April 14, 1970 F. E. ULLMAN 3,505,722

RECONDITIONABLE CONTAINER

Filed June 28, 1967 2 Sheets-Sheet 1

Fig. 1.

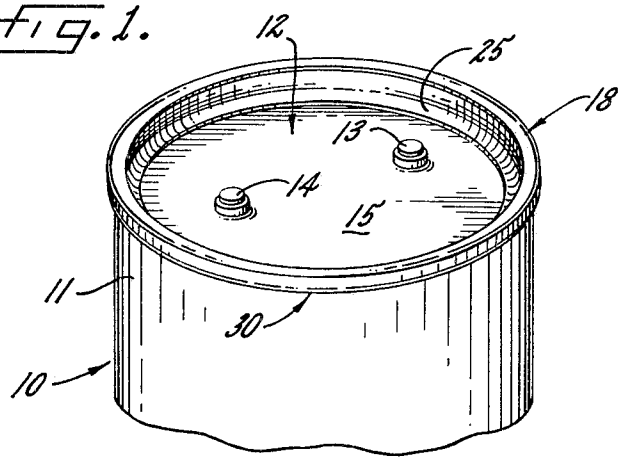


Fig. 2.

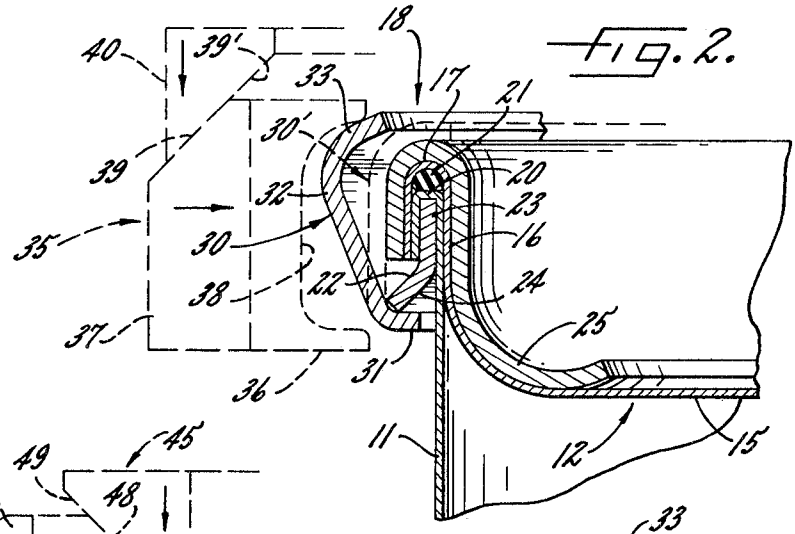


Fig. 3.

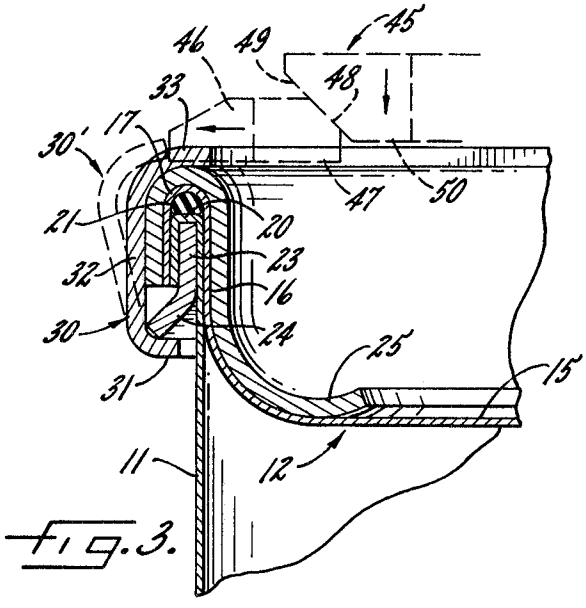
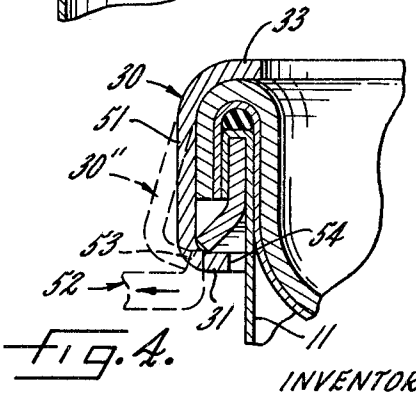


Fig. 4.



