but spaced from said portion of the piece of glass on the side thereof remote from the heating element.

In use of the apparatus of this invention the body of thermally insulating material serves as a reflector/scatterer and produces a non-specular distribution of the heat energy impinging thereon after passing through the piece of glass being formed,

thereby producing a non-uniform temperature distribution in the piece of glass, a higher temperature being obtained where greater sagging of the piece of glass is required.

This invention will now be described by way of example with reference to the drawing, in which:-

Figure 1 is a diagrammatic sectional side elevation view of apparatus according to the invention; and

Figure 2 is a side elevational view of a curved glass item manufactured with the apparatus of Figure 1.

The apparatus comprises an enclosure (not shown) containing a support 1 comprising three vertical fire bricks 2 spaced by two longitudinal fire bricks 3. Mounted above the support 1 is an electric heating element 4 having an associated non-specular reflector 5 made of microporous thermally insulating material such as insulation board. The three vertical fire bricks 2 provide two spaces 6 and 7 in one of which (7) there is located a body 8 of thermally insulating material such as microporous insulation board.

The upper free ends of the fire bricks 2 support a piece of glass 100 which is to have a curve formed therein.

As shown, the distance between the heating element 4 and the glass 100 is known as the "stand off" while the distance between the glass 100 and the body 8 is known as the "set back".

In operation, a significant proportion of the radiation from the heating element 4 incident upon the upper surface of the glass 100 is absorbed during transmission through the glass. Without the presence of the insulating reflecting/scattering body 8, the glass 100 would attain a temperature T2 in both spaces 6 and 7. When the body 8 is present, it re-radiates in a non-specular manner a high proportion (some 95% e.g.)

of the energy transmitted through the glass 100 on to the under side of the glass. The temperature of the glass above space 7 is consequently raised by an amount ΔT above T2, to the higher temperature T1. These temperatures result in sagging of the glass 100 into the spaces 6 and 7 by amounts $\Delta S2$ and $\Delta S1$ respectively, and the glass assumes a curved shape as shown in Figure 2 which it retains on cooling.

With a number of operations of the apparatus, each with a piece of glass 203mm x 76mm in size, the following results were obtained:-

T1°C	T2°C	Set Back	Stand Off	$\Delta S1$	$\Delta S2$
550	540	4cm	3.5cm	0.104mm	0.05mm
600	484	4cm	2.5cm	0.8mm	0.05mm
630	480	3cm	2.5cm	0.9mm	0.05mm
650	472	2cm	2.5cm	3.0mm	0.05mm
730	460	1.2cm	2.5cm	9.0mm	0.05mm

From the above results it can be seen that the body 8 of thermally insulating material serves to increase the temperature of the glass 100 over the space 7 relative to that of the glass 100 over the space 6, this increased temperature resulting in proportionally increased sagging of the piece of glass 100 into the space 7 as compared with the space 6.

Thus, by appropriate arrangement of the support 1 and a body 8 (or bodies) of thermally insulating material, a piece of glass 100 can be formed into a required curved shape.

As mentioned above, the body 8 of thermally insulating material provides non-specular reflection and/or

scattering of the thermal energy in the space 7. It has been found that the body 8 cannot be replaced with a mirrored surface since such provides very sharply defined specular reflection of the heat energy, this resulting in too sudden a change in the temperature of the glass due to is relatively poor thermal conductivity which can produce, inter alia, visible pattern effects within the glass.

CLAIMS

1. Glass forming apparatus comprising an enclosure; a heating element in the enclosure; means to support a piece of glass in the enclosure to receive heat energy from the heating element, a portion of the piece of glass being unsupported whereby said portion can sag relative to the supported portions of the piece of glass; and a body of thermally insulating material located adjacent to but spaced from said portion of the piece of glass on the side thereof remote from the heating element.

2. Apparatus as claimed in Claim 1, including a non-specular reflector of thermally insulating material on the side of the heating element remote from the piece of glass.

3. Apparatus as claimed in Claim 1 or Claim 2, in which the heating element emits radiation in the infra red region.

4. Apparatus as claimed in any preceding claim, in which said body is of microporous insulating board.

5. Glass forming apparatus substantially as hereinbefore described with reference to the drawing.

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