Oct. 31, 1967 L. A. N. BIJVOET 3,349,952

REINFORCEMENT STRUCTURE FOR SHIPPING CONTAINERS MADE OF LIGHT GAUGE STEEL OR THE LIKE

Filed May 3, 1966

2 Sheets-Sheet 1

Fig. 1.

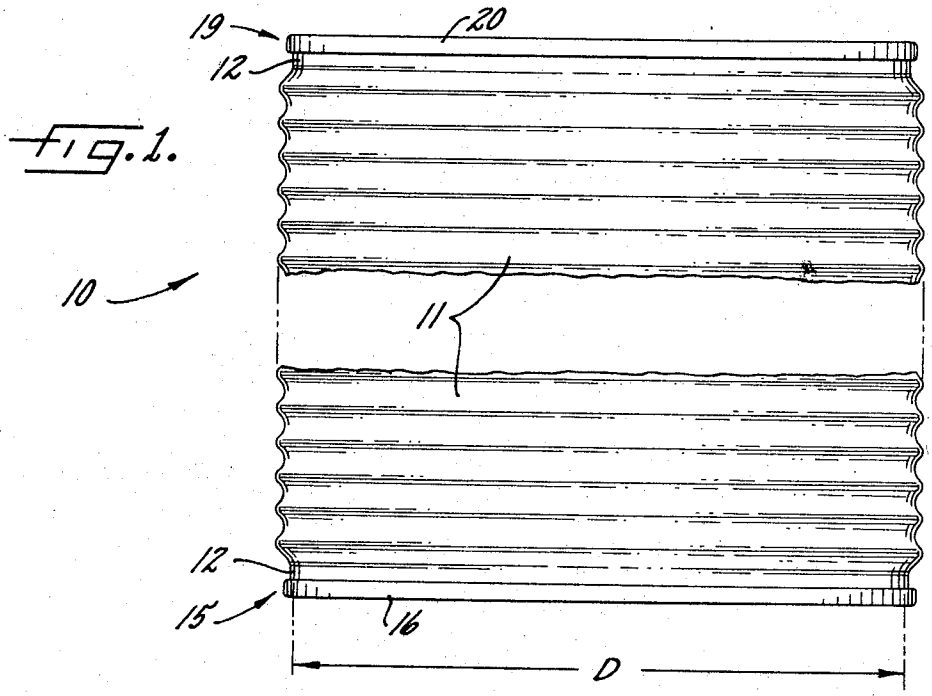
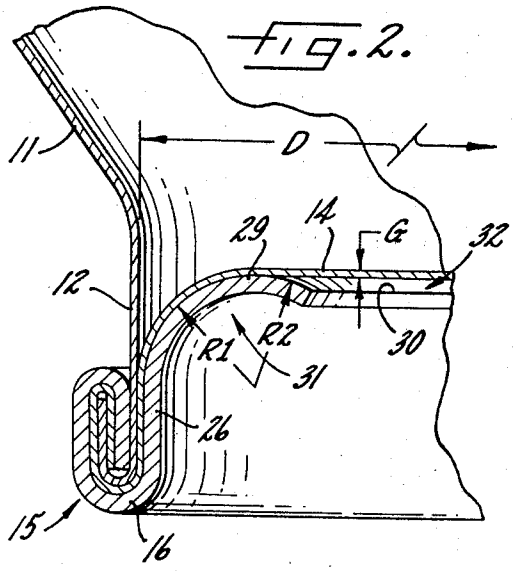


Fig. 2.



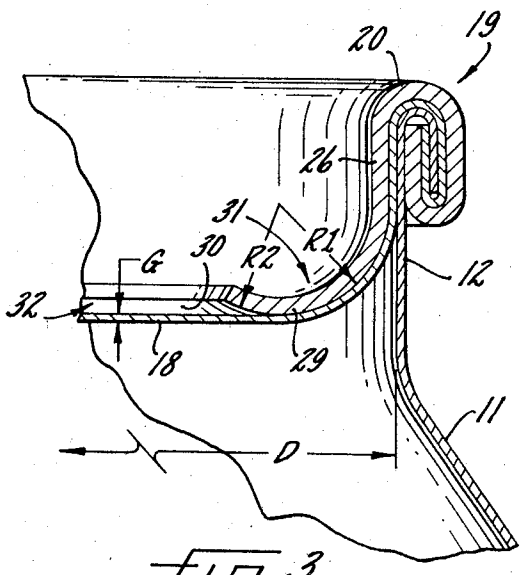


Fig. 3.

