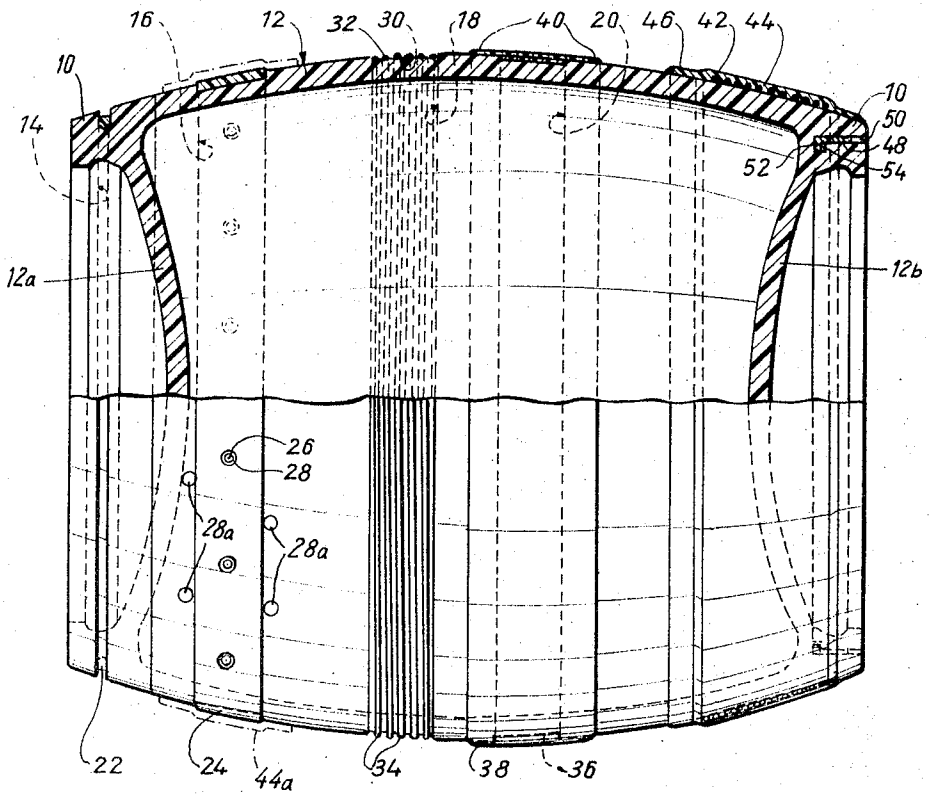
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CONTAINER

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CONTAINER

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The present invention relates to containers in general, and more particularly to barrels for storage of beer and similar taste- and color-sensitive liquid substances. Still more particularly, the invention relates to improvements in reinforcing or armoring means for side walls of barrels at least the major part of which consists of synthetic plastic material.

It is already known to provide a plastic barrel with annular reinforcing elements which are applied to and integrally connected with the side wall in the manufacture of the barrel so that such reinforcing elements actually form integral parts of the side wall. Such methods are quite expensive, and if the side wall expands more than the reinforcing elements when the barrel is heated, certain portions of the side wall which extend between a pair of adjacent reinforcing elements will bulge outwardly to form at the inner side of the wall pockets which are difficult to clean and which might serve as a breeding ground for bacteria. If the stored liquid is beer, bacteria will affect the taste and the appearance of the brew.

It is also known to provide the side walls of plastic barrels with comparatively thick and strong hoops which are forcibly shrunk onto the side walls to limit radial expansion and to prevent excessive increases in the volume of a barrel. However, such heavy hoops must be applied with great force in order to make sure that they remain on the bulged side wall when the barrel is cooled to and below 0° C. When a strong hoop is driven in position with great force, the material of the side wall bulges outwardly at both sides of the hoop and the inner side of the side wall is formed with complementary annular depressions which are difficult to clean and which will be filled with beer stone if the stored liquid is beer. Furthermore, the portions of the side wall which bulge outwardly and beyond a hoop will affect the appearance of the barrel and will come in actual contact with the ground when the barrel is rolled so that they wear away rapidly and their surfaces will be scratched or otherwise damaged to allow for accumulation of dirt which is difficult to remove.

Accordingly, it is an important object of my invention to provide an improved plastic barrel whose side wall is armored with one or more reinforcing elements of novel construction, of lightweight design, of strongly wear-resistant material, and wherein the reinforcing elements not only control the expansion of but also protect the side wall when the barrel is rolled along the ground.

Another object of the invention is to provide a novel method of applying one or more lightweight reinforcing elements to the peripheral surfaces of side walls of plastic barrels and similar containers.

