

[72] Inventor **Frederick E. Ullman**
Winnetka, Ill.
 [21] Appl. No. **871,061**
 [22] Filed **July 24, 1969**
Division of Ser. No. 649,714, June 28, 1966,
Patent No. 3,505,722.
 [45] Patented **Feb. 2, 1971**
 [73] Assignee **Inland Steel Company**
Chicago, Ill.
a corporation of Delaware

[50] Field of Search..... 220/46, 55,
 73, 67; 292/256.6, 61; 222/(Inquired);
 229/5.7

[56] **References Cited**
UNITED STATES PATENTS
 3,401,864 9/1968 Schuringa..... 220/46(X)
 3,437,254 4/1969 Bergstrom..... 229/5.7
Primary Examiner—George T. Hall
Attorney—Wolfe, Hubbard, Leydig, Voit & Osann

[54] **RECONDITIONABLE CONTAINER**
17 Claims, 8 Drawing Figs.

[52] U.S. Cl..... 220/46,
 220/55, 220/73; 292/256.6; 229/5.7
 [51] Int. Cl..... B65d 53/00,
 A47j 27/08, A47j 36/10

ABSTRACT: An improved multitrip metallic shipping container which permits 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.

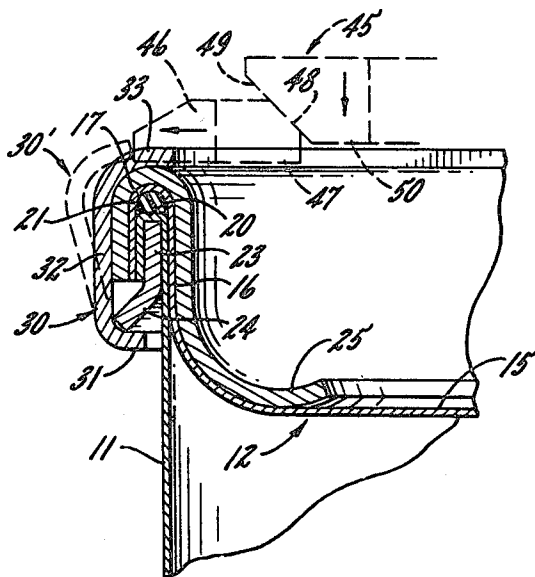


Fig. 1.

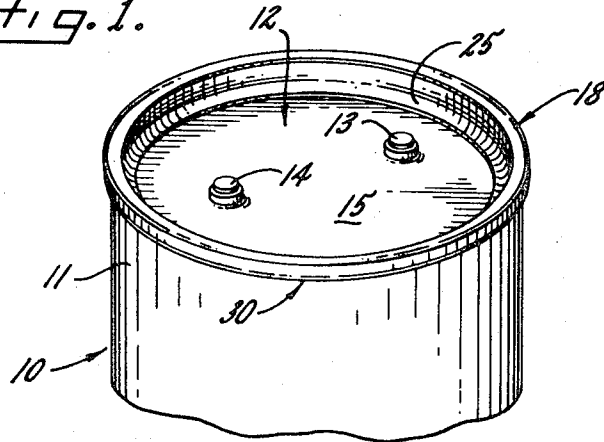


Fig. 2.

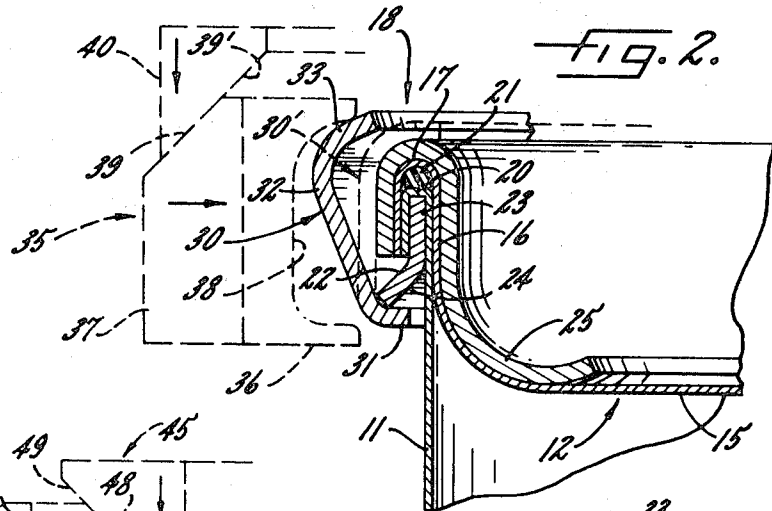


Fig. 3.

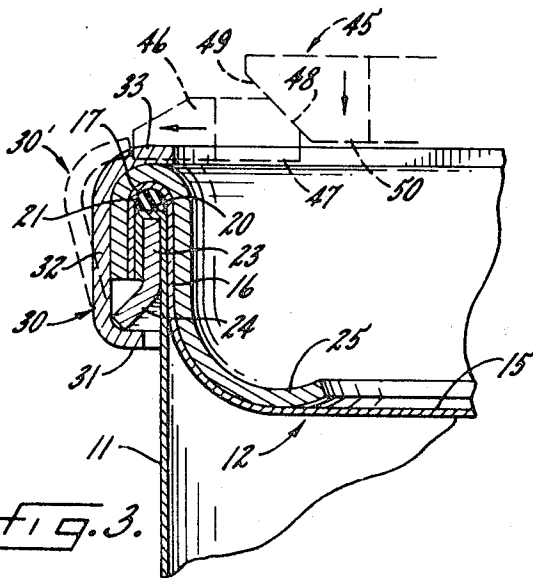
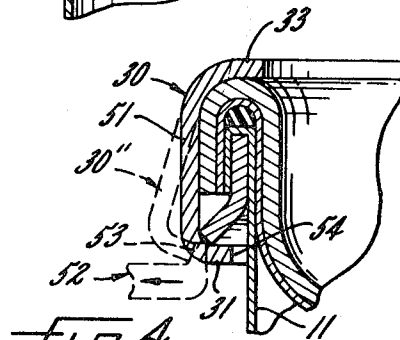
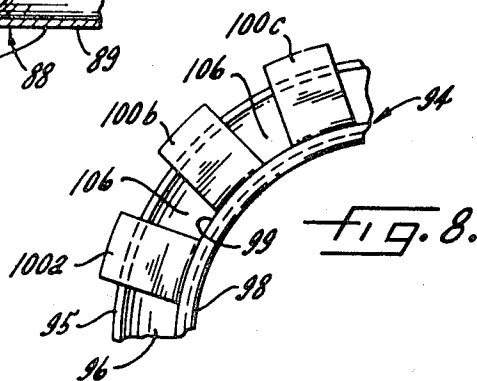
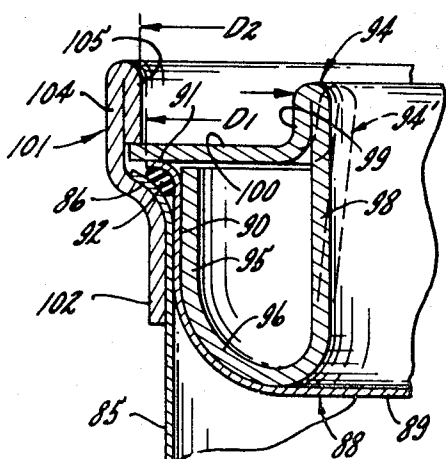
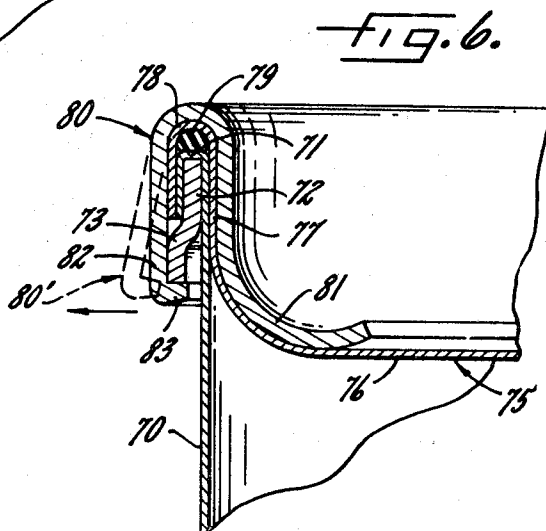
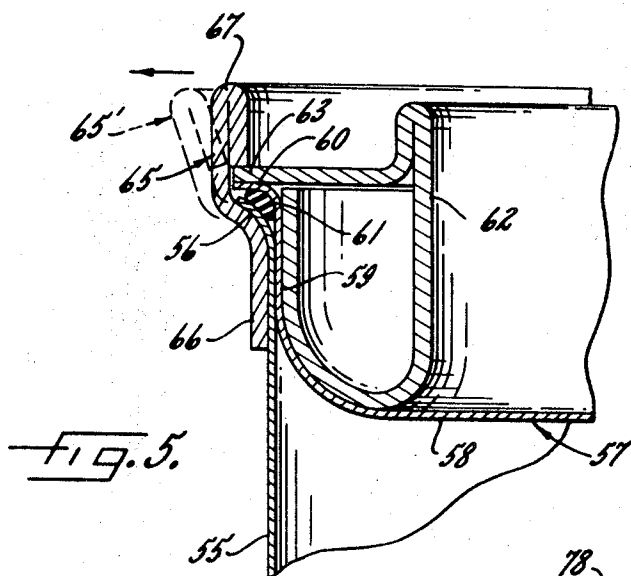


Fig. 4.