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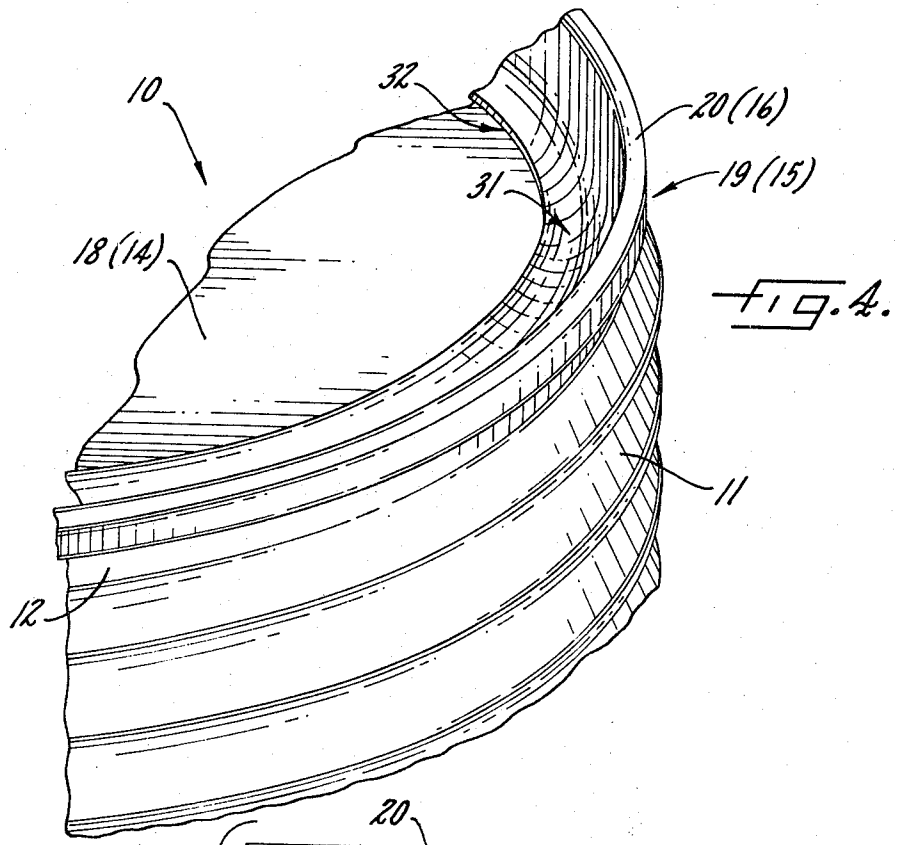


Fig. 4.

