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# United States Patent [19]

Clark

[11] E

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[54] **FOAM INSULATED TANK**

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[73] Assignee: **Rheem Manufacturing Company**, New York, N.Y.

[21] Appl. No.: **282,301**

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**Related U.S. Patent Documents**

Reissue of:

[64] Patent No.: **4,687,118**
Issued: **Aug. 18, 1987**
Appl. No.: **910,973**
Filed: **Sep. 24, 1986**

U.S. Applications:

[62] Division of Ser. No. 705,226, Feb. 25, 1985, Pat. No. 4,632,792.

[51] **Int. Cl.**[5] ..... **B65D 25/00**

[52] **U.S. Cl.** ..... **220/444**; 220/465; 220/466

[58] **Field of Search** ..... 220/444, 465, 466; 264/45.2, 46.5, 46.6, 46.7, 46.9; 219/312; 126/375

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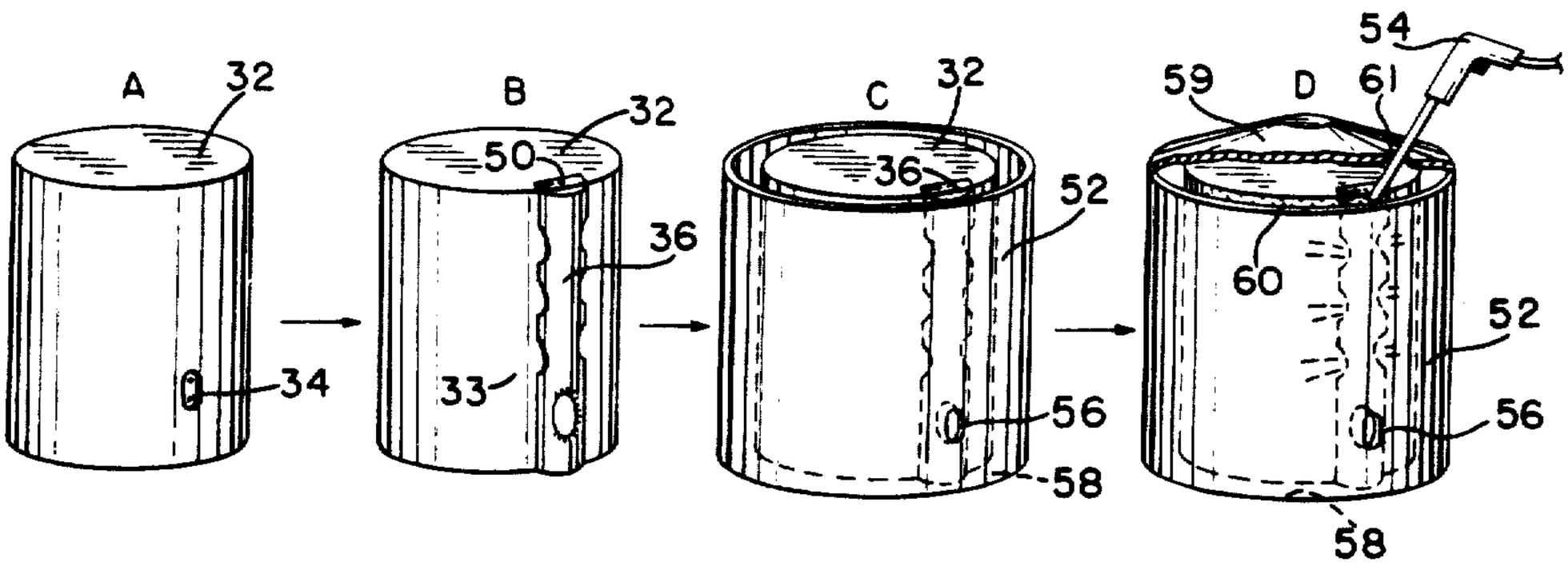
[57] **ABSTRACT**

A method of manufacturing a foam insulated water heater of the type having an inner tank, a layer of insulating foam material surrounding the inner tank and an outer protective shell includes, in one embodiment, the steps of (1) forming a flexible, expandable bag in a configuration which may be placed between the tank and shell, (2) attaching the flexible bag between the tank and shell, (3) filling the bag with a foam material which expands, and (4) continuing to fill the bag so that foam material expands through relief openings in the bag to fill the remainder of the space between the tank and the shell.