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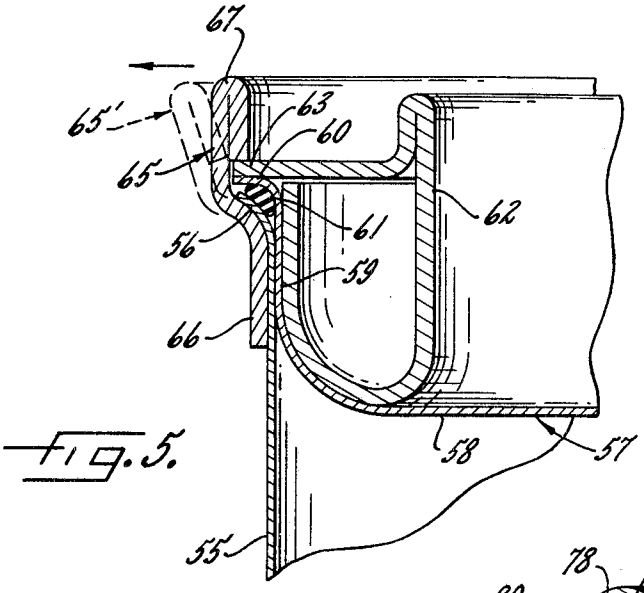


Fig. 5.

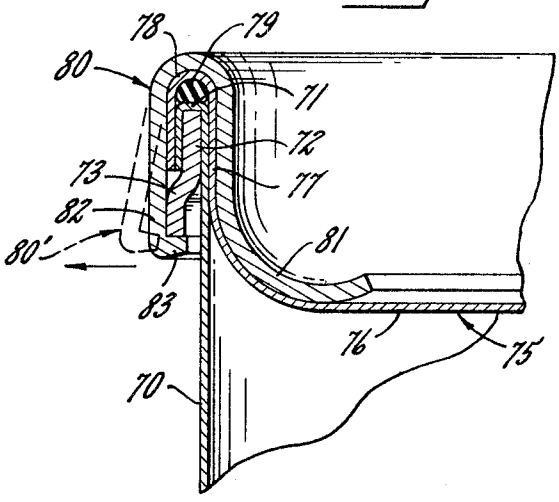


Fig. 6.

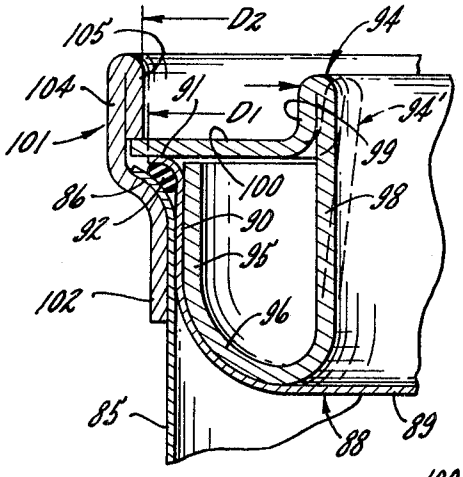


Fig. 7.

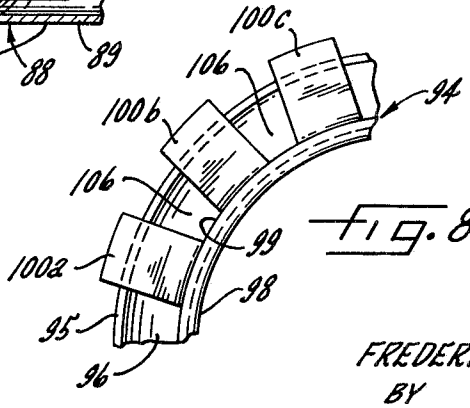


Fig. 8.

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United States Patent Office 3,505,722
Patented Apr. 14, 1970

3,505,722

RECONDITIONABLE CONTAINER

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Filed June 28, 1967, Ser. No. 649,714
Int. Cl. B23p 7/00
U.S. Cl. 29—401 22 Claims

ABSTRACT OF THE DISCLOSURE

An improved multi-trip metallic shipping container and method of assembly and disassembly thereof which permit of repetitive use of the metallic container components while at the same time permitting unimpeded access into the interior of the container and into the normally inaccessible chime portions thereof for cleaning, dedenting and related container reconditioning purposes.

The present invention relates in general to shipping containers and more particularly, to multi-trip metallic shipping containers of the cylindrical or drum like type, generally having a capacity on the order of 5 to 55 gallons, and which are commonly shipped without an overpack, and to methods of assembly and disassembly thereof. In its principal aspect, the invention is concerned with improved methods of assembly and disassembly of metallic closed or "tight-head" shipping containers and with the containers produced thereby, whereby the repetitive removal and/or replacement of at least one, and preferably both ends, which are otherwise permanently affixed to the container sidewall is made feasible with minimal plastic strain to the metallic closure components so as to permit unimpeded access to the container interior for all reconditioning purposes, yet wherein the same metallic container components may be reused many times without sacrifice to container performance or integrity.

Metallic shipping containers are widely used for packaging, storage and transport of materials such, merely by way of example, as crude oil products, food products, liquid chemicals, paints and other liquid, semiliquid, pulverous or granular materials. In use, these containers may become damaged, dented or otherwise deformed. The contents are also frequently of the character which, once removed from the container, leave a residue that cannot satisfactorily be removed when attempting to use the bung hole or similar orifice of but limited size for access to and cleaning of the container interior. Therefore, a larger opening must be made which permits the insertion of suitable tools or devices for removing dents and otherwise reshaping the container walls where necessary. To this end, it is known to cut the empty "tight-head" container into two halves or to cut out the container ends, clean and reshape the parts and again weld the parts together. These processes, in addition to being complicated, time-consuming and expensive operations, may considerably reduce the capacity of the container when repeated several times. Moreover, such known reconditioning processes are still substantially incapable of coping with the problem of contamination in the chime crevices of a container even after the container has been cut apart. And, of course, such known reconditioning processes will not permit of dedenting or similar reshaping processes in the chime region.

It is also known to unfold the folded chime portions of a "tight-head" drum so as to permit removal of the head and closure components. However, this procedure has not proved satisfactory for a number of reasons. For example, the chime portions of a conventional "tight-head" drum are normally formed by folding overlapping portions of the drum body, head and reinforcing members over upon themselves through at least one, and normally more than one, complete angle of 180°. As a consequence, considerable plastic deformation of the metallic components occurs in the region of the folds even during the initial drum forming operation, which deformation tends to weaken the metal in that area. Thus, when one attempts to unfold the construction by again bending the metal components through angles of 180° in the opposite direction, the material is further weakened and, indeed, excessively stretched. Even were it feasible to do this repetitively on a multi-trip basis, the resulting product is not precisely the same each time. And, in any event, it becomes weaker each time, thereby preventing the commercial use of such a process. Moreover, where more than one fold is present, such folds must be unfolded in successive order and then successively refolded, thus increasing the length of time required for the reconditioning process and the complexity of the tooling used.

Recognizing the many difficulties presented by the foregoing processes, it has further been proposed that the chime or similar closure components can be partially unfolded, and a portion thereof cut off. After reconditioning the parts are then welded in place during reassembly. Again, however, this procedure is time consuming and expensive and does not, in any event, result in a container which is the same as the original container.

Those skilled in the art will appreciate from the foregoing and as the ensuing description proceeds that the particular problems which have continued to plague the industry and with which the present invention is concerned are peculiar to a particular type of container—viz., a "tight head" drum. Thus, such problems are not encountered when dealing with that classification of shipping container commonly referred to as "open head" drums. That is, an "open head" drum or container is one in which the head is not permanently affixed to the drum body, but rather it is removably affixed thereto in such a manner that the head can be easily removed. Such "open head" drums, for example, commonly employ split closure rings or the like to secure the head to the body, which rings can be tightened down by clamping mechanisms, bolts or similar fastening devices.

It is a general aim of the present invention to provide an improved multi-trip "tight-head" shipping container and methods of assembly and disassembly thereof wherein all parts of the container may be readily assembled and disassembled during manufacturing and subsequent reconditioning processes with minimal plastic strain whereby such components may be used repetitively on a multi-trip basis, yet wherein the container after each reconditioning operation is identical in construction, capacity, form and appearance with the container as originally manufactured. Stated another way, it is an object of the present invention to provide a "tight-head" shipping container which permits of ease of repetitive assembly and disassembly and wherein this is accomplished by plastic deformation of a closure component within prescribed limits.

An associated object is the provision of a multi-trip shipping container which may be easily disassembled and later reassembled in such a manner as to facilitate more effective and economical cleaning and/or reconditioning of the container parts.

It is a more specific object of the invention to provide a novel end closure assembly having components which may be either shrunk or expanded by plastic strain to tightly seal at least ont and preferably both, ends of the container to the container body, with such end closure components also being plastically expandable or shrinkable to permit disassembly of the container for cleaning and reconditioning.

It is also an object to provide a shipping container as set forth which has a reliable and effective seal between the container end and body.

As a consequence of attaining the foregoing general objectives of the invention, it has been found that ancillary benefits are also achieved in that the container is of rigid and durable construction and is particularly reinforced around the periphery of the container ends so as to resist deformation in those areas which are most often subject to damage during transit.

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 perspective view of the upper portion of a "tight-head" drum-shaped shipping container embodying the features of the present invention;

FIG. 2 is an enlarged fragmentary section of a partially formed joint, commonly referred to as the chime, between the drum head and body of the container shown in FIG. 1 with the end connecting ring of the chime shown in solid lines about to be shrunk by a conventional shrinking machine from its expanded position to an assembled position as shown in phantom;

FIG. 3 is an enlarged fragmentary section of the chime betwen the drum head and body of the container shown in FIG. 1 with a portion of a conventional expanding machine shown in phantom commencing to plastically expand the end connecting ring of the chime from its assembled solid line position to an expanded or open position as indicated in phantom;

FIG. 4 is an enlarged fragmentary vertical section similar to FIG. 3, but here depicting a slightly different expanding procedure for permitting removal of the head from the container body wherein the connecting ring may also be removed;

FIG. 5 is an enlarged fragmentary vertical section similar to FIGS. 3 and 4 of a slightly modified chime construction also embodying the features of the present invention;

FIG. 6 is an enlarged fragmentary vertical section similar to FIGS. 3, 4 and 5 of still another modified form of chime construction embodying the features of the present invention;

FIG. 7 is an enlarged fragmentary vertical section similar to FIG. 5, differing therefrom primarily in that in this exemplary form of the invention the head is freed for removal from the container by plastically shrinking the reinforcing ring rather than by plastic expansion of the connecting ring; and,

FIG. 8 is an enlarged fragmentary end view depicting details of an exemplary reinforcing ring particularly suitable for use with the form of the invention shown in FIG. 7.