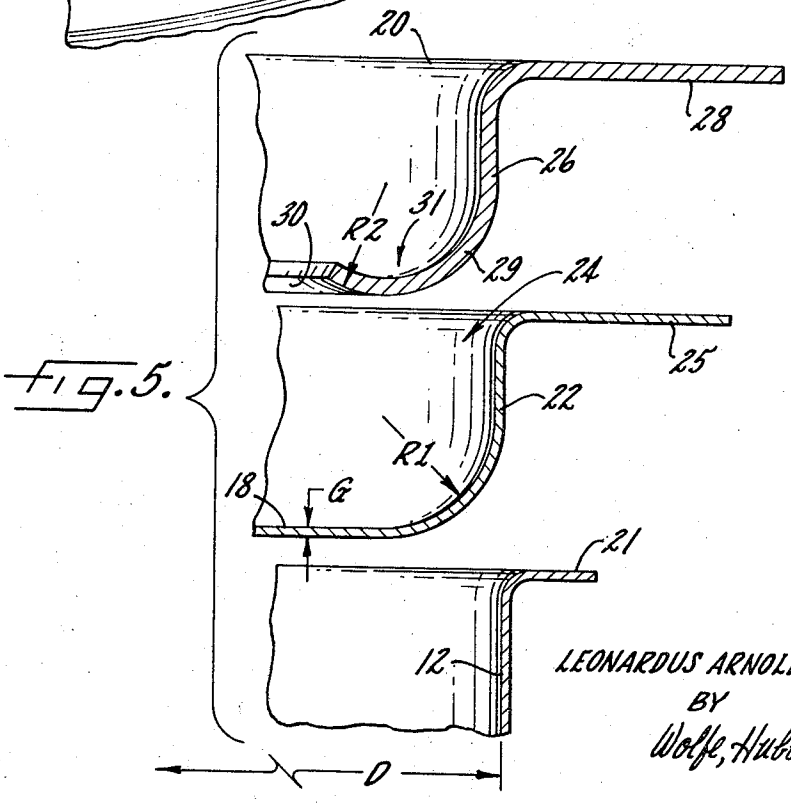


Fig. 5.

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3,349,952

REINFORCEMENT STRUCTURE FOR SHIPPING CONTAINERS MADE OF LIGHT GAUGE STEEL OR THE LIKE

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Claims priority, application Great Britain, Jan. 8, 1963, 845/63, Patent 961,802
11 Claims. (Cl. 220—67)

The present application is a continuation-in-part application based on the copending application of Leonardus Arnoldus Nicolaas Bijvoet, Serial No. 336,454, filed January 8, 1964, now abandoned.

The present invention relates to containers and, more particularly, to an improved end connection suitable for use in securing the end and side walls of a shipping container together. In its principal aspects, the invention is concerned with an improved reinforcement structure for strengthening and protecting the chime area of a lightweight metallic shipping container, and for supporting the weakest area of the container end wall, particularly the bottom end wall.

There has been a perennial problem in the shipping container industry of providing an end connection between a container side wall and end wall which has sufficient strength to withstand the rigors of transportation, storage and handling. Generally, containers fabricated from sheet metal, for example, steel, comprise a side wall and a flanged end member with the flange and side wall being curled together or otherwise formed into a seamed connection commonly known as a "chime." Such a chime, or similar seamed connection is subject to weakening, failure, or other damage, particularly when the container is rolled on its chime or is dropped on its chime.

In an effort to reinforce the seamed connection, it has heretofore been the practice to provide an annular metallic reinforcing ring which at least partially envelopes the seam or chime, thus protecting and strengthening the latter. Such a ring is conventionally provided with an inturned annular portion adapted to engage and snugly conform to the outer peripheral portion of the container end member. However, it has been found that this type of construction does not provide a satisfactory solution to the problem. Indeed, while the reinforcing ring of such conventional containers does serve to strengthen the chime area, it also serves to increase the likelihood of fracture or other damage to the end member itself. For example, when a filled container is standing upright, particularly one filled with liquid, the weight of the contents will cause the container bottom or end member to sag or bulge downwardly. When this occurs, the relatively stiff inner edge of the inturned annular portion of the reinforcing ring is in intimate contact with the sagging portion of the container bottom, thus concentrating stress in the container bottom at the inner edge of the ring. In addition, when there is an increase in the internal pressure of the filled container, such increase can cause both the top and the bottom to bulge outwardly, resulting in additional stress concentrations.

When the filled container is being transported from place to place, the container bottom is subjected to road vibrations and harmonics thereof. Under these conditions, fatigue failures occur in the region of stress concentrations which often result in fracture of the bottom material, thus leading to leakage and spoilage of the container contents. To a somewhat lesser extent, the container top can also be damaged in a similar way. Moreover, many times the containers will be shipped upside down, in which event the container top actually serves as a bottom wall.

With the present day demand for more and more shipping containers formed of thinner or lighter gauge sheet metal, this problem has become a particularly vexing one. Often in such containers, the problem manifests itself in failure of the end member.

It is a general aim of the present invention to provide an improved container end connection which overcomes all of the foregoing disadvantages, yet which is characterized by its simplicity and which retains all of the advantages of the conventional reinforcing ring structures.