**3 Claims, 1 Drawing Sheet**



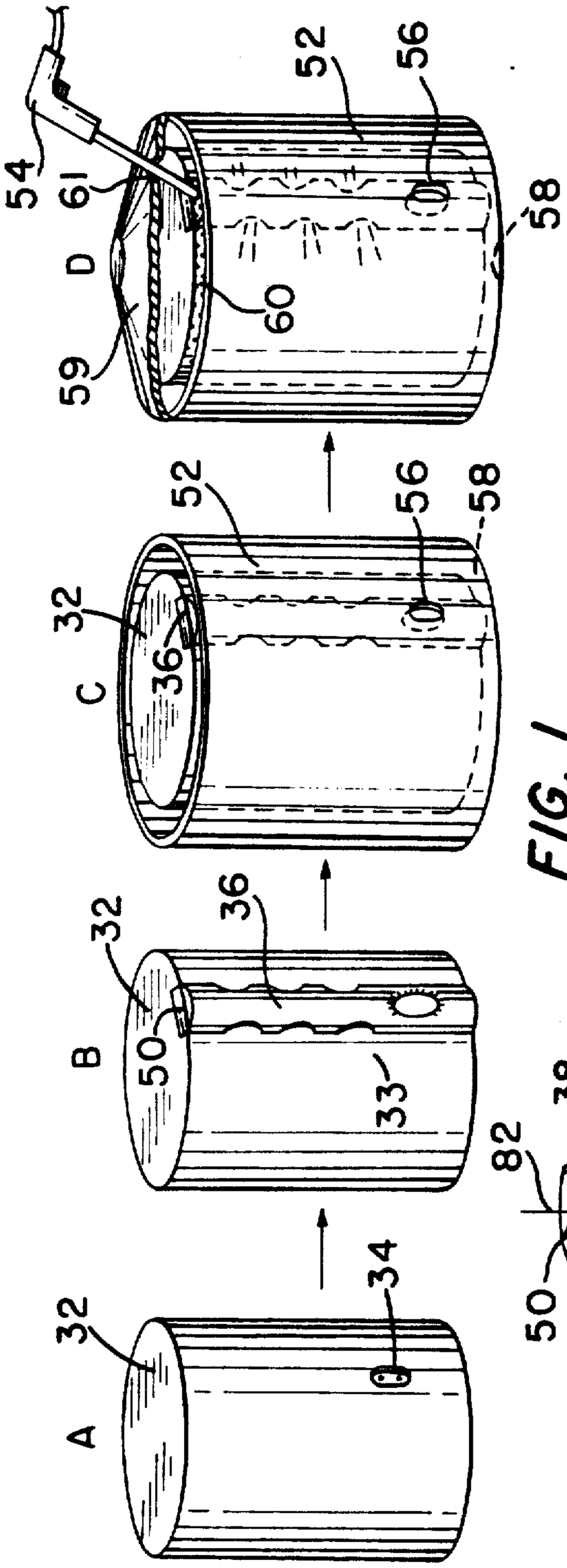



FIG. 1

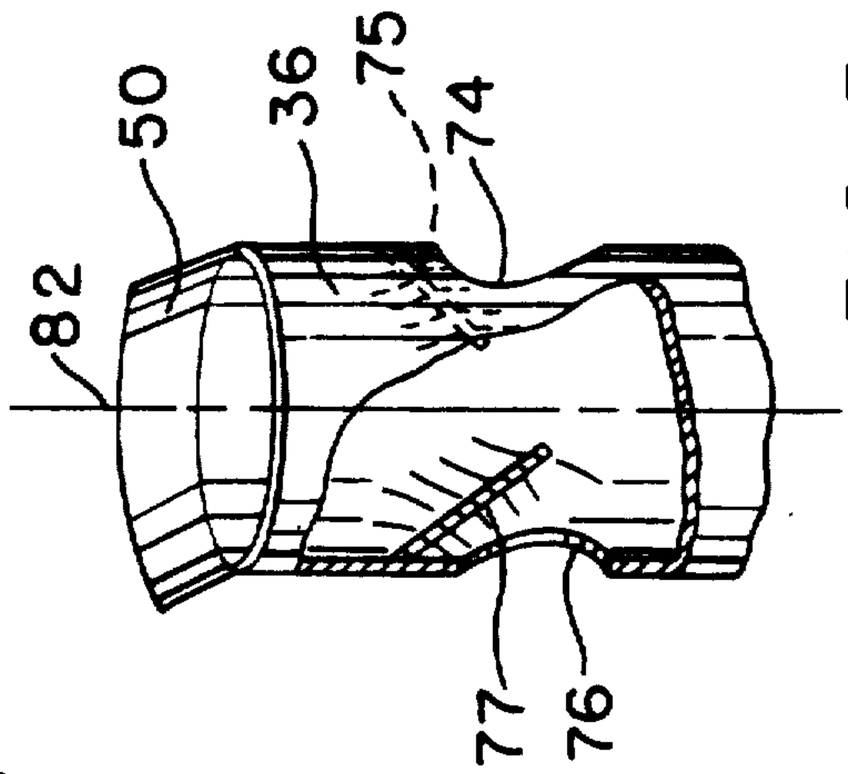



FIG. 3

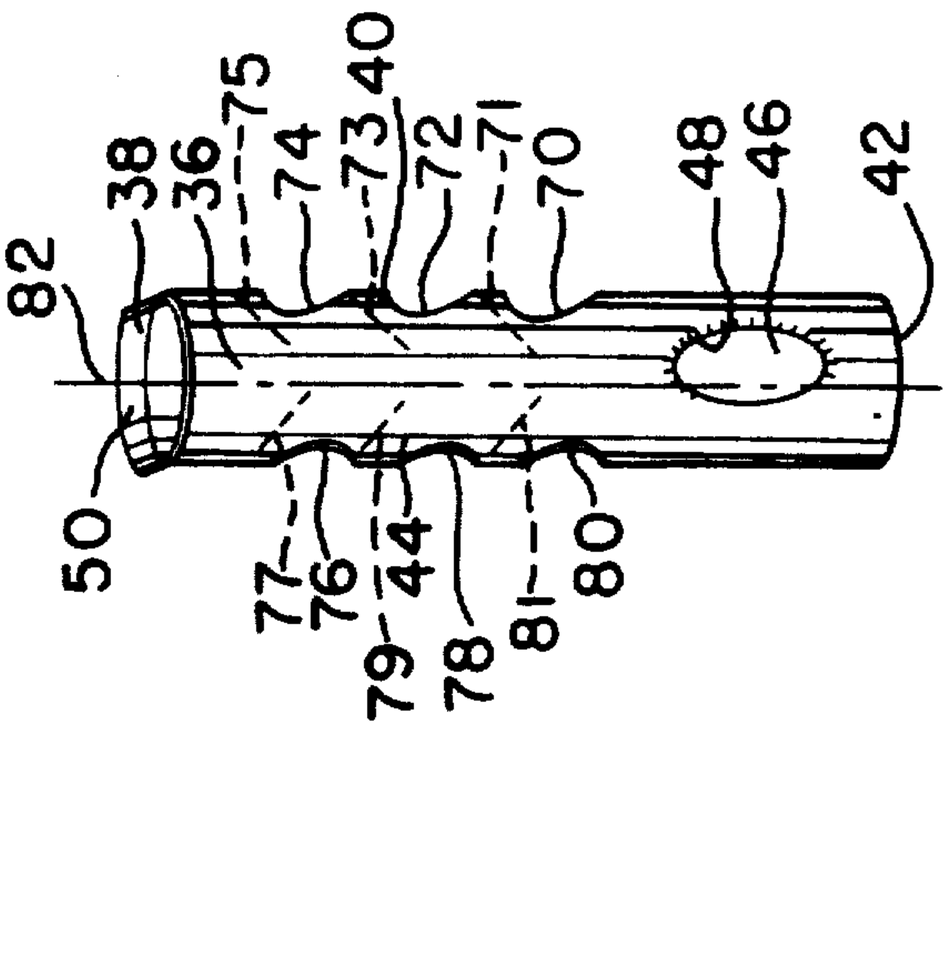



FIG. 2

# FOAM INSULATED TANK

**Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.**

This application is a division of application Ser. No. 705,226, filed Feb. 25, 1985, now U.S. Pat. No. 4,632,792.

