

PATENT SPECIFICATION

(11) 1 321 123

DRAWINGS ATTACHED

- (21) Application No. 41148/70 (22) Filed 26 Aug. 1970
(44) Complete Specification published 20 June 1973
(51) International Classification B29C 5/04
(52) Index at acceptance B5A 1D1A1A 1DX 2A1



(54) IMPROVEMENTS IN OR RELATING TO METHOD AND APPARATUS FOR MOLDING HOLLOW PLASTIC ARTICLES

(71) I, STEWART PIVAR, a citizen of the United States of America, residing at 1 Lynn Drive, Muttontown, Long Island, State of New York, United States of America, do hereby declare the invention, for which I pray a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for molding hollow objects of thermoplastic materials and particularly those in the form of fluids or finely divided powders such as vinyl plastisols and powdered polyolefins.

A method of molding called rotational molding has been known for many years and is widely used. This method involves the use of hollow molds rotatable simultaneously about two mutually perpendicular axes within a heating oven. Such machines generally embody three spindles each mounted with a plurality of molds. The spindles are arranged to enter consecutively three stations, these being the heating oven, a cooling chamber and an area whereat the molds are emptied and recharged. The oven usually includes a system to circulate the air for the purpose of evenly distributing the heat. Where a multiplicity of small molds is being used, the output of molded parts per unit time can be quite large. This is not the case, however, when large moldings are being made where limitations in the size of the heating oven preclude the use of more than one mold at a time.

In cases where the number of molded pieces required is small, it is not economically feasible to build a large number of molds. In such instances, oven-type rotational molding machines do not function efficiently and do not justify their high cost.

The apparatus which is the subject of the present invention provides simpler and less expensive means to manufacture hollow thermoplastic moldings.

In accordance with the present invention,

[Price 25p]

there is provided a method of manufacturing a plastic article including the steps of charging a hollow mold with a thermoplastic material, rotating the mold simultaneously on two mutually perpendicular axes one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, and generating heat at a position spaced beneath and parallel to said one axis and which extends longitudinally thereof to heat the mould and the material therein and to form a molded product.

The present invention additionally provides an apparatus for use in manufacturing hollow plastic articles according to the aforescribed method, the apparatus including the mold in which said articles are formed, means for rotating said mold simultaneously about two mutually perpendicular axes, one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, whereby the ends of the mold describe at least one circle, and heating means extending parallel to said horizontal axis at a position beneath said horizontal axis and adjacent to but outside of said circle.

The invention also provides novel and improved means of creating the necessary rotational movements of the mold which are uniquely adaptable to an apparatus which is not constrained to function in the confined environment of the inside of a heating oven.

In the accompanying drawings:

Figure 1 is a generally diagrammatic front view of a molding apparatus provided in accordance with the invention; and

Figure 2 is a diagram illustrating in perspective the geometric relationships of the different elements of the process of the invention.

Referring to Fig. 1, on a supporting frame 1 are mounted drive shaft pillow blocks 2 which support a hollow drive shaft 3, an end of which is attached to a right angle

SPECIFICATION AMENDED - SEE ATTACHED SLIP

drive or T-coupling 4 which in turn is attached to and supports a radial member 5 of the rotation frame 9. At the opposite end of the machine is another radial member 6 which is supported by a shaft 7 which is free to rotate in and is supported by pillow blocks 8. The rotation frame 9 comprises also two horizontal members 10 and 16 which are attached adjustably to the radial members by sliding clamps 11 by means of which the horizontal members may be set at any distance from each other permitted by the extent of the distance of travel along the radial members.

Molds are mounted removably on the rotation frame by means of mold brackets 13 attached to the molds which engage attaching clamps 14 which are attached to the horizontal member 16 and to which are attached pins 17 which engage a hole in the mold bracket 13 in which it is free to rotate. The opposite end of the mold is attached to drive brackets 18 to which are attached two pins 19 which withdrawably enter corresponding holes in the mold bracket 13. Rotation is imparted to the molds through the drive brackets 18 by means of a secondary drive shaft system comprising right angle drives 20a—c which transmit the power from the secondary drive shaft 21 which passes through the hollow drive shaft 3. The telescoping shaft 21a is a keyed hollow telescoping shaft, the bore of which engages shaft 22 which is free to slide in and out when the horizontal member is adjusted to different positions along the radial members 5 and 6. Power is supplied to the drive shaft by a motor 23 and to the secondary shaft 21 by a motor 24.

A burner 25 is located beneath the molds and is supported adjustably by the burner supports 26a and b which permit a raising or lowering of the position at which the burner is set. The length of the burner is less than the distance between the radial members 5 and 6.

The steps of producing a molded article by the apparatus described in the subject invention are as follows: a measured quantity of fluid or powdered thermoplastic molding material is placed into a mold which is mounted on the machine by engaging the associated mold brackets 13 with the attaching clamps 14 and the drive brackets 18. The burner is raised to a position as close as possible to the mold by adjusting the mold support brackets 26a and b.

The mold is caused by operation of motors 23 and 24 to rotate simultaneously about the two mutually perpendicular axes for a preset interval of time which usually amounts to two to five minutes while being exposed to the heat of the gas burners. At the end of this interval, rotation is halted.

The burner is then turned off and the mold is dismantled for cooling and is thereafter emptied of the finished molded article therein.

The mold chosen for illustration in the drawing is irregular in shape in the thermal sense in that some parts thereof are very much closer than others to the source of heat during rotation. It might be expected that these areas will receive more heat and consequently will produce a greater wall thickness in the corresponding areas of the molded article. However, examination of a finished molded article reveals satisfactory distribution of the material over the surface of the mold.

This phenomenon can be understood by an analysis of the motion imparted to a given point on the mold surface with respect to its distance from the heat source. The velocity of such a point during rotation is more or less inversely proportional to the distance from the heat source. Points at a greater distance from the heat source will tend to remain exposed to heat for a proportionally longer time thereby tending to minimize the ostensible inequity. Observation of the apparatus in operation will show that the extremities of an irregularly shaped mold will actually pass through the flames while parts close to the center of rotation may be a foot or more from the flames. However, it is seen that the greater velocity of the extremities causes these parts to pass through the flames in a fraction of a second while the parts remote from the flames are exposed to heat for a noticeably longer period of time.

The apparatus as illustrated in Fig. 1 accommodates two molds. The rotation frame is shown supported at both ends. It can be supported by the drive shaft alone especially if only one mold is to be used. By building the rotation frame sufficiently long, four or five molds can be used simultaneously. Such a machine will nevertheless require about one fifth the space required by an oven-type rotational molding machine.

Reference to Fig. 2 will provide a diagrammatic illustration of some of the principles involved in the process of the invention. In Fig. 2, line 30 represents one of the two mutually perpendicular axes referred to above and in particular represents the axis about which the frame of the apparatus rotates such as, for example, in the direction indicated by arrow 32. Line 34 indicates the axis of the mold which second axis is perpendicular with the axis 30. The mold rotates in one direction or the other as indicated by way of example by arrow 36.

Generally speaking, the ends of the mold can be assumed to exist at the ends of axis 34

70

75

80

85

90

95

100

105

110

115

120

125

130

such as at 38 and 40. During the rotation contemplated in accordance with arrow 32, the ends 38 and 40 will describe a circle 42 concentric with axis 30 and lying in a plane which is perpendicular to the latter. The source of heat is indicated by arrow 44, this being directed radially inwards with respect to circle 42 towards the center 46 of the circle. The source 44 will be located in a position parallel to the axis 30 and adjacent but outside the circle 42.

It follows from what has been stated above that a method of manufacture is contemplated whereby a hollow mold is charged with a thermoplastic material, the mold being rotated simultaneously on two mutually perpendicular axes whereby the axis of the mold, which may for example be cylindrical in shape, moves through a plane perpendicular to the other axis and during which movement heat is directed from a fixed position spaced from the axis 30 but in a radially inwards direction towards the latter and against the mold to heat the material therein to form a molded product.

The heating means as illustrated is preferably an elongated gas burner which is parallel to the axis 30 and perpendicular to the plane of the circle 32. The diameter of the circle 42 will be determined by the dimensions of the mold for whose variance the support members 10 and 16 are provided in adjustable relationship. It will be noted of course that members 10 and 16 are preferably arranged parallel to the axis 30 and that members 5 and 6 extend generally radially with respect to the latter said axis.

An inspection of Fig. 1 will also reveal that the T-shaped drive member 4 is coaxial with the axis 30 as is the supporting member 7.

Finally, as described above, it will be appreciated that a point A on the periphery of circle 42 will have a linear velocity which is greater than that of a point B lying closer to the center 46 as a result of which point A will spend less time in the vicinity of the source of heat than will the point B. This is due to the heat gradient between the source of heat, which is outside of the circle, and the center 46 of the circle. By taking advantage of this, the invention provides for a novel and useful technique which has not been heretofore available.

WHAT I CLAIM IS:—

1. A method of manufacturing a plastic article, including the steps of charging a hollow mold with a thermoplastic material, rotating the mold simultaneously on two mutually perpendicular axes one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, and generating heat at a position spaced beneath and parallel to said

one axis and which extends longitudinally thereof to heat the mould and the material therein and to form a molded product.

2. The method as claimed in claim 1, in which the mold is of generally cylindrical form and is rotated about its longitudinal axis.

3. The method as claimed in claim 1 or claim 2, in which the ends of the mould describe a circle as the mould is rotated about said horizontal axis, and, the heat is generated at a position outside of the circle and beneath the horizontal axis.

4. Apparatus for use in manufacturing hollow plastic articles according to the method of any one of claims 1 to 3, including a mould in which said articles are formed, means for rotating said mold simultaneously about two mutually perpendicular axes, one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, whereby the ends of the mould describe at least one circle, and heating means extending parallel to said horizontal axis at a position beneath said horizontal axis and adjacent to but outside of said circle.

5. Apparatus as claimed in claim 4, in which said heating means is an elongate gas burner.

6. Apparatus as claimed in claim 4 or claim 5, including a frame with spaced end members extending radially from said horizontal axis, and support members extending between the end members and which are adjustably secured thereto, said mould being supported on said support members symmetrically of said horizontal axis.

7. Apparatus as claimed in claim 6, including a drive for rotating the mold about said other axis, and wherein said drive includes a telescopic coupling to accommodate adjustment of the support members.

8. Apparatus as claimed in any one of claims 4 to 7, including a frame, means rotatably supporting the mould on said frame, a coupling connected to said frame, a motor coupled to and driving the coupling to rotate the frame about said horizontal axis, two secondary drive shafts perpendicular to each other and extending into engaged driving relationship with the mould, a motor coupled to and driving one and thereby the other of said shafts, and means coupling the other of the said shafts to said mould to rotate the mould about its longitudinal axis.

9. Apparatus as claimed in claim 8, in which the frame includes adjustably related members and one of said shafts includes telescopically related parts to accommodate adjustment of the said members.

10. Apparatus as claimed in any one of

such as at 38 and 40. During the rotation contemplated in accordance with arrow 32, the ends 38 and 40 will describe a circle 42 concentric with axis 30 and lying in a plane which is perpendicular to the latter. The source of heat is indicated by arrow 44, this being directed radially inwards with respect to circle 42 towards the center 46 of the circle. The source 44 will be located in a position parallel to the axis 30 and adjacent but outside the circle 42.