A more specific object of the invention is to provide a novel container end connection and reinforcing ring therefor which permits of outward bulging of the container end members, yet where the inner marginal edge of the reinforcing ring is precluded from engaging the end member. As a result of elimination of the circular region of line contact between the end member and ring edge, the end member is free to flex as a result of vibrations without interference from the reinforcing ring, thus precluding or substantially minimizing the tendency to build up undesirable stress concentrations in the end member.

It is a further object of the invention to provide an improved container end connection which is less susceptible to damage resulting from rust occurring between the end member and the metallic reinforcing ring.

Other objects and advantages of the invention will become apparent as the following description proceeds, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary side elevational view of a shipping container here embodying the features of the present invention;

FIG. 2 is a fragmentary enlarged vertical sectional view of the lower left chime portion of the shipping container shown in FIG. 1, here depicting details of an exemplary reinforced end seam or chime which forms the bottom connection between the side wall and the bottom end wall of the container;

FIG. 3 is a fragmentary enlarged vertical sectional view similar to FIG. 2, but here depicting the features of the present invention as embodied in the upper reinforced chime construction associated with the top of the container shown in FIG. 1;

FIG. 4 is a fragmentary perspective view on an enlarged scale depicting one end, which may be either the bottom or top end, of the container shown in FIG. 1; and,

FIG. 5 is an exploded fragmentary sectional view here illustrating the separate components of the end connection shown in FIG. 3 prior to assembly thereof.

While the invention is susceptible of various modifications and alternative forms, a specific embodiment thereof has been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular form disclosed, but, on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as expressed in the appended claims.

Referring now to the drawings, and with particular reference to FIGS. 1–3 conjointly, there is illustrated a fragmentary portion of a shipping container, generally indicated at **10**, which in the exemplary form of the invention comprises a 55-gallon lightweight steel drum. As here shown, the exemplary container **10** is provided

with a beaded side wall **11**, the upper and lower extremities of which are preferably unbeaded and generally cylindrical as indicated at **12**. A bottom member or end wall **14** (FIG. 2) is permanently joined to the lower unbeaded extremity **12** of the side wall **11** in a liquid-tight manner to form a conventional seam or chime, generally indicated at **15**. The bottom chime **15** is here reinforced by means of an annular reinforcing ring **16** which at least partially envelopes the connection between the side wall **11** and the bottom end member **14**. Similarly, a top member or end wall **18** (FIG. 3), which is preferably identical to the bottom wall **14**, is permanently joined to the upper unbeaded extremity **12** of the side wall **11** in the same manner to form a top chime, generally indicated at **19**. A reinforcing ring **20**, which here is identical to the ring **16**, is applied to the top chime **19** for the purpose of reinforcing the latter.

As best shown in FIG. 5 (which is here representative of the top seamed connection shown in FIG. 3, it being understood that FIG. 5 is also fully applicable to the bottom connection shown in FIG. 2), the upper unbeaded extremity **12** of the side wall **11** is provided with an outwardly extending radial flange **21** adjacent the extremity thereof. The end member **18** is provided with an upstanding circumferential flange **22** defining an outwardly directed recess **24**, with the upper or free extremity blending smoothly into a radially extending flange **25**. The reinforcing ring **20** includes an upstanding circumferential flange portion **26** adapted to be positioned within the recess **24** in the end member **18** and to snugly engage the inner surface of the circumferential flange **22** of the latter. The upper end of the flange **26** is blended smoothly into an outwardly extending radial flange **28** adapted to overlie the flange **25** of the end member **18**, while the lower end of the flange **26** is turned inwardly to form an annular flange portion **29** adapted to overlie the outer peripheral portion of the end member **18**.

In assembly of the three basic components of the exemplary container **10**, the top end member **18** is placed in the upper unbeaded extremity **12** of the container side wall **11** with the flanges **22**, **25** of the former snugly engaging respective ones of the side wall extremity **12** and its flange **21**. The reinforcing ring **20** is then positioned in the recess **24** of the end member **18** with the flanges **26**, **28** of the former snugly engaging the flanges **22**, **25** of the latter. The flanges **28**, **25** of the ring **20** and end member **18** respectively are then folded through an angle of 180 degrees so as to envelope the radially projecting edge of the flange **21** on the side wall **11**. The resulting composite flange thus formed by the folded-over flanges **25**, **28** and the flange **21** are then bent downwardly into snug conformity with the outer surface of the unbeaded extremity **12** of the container side wall **11**, thus forming the "double fold" seam or chime **19** shown in FIGS. 1 and 3. Those skilled in the art will appreciate that the chime **19** can be formed by any conventional machine or process such, for example, as by crimping, wheeling, turning, or simply by folding. Moreover, it will also be understood that the bottom seam or chime **15** (FIGS. 1 and 2) is formed in precisely the same manner.