The prior application is assigned of record to Rheem Manufacturing Company.

## BACKGROUND OF THE INVENTION

This invention relates to an improved method for the manufacture of insulated containers, particularly water heaters.

Electric and gas water heaters are generally comprised of a glass-lined, metal tank usually in the form of a cylinder which is surrounded by an insulating material retained about the tank by means of a protective, outer, sheet metal shell. In gas models, a burner compartment is normally located below the tank within the protective sheet metal shell. In electric models, a heating element normally projects through a side wall of the tank.

In order to improve the efficiency of such water heaters, it is desirable to provide external insulation for the tanks between the tank and the outer shell. Heretofore Fiberglas insulation has proven to be an excellent insulating material. More recently, expanded urethane foam has been utilized as the insulating material surrounding a water heater tank.

One of the problems associated with such a water heater assembly, particularly one having urethane foam as the insulating material, has been the method by which the foam material is formed about the tank. Generally the foam is injected as a liquid into the annular space between the inner tank and outer shell. However, it is necessary to use a core piece or other mold forming device within the space between the inner tank and outer protective shell to retain the foam within a desired region. For example, in an electric model the heating rod and controls are attached to the side wall of the tank and cannot be covered with foam.

One way of preventing foam from covering or forming over the controls has been to pack the region around the controls with Fiberglas insulation material. The Fiberglas insulation material then serves as a barrier during the foam molding operation.

Another procedure has been adopted by State Industries, Inc. of Ashland City, Tenn. The State Industries procedure calls for forming a flexible plastic bag with an open top, closed sides and a closed bottom edge. The bag then attaches to and partially encircles the inner tank. Expandable urethane foam is next injected into the bag causing the bag to expand and fill the space between the inner tank and the outer shell of the heater. In practice, the bag extends only partially around the circumference of the tank thus leaving a space or void in the region between the inner tank and outer shell defined by the opposite ends of the bag. Controls, inlets, outlets and the like are positioned in the void region, and the spaces between the controls are appropriately packed with a Fiberglas insulation material.

Another procedure is described in U.S. Pat. No. 4,372,028 issued Feb. 8, 1983 for a Method of Manufacturing Foam Insulated Tank. In that patent, the use of a small flexible bag to define the control space and the boundary for flow of foam material is disclosed. That invention permits utilization of expandable foam over substantially the entire outside surface area of a water heater tank. The method insures accurate and easily reproducible positioning of voids or spaces in the insulation through which controls, inlets, outlets and the like may be affixed to the tank. The method also eliminates usage of a large plastic bag from the manufacturing process and substitutes usage of a smaller, less expensive bag. As a result, undesired folds which may form in the large bag are avoided. Also, the insulating capability of the foam is enhanced since the foam will bond directly to the walls of the container and will not be retained in an air permeable bag. U.S. Pat. No. 4,372,028 is incorporated herewith by reference.



The present invention is an improvement of the subject matter of U.S. Pat. No. 4,372,028 and is especially useful in the manufacture of electric water heaters. The present invention eliminates the need for a secondary, separate injection of foam material as described in U.S. Pat. No. 4,372,028. Additionally, there is less leakage of foam material as well as less possibility for distortion of the flexible bag during the manufacturing process.

Thus, it is an object of the invention to provide an improved method of manufacturing a multiple layer container of the type having an inner wall, an intermediate insulating layer and an outer protective wall.

A further object of the present invention is to provide a method of manufacturing a water heater tank having an inner metal tank, an intermediate layer of expanded urethane foam material and an outer protective shell or cover.

