April 29, 1947. G. W. BORKLAND 2,419,758

METHOD AND APPARATUS FOR COATING FRANGIBLE ARTICLES

Filed Aug. 12, 1943 2 Sheets-Sheet 1

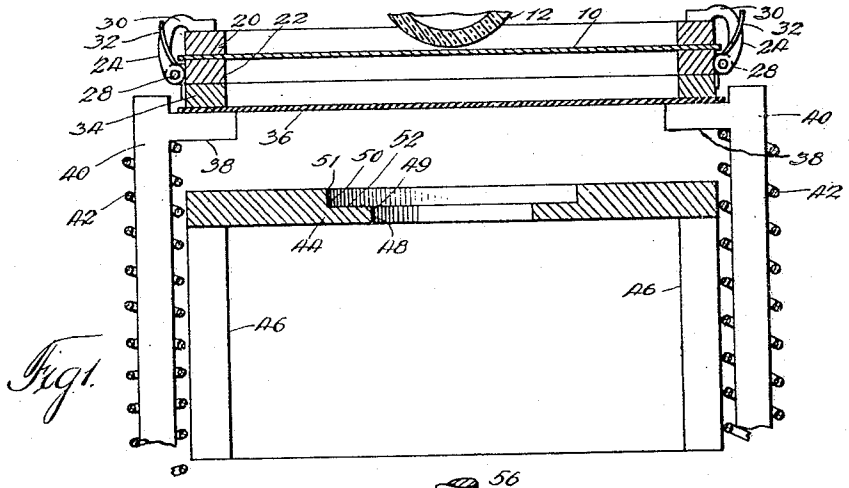



Fig. 1.

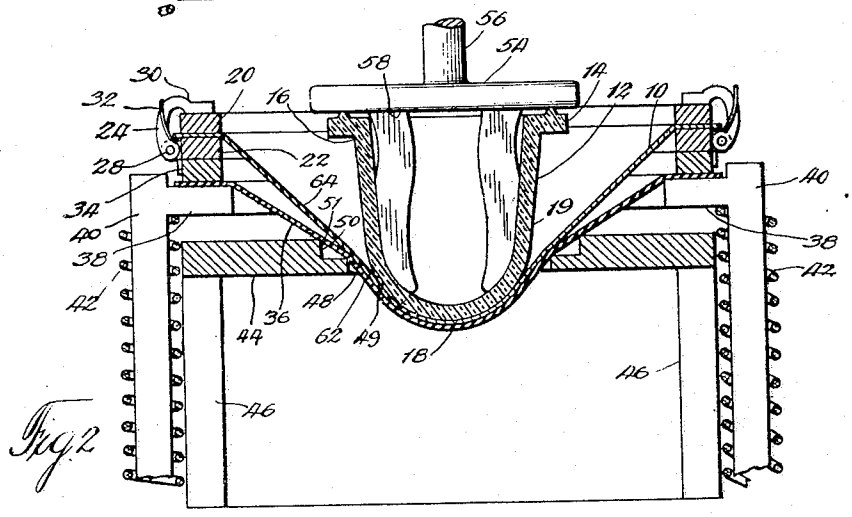



Fig. 2.

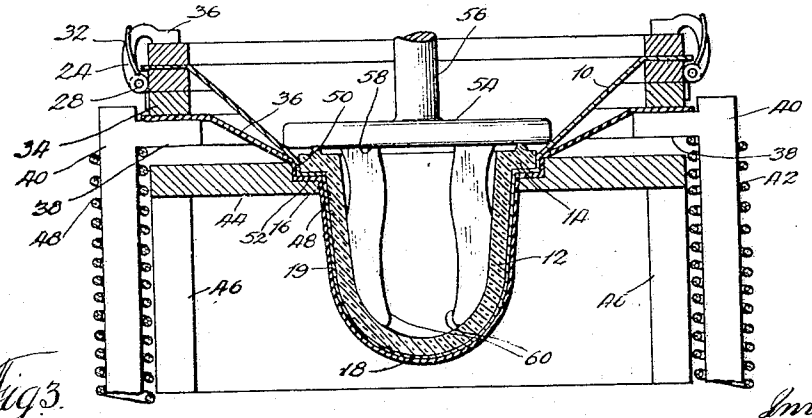



Fig. 3.