In accordance with one of the important aspects of the present invention, provision is made for permitting flexure or outward bulging of the end members **14**, **18** while simultaneously precluding damage thereto which could otherwise result from engagement between the relatively sharp free edge **30** of the ring flange **29** and the outer surface of the end members **14**, **18**. To accomplish this, the inner edge **30** of the annular ring flange **29** is bent or curved outwardly or away from the end members **14**, **18** as best indicated at **31** in FIGS. 2 and 3 respectively. As a consequence of this construction, the end members **14**, **18** may flex or be bulged outwardly to a considerable extent without the edge **30** of the reinforcing rings **16**, **20** engaging the material of the end members, thus eliminating any circular region of line contact between the edge **30** and the adjacent end member. Therefore, the tendency for stress concentrations to build up in such region are minimized and, indeed, substantially eliminated. Rather, as the end member bulges outwardly it will simply progressively conform to the outwardly extending smoothly curved portion **31** of the annular flange **29**.

In carrying out the present invention, it has been found that when dealing with relatively lightweight shipping containers—for example, a 55-gallon shipping drum made of 24 gauge metal as contrasted with the more conventional drums which are normally made of 18 gauge metal—the particular radii selected for forming the smoothly curved portion **31** of the reinforcing rings **16**, **20** and the complementary curved portions of the end members **14**, **18** are quite critical. Moreover, it has also been found in the practice of the present invention that the values of such radii bear a direct relation to the gauge of the material used in forming the end members, and such gauge, in turn, bears a direct relation to the size of the container, particularly the size as expressed in terms of the diameter of the container. For example, referring to FIGS. 2, 3 and 5 conjointly, it will be observed that the radius of curvature of the smooth fluent bend which connects the generally flat central portions of the end members **14**, **18** to the upstanding flange portions **22** thereof has been designated R1, such radius being an inside radius. This radius is commonly referred to in the art as the "knuckle radius" and it is this general region of the end member which is most susceptible to fatigue failures resulting from undesirable stress concentrations. Similarly, the flange **29** on the reinforcing rings **16**, **20** is entirely arcuate in cross section, having an outside radius of curvature designated at R2. The arrangement is such that the upstanding ring flange **26** is tangent with and blends smoothly into the curved flange **29** which lies on an arc having the radius of curvature R2. Preferably R2 is selected so that it is equal to R1±3%, thereby insuring that when the components are assembled in the manner previously described, the outer face of the curved flange **29** is in intimate face-to-face contact with the complementally curved surface of the respective end members **14**, **18** throughout an arc of approximately 90 degrees. However, in keeping with the important aspects of the invention, the flange **29**, after it reaches the point of tangency with the generally flat central portion of the associated end member **14**, **18**, continues to smoothly curve about the radius of curvature R2 towards its relatively sharp, peripherally innermost free edge **30**, thus insuring that the flange **29** curves away from the end members **14**, **18** and the edge **30** is normally spaced therefrom.

In the practice of the invention, it has been found that the radius R1 (and consequently the radius R2 which is substantially equal thereto) does bear a direct and critical relationship to the thickness or gauge G of the end members **14**, **18**. For example, in order to achieve the requisite degree of support and reinforcement for the knuckle radius of the end members **14**, **18**, it has been found that R2 (the outside radius of curvature for the curved flange **29**) should fall within the range of 10 to 20 times the thickness G of the end member and, preferably, the radius R2 (and, therefore, radius R1) should be on the order of 14.4 times the thickness G of the end members **14**, **18**. In a typical instance where the container **10** comprises a 55-gallon drum made of 24 gauge metal, since the thickness G is on the order of .025 inch, the radii R1 and R2 are preferably .360 inch.