INVENTOR:—
 FREDERICK E. ULLMAN,
 By: Wolfe, Hubbard, Toit & Orman,
 ATTORNEYS.



INVENTOR:
FREDERICK E. ULLMAN,
By: Wolfe, Hubbard, Voigt & Oramm,
ATTORNEYS.

RECONDITIONABLE CONTAINER

The present application is a divisional application based on the copending application of Frederick E. Ullman, Ser. No. 649,714, filed Jun. 28, 1966, now U.S. Pat. No. 3,505,722, issued Apr. 14, 1970.

The present invention relates in general to shipping containers and more particularly, to multitrip 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 "tight head" shipping containers wherein 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 de-denting 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 multitrip 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 re-folded, 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 multitrip "tight head" shipping container 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 multitrip 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 case 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 multitrip 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 one 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:

FIG. 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 between 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 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 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, 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 contractible 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 occasion, the container may be completely and simply disassembled for reconditioning and/or cleaning by expanding the expandible 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 a plastically expandable and contractible 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 the 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 sidewall 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 position 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 65 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 shrunk 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 "knuckle radius" of the cup-shaped drum head 75, and an expandable and contractible portion 82 which may be plastically shrunk from an expanded open position shown in phantom in FIG. 6 at 82' to a closed position shown by solid lines. The expandable 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 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 "k-nuckle radius" of the head 88. The ring 94 is further provided with a plastically expandable and contractible 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 100a, 100b, 100c, 100n (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 contractible 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 preexpanded 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 foregoing 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 20 to 30 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:

1. A multitrip tight head shipping container of the type which may be repeatedly used comprising, in combination, a cylindrical drum body, a pair of drum heads closing the opposite ends of said body, at least one of said drum heads having a peripheral edge overlapping the adjacent end of said body, an endless connecting ring surrounding the peripheral edge of said head and said body end and rigidly securing said head to said body in liquid-tight relation, said endless connecting ring being plastically expandable to permit the disassembly of said head from said body to facilitate reconditioning of said container and being plastically shrinkable after reassembly of said head and said body to again secure said head and body in liquid-tight relation.

2. The multitrip tight head shipping container as set forth in claim 1 further characterized in that resilient sealing means is interposed between said body end and overlapping peripheral head portion, said resilient sealing means being compressed between said body and said head when said connecting ring is plastically shrunk to its securing position.

3. The multitrip tight head shipping container of claim 1 in which said connecting ring has an inwardly extending radial flange adjacent the outer surface of said body and a plastically expandable and contractible portion surrounding the peripheral edge of said head and body end.

4. The multitrip tight head shipping container of claim 2 in which an end reinforcing ring overlaps the periphery of said removable head, said end reinforcing ring, drum head, resilient sealing means, and body end being compressed and rigidly held together when said connecting ring is plastically shrunk to its securing position, and said end reinforcing ring,

drum head and resilient sealing means being removable from said body end when said connecting ring is in an expanded position.

5. The multitrip tight head shipping container of claim 4 further characterized in that said reinforcing ring is integral with said endless connecting ring.

6. The multitrip tight head shipping container of claim 2 in which a curl reinforcing ring is secured to the outside of said body adjacent said body end, said curl reinforcing ring having a flaring skirt extending outwardly from said body, said removable head being cup-shaped and having a generally flat central portion set within said body and a cylindrical sidewall terminating in a curved flange which overlaps said body end, an end reinforcing ring overlapping the curved flange and sidewalls of said drum head, said connecting ring having a first flange abutting against said curl reinforcing ring skirt, a second flange and an expandable and shrinkable portion including one of said first and second flanges, said end reinforcing ring, curved drum head flange, resilient sealing means, body end, and curl reinforcing ring being compressed between said first and second connecting ring flanges when said expandable and shrinkable connecting ring portion is plastically shrunk to its securing position, and said end reinforcing ring, drum head, and sealing means being removable from said body end when said expandable and shrinkable connecting ring portion is in an expanded position.

7. The multitrip tight head shipping container of claim 6 further characterized in that said expandable and shrinkable connecting ring portion includes said first flange, said connecting ring being removable from said body when said plastically expandable and shrinkable connecting ring portion is in an expanded position.

8. The multitrip tight head shipping container of claim 6 further characterized in that said expandable and shrinkable connecting ring portion includes said second flange, said connecting ring being loosely retained on said body when said plastically expandable and shrinkable connecting ring portion is in an expanded position.

9. The multitrip tight head shipping container of claim 2 in which the end of said body enclosed by said removable head has an outwardly flaring extremity, said removable head being cup-shaped and having a generally flat central portion within said body and a cylindrical sidewall terminating in a radial flange overlapping said flaring body extremity, a reinforcing ring fitted with the cup-shaped head immediately adjacent said cylindrical sidewall, said reinforcing ring having a radial flange overlapping said drum head flange, said connecting ring having a cylindrical first leg portion telescoping the outside of said body and a plastically expandable and shrinkable portion surrounding the end of said container and including a second leg portion, said end reinforcing ring flange, drum head flange, sealing means and flaring extremity being rigidly compressed between said connecting ring first and second leg portions when said expandable and shrinkable connecting ring portion is in its shrunk position, and said end reinforcing ring, drum head, and sealing means being removable from said body end when said expandable and shrinkable connecting ring portion is in its expanded position.

10. The multitrip tight head shipping container of claim 2 in which said connecting ring has a reinforcing portion overlapping in close relation the periphery of said head and a plastically expandable and shrinkable portion surrounding the end of said body, said expandable and shrinkable portion being engageable with said body when in a shrunk position so that said connecting ring secures said drum head to said body end, and said connecting ring expandable and shrinkable portion being disengaged from the outside of said body when in an expanded position so that said connecting ring, drum head and sealing means may be removed from the end of said body.

11. The multitrip tight head shipping container of claim 2 in which a curl reinforcing ring is secured to the outside of said body adjacent the end enclosed by said removable head, said curl reinforcing ring having a flaring skirt extending outwardly

from said body, said removable drum head being cup-shaped and having a generally flat central portion set within said body and a cylindrical sidewall terminating in a curved flange overlapping said body end, said connecting ring having a reinforcing portion overlapping in close relationship the curved flange and sidewalls of said head, said connecting ring also having a plastically expandable and shrinkable portion surrounding said curl reinforcing ring, said expandable and shrinkable portion having a flanged extremity engaging said curl reinforcing skirt when said portion is in a shrunk position so that said connecting ring securely holds said drum head and sealing means against the end of said body, and said connecting ring flanged extremity being disengaged from said skirt when said connecting ring portion is expanded so that said connecting ring, drum head, and sealing means may be removed from said body.

12. A multitrip tight head shipping container of the type which may be repeatedly used comprising, in combination, a cylindrical drum body, a pair of drum heads closing the opposite ends of said body, at least one of said drum heads having a peripheral edge overlapping the adjacent end of said body, an endless reinforcing ring overlapping the said peripheral edge of said drum head, an endless connecting ring surrounding the peripheral edges of said reinforcing ring, head and said body end and rigidly securing said head to said body in liquid-tight relation, at least one of said reinforcing ring and said connecting ring having a plastically expandable and contractible portion so that upon plastic deformation of said at least one ring at least said head and said reinforcing ring may be removed from said body to facilitate reconditioning of said container, said plastically expandable and contractible portion being plastically deformable after reassembly of said head, reinforcing ring and said body to again secure said head and body in liquid-tight relation.

13. The multitrip tight head shipping container as set forth in claim 12 further characterized in that said reinforcing ring includes said plastically expandable and contractible portion, said portion being plastically shrunk to release said head from said body and plastically expanded to secure said head to said body.

14. The multitrip tight head shipping container as set forth in claim 12 further characterized in that said connecting ring includes said plastically expandable and contractible portion, said portion being plastically expanded to release said head from said body and plastically shrunk to secure said head to said body.

15. The multitrip tight head shipping container as set forth in claim 12 further characterized in that said connecting ring and said reinforcing ring each include a said expandable and contractible portion, said reinforcing ring portion being plastically shrunk and said connecting ring portion being plastically expanded to release said head from said body, and said reinforcing ring portion being plastically expanded and said connecting ring portion being plastically shrunk to secure said head to said body.

16. The multitrip tight head shipping container as set forth in claim 13 further characterized in that the said peripheral edge of said reinforcing ring comprises a radially extending flange, said flange being defined by a plurality of coplanar radially extending teeth.

17. A multitrip tight head shipping container of the type which may be repeatedly used comprising, in combination, a cylindrical drum body, a pair of drum heads closing the opposite ends of said body, at least one of said drum heads having a peripheral edge overlapping the adjacent end of said body, endless closure means surrounding the peripheral edge of said head and said body end and rigidly securing said head to said body in liquid-tight relation, said endless closure means including an endless closure component having a plastically expandable and contractible portion, said portion being plastically deformable to permit disassembly of said head from said body to facilitate reconditioning of said container, said portion being also plastically deformable upon reassembly of the reconditioned container components to again secure said head and said body in liquid-tight relation.