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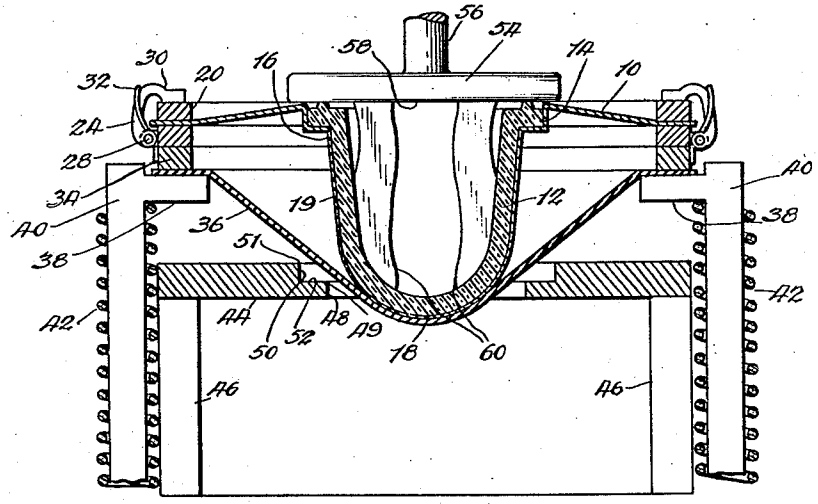



Fig. 4.

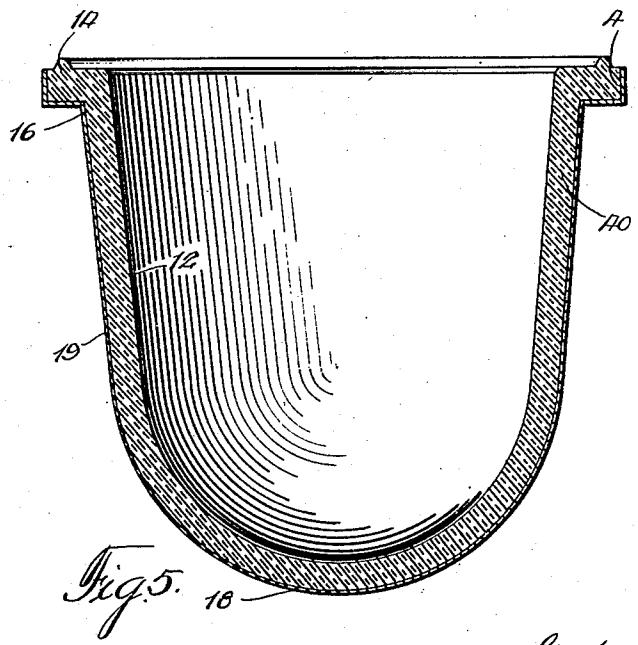



Fig. 5.

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# UNITED STATES PATENT OFFICE

2,419,758

## METHOD AND APPARATUS FOR COATING FRANGIBLE ARTICLES

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Application August 12, 1943, Serial No. 498,381

8 Claims. (Cl. 18—19)

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This invention relates to an improved protected shatter-proof globe, and to a new method for making the same.

Globes for use with electric light bulbs may comprise a body of translucent or transparent material, frequently of colored glass, constructed with dimensions suitable for surrounding an electric light bulb in spaced relation, and having a flange around the base to hold the base of the globe against a ceiling, wall, or other surface. Notwithstanding the fact that these globes are usually formed of relatively thick glass, under the conditions to which they are subjected, e. g., the shock of guns firing or shells exploding when used on shipboard, considerable difficulty has been encountered due to shattering of the globes and flying of the glass particles.

It is an object of the present invention to provide a protected hollow globe of frangible material such as glass, in which fragments of the glass if it is broken are strongly retained and do not fall or fly.

It is a further object to provide a translucent, frangible globe or hollow body having a formed sheet of translucent, tough and flexible material in tensioned engagement with the globe or body to strengthen the body against fracture due to shock or impact of bodies.

It is an additional object to form a relatively strong protective sheet about a convex body of frangible material by a simple, speedy method, which does not require expensive chemicals nor complicated apparatus.