The foregoing ranges and dimensions may be readily contrasted with conventional reinforced chime constructions wherein the radius R1 is normally within the range of 3 to 6 times the thickness G of the end member and,

generally, on the order of 4.6 times the thickness G. Thus, in a conventional 55-gallon drum which does not embody the features of the present invention, and where the thickness G is on the order of .050 inch (an end member formed of 18 gauge metal), the radii R1 and R2 would normally be on the order of only .230 inch. Typical instances of such conventional constructions are found in Italian Patent No. 474,589 issued to Marcel Defauw, and Bergen et al. U.S. Patent No. 2,810,492.

It has further been found in the practice of the present invention that the gauge or thickness G of the end members **14, 18** also bears a mathematical relation to the diameter D of the container, it being understood that the diameter here referred to is the inside diameter of the shell from which the beaded side wall **11** is formed, as best depicited in FIGS. 1–3 and 5 where the diameter D is represented as the inside diameter of the unbeaded extremities **12** of the side wall **11**. Thus, in carrying out the present invention, it has been found that the diameter D should generally fall within the range of 600 to 1200 times the thickness G of the end members **14, 18** and, preferably, it should be on the order of 900 times the thickness G. Again, in the typical instance of a 55-gallon drum which has an inside shell diameter D of 22.5 inches, it is found that the thickness G of the end members **14, 18** is preferably .025 inch or, stated in other terms, the gauge G is preferably 24 gauge. Thus, it will be apparent from the foregoing that the radii R1 and R2 will also bear a direct mathematical relation to the diameter D of the drum.

Again, the foregoing dimensions may be readily contrasted with conventional drum constructions which do not embody the features of the invention. Thus, in conventional 55-gallon drums having an inside shell diameter D of 22.5 inches, it is found that the diameter D is generally within the range of 250 to 500 times the thickness G of the end members, and normally about 450 times the thickness G. For example, in conventional drums having a diameter D on the order of 22.5 inches, the end members are normally made of 18 gauge metal having a thickness G of approximately .050 inch.

It will be appreciated from the foregoing that there has herein been described an improved reinforced end connection for use in lightweight metallic shipping containers wherein the particular configuration of the reinforcing ring **16, 20** and the complementally curved portion of the end wall **14, 18** is so selected that the reinforcing ring not only strengthens and protects the seamed connections or folded chimes **15, 19**, but even more significantly, considerably greater support and reinforcement is provided in the region of the knuckle radius of the end member, the very region where such end members have traditionally been subject to fatigue failures. Moreover, since the inturned flange **29** of the reinforcing rings **16, 20** is arcuate throughout its entire cross section and is extended beyond the point of tangency with the flat central portion of the end member **14, 18** so as to curve away therefrom, there is no localized region of circular line contact between the flange **29** (and particularly its sharp edge **30**) and the end member itself, thus precluding the buildup of undesired stress concentrations in the weakest area of the end member. Indeed, even under adverse transportation conditions where the end members **14, 18** (particularly the bottom end member **14**) are subjected to vibrations and harmonics thereof, the provision of a smoothly curved flange, such as shown at **31** in the drawings, permits flexure and bulging of the end members without creating a localized region of circular line contact and, consequently, even under such adverse conditions there is still no buildup of stress concentrations sufficient to promote failure of the end member due to metal fatigue in the knuckle radius area. Of course, while the invention has herein been illustrated and described as including smoothly curved reinforcing rings and complementally curved end members having arcuate cross sections lying on a circular arc, it will be understood that some minor deviations can be made from a purely circular arc while still achieving a certain measure of the benefits of the invention. For example, the smoothly curved portions could be somewhat parabolic or hyperbolic in cross section provided that they are maintained smoothly curved throughout and as long as they fall within the general ranges as expressed above in terms of the degree of curvature, the gauge of the end members, and the diameter of the side wall.

Those skilled in the art will appreciate that shipping containers of the type illustrated, particularly metallic containers, are generally painted, lacquered, or sprayed after assembly in order to protect the exposed exterior portions of the container from rust, corrosion, or attack by water or aggressive commodities. In a container embodying the features of the present invention, the edge **30** of the annular ring **16, 20** is spaced outwardly from the outer surface of the end member **14, 18** respectively, thus defining an annular crevice **32** therebetween. Therefore, when the container is treated, the lacquer or other coating may readily penetrate into the crevice **32** thus formed and, even where there exists a slight deformation in either the end member **14, 18** or the flange **29**, there will be no untreated or uncoated exposed container portion. With conventional containers, on the other hand, often the coating material cannot penetrate between the inturned annular ring flange and the end member because of the close contact therebetween and, if a slight deformation is present in either the ring or the end member, such deformity may not be coated and thus may constitute an exposed area subject to rusting or similar corrosive attack. Therefore, containers embodying the present invention possess the additional advantages of being less subject to rusting or the like while having a lasting neat appearance.

Of course, while the invention has herein been described in conjunction with a container **10** having a double-fold seam or chime **15, 19**, it will be understood that the seam could comprise a single fold seam or any other seam construction suitable for establishing an end connection between a container side wall and end member.

I claim as my invention:

1. A shipping container comprising, in combination, a generally cylindrical side wall having a diameter D, closure means for said container including an end member secured to at least one extremity of said side wall, said end member being formed of sheet metal having a gauge G, said end member including a generally flat central portion and an integral, circumferentially disposed upstanding flange surrounding said central portion and in engagement with the inner surface of said side wall, the junction between said central portion and said flange comprising a smooth fluent bend having an inside radius of curvature R1, and a metallic reinforcing ring at least partially enveloping said flange and the adjacent extremity of said side wall, said ring having a first portion engaging the inner surface of said flange and a second annular portion integral with said first portion and extending inwardly therefrom, said second portion of said ring being entirely arcuate in cross section and having an outside radius of curvature R2 with said first portion being generally tangent to said second portion and with the inner free peripheral extremity of said second portion curved away from and spaced from said flat central portion of said end member and extending radially inwardly from said cylindrical side wall, said radius R2 being within the range of 10 to 20 times greater than the thickness G of said end member.

2. A shipping container as set forth in claim **1** further characterized in that said end member comprises the bottom closure for said container.

3. A shipping container as set forth in claim **1** further

characterized in that said closure means include a second end member and a second reinforcing ring identical in construction to said end member and said reinforcing ring for closing the opposite end of said container.

4. A shipping container as set forth in claim **1** further characterized in that **R2** is on the order of 14.4 times greater than the thickness G of said end member.

5. A shipping container as set forth in claim **1** further characterized in that **R2** is equal to **R1**±3%.

6. A shipping container as set forth in claim **1** further characterized in that D is within the range of 600 to 1200 times greater than the thickness G of said end member.

7. A shipping container as set forth in claim **1** further characterized in that D is on the order of 900 times greater than the thickness G of said end member.

8. A shipping container as set forth in claim **4** further characterized in that D is on the order of 900 times greater than the thickness G of said end member.

9. A shipping container as set forth in claim **8** further characterized in that **R2** is equal to **R1**±3%.

10. A shipping container as set forth in claim **1** further characterized in that D is on the order of 22.5 inches, G is on the order of .025 inch, and **R1** and **R2** are on the order of .360 inch.

11. In a shipping container of the type having a side wall with a diameter D and an end member comprising a generally metallic sheet having a gauge G with said sheet having an upstanding flange in engagement with the inner surface of said side wall and curled together with a free extremity of said side wall to form a seamed connection, and with said flange being bent out of the plane of said sheet about an inside radius of curvature **R1**, the combination with said seamed connection of a metallic reinforcing ring, said ring partially enveloping said seamed connection and comprising a first portion in engagement with the inner surface of said flange and a second annular portion integral with said first portion and extending inwardly therefrom with said first and second portions being joined together about an outside radius of curvature **R2**, said second annular portion having a smooth arcuate cross section with an outside radius **R2** and with the free peripheral edge of said second portion curved away from and spaced from said end member and extending radially inwardly from said side wall, said radius **R2** being within the range of 10 to 20 times greater than the thickness G of said end member.

References Cited

UNITED STATES PATENTS

2,810,492	10/1957	Bergen et al.	220—67
3,079,031	2/1963	Henchert	220—27

FOREIGN PATENTS

506,718	10/1954	Canada.

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