A further object of the invention is to provide novel reinforcing elements which may be used on side walls of plastic barrels and similar containers.

An additional object of the invention is to provide an improved plastic barrel whose side wall is constructed and configurated in a novel way to receive one or more reinforcing elements of the above outlined characteristics.

A concomitant object of the invention is to provide an improved lightweight plastic barrel which is especially suited for storage of beer and other taste- and color-sensitive carbonated liquids.

Still another object of the invention is to provide a reinforcing element which will prevent excessive expansion of the side wall in a plastic barrel even though its weight is negligible in comparison with the weight of the side wall, and which may be applied to the side wall in a very simple manner upon completion of the remainder of the barrel.

An additional object of the invention is to provide a reinforcing element which may be applied to the side wall without excessive deformation of the side wall and/or the reinforcing element and which may be held in position against axial shifting in a very simple and efficient way.

With the above objects in view, one feature of my invention resides in the provision of a container, particularly for storage of beer and other taste- and color-sensitive carbonated beverages. The barrel comprises a tubular side wall at least the major part of which consists of synthetic plastic material, such as low-pressure polyethylene, and which has a tendency to expand and contract radially in response to changes in temperature. The side wall is surrounded by at least one annular reinforcing element which exhibits a tendency to expand and contract less than the side wall in response to changes in temperature so that each reinforcing element limits the expansion of the side wall in response to heating. The side wall is provided with circumferential shoulders, projections or analogous stop means to prevent axial shifting of reinforcing elements when the side wall contracts more than a reinforcing element in response to cooling.

The novel features which are characteristic of the invention are set forth in particular in the appended claims. The improved container itself, however, both as to its construction and the method of making and assembling the same, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing the single illustration of which is a partly elevational and partly sectional view of an armored barrel whose side wall is provided with a series of annular reinforcing elements.

Referring to the drawing, there is shown a container in the form of a barrel for beer and similar taste- and color-sensitive carbonated beverages. The barrel comprises a tubular side wall **12** whose chimes **10** are integral with two concavo-convex end walls **12***a*, **12***b* of the type described and claimed in my copending application Serial No. 207,513. The walls **12**, **12***a*, **12***b* consist at least in part but preferably entirely of suitable synthetic plastic material, e.g., low-pressure polyethylene, and may be formed in accordance with a blowing method as described in the aforementioned application Serial No. 207,513. The side wall **12** is surrounded by a series of axially spaced annular reinforcing elements which are constructed, mounted and secured in accordance with various embodiments of my invention. As shown, the peripheral surface of the side wall **12** is provided with four axially spaced annular grooves or recesses **14**, **16**, **18** and **20** which serve as stop means to prevent axial shifting of the respective reinforcing elements in response to cooling the barrel.

The reinforcing element **22** which is received in the left-hand groove **14** is a one-piece ring of metallic or plastic wire whose ends are welded together and which, at normal temperature, abuts against the bottom surface of the groove **14**. The material and the cross-sectional dimensions (diameter) of the ring **22** are selected in such a way that this ring will expand less than the side wall **12** in response to heating and that this ring contracts less than the side wall in response to cooling whereby the ring prevents radial expansion of the corresponding part of the side wall **12** beyond a predetermined limit. When

the barrel is cooled, not necessarily on purpose but because the temperature of the surrounding air changes, the side wall will contract more than the ring **22** and, therefore, the depth of the groove **14** is selected in such a way that its side walls prevent axial shifting of the ring even if the barrel is cooled to about or even below 0° C.

The second groove **1** receives a different reinforcing element **24**, here shown as a comparatively wide one-piece hoop which is provided with circumferentially spaced apertures **26** to receive radially outwardly extending projections **28** which are integral with or which are detachably secured to the side wall **12**. While the depth of the groove **16** normally suffices to prevent axial shifting of the hoop **24** when the barrel is cooled, the height of the projections preferably exceeds at least slightly the depth of this groove to insure that the hoop is held against axial shifting even if the barrel is cooled to an exceptionally low temperature. In other words, the groove **16** and the projections **28** constitute a composite stop means and serve to prevent any axial displacements of the hoop **24**. If desired or necessary, the side wall **12** may be provided with additional stop means, here shown as radially outwardly extending projections **28***a*, which are adjacent to the opposite sides of the hoop **24** and which serve the same purpose as the groove **16** and projections **28**. It goes without saying that each of the stop means **16**, **28** and **28***a* may be used singly or in combination with one additional stop means. Thus, the groove **16** and/or projections **28***a* may be omitted or, alternatively, the projections **28** with apertures **26** and/or the projections **28***a* may be dispensed with. The projections **28***a* may be replaced by annular ribs which flank the edge faces of the hoop **24**.