Further objects and advantages will be in part described hereinafter and in part illustrated in the enclosed drawings, in which—

Fig. 1 is a sectional elevation showing apparatus for making the protected globe according to my invention, illustrating the position of the parts prior to any forming action;

Fig. 2 is a sectional elevation showing the apparatus and illustrating an intermediate step in the process;

Fig. 3 is a sectional elevation showing the apparatus and illustrating the position of the parts on completion of the forming operation;

Fig. 4 is a sectional elevation showing the apparatus and illustrating the position of the parts when removal of the forming device is almost complete; and

Fig. 5 is a sectional elevation showing the completed article according to my invention.

In accordance with the present invention, a sheet 10 of tough translucent or transparent plastic material such as the thermoplastic, ethyl cellulose, or similar material, is softened, e. g., heated to a predetermined temperature and stretched into snug engagement around a convex body or globe 12. When the sheet 10 hardens, i. e., on cooling, it shrinks into tensioned engagement with the globe 12 and will remain firmly attached to the globe so that special handling of the combination is not required to prevent separation.

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A globe 12 suitable for use in the present invention comprises (see Figs. 1 and 2) a convex body, circular in cross section, having a flange 14 extending around its base portion. The globe 12 progressively decreases in diameter from the base portion 16, and terminates in a rounded closed end portion 18. In the form shown in the drawing the sides 19 of the globe are substantially frusto-conical and the end 18 is a section of a sphere tangent to the conical sides.

It has been found that the sheet 10 can be most uniformly applied to the globe 12 by a new procedure which involves the use of a very simple apparatus and a careful control of temperatures.

The apparatus comprises (see Figs. 1, 2, 3, and 4) an upper annular ring member 20, a lower annular ring member 22, and clamps 24 for pressing the rings together in coaxial relation. A sheet 10 of thermoplastic material is clamped between the opposed surfaces of the rings 20 and 22 and extends across the openings in the rings, in position to be formed in the subsequent operation of the apparatus. The clamps 24 are C-shaped members preferably having one end 28 of the C pivotally connected to the lower ring 22 so that the clamp 24 may be swung to a position in which the other end 30 of the clamp is above the upper ring member 20. Springs 32 are provided to force inwardly the free ends 30 of the C-shaped members 24, to exert pressure against the upper surfaces of the upper ring member 20 to urge the ring members 20 and 22 together.

Disposed below the cooperating rings is an annular ring member 34 having a sheet 36 of elastic material such as rubber or synthetic rubber secured across its opening in spaced relation below the sheet 10 of thermoplastic material in the cooperating rings.

Arms 38 are disposed in supporting relation beneath the rings at spaced intervals about their circumference to support the rings in position for forming. The supporting arms 38 are secured to posts 40 which are vertically reciprocable. Spring members 42 are provided to urge the posts 40 to their raised position.

An annular forming ring or die 44 is supported by the supports 46 with its forming opening be-

low and coaxial with the above-mentioned rings. As shown in Fig. 1, the forming surface of the forming ring 44 comprises a lower portion 48 with a diameter at its inner edge 49 substantially equal to the external diameter of the base 16 of the globe to be protected, plus twice the combined thickness of the thermoplastic sheet 10 and the sheet 36, and an upper portion 50 with a diameter at its inner edge 51 which corresponds substantially to the diameter of the flange portion 14 of the globe plus twice the combined thickness of the thermoplastic sheet 10 and the sheet 36. A flat shoulder 52 is provided between the upper edge of the lower portion 48 and the lower edge of the upper portion 50 of the opening.

A vertically reciprocable plunger member 54 is disposed above and coaxial with the openings in the above mentioned rings. As shown in Figs. 2 to 4, the plunger 54 comprises a vertically reciprocable shaft 56, a flat face portion 58, normal to the shaft, and resilient fingers 60 projecting downwardly from the face portion 58 adapted to press against the interior of a globe 12 and to retain it in position with its flange portion 14 against the face portion of the plunger.

The operation of forming the protected globe may be as follows:

A sheet 10 of thermoplastic material is clamped in the ring members 20 and 22 and is carefully warmed to a temperature within a narrow predetermined range to bring it to a condition where the unsupported body of the sheet 10 will almost stretch itself or sag down by its own weight. For a material such as an ethyl cellulose sheet having a thickness of approximately 0.010 to 0.250 inch, a temperature within the range of 180° to 325° F. has been found to give a satisfactory plastic condition. The exact temperature employed depends upon the depth to which the thermoplastic sheet is to be drawn. Where the draw is relatively shallow, temperatures in the lower ranges will be employed, and for a deep draw temperatures in the higher range must be employed.

When the sheet 10 has been warmed to the desired condition, the globe member 12 is secured with its flange against the face 58 of the plunger 54 and the plunger is moved axially downwardly to bring the rounded closed end 18 of the globe 12 into forming engagement with the plastic sheet.

As shown in Fig. 2, at an intermediate point in the descent of the plunger 54, the rounded end 18 of the globe has moved the thermoplastic sheet 10 into engagement with the rubber sheet 36 and has forced the composite sheet, i. e., 10 and 36, downwardly partially into the opening of the forming ring 44. The portion of the thermoplastic sheet 10 between the inner edge of the cooperating rings 20 and 22 and the rounded portion 18 of the globe 12 is out of engagement with any surface except the inner edge of the forming ring 44, so that the thermoplastic sheet 10 is stretched uniformly between the rounded end 18 of the globe 12 and the inner edge of the forming ring 44, and between the inner edge of the forming ring 44 and the inner edge of the cooperating rings 20 and 22. The rubber sheet 36 is interposed between the inner edge of the forming ring 44 and the thermoplastic sheet 10, and prevents uneven drag of the edge of the forming ring 44 on the thermoplastic sheet 10, so that the sheet stretches evenly and uniformly.

As the plunger 54 forces the globe 12, together with the sheet 10 of thermoplastic, and sheet 36 of rubber, downwardly, the cooperating rings 20 and 22 and rubber sheet-supporting ring 34 are forced downward against the action of the springs 42, thus providing additional thermoplastic material so that the required per cent elongation of the thermoplastic sheet 10 is reduced. Also, the rubber sheet resiliently presses portions of the sheet into engagement with the rounded end 18 of the globe so that the sheet 10 is shaped evenly and firmly around the rounded portion 18.



When the plunger 54 has been moved to force the globe 12 to the position shown in Fig. 3, with the lower surface of its flange 14 adjacent the shoulder portion 52 of the forming ring 44, the plastic sheet 10 will have been brought into engagement with the tapering conical surface 19 of the globe 12 and the flange 14 will flatten a portion of the sheet 10 against the shoulder portion 52 of the forming ring 44. The sheet 10 will thus be in snug engagement with the globe 12 and flange 14.

It will be observed that the openings in the cooperating rings 20 and 22, and in the rubber sheet-supporting ring 34 are very appreciably greater than the opening in the forming ring 44. This structure provides a considerably free extent of thermoplastic sheet 10 so that in forming the relatively deep draw illustrated in the drawings, the extenuation of the sheet 10 is distributed over a considerable distance. By this relation, a smoother drawing action is obtained, and danger of rupture of the sheet 10 is substantially eliminated. Also, the rubber sheet 36 insures smooth, substantially friction-free movement of the thermoplastic sheet 10 past the inner edge of the forming ring 44, so that the stretching action on the thermoplastic sheet 10 is balanced between the portion 62 of thermoplastic sheet 10 extending between the rounded end 18 of the globe 12 and the inner edge of the ring 44, and the portion 64 of the sheet 10 between the inner edge of the ring 44 and the inner edges of the cooperating rings 20 and 22.

The thermoplastic sheet 10 on the surface of the globe 12 is then cooled to a condition in which it is no longer plastic. The plunger 54 is moved upwardly, carrying the globe 12 with it, and the rubber shet 36 moves away from the formed thermoplastic on the globe 12, as shown in Fig. 4. It is found that in cooling, the thermoplastic sheet 10 shrinks into tensioned engagement with the globe 12 and forms a strong connection between the globe and sheet, so that there is no tendency for them to become separated. Also, because of the very snug engagement of the sheet and globe, there is apparently created a partial vacuum in any spaces which may exist between the globe and sheet due to irregularities in the globe or sheet, which vacuum aids in maintaining the globe 12 and sheet 10 firmly together throughout subsequent handling of the article.

While in the embodiment hereinabove described, the method has been described in connection with the forming of a protective sheet around a glass globe, it will be obvious that the method can be used to form protective sheets for other frangible bodies. Also, details of the operation may be varied somewhat without departing from the spirit of the invention. Thus, it would be possible to warm the thermoplastic sheet before inserting it between the rings of the forming frame. Accordingly, it is to be understood that the invention comprises not only the procedure and article above described, but all modifications within the spirit thereof which may

be held as a matter of language to come within the scope of the following claims.

I claim:

1. The method of coating a frangible convex body having a progressively decreasing cross section from a base portion to a blunt end portion, which comprises supporting by its edges a sheet of deformable material having a materially greater diameter than the diameter of the base portion, and stretching and extending said sheet around said frangible convex body by forcing the said body with its end portion first against said sheet, bringing the sheet into contact with an elastic sheet supported parallel to the sheet of deformable material, and moving the deformable sheet and elastic sheet through an opening defined by a shaping edge substantially complementary in shape to the exterior of the base portion of the body until the base portion substantially reaches said shaping edge, the shaping edge and elastic sheet cooperating to shape the deformable sheet uniformly around said body, said elastic sheet serving to facilitate movement of said deformable sheet past the shaping edge so that the sheet is extended evenly through the space between the frangible body and said shaping edge.

2. The method of coating a frangible convex body having a progressively decreasing cross section from a base portion to a blunt end portion, which comprises securing a sheet of deformable material across an opening having a materially greater diameter than the diameter of the base portion, and stretching and extending said sheet around said frangible convex body by forcing the said body with its end portion first through said opening against said sheet, bringing the sheet into contact with an elastic sheet secured across an opening parallel to the sheet of deformable material, and moving the deformable sheet and elastic sheet through an opening defined by a shaping edge substantially complementary in shape to the exterior of the base portion of the body until the base portion substantially reaches said shaping edge, the shaping edge and elastic sheet cooperating to shape the deformable sheet uniformly around said body, said elastic sheet serving to facilitate movement of said deformable sheet past the shaping edge so that the sheet is extended evenly through the space between the frangible body and said shaping edges.

3. The method of coating a frangible convex body having a progressively decreasing cross section from a base portion to a blunt end portion, which comprises securing a sheet of thermoplastic material across an opening having a materially greater diameter than the diameter of the base portion, warming said sheet to soften it to a condition in which the unsupported body of the sheet will almost stretch itself or sag down by its own weight, stretching and extending said sheet around said frangible body by forcing the said convex body with its end portion first through said opening, bringing the sheet into contact with an elastic sheet secured across an opening parallel to the sheet of thermoplastic material, and moving the thermoplastic sheet and elastic sheet through an opening defined by a shaping edge substantially complementary in shape to the exterior of the base portion of the body until the base portion substantially reaches said shaping edge, the shaping edge and elastic sheet cooperating to shape the thermoplastic sheet uniformly around said body, said elastic sheet serving to facilitate movement of said thermoplastic sheet past the shaping edge so that the sheet is extended evenly through the space between the frangible body and said shaping edges, and cooling the thermoplastic sheet, whereby it hardens and shrinks around the convex body into tensioned engagement therewith to form a protective sheet therearound.



4. The method of coating a frangible convex body having a progressively decreasing cross section from a base portion to a blunt end portion, which comprises resiliently supporting by its edges a sheet of deformable material having a materially greater diameter than the diameter of the base portion, stretching and extending said sheet around said frangible convex body by forcing the said body with its end portion first against said sheet, bringing the sheet into contact with an elastic sheet resiliently supported by its edges parallel to the sheet of deformable material and moving the deformable sheet and elastic sheet through an opening defined by a shaping edge substantially complementary in shape to the exterior of the base portion of the body, the shaping edge and elastic sheet cooperating to shape the deformable sheet uniformly around said body, said elastic sheet serving to facilitate movement of said deformable sheet past the shaping edge so that the sheet is extended evenly through the space between the frangible body and said shaping edge.