While the invention is susceptible of various modifications and alternative forms, specific embodiments thereof have 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 forms disclosed, but on the contrary, the invention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention.

Referring now to the drawings, there is shown in FIG. 1 the upper portion of an exemplary "tight-head" drum-shaped shipping container, generally indicated at **10**, having a cylindrical body portion **11** adapted to be closed by an upper drum head **12**. Those skilled in the art will appreciate that, while not shown in FIG. 1, the lower end of the container body could be, and normally would be, closed in a similar manner so as to form a liquid-tight container unit. The container **10** preferably is made from sheet steel, although it is apparent that other materials could be used as well. The illustrative upper drum head

12 may include a filling and emptying orifice **13** and an air inlet and an escape orifice **14**. The openings **13**, **14** can be provided with an appropriate removable closure to seal the container after it is filled.

In accordance with the present invention, at least one and preferably both of the container drum heads may be readily removed to make fully accessible the interior portions of the container and its chime for cleaning and reconditioning thereof, and then may be easily reassembled utilizing the same procedure and forming equipment to form a container which has the same capacity and is indistinguishable from its original form. In the embodiment illustrated in FIGS. 1–3, the drum head **12** is cup-shaped having a generally flat central surface **15** set within the drum body **11** and a cylindrical sidewall **16** terminating in a curved flange **17** which overlaps an outwardly rounded end **20** of the drum body **11** in the region of the container chime **18**. Interposed between the rounded end **20** of the sidewall and the curved flange **17** of the drum head is a resilient sealing member such as an O-ring **21**. To reinforce the end **20** of the drum body an annular curl ring **22** is permanently crimped in place by the outwardly folded-over body end **20**. Such ring **22** may, and often will be welded directly to the body. The curl ring **22** is formed with a cylindrical portion **23** which is held adjacent the outside wall of the body and a flaring skirt **24** extending outwardly from the body. If desired to additionally strengthen the ends of the container, an end reinforcing ring **25** overlaps the sidewall **16** and curved flange **17** of the drum head.

In carrying out one form of the invention and in order to secure the drum head **12** to the container body **11**, an endless end connecting ring **30** (FIG. 2) is provided which may be plastically shrunk around the peripheral edge of the drum head and body end, thereby rigidly holding the head and body together in liquid-tight relation so as to form a liquid-tight "tight-head" container **10**. Such end connecting ring **30** is also plastically expandable to permit removal of the head during reconditioning of the container and is plastically shrinkable after reassembly of said head to again secure the head and body in liquid-tight relation. In the illustrated embodiment, the endless connecting ring **30** is formed with a lower horizontal flange **31** which overlaps curl ring **22** and a plastically expandable and contractable portion **32** which includes an upper flange **33**. The connecting ring **30** is shown in FIG. 2 in its open or expanded position as indicated by solid lines, during which time it can be seen that the drum head **12** reinforcing ring **25**, and sealing member **21** are easily removable and replaceable on the end **20** of the drum body, while the connecting ring **30** will be loosely retained on the drum body through coaction between the flange **31** and curl ring **22**.

After the drum head **12**, reinforcing ring **25** and sealing member **21** are properly assembled on the end of the container, the end connecting ring **30** is shrunk to its closed or securing position by any conventional shrinking machine, there being a portion of such a machine shown diagrammatically in phantom at **35** in FIG. 2. The shrinking machine **35** includes an annular series of spaced die segments **36** each mounted on a radially movable carrier **37** which is precluded from axial movement in any conventional manner (not shown). The dies **36** each have a forming area **38** with a configuration complementary to the desired shape of the outer surface of connecting ring **30** when the ring is in a closed position. In order to impart radial movement to each die segment and carrier, the carrier is formed with an inclined cam surface **39** which mates in sliding relationship with a similarly inclined cam surface **39'** on an axially movable drive member **40**. To plastically shrink the connecting ring **30** to its closed position the die segments **36** of the machine are placed adjacent the connecting ring and the drive member **40** is moved axially downward, thus causing inward radial movement of the carrier and die segments.