Still another object of the present invention is to provide a method of manufacturing a multiple layer container having improved insulating features, improved economy of manufacture, and which does not require significant capital investment in new equipment.

Another object of the invention is to eliminate the necessity of using a large, tank encompassing bag to receive foam and surround an inner metal tank in an assembly which incorporates an inner tank, an insulating layer on the tank and an outer shell over the insulating layer.

A further object of the invention is to provide a method of manufacturing a foam insulating tank assembly having a single foam injection step.

These and other objects advantages and features of the invention will be set forth in the detailed description which follows.

## SUMMARY OF THE INVENTION

Briefly, the present invention comprises a method of manufacturing a multiple layer container of the type having an inner wall, an intermediate layer of expanded foam material and an outer wall. The inner and outer walls serve to retain the expanded foam material during the manufacturing process. The method comprises the steps of (1) forming a flexible, expandable bag in a configuration which may be attached to the inner wall, (2) positioning the flexible bag in the desired position on the inner wall, (3) positioning the outer wall in spaced relation and about the flexible bag and inner wall to define a space between the inner wall and outer wall, (4) filling the flexible bag, which has relief openings, with expandable foam material; and (5) expanding the flexible bag contents to form a barrier between the inner and outer walls while filling the remaining space between

the walls with expandable foam flowing through relief openings in the bag. The sequence of the aforesaid steps may be altered. The configuration of the flexible bag and the position and manner of attachment to the tank may also be varied to define different sections of the mold wall. The flexible bag is configured to define voids or spaces in the final foam layer of the multiple layer container.

## BRIEF DESCRIPTION OF THE DRAWING

In the detailed description which follows, reference will be made to the drawing comprised of the following figures:

FIG. **1**, parts A through D, is a schematic representation of the sequential steps of an embodiment of the manufacturing process of the present invention;

FIG. **2** is a perspective view of the preferred embodiment of the flexible bag used in the process; and

FIG. **3** is an enlarged perspective view of the flexible bag of FIG. **2**.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In the figures, FIG. **1**, parts A–D relate, in general, to the method of manufacture of an electric water heater utilizing the method of the present invention. It is, of course, possible to utilize the techniques and method of the present invention for manufacture of other devices in addition to water heaters. The invention thus relates to the method of manufacture of any multi-layered container wherein the intermediate layer is comprised of expanded foam, for example expanded urethane foam, and the other or surrounding layers are comprised of walls which act as a mold form, at least in part, for the expanded foam material. Thus, inner and the outer walls serve only as mold forms in forming the opposite side faces of the insulating layer. The invention relates particularly to the method for forming voids or passages through the insulating layer between the walls for receipt of controls, inlets and outlets, etc.

In general, a flexible bag, for example a polyethylene bag, which is sized and configured to fit in the space between the inner and outer walls, is provided with one or more sealed passages therethrough. The bag expands tightly against the inner and outer walls when filled with expandable foam material. Thus, the bag is positioned between the inner and outer walls, filled with foam and permitted to expand tightly against the inner and outer walls. The flexible and expandable bag can be configured so that voids or spaces will be defined by the bag between the walls. Importantly, in addition, the bag includes at least one relief opening through the bag to the region between the inner wall and outer wall for the flow of foam material from the bag into the space between the inner wall and outer wall or shell. Thus, it is possible to simply inject foam material into the flexible bag to fill the bag as well as the entire space between the walls. The provision of relief openings in the bag as well as diversion panels within the bag associated with the relief openings insures sequential filling of the bag by foam material followed by filling the space between the walls. Further details of these features are set forth with respect to the specific example of the invention discussed below.



## METHOD OF MANUFACTURING ELECTRIC WATER HEATER

FIG. **1**, parts A–D, illustrates application of the method of the present invention to the manufacture of a typical electric water heater tank assembly. As shown in FIG. **1A**, a tank **32** is generally cylindrical in shape and has a closed top and bottom. A control panel **34** is defined on the side of the tank **32** projecting from surface **33**. Panel **34** may comprise, for example, controls mounted on the wall surface **33** of the tank and projecting outward, as well as electric heating rod elements which project into the interior of the tank **32**.

An expandable flexible bag **36**, preferably of a polyethylene plastic material, is formed to receive expandable foam, for example, urethane foam. As shown in FIG. **2**, bag **36** is formed as a tube by opposed flat sheets of plastic material which are heat sealed together along sealed edges **40**, **42** and **44** to form the bag **36** with a top opening **38**. A void or opening **46** is defined in the bag **36** by overlying cutouts in the sheets which are sealed along a circular or oblong sealed edge **48**. In other words, the sheets of polyethylene or plastic material forming the bag **36** are sealed along the edge **48** to define opening **46**. An optional support flap **50** is defined adjacent the top opening **38**.

As depicted in FIGS. **2** and **3**, the bag **36** includes, in the embodiment shown, a series of six relief passages or openings **70**, **72**, **74**, **76**, **78**, **80** in the side walls of bag **36**. The relief passages **70**, **72**, **74**, **76**, **78**, **80** are divided into opposite sets of three passages **70**, **72**, **74** and **76**, **78**, **80**. Each set of passages **70**, **72**, **74** and **76**, **78**, **80** are positioned on opposite sides of bag **36**, the lowest being generally above the initial liquid level of the injected foam material and preferably vertically above the void or opening **46** through bag **36**. In this manner, when foam material is injected into bag **36**, foam material will initially fill the bottom of bag **36**, and expand in the region adjacent void **46** before spilling through passages **70**, **72**, **74**, **76**, **78**, **80**. As a result, the bag **36** will be held substantially rigid in position between tank **32** and an outer shell or wall **52** before foam material flows from bag **36**. Also, the passages **70**, **72**, **74**, **76**, **78**, **80** are preferably aligned and oriented so that they lead directly into the annular space between tank **32** and shell **52**.

As depicted in FIG. **2**, the bag **36** may include diversion shunts **71**, **73**, **75**, **77**, **79** and **81** associated with each or some of the relief openings **70**, **72**, **74**, **76**, **78** and **80**, respectively. Diversion shunt **71** is exemplary of the structure and function of the diversion shunts. Shunt **71** is formed by heat sealing a sector of the bag **36**, which is polyethylene or other bag material. The shunt **71** may thus be formed by sealing the sides of bag **36** together above opening **70** along a line which inclines downward from above opening **70** for a distance approximately equal to the diameter of opening **70**. The downward inclination of shunt **71** is preferably 30° to 45° from horizontal though this angle may be varied to accommodate the foam material being used for example.

In review, the shunt **71** preferably has a straight line form when the bag **36** is filled. The shunt **71** is also preferably inclined slightly downward with respect to a vertical central axis **82** of the bag **36**. In this manner, as the bag **36** is filled with foam material, the bag **36** will initially fill at the bottom. As the level of foam material increases due to the addition of foam material and the expansion thereof, foam material will be diverted, in

part, by the shunt **71** through the associated opening or passage **70**. By positioning the opening **70** as well as the shunt **71** above the void **46**, the lower portion of the bag **36** will expand and hold the bag in position. Then as the bag **36** fills, foam material will exude through the passages, as at **70**, being diverted, in part, by the shunt **71**. FIG. **3** is an enlarged cutaway section of the bag **36** illustrating the manner in which the shunt **71** is positioned relative to the passage **70** and also relative to vertical axis **82** associated with the bag **36** as the bag **36** is positioned on the outside surface **33** of tank **32**.

As shown in FIG. **1B**, the bag **36** is initially affixed to the side of the tank **32**. For example, the optional flap **50** may be taped to the top of tank **32** in order to support the bag **36** on the outside surface **33** of the tank **32**. The bag **36** is dimensioned to extend from the top to the bottom of the tank **32**. Also, the void or opening **46** is positioned over the panel **34**. Optionally, the bag **36** may be attached to the surface **33** of tank **32** or to the inner surface of the outer shell **52** by use of hot melt glue or another adhesive, for example.

FIG. **1C** illustrates the next step in the manufacture of the assembly. First, outer shell **52** is positioned over the tank **32** and bag **36**. Optionally, of course, if the bag **36** is attached to shell **52**, both fit over tank **32**. Note that in an electric water heater, the shell **52** has approximately the same elevational dimension as the tank **32**. This results because there is no requirement for a burner section below the tank **32**. The shell **52** also includes an access port **56** which is placed in register with opening **46** and panel **34**.

As depicted by FIG. **1D**, subsequent to positioning the shell **52** with respect to the tank **32**, an expandable foam material is injected into the bag **36** by means of injector mechanism **54**. The foam material is then permitted to expand. In this manner the bag **36** impinges on the opposed surfaces of the tank **32** and shell **52** simultaneously along a narrow longitudinal strip defined by bag **36**. The opening **46** is maintained in proper register with the panel **34** on the tank **32** and an opening **56** defined in the outer shell **52**. Consequently, proper access can be maintained for inserting a heating element or other controls into the tank **32**. Though only one bag **36** having a single opening **46** is described, it is possible to have multiple bags having any number of openings or without openings.

As also represented by FIG. **1D**, the outer shell **52** connects to a lower end or bottom panel **58** that blocks foam material. This lower end **58** thus defines the bottom of a mold form which is adapted to receive expandable foam. A top cover of pan **59** fits over the top of shell **52** and includes an opening **61** for receipt of a foam injector mechanism **54**. Alternatively, the foam material may be injected before positioning pan **59** on the shell **52**.

As shown in FIG. **1D**, the injector mechanism **54** is used to inject foam material into the annular space between the shell **52** and tank **32** by introduction through bag **36** and subsequent flow through relief openings **70**, **72**, **74**, **76**, **78**, **80** as required. This foam will flow into bag **36** and then flows from bag **36**, through the relief openings, e.g. **70** as diverted by shunt **71**, and about the tank **32**. The foam will subsequently expand to form an insulating layer **60** partially depicted in FIG. **1D** which totally surrounds the tank **32**.

It can be seen that the application of the method of the present invention illustrated in FIG. **1** contemplates utilization of a flexible expandable bag to define, in part the mold form in the space between a container or tank and an outer shell. Many variations of the described method are possible. Container size and shape may vary. Expandable bag size and position may vary. The number, size and position of relief passages or openings in the bag may vary. The shape, size and position of shunts in the bag may be varied. Thus, while there has been set forth a preferred embodiment of the invention, it is to be understood that the invention is to be limited only by the following claims and their equivalents.

What is claimed is:

**1**. An improved water tank assembly comprising, in combination:

(a) an inner tank for containing water defining a vertical axis;

(b) an outer shell surrounding the inner tank and spaced from the inner tank, said outer shell including at least one opening for access to the inner tank;

(c) a bottom pan between the inner tank and outer wall;

(d) a flexible bag having a void therethrough defining a passage aligned with the outer shell opening, said bag including at least [one side relief opening into] *a plurality of vertically displaced relief openings in a vertical portion of the side of the bag opening into* the space between the inner tank and outer shell and also including a top opening, said bag being generally elongated and aligned with the vertical axis; [and]

(e) said bag being filled with expandable foam material through the top opening to fill the bag and then the space between the inner tank and outer shell by flow through the relief [opening.] *openings, first through the lower of said vertically displaced relief openings and then through the upper of said vertically displaced relief openings;*

*(f) said bag further having a diversion shunt formed in the bag above each relief opening for diverting some of the expandable foam through the associated relief opening.*

[**2**. The assembly of claim **1** including diversion means within the bag for directing flow of expandable foam.]

[**3**. The assembly of claim **1** wherein the bag includes a plurality of relief openings.]

**4**. The assembly of claim **1** wherein [the bag includes a plurality of] *said* relief openings *are* arranged vertically one above the other on opposite sides of the bag for discharge of foam material into the space.

**5**. The assembly of claim **1** [including a] *wherein each said* diversion shunt *is* defined by a flexible, generally short linear seal of the bag extending laterally from the edge of the bag slightly inclined down towards the center of the bag and positioned vertically above a relief opening for diverting some foam material from the bag while simultaneously permitting some flow of foam material into the length of the bag.

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