5. The method of coating a translucent frangible convex body progressively decreasing in diameter from a base portion to a blunt end portion and having a flange around its base portion which comprises supporting by its edges a sheet of thermoplastic material having a materially greater diameter than the diameter of the base portion, warming said sheet of thermoplastic material to a temperature where it is softened to a condition in which the unsupported body of the sheet will almost stretch itself or sag down by its own weight, forcing the said body with its end portion first against said sheet, bringing the sheet into contact with an elastic sheet supported by its edges parallel to the sheet of thermoplastic material, and moving the thermoplastic sheet and elastic sheet past a forming edge defining an opening of which the lower portion has an internal diameter at least equal to the sum of the external diameter of the base portion of said body plus twice the thickness of said sheets, the upper portion has an internal diameter at least equal to the diameter of the flange plus twice the thickness of said sheets, and the upper edge of the lower portion is joined to the lower edge of the upper portion by a flat surface, said movement of the body and sheets being continued to stretch and extend said thermoplastic sheet around said body and to flatten portions of said sheet between said flange and said flat surface, said elastic sheet serving to facilitate movement of said deformable sheet past the shaping edge so that the sheet is extended evenly through the space between the frangible body and said shaping edge, and cooling the thermoplastic sheet, whereby it hardens and shrinks around the convex body into tensioned engagement therewith to form a protective sheet therearound.

6. Apparatus for coating a body having a progressively decreasing cross section from a base portion to an end portion, which comprises a frame defining an opening, means to secure a sheet of deformable material across the opening in said frame, a further frame concentric with

said first mentioned frame defining an opening concentric with the opening in said first mentioned frame, a sheet of elastic material across the opening in said last mentioned frame, a shaping edge substantially complementary in shape to the exterior of the base portion of the body to be treated disposed below and concentric with said frames, and vertically reciprocable plunger means adapted to support a body to be treated coaxially with the frames, and to force said body down through the openings in said frames to shape a deformable sheet therearound and to form it between said convex body and said shaping edge.

7. Apparatus for coating a body having a progressively decreasing cross section from a base portion to an end portion, which comprises a frame defining an opening, means to secure a sheet of deformable material across the opening in said frame, a further frame concentric with said first mentioned frame defining an opening concentric with the opening in said first mentioned frame, a sheet of elastic material across the opening in said last mentioned frame, means supporting said frames for movement up and down in a substantially vertical path, means resiliently resisting downward movement of said frames, a shaping edge substantially complementary in shape to the exterior of the base portion of the body to be treated disposed below and concentric with said frames, and vertically reciprocable plunger means adapted to support a body to be treated coaxially with the frames, and to force said body down through the openings in said frames to shape a deformable sheet therearound and to form it between said convex body and said shaping edge.

8. Apparatus for coating a frangible body having a progressively decreasing cross section from a base portion to an end portion, which comprises



concentric frames defining an opening, means to force said frames together to secure a sheet of deformable material therebetween across the opening in said frames, a further frame concentric with said first mentioned frames defining an opening concentric with the openings in said first mentioned frames, a sheet of elastic material across the opening in said last mentioned frame, means supporting said frames for movement up and down in a substantially vertical path, spring means resisting downward movement of said frames, shaping edges substantially complementary in shape to the exterior of the base portion of the frangible body to be treated disposed below and concentric with said frames, and vertically reciprocable plunger means adapted to support a body to be treated coaxially with the frames, and to force said body down through the openings in said frames to shape a deformable sheet therearound and to form it between said convex body and said shaping edges.

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## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS


| Number | Name | Date |
|---|---|---|
| 1,385,240 | Bell | July 19, 1921 |
| 2,193,242 | Smith | Mar. 12, 1940 |
| 2,096,044 | Johns | Oct. 19, 1937 |
| 2,238,579 | Cabell | Apr. 15, 1941 |
| 2,101,128 | Cabell | Dec. 7, 1937 |
| 982,467 | Brandenberger | Jan. 24, 1911 |
| 2,168,651 | McCoy | Aug. 8, 1939 |
| 2,210,509 | Strauch | Aug. 6, 1940 |
| 2,301,106 | Brown | Nov. 3, 1942 |