When the connecting ring **30** is in its closed position, as indicated in phantom at **30'** in FIG. 2 and in solid lines in FIG. 3, the head **12** is held tightly against the body end **20**. The lower flange **31** of the connecting ring bears against the end of the skirt **24** of the curl reinforcing ring **22**, while the upper flange **33** bears against the end reinforcing ring **25** so that the end reinforcing ring **25**, drum head **12**, sealing member **21**, body end **20** and curl ring **22** are tightly compressed between the connecting ring flanges **31**, **33**. The resilient sealing member **21** is thereby compressed between the overlapping portions of the head and body end to create a liquid-tight seal. It will, of course be understood by those skilled in the art that suitable axially directed forces may be applied to the components prior to and during the shrinking operation by any suitable equipment (not shown) so as to establish the requisite compressive loading forces for the seal in which event the connecting ring **30** will, upon shrinkage to the solid line position shown in FIG. 3, serve to hold the components in place against the bias provided by the sealing member **21** so as to maintain an effective liquid tight seal.

After the container has been used on one or more occasions, the container may be completely and simply disassembled for reconditioning and/or cleaning by expanding the expandable portion **32** of the connecting ring **30** to its open position. In order to accomplish this, a conventional expanding machine, a portion of which is diagrammatically shown in phantom at **45** in FIG. 3, can be employed. The expanding machine **45**, which operates in a manner similar to the shrinking machine **35** described above in conjunction with FIG. 2, includes a plurality of annularly-spaced die segments **46** secured on respective radially movable carriers **47**. Each carrier is formed with an inclined cam surface **48** which is complementary to an inclined cam surface **49** formed on an axially movable annular drive ring **50**. When the ring **50** is moved axially downward, outward radial motion is simultaneously imparted to the carriers **47** and die segments **46**, thereby causing plastic expansion of the connecting ring portion **32** to the open position shown in phantom at **30'** in FIG. 3 so that the end reinforcing ring **25**, drum head **12**, and sealing member **21** may be removed as described above.

Referring next to FIG. 4, there has been illustrated an improved "tight-head" container construction which is essentially identical to that depicted in FIGS. 2 and 3, but wherein the expanding procedure is slightly modified so as to permit removal of the connecting ring **30** from the drum body **11** during the reconditioning operation. Thus, in this form of the invention the connecting ring **30** is formed with lower and upper horizontal flanges **31** and **33** respectively and plastically expandable and contractable portion **51** which is identical to the portion **32** shown in FIGS. 2 and 3 except that it includes the lower flange **31** rather than the upper flange **33**. The arrangement is such that when a reconditioning operation is to be performed, it is merely necessary to position a suitable expanding tool (diagrammatically indicated at **52** in FIG. 4) beneath the flange **31**, the tool **52** having an upstanding flange **53** adapted to be positioned in the space between the drum body **11** and the innermost edge **54** of the flange **31**. Thereafter, the tool **52** is expanded radially outward by any suitable drive mechanism (not shown) to shift the connecting ring **30** from solid line closed position shown in FIG. 4 to the phantom open or expanded position **30''**, whereupon the ring **30** and all of the closure components including the head **12** can be removed from the body **11**.

It will be appreciated from the foregoing that the container of the present invention may be completely disassembled so that no crevices exist in any of the disassembled parts which, when assembled, form a chime **18** having crevices therein. All container components therefore, including the chime components, may be thoroughly and conveniently cleaned and reconditioned. After reconditioning is completed, the container may be easily reassembled utilizing the same components and the same procedures described above, and the connecting ring at each end will be plastically shrunk to its securing position. Moreover, it will be apparent to those skilled in the art that the assembly and disassembly may be readily accomplished since the design of the assembled container provides room for engagement of the expanding and shrinking tooling.

A slightly modified construction also embodying the features of the present invention has been illustrated in FIG. 5. In this embodiment, a cylindrical drum body **55** is formed with an outwardly curved extremity **56** and is closed by a cup-shaped drum head **57**. The drum head **57** has a generally flat central portion **58** adapted to fit within the cylindrical body **55** and a cylindrical sidewall portion **59** terminating in a radial flange **60** which overlaps the curved body extremity **56**. Interposed between the overlapping portions of the head and container end is a resilient sealing member such as an O-ring **61**. To reinforce the container structure, a hollow reinforcing ring **62** is fitted within the cup-shaped head **57** immediately adjacent the side wall **59**, such ring **62** having a radially extending flange **63** which overlaps the drum head flange **60**. Of course, as the ensuing description proceeds it will become apparent that the ring **62** need not be hollow as shown. Indeed, it could be solid or filled, or it could take any of a variety of other shapes provided that it includes a portion shaped complementary to the "knuckle radius" of the head **57** for supporting the latter and a flange such as the flange **63**.

To secure and seal the head **57** to the end of the drum body **55**, an end connecting ring **65** is shrunk from an expanded posiiton shown in phantom in FIG. 5 at **65'** to a closed securing position as shown in solid lines. The connecting ring **65** in this case includes a cylindrical leg **66** adjacent to and which may be welded or otherwise affixed to the outside of the body **55** and an expandable and shrinkable portion in the form of a double thickness of metal **67** defined by a 180° bend, which double thickness **67** may be shrung around the flaring drum extremity **56** and the radial flange **63** so that the flange **63**, drum head flange **60**, sealing member **61**, and flaring body extremity **56** are compressed between the connecting ring leg **66** and double thickness **67**. The sealing member **61** is thereby maintained under compressive loading forces between the overlapping portions of the head and body to create an effective liquid-tight seal. The drum head **57** may be conveniently removed to make the container interior accessible for reconditioning by plastically expanding the connecting ring **65** to its open position as indicated at **65** in FIG. 5. The expanding and shrinking functions may be accomplished by any appropriate tooling of the type described above.

