Jan. 8, 1957 D. MAPES 2,776,475

METHOD OF MAKING CYLINDRICAL METALLIC CONTAINERS FOR CONFINING FLUID MEDIUM UNDER PRESSURE

Filed Sept. 30, 1953

Fig. 1.

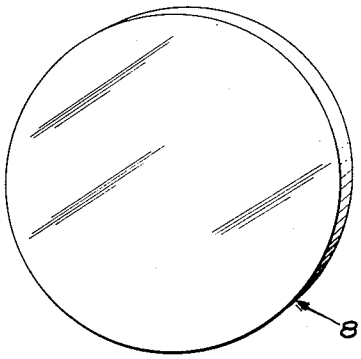


Fig. 4.

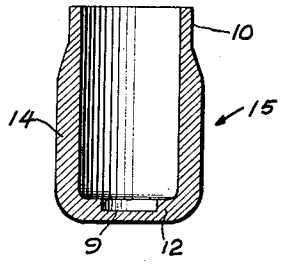


Fig. 5.

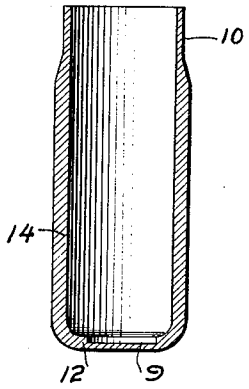


Fig. 2.

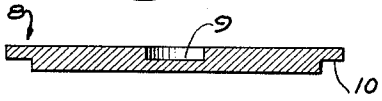


Fig. 2b.

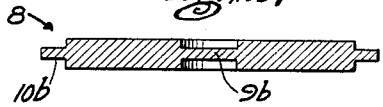


Fig. 2a.



Fig. 2c.

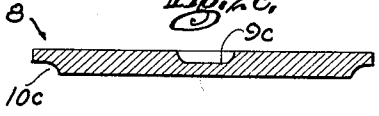


Fig. 6.

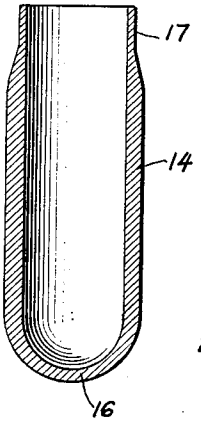


Fig. 7.

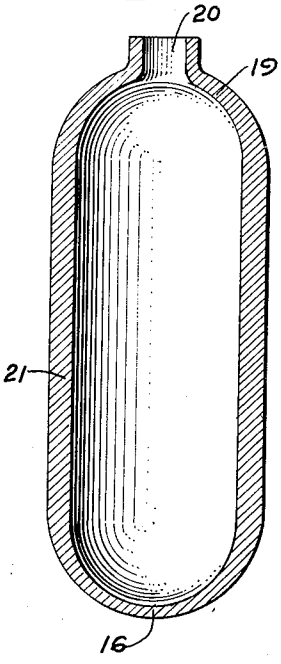
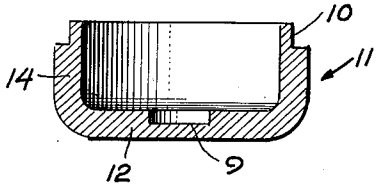


Fig. 3.



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METHOD OF MAKING CYLINDRICAL METALLIC CONTAINERS FOR CONFINