METHOD FOR RESHAPING GLASS ARTICLES

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This invention relates to methods for reshaping glass articles.

It is an object of the present invention to provide a method for reshaping glass articles which does not necessitate the use of expensive molding equipment.

A further object is the provision of a method wherein only minor modifications in equipment are necessary to produce varying shapes in glass articles.

A further object is the provision of a method which is capable of producing smoother surfaces in reshaped glass articles than are obtainable by conventional tooling methods.

These and other objects, which will be apparent from the following description, are accomplished, according to one embodiment of the invention, by heating a wall of a glass article from beneath the wall by means of a high-velocity flame until a portion of the wall is softened and displaced upwardly by the force of the burner flame and subsequently extinguishing the flame and replacing it by a jet of cooling gas at a velocity sufficient to maintain the previously displaced portion of the thin wall in a shape differing from its original shape until the wall has hardened.

The invention will be described with reference to the accompanying drawing, which is a schematic view of apparatus for carrying out the present invention.

Referring to the drawing, glass tubing 10 is suspended, with its axis substantially horizontal. Gas-air-oxygen burner 11 is located beneath the tubing. Air, combustible gas and oxygen are supplied to burner 11 through inlets 12, 13 and 14, respectively. After entering inlet 14, oxygen passes through conduit 15, which is provided with solenoid valve 16 and needle valve 17. Similarly, the combustible gas passes through conduit 18, which contains solenoid valve 19 and needle valve 20. After entering inlet 12, air passes through each of conduits 21 and 22. Conduit 21 contains solenoid valve 23 and needle valve 24, and conduit 22 contains solenoid valve 25 and needle valve 26.

The needle valves are provided for the purpose of regulating the flow rates of the respective gases to burner 11. The solenoid valves permit the respective flows to be turned on and off as required.

Initially, during the operation of the device, the respective gases are supplied to inlets 12, 13 and 14. Solenoid valves 16, 19 and 25 are open, while solenoid valve 23 is closed. The respective needle valves are adjusted to permit flows of the respective gases to provide a burner velocity which will produce sufficient force on the glass tubing after it has been heated to force the heated portion of the tubing upward. After the portion of tubing 10 adjacent to burner 11 has been heated sufficiently, the force of the burner flame causes the softened portion of the tubing to move upwardly. As the softened portion moves and the distance between the burner and the softened glass decreases, the burner exerted force on the soft glass decreases until this force is equal to the force of gravity upon the softened glass. When this equilibrium has been reached, the softened portion of the tubing remains stationary. At this point, solenoid valves 16 and 19 are closed, extinguishing the burner flame, and solenoid valve 23 is opened in order to augment the flow of air to burner 11, thereby producing a flow of cooling air having a force substantially equal to that formerly provided by the flame. The flow of air is maintained until the tubing has hardened, at which time solenoid valves 23 and 25 are closed, and the process is complete.

Although the respective gases may be supplied to the inlets at various pressures and the respective needle valves adjusted to provide various flow rates depending upon the size and thickness of the glass object being reshaped and the size of the depression which it is desired to form in the object and can easily be determined by experimentation, the following is provided as a specific example of a preferred embodiment of the invention:

Glass tubing 10 may be a section of borosilicate glass tubing two inches in outer diameter and having a thickness of 0.112 inch. Burner 11 may comprise a plate having therein three rows of holes for the escape of gas therefrom. The rows may consist of sixteen holes of approximately 0.050 inch in diameter, the centers of the holes being spaced approximately 3/32 inch apart along the rows and ½ inch between the rows. Air, gas and oxygen may be supplied to the respective inlets at pressures of 25, 20 and 25 pounds per square inch, and needle valves 17, 20, 26 and 24 may be adjusted to provide flow rates of 25, 35, 199 and 8 cubic feet per hour, respectively. With these values for the respective process variables, a generally oval-shaped depression having a major axis approximately 1.89 inches, a minor axis of approximately 1.10 inches and a depth of approximately 0.55 inch will be formed when solenoid valves 16, 19 and 25 remain open to provide a burner flame for 35 seconds, and subsequently solenoid valves 16 and 19 are closed and solenoid valve 23 is opened to provide cooling air for approximately 5 seconds.

Although the invention has been described with reference to a process for forming a depression in a section of glass tubing, the present invention may equally well be utilized to reshape various glass articles other than glass tubing. The described apparatus may be utilized for forming variously shaped depressions in various articles with only slight modification of the apparatus. The needle valves may be reset in order to provide appropriate gas flow rates, and variously shaped burners may be employed in order to produce depressions of various shapes. It will be apparent that the present process permits the forming of variously shaped objects without requiring the fabrication of individual molding apparatus for the formation of each such depression, as generally required by conventional mechanical reshaping methods.

Although an air-gas-oxygen burner has been illustrated as the preferred means for heating and reshaping glass, it will be understood that other means, such as plasma-jet arcs, may be employed for heating a localized area of a glass article and propelling a stream of gas against the area to form a depression therein.

Inasmuch as the foregoing description has been provided solely as that of a preferred embodiment of the present invention, it is intended that the scope of the present invention be limited only by the scope of the appended claims.

We claim:

1. The method of reshaping a glass article which comprises the steps of directing against a bottom surface of a portion thereof a burner flame having heat and force sufficient to soften said portion and displace said portion upwardly and subsequently substituting for said burner flame a cooling gas having a force sufficient to maintain said portion in an upwardly displaced position until said portion has hardened in said position.

2. The method of reshaping a glass article which comprises the steps of heating a portion thereof to soften said portion, directing gas from beneath said softened portion, and subsequently extinguishing the burner flame, thereby producing a flow of cooling air having a force substantially equal to that formerly provided by the flame.
portion while said portion is soft with force sufficient to displace said portion upwardly and subsequently directing cooling gas against said portion from beneath with the force sufficient to maintain said portion displaced upwardly until it has hardened.

3. The method of forming a depression in glass pipe which comprises the steps of directing from beneath said pipe against a portion thereof a burner flame having heat and force sufficient to soften said portion and to cause it to move upwardly and subsequently directing against said portion from the bottom thereof cool gas having a force sufficient to maintain said portion in an upwardly displaced position until said portion has hardened in said position.

4. The method of reshaping a glass article which comprises the steps of supporting said article with a portion thereof oriented substantially horizontally, directing against a bottom surface of said portion a burner flame having sufficient heat and force to soften said portion and to displace said portion upwardly and subsequently substituting for said burner flame a cool gas having a force sufficient to maintain said portion in an upwardly displaced position until said portion has hardened.

5. The method of reshaping a glass article which comprises the steps of supporting said article with a portion thereof oriented substantially horizontally, directing against a bottom surface of said portion a burner flame having heat and force sufficient to soften said portion and to displace it upwardly, subsequently extinguishing said flame and providing a flow of cooling gas through said burner and against said portion with a force sufficient to maintain said portion displaced upwardly and maintaining said flow of cooling gas until said portion has hardened.

6. The method according to claim 5 in which air, oxygen and a combustible gas are supplied to said burner to provide said flame, and said flame is extinguished by interrupting the flow of said combustible gas to said burner.

7. The method of forming a depression in glass pipe which comprises the steps of supporting said pipe with its axis substantially horizontal, locating a gas burner beneath a portion of said pipe, directing a flame from said burner against the bottom of said portion with heat and force sufficient to soften said portion and to displace it upwardly, and subsequently extinguishing said flame and providing a flow of cooling gas through said burner and against said portion with a force sufficient to maintain said portion displaced upwardly until said portion has hardened.

8. The method according to claim 7 in which air, oxygen and a combustible gas are supplied to said burner to provide said flame and said flame is extinguished by interrupting the flow of said combustible gas to said burner.

9. The method of reshaping a glass article which comprises the steps of directing against a bottom surface of a portion thereof a burner flame having heat and force sufficient to soften said portion and displace said portion upwardly, maintaining said burner flame against said surface until said surface has been displaced upwardly to a position at which the force of said flame upon said portion is substantially equal to the force of gravity thereon, such that said portion remains stationary at said position, subsequently substituting for said burner flame a cooling gas directed against said bottom surface with a force sufficient to maintain said portion at said position, and continuing to direct said cooling gas against said surface until said portion has hardened in said position.

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