Referring next to FIG. 6, there is illustrated yet another form of the invention which is similar to the embodiment of FIGS. 1–3 except that the connecting ring and reinforcing ring are formed integrally with each other. Thus, a cylindrical drum body **70** is here provided with an extremity **71** which is folded outwardly to embrace one end of a curl reinforcing ring **72**, the other end of which is formed with a flaring skirt **73** extending a distance out from the drum body. As in the form of the invention shown in FIGS. 1–3, the curl ring **72** could, and normally would, be welded or otherwise permanently affixed to the drum body **70**. A cup-shaped drum head **75** closing the end of the body **70** has a generally flat central bottom surface **76** set within the body, and a sidewall **77** terminating in a curved flange **78** which overlaps the body extremity **71**. Interposed between the overlapping portions of the body and head is a resilient sealing member **79**.

In this embodiment a connecting ring **80** is provided which has a reinforcing portion **81** overlying the curved flange **78** and the sidewall **77** and "nuckle radius" of the cup-shaped drum head **75**, and an expandable and contractable portion **82** which may be plastically shrunk from an expaned open position shown in phantom in FIG. 6 at **82'** to a closed position shown by solid lines. The expanable connecting ring portion **82** has an extremity in the form of a radial flange **83** which underlies and abuts against the flaring skirt **73** of the curl reinforcing ring **72** when the connecting ring **80** is in a closed position so that the drum head flange **78**, sealing member **79**, body extremity **71**, and curl reinforcing ring **72** are securely held together by the connecting ring **80**. When the connecting ring portion **82** is expanded to the phantom position **82'** shown in FIG. 6 the connecting ring **80**, drum head **75**, and sealing member **79** are removable from the drum body **70**. It will, of course, be appreciated that to achieve such expansion any suitable tooling may be used such, for example, as that shown diagrammatically at **52** in FIG. 4.

Thus far the invention has been described in connection with diverse "tight-head" container constructions and methods for assembling and disassembling the same wherein the drum head and some, if not all, of the related closure components are rendered removable for reconditioning purposes by plastic expansion of at least one of the closure components, with the same parts later being reassembled by plastically shrinking at least one of the closure components to form a reconditioned container which is identical to the original container having essentially the same form, construction, capacity, appearance, and strength and performance characteristics as the original. However, those skilled in the art will appreciate that the invention, in its broadest aspects, is not limited to the use of shrinking procedures for assembly and expanding procedures for disassembly. To the contrary, it is within the scope of the present invention to employ plastic shrinking procedures for disassembly and plastic expanding procedures for assembly.

To this end, and as best illustrated in FIG. 7, there has been depicted and will herein be described below a modified "tight-head" drum construction which, although generally similar in appearance and arrangement to the modification shown in FIG. 5, here is advantageously designed to permit of disassembly by plastic shrinking procedures and reassembly by plastic expansion procedures. Thus, a cylindrical drum body **85** is here provided with an outwardly flared extremity **86**. The end of the body **85** is closed by a cup-shaped head **88** having a generally flat central portion **89** set within the drum body, and a cylindrical sidewall **90** terminating in an outwardly curved radial flange **91** having an outside diameter D1. As here shown the flange **91** at least partially overlies the outwardly flared extremity **86** of the drum body **85**. A resilient sealing member **92** is interposed between the overlapping portions of the body and head.

In this form of the invention, there is provided a hollow reinforcing ring, generally indicated at **94**, having an outer cylindrical sidewall **95** blending into a smoothly curved portion **96** adapted to overlie and thus reinforce the sidewall **90** and "knuckle radius" of the head **88**. The ring **94** is further provided with a plastically expandable and contractable portion comprising an upright leg **98** having a reversely bent shorter leg **99** with the adjacent portions of the legs **98**, **99** defining a double thickness of material. The innermost portion of the shorter leg **99** terminates in an outwardly extending radial flange **100** adapted to overlie the radial head flange **91**.

For the purpose of holding the container components rigidly together to form a "tight-head" drum, there is provided a connecting ring **101** which is substantially identical in construction to the ring **65** shown in FIG. 5. Thus, the ring **101** includes a cylindrical portion **102** adapted to be welded or otherwise affixed to the drum body **85** and a reversely bent double-leg portion **104**, **105** which forms a double thickness of material wherein the shorter inner leg **105** overlies the outer peripheral edge of the flange **100**, thus serving to maintain compressive loading forces on the closure components including the sealing member **92**. For a reason which will become apparent below, the inner leg **105** is dimensioned to have an inside diameter D2 which is slightly greater than the outside diameter D1 of the head flange **91**.