The bottom surface **30** of the third groove **18** is surrounded by a reinforcing element which comprises at least one complete but preferably a plurality of helical convolutions **34**. This bottom surface **30** is provided with a helical channel **32** which receives the convolutions **34** so that each convolution is held against axial movement. The material of the convolutions **34** is a metal or a synthetic plastic substance and, here again, the reinforcing element including the convolutions **34** tends to expand or contract less than the material of the side wall **12** in response to changes in temperature so that the adjacent portion of the side wall cannot expand beyond a given limit which is determined by the expansion of the convolutions **34** at an elevated temperature. This is true for all types of reinforcing means which are used on the barrel of my invention to prevent excessive radial expansion of the side wall **12**. Not only is the depth of channels **32** sufficient to prevent axial shifting of the convolutions **34** in response to cooling of the barrel but, should the convolutions actually move out of the respective channels, the depth of the groove **18** suffices to prevent axial shifting of the reinforcing element which includes the convolutions **34**. The free ends of the outermost convolutions **34** are welded or otherwise secured to the material of the side wall. It is also possible to connect the free ends of the outermost convolutions to each other, e.g., by a suitable knot or by welding.

The fourth groove **20** accommodates a reinforcing element **36** here shown as a comparatively wide one-piece plastic or metallic hoop which is surrounded by an annular outer covering **38** of low-pressure polyethylene or another suitable wear-resistant synthetic plastic material. The marginal portions **40** of the outer covering **38** extend beyond the hoop **36**, as seen in the axial direction of the barrel, and are welded, glued or otherwise secured to the peripheral surface of the side wall **12**. Thus, the groove **20** and the outer covering **38** serve as stop means to prevent axial shifting of the hoop **36** when the barrel is cooled to a temperature at which the bottom surface of the groove **20** moves away from the internal surface of the hoop. Of course, the outer covering **38** or the groove **20** may be used alone as long as each of these stop means is capable of preventing axial shifting of the hoop **36** at temperatures in the range of about or below 0° C. It will be noted that the outer covering **38** surrounds a median portion of the side wall **12** whose diameter exceeds the diameters of the chimes **10** so that, when the barrel is rolled, the outer side of the covering **38** will come in actual contact with the ground and will protect the peripheral surface of the side wall **12**. Therefore, this outer covering **38** preferably consists of highly wear-resistant material.

The reinforcing means for the side wall **12** comprises a further reinforcing element which consists of a helically convoluted wire or strip material **42**. The free ends of the outermost convolutions of the reinforcing element **42** may but need not be secured to the side wall **12** or to each other because this element is surrounded by an annular outer covering **44** whose marginal portions **46** extend axially beyond the outermost convolutions and are welded, glued or otherwise secured to the peripheral surface of the side wall **12**. If desired, and as shown, the convolutions of the reinforcing element **42** may be at least partially embedded in the material of the outer covering **44** which may consist of low-pressure polyethylene or another wear-resistant material. The peripheral surface of the side wall **12** may but need not be provided with a helical channel to receive portions of the convolutions which form the reinforcing element **42**. The element **42** consists of metal or another unorganic material.

The convolutions of the reinforcing element **42** may be embedded in the material of the outer covering **44** before the latter is applied around the side wall **12**. This outer covering constitutes the sole stop means for preventing axial shifting of the reinforcing element **42**. Furthermore, it is equally possible to apply an outer covering **44***a* (indicated by phantom lines) about the hoop **16** and to actually embed the hoop in the material of the outer covering **44***a*. As a rule, the bond between the side wall **12** and the outer covering will be stronger if the reinforcing element is embedded in or secured to the outer covering before the latter is affixed to the side wall. Since the coverings are rather thin, and since they consist of elastically deformable material, each thereof can be readily expanded without any danger of permanent deformation at the time it is applied about the side wall **12**.

The right-hand chime **10** is formed with an annular groove including an axially extending annular portion **50** which extends inwardly from the end face of the chime and whose inner end communicates with a radially extending second annular portion **52**. These annular portions receive a further annular reinforcing element including a hoop-shaped portion **48** which is fully received in the annular portion **50** and a ring-shaped portion **54** which is fully received in the annular portion **52**. The reinforcing element **48**, **54** is placed in position at the time the chime **10** is formed and assists the latter in preventing excessive radial expansion of the right-hand axial end of the side wall **12** and of the end wall **12***b*. The other chime **10** may be provided with a similar reinforcing element. The annular portion **48** is integral with the ring-shaped portion **54** so that these portions are held against axial movement in the grooves **50**, **52**.

The reinforcing elements **22**, **24**, **36** may be mounted on the side wall **12** by cooling the barrel to a very low temperature and by heating the reinforcing elements so that the side wall contracts and that the reinforcing elements expand sufficiently to be slidable along the peripheral surface of the side wall and into the respective grooves. If the expansion of the heated reinforcing elements and the contraction of the cooled side wall are insufficient to permit insertion of the reinforcing elements into their grooves, the reinforcing elements are applied by force, i.e., either by expanding them to a degree just below the elastic limit of their material or by mechanically compressing the side wall **12** within the elastic limit. Depending on the dimensioning of the reinforcing ele-

ments, they are received in the respective grooves rather snugly (i.e., they may be subjected to slight expanding stresses) or with some radial play when the barrel is stored or transported at normal temperatures. However, the dimensioning of the reinforcing elements must be such that they cannot leave the respective grooves in response to contraction of the side wall **12** when the temperature of this side wall equals or approximates the temperature of the reinforcing elements. Of course, these elements may leave their grooves if they are additionally held by radial projections or outer coverings. The extent to which the side wall **12** may expand in response to heating can be determined in advance by proper dimensioning of the reinforcing elements and/or by proper selection of the material of which the reinforcing elements are made. The outer coverings cooperate with the reinforcing elements to prevent excessive radial expansion of the side wall. The feature that the reinforcing elements will prevent radial expansion of the side wall **12** beyond a predetermined limit is of particular importance when the barrel serves for storage of beer and similar taste- and color-sensitive carbonated liquids because it is well known that carbon dioxide gas should remain in the beer and that such gas will be separated from the beer if the volume of the barrel is permitted to increase beyond a given maximum volume. Of course, each reinforcing element is dimensioned in such a way that it can withstand the tensional stresses which arise in response to heating when the side wall **12** tends to expand more than the reinforcing elements. Also, such tensional stresses upon the reinforcing elements should remain within Hooke's elastic limit, i.e., the material of the reinforcing elements should not be subjected to permanent deformation.

At least some or all reinforcing elements may consist of comparatively thin metallic or plastic material so that their combined weight adds comparatively little to the combined weight of the walls **12**, **12***a*, **12***b*. This is of considerable advantage since an important feature of a plastic barrel is low weight combined with high resistance to wear. Certain known types of plastic barrels of which I am aware at this time must be provided with exceptionally strong metallic hoops to insure that the hoops may withstand stresses which develop during application to the side wall of a barrel at normal temperature. Consequently, such heavy hoops add considerably to the weight of the barrel which is highly undesirable especially when the barrels are used not only for storage but also for transportation of beer and similar liquids.

It is to be understood that each of the reinforcing elements shown in the drawing may be utilized alone or in combination with one or more differently constructed reinforcing elements, as well as that the side wall may be armored with two or more identically constructed and configurated reinforcing elements. For example, all reinforcing elements may be constructed as hoops, rings or helically convoluted wires as long as they tend to expand less than the side wall and as long as they are held against axial shifting in response to cooling.

Wherever utilized in the appended claims, the expression "cooling" is intended to embrace cooling from a maximum temperature to a minimum temperature at which the container of my invention is normally stored or transported. As a rule, such containers will be stored or transported in climates wherein the temperature ranges from about 50° C. to about —15° C. In case of beer, the temperature range is normally between 30° C. and —5° C. It was found that the reinforcing elements of my invention will prevent any further radial expansion of a plastic barrel at a temperature of 30° C. or higher to insure that the carbon dioxide gas remains dissolved in the brew and that the colloidal equilibrium of the liquid remains unaffected. Otherwise, the liquid would become turbid and stale, i.e., excessive expansion of the internal space in a beer barrel would affect not only the appearance but also the taste of the beverage. Excessive expansion of the side wall must be prevented because the side wall expands more rapidly than beer when the barrel is heated so that the carbon dioxide gas tends to become separated from the liquid carrier.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A barrel, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; at least one annular reinforcing element surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature; and stop means provided on said side wall and including an annular groove in said side wall in which said hoop is at least partially received for preventing axial shifting of said reinforcing element when said side wall contracts more than said reinforcing element in response to cooling.

2. A container, particularly a barrel for storage of carbonated liquids, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; at least one annular reinforcing element surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature so that said reinforcing element limits the expansion of said side wall in response to heating; and stop means provided on said side wall and including an annular groove in said side wall in which said hoop is at least partially received for preventing axial shifting of said reinforcing element when said side wall contracts more than said reinforcing element in response to cooling.

3. A barrel, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; at least one annular reinforcing element surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature, the cross-sectional dimensions of said reinforcing element being such that said element prevents expansion of said side wall beyond a predetermined limit in response to heating of said side wall to a temperature at which, in the absence of said element, the side wall would expand beyond said predetermined limit; and stop means provided on said side wall and including an annular groove in said side wall in which said hoop is at least partially received for preventing axial shifting of said reinforcing element when said side wall contracts more than said reinforcing element in response to cooling.

4. A barrel, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; a reinforcing hoop surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature; and stop means provided on said side wall and including an annular groove in said side wall in which said hoop is at least partially received for preventing axial shifting of said hoop when said side wall contracts more than said hoop in response to cooling.

5. A barrel, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially

in response to changes in temperature; and at least one annular reinforcing element comprising a plurality of successive increments surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature, said side wall having a peripheral surface provided with an annular groove receiving said reinforcing element and the depth of said groove being sufficient to prevent shifting of said increments of said reinforcing element in both axial directions of said side wall when the latter contracts more than said reinforcing element in response to cooling.

6. A barrel, particularly for storage of carbonated liquids, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; at least one annular reinforcing hoop surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature so that said reinforcing hoop limits the expansion of said side wall in response to heating; and stop means for preventing axial shifting of circumferentially successive increments of said hoop in both axial directions of said side wall when said side wall contracts more than said reinforcing hoop in response to cooling, said stop means comprising an annular groove in which said hoop is at least partially received and an annular outer covering surrounding said reinforcing hoop and having marginal portions extending beyond said reinforcing hoop, as seen in the axial direction of said side wall, said marginal portions being secured to said side wall.

7. A barrel as set forth in claim 6, wherein the marginal portions of said outer covering are welded to said side wall.

8. A barrel as set forth in claim 6, wherein said outer covering consists of wear-resistant synthetic plastic material.

9. A barrel as set forth in claim 8, wherein said outer covering consists of low-pressure polyethylene.

10. A barrel, particularly for storage of carbonated liquids, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; at least one annular reinforcing hoop surrounding said side wall and having a tendency to expand and contract less than said side wall in response to changes in temperature so that said reinforcing hoop limits the expansion of said side wall in response to heating; and stop means for preventing axial shifting of circumferentially successive increments of said hoop in both axial directions of said side wall when said side wall contracts more than said reinforcing element in response to cooling, said stop means comprising an annular groove in which said hoop is at least partially received and an annular outer covering surrounding said reinforcing hoop and having marginal portions extending beyond said reinforcing hoop, as seen in the axial direction of said side wall, said marginal portions being secured to said side wall and said reinforcing hoop being embedded in the material of said outer covering.

11. A container, particularly a barrel for storage of carbonated liquids, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature; a plurality of axially spaced annular reinforcing hoops surrounding said side wall and each thereof having a tendency to expand and contract less than said side wall in response to changes in temperature so that said reinforcing hoops limit the expansion of said side wall in response to heating; and stop means provided on said side wall and comprising a corresponding plurality of annular grooves provided in the outer peripheral surface of said side wall, said hoops each being received in all of said grooves for preventing axial shifting of circumferentially distributed increments of the respective hoops in direction toward both ends of said side wall when said side wall contracts more than said reinforcing hoops in response to cooling.

12. A container, particularly a barrel for storage of carbonated liquids, comprising a tubular side wall at least the major part of which consists of synthetic plastic material and which has a tendency to expand and contract radially in response to changes in temperature, said side wall comprising two chimes at the axial ends thereof; first reinforcing means comprising at least one annular reinforcing hoop surrounding said side wall at a point intermediate said chimes and having a tendency to expand and contract less than said side wall in response to changes in temperature so that said hoop means limits the expansion of the side wall in response to heating; stop means provided on said side wall and comprising an annular groove provided in the outer peripheral surface of said side wall, said hoop being received in said groove for preventing axial shifting of circumferentially distributed increments of said hoop in direction toward both ends of said side wall when said side wall contracts more than said hoop in response to cooling; and second reinforcing means comprising an annular reinforcing element embedded in one of said chimes.

13. A container as set forth in claim 12, wherein said one chime has an annular end face and is provided with a composite groove including a first annular portion extending inwardly from said end face in the axial direction of said side wall and a second portion extending radially from said first portion and spaced from said end face, the reinforcing element of said second reinforcing means comprising a first annular portion received in the first portion of said groove and a second annular portion received in the second portion of said groove, said last mentioned reinforcing element having a tendency to expand and contract less than said one chime in response to changes in temperature.

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