It follows from what has been stated above that a method of manufacture is contemplated whereby a hollow mold is charged with a thermoplastic material, the mold being rotated simultaneously on two mutually perpendicular axes whereby the axis of the mold, which may for example be cylindrical in shape, moves through a plane perpendicular to the other axis and during which movement heat is directed from a fixed position spaced from the axis 30 but in a radially inwards direction towards the latter and against the mold to heat the material therein to form a molded product.

The heating means as illustrated is preferably an elongated gas burner which is parallel to the axis 30 and perpendicular to the plane of the circle 32. The diameter of the circle 42 will be determined by the dimensions of the mold for whose variance the support members 10 and 16 are provided in adjustable relationship. It will be noted of course that members 10 and 16 are preferably arranged parallel to the axis 30 and that members 5 and 6 extend generally radially with respect to the latter said axis.

An inspection of Fig. 1 will also reveal that the T-shaped drive member 4 is coaxial with the axis 30 as is the supporting member 7.

Finally, as described above, it will be appreciated that a point A on the periphery of circle 42 will have a linear velocity which is greater than that of a point B lying closer to the center 46 as a result of which point A will spend less time in the vicinity of the source of heat than will the point B. This is due to the heat gradient between the source of heat, which is outside of the circle, and the center 46 of the circle. By taking advantage of this, the invention provides for a novel and useful technique which has not been heretofore available.

WHAT I CLAIM IS:—

1. A method of manufacturing a plastic article, including the steps of charging a hollow mold with a thermoplastic material, rotating the mold simultaneously on two mutually perpendicular axes one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, and generating heat at a position spaced beneath and parallel to said

one axis and which extends longitudinally thereof to heat the mould and the material therein and to form a molded product.

2. The method as claimed in claim 1, in which the mold is of generally cylindrical form and is rotated about its longitudinal axis.

3. The method as claimed in claim 1 or claim 2, in which the ends of the mould describe a circle as the mould is rotated about said horizontal axis, and, the heat is generated at a position outside of the circle and beneath the horizontal axis.

4. Apparatus for use in manufacturing hollow plastic articles according to the method of any one of claims 1 to 3, including a mould in which said articles are formed, means for rotating said mold simultaneously about two mutually perpendicular axes, one of which is substantially horizontal and the other of which moves in a plane perpendicular to said one axis, whereby the ends of the mould describe at least one circle, and heating means extending parallel to said horizontal axis at a position beneath said horizontal axis and adjacent to but outside of said circle.

5. Apparatus as claimed in claim 4, in which said heating means is an elongate gas burner.

6. Apparatus as claimed in claim 4 or claim 5, including a frame with spaced end members extending radially from said horizontal axis, and support members extending between the end members and which are adjustably secured thereto, said mould being supported on said support members symmetrically of said horizontal axis.

7. Apparatus as claimed in claim 6, including a drive for rotating the mold about said other axis, and wherein said drive includes a telescopic coupling to accommodate adjustment of the support members.

8. Apparatus as claimed in any one of claims 4 to 7, including a frame, means rotatably supporting the mould on said frame, a coupling connected to said frame, a motor coupled to and driving the coupling to rotate the frame about said horizontal axis, two secondary drive shafts perpendicular to each other and extending into engaged driving relationship with the mould, a motor coupled to and driving one and thereby the other of said shafts, and means coupling the other of the said shafts to said mould to rotate the mould about its longitudinal axis.

9. Apparatus as claimed in claim 8, in which the frame includes adjustably related members and one of said shafts includes telescopically related parts to accommodate adjustment of the said members.

10. Apparatus as claimed in any one of



claims 4 to 9, in which the mold is a substantially cylindrical element.

5 11. A method of manufacturing a plastic article, substantially as hereinbefore described with reference to the accompanying drawings.

12. Apparatus for use in manufacturing hollow plastic articles, substantially as hereinbefore described with reference to the accompanying drawings.

10

REDDIE & GROSE,
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1973.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