The arrangement is such that when the "tight-head" drum shown by way of example in FIG. 7 is to be opened for purposes of reconditioning, it is merely necessary to apply a radially inwardly directed force to the double leg portion **98**, **99** of the reinforcing ring (as indicated by the arrow) with any suitable shrinking tooling (not shown). This serves to plastically deform or shrink the annulus defined by the leg portions **98**, **99** and shifts the reinforcing ring **94** to the dotted line position **94'**. As the leg portions are plastically shrunk to the position indicated at **94'**, the outwardly directed radial flange **100** is carried radially inwardly towards the axis of the drum body **85**, thus resulting in withdrawal of the outer peripheral edge of the flange **100** from beneath the leg **105** of the connecting ring **101** and thereby unlocking the container closure components. As a consequence, the reinforcing ring **94**, head **88** (the flange **91** of which has a smaller diameter D1 than the inside diameter D2 of the leg **105**), and gasket **92** may all be removed from the drum body **85**, thus exposing the interior thereof for reconditioning purposes.

In order to further facilitate the foregoing plastic shrinking operation and to minimize the force required to effect such shrinking, the flange **100** may be formed of a plurality of coplanar radially extending fingers **100*a***, **100*b***, **100*c***, **100*n*** (best illustrated in FIG. 8) which are preferably equally spaced about the double leg portions **98**, **99** and which are spaced apart by relatively narrow slots **106**. It will be appreciated that with such a construction it is unnecessary to shrink the metal which defines the flange **100** but, rather, the fingers will simply shift inwardly with the leg portions **98**, **99**. Similarly, during a reclosure operation force will be applied in the opposite direction so as to plastically expand the leg portions **98**, **99** and thus urge the flange fingers outwardly until their free peripheral extremities are again retained in locking position beneath the short leg **105** of the connecting ring **101**.

Those skilled in the art will appreciate that various modifications may be made in the foregoing procedures without departing from the spirit and scope of the invention. Merely by way of example, it will be observed upon inspection of FIG. 7 that during a disassembly operation it would be feasible to plastically shrink the expandable and contractable portion **98**, **99** of the reinforcing ring **94** while at the same time the portion **104**, **105** of the connecting ring **101** could be plastically expanded. The two plastic deforming operations could either take place simultaneously or successively, but in either case the amount of plastic deformation of any given component would be halved, thereby further prolonging the useful lives of the components. Moreover, it would also be feasible to use the same type of plastic deforming operation—e.g. expanding or shrinking—to both disassemble and assemble. Thus, and considering for the moment FIG. 5, it will be recalled that to effect disassembly of the container the portion **67** of the connecting ring **65** is plastically expanded until the latter is in the position designated at **65'**, whereupon the component parts of the container are separated and reconditioned. During the reconditioning operation it may be expedient to restore the connecting ring **65** to its pre-expanded solid line position. At the same time, while the reinforcing ring **62** is being reconditioned, it may be plastically shrunk in a manner similar to that described for the ring **94** shown in FIG. 7. Thereafter, upon reassembly of the components which were separated

by plastic expansion, the reinforcing ring **62** can be plastically expanded until the peripheral edge of its radial flange **63** is in locking engagement with the connecting ring **65**.

It will be appreciated from the forgoing that the container of the present invention may be conveniently disassembled, reconditioned and reassembled on numerous occasions with but minimal plastic strain of the component parts. For example, the drum heads shown in FIGS. 2–7 can be removed or replaced and resealed by plastically expanding or plastically shrinking a selected closure component on the order of only 1 to 2 percent (such percentage representing an expression of the change in diameter of the plastically deformed component). It has been established that ordinary carbon steel can be expanded and shrunk on the order of 2 percent for twenty to thirty cycles without significant loss to those properties necessary for the functions performed by the closure components. It has further been found that the smaller the plastic strain, the greater the number of reconditioning operations that can be performed without sacrifice to the container performance characteristics. Conversely, the greater the plastic strain, the fewer the number of reconditioning operations that can be performed. However, it has been found that satisfactory results at a minimal level can be achieved where the plastic strain is kept below 5 percent. Thus, a shipping container embodying the principles of the present invention wherein the degree of expansion and contraction is controlled within 5 percent will be reconditionable many times without replacement of any parts, excepting possibly the sealing gasket.

I claim as my invention:

1. The method of forming a reusable multi-trip tight-head shipping container comprising the steps of forming a cylindrical drum body, applying drum heads to the opposite ends of said body to close the same in a liquid-tight manner, and securing at least one of said heads to said body in liquid-tight overlapping relation therewith by plastically deforming an endless metallic closure member in one direction about the peripheral edge of said head and body and so as to rigidly secure said head to said body, and plastically deforming said member in the opposite direction to permit removal of said head from said body and reconditioning of said body.

2. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **1** further characterized in that said member is plastically deformed on the order 2 percent or less.

3. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **1** further characterized in that the degree of plastic deformation of said member is less than 5 percent.

4. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **1** further characterized in that resilient sealing means is positioned between the overlapping portion of said head and said body end, and compressing said resilient sealing means between said head and said body when said member is plastically deformed into a securing position so as to create a liquid-tight seal between said head and body.

5. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **1** further characterized in that said member comprises an endless connecting ring and that during said first plastic deforming step said connecting ring is plastically shrunk to secure said head to said body, and that during said second plastic deforming step said connecting ring is plastically expanded to permit removal of said head from said body.

6. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **1** further characterized in that said member comprises an endless reinforcing ring and that during said first plastic deforming step said reinforcing ring is plastically expanded to secure said head to said body, and that during said second plastic deforming step said reinforcing ring is plastically shrunk to permit removal of said head from said body.

7. The method of forming a reusable multi-trip tight-head shipping container as set forth in claim **5** further characterized in that said connecting ring comprises an integral unitary portion of a reinforcing ring, and that during said plastic deforming steps only the connecting ring portion of said reinforcing ring is deformed.

8. The method of disassembling and reassembling a multi-trip tight-head shipping container of the type having at least one drum head secured to a drum body by at least one endless metallic closure member so as to permit reconditioning of the disassembled container components comprising the steps of:

(A) plastically deforming said endless metallic closure member to release said head from said body;

(B) reconditioning the disassembled container components; and,

(C) plastically deforming said endless metallic closure member to secure said head to said body to form a tight-head shipping container identical in all respects to the original said multi-trip tight-head shipping container.

9. The method of disassembling and reassembling a multi-trip tight head shipping container as set forth in claim **8** further characterized in that said endless metallic closure member comprises an endless connecting ring and that during said step (A) said conecting ring is plastically expanded while during said step (C) said connecting ring is plastically shrunk.

10. The method as set forth in claim **9** further characterized in that upon completion of said step (A) said connecting ring is maintained loosely captive on said body.

11. The method as set forth in claim **9** further characterized in that upon completion of said step (A) said connecting ring is removable from said body.

12. The method of disassembling and reassembling a multi-trip tight head shipping container as set forth in claim **8** further characterized in that said endless metallic closure member comprises an endless reinforcing ring and that during said step (A) said reinforcing ring is plastically shrunk while during said step (C) said reinforcing ring is plastically expanded.

13. The method of disassembling and reassembling a multi-trip tight head shipping container as set forth in claim **8** further characterized in that said endless metallic closure member comprises an integral unitary reinforcing ring having a connecting ring portion and that during said step (A) said connecting ring portion is plastically expanded while during said step (C) said connecting ring portion is plastically shrunk.

14. The method of disassembling and reassembling a multi-trip tight-head shipping container of the type having at least one drum head secured to a drum body by first and second metallic closure members so as to permit reconditioning of the disassembled container components comprising the steps of:

(A) plasticaly deforming at least one of said first and second metallic closure members to release said head from said body;

(B) reconditioning the disassembled container components; and

(C) plastically deforming at least one of said first and second metallic closure members to secure said head to said body to form a tight-head shipping container identical in all respects to the original said multi-trip tight-head shipping container.

15. The method as set forth in claim **14** further characterized in that during said step (A) said first closure member is plastically expanded and during said step (C) said first closure member is plastically shrunk.

16. The method as set forth in claim **14** further characterized in that during said step (A) said second closure member is plastically shrunk and during said step (C) said second closure member is plastically expanded.

17. The method as set forth in claim 14 further characterized in that during said step (A) said first closure member is plastically expanded and said second closure member is plastically shrunk, and during said step (C) said first closure member is plastically shrunk, and said second closure member is plastically expanded.

18. The method as set forth in claim 17 further characterized in that the plastic expanding and shrinking operations of step (A) are carried out simultaneously and in that subsequently the plastic shrinking and expanding operations of step (C) are carried out simultaneously.

19. The method as set forth in claim 17 further characterized in that the plastic expanding and shrinking operations of step (A) are carried out successively and in that subsequently the plastic shrinking and expanding operations of step (C) are carried out successively.

20. The method as set forth in claim 14 further characterized in that during said step (A) one of said first and second closure members is plastically deformed; that during said step (B) said one closure member is restored to the state it occupied prior to step (A) and the other of said first and second closure members is plastically deformed; and that during said step (C) said other closure member is again plastically deformed to restore it to the state it occupied prior to step (B).

21. The method as set forth in claim 20 further characterized in that during said step (A) said first closure member is plastically expanded to permit separation of the container components; that during and incident to said step (B) said first closure member is restored to its pre-expanded state and said second closure member is

plastically shrunk; and that during said step (C) said second closure member is plastically expanded to restore it to its pre-shrunk state.

22. The method as set forth in claim 20 further characterized in that during said step (A) said second closure member is plastically shrunk to permit separation of the container components; that during and incident to said step (B) said second closure member is restored to its pre-shrunk state and said first closure member is plastically expanded; and that during said step (C) said first closure member is plastically shrunk to restore it to its pre-expanded state.

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U.S. Cl. X.R.

113—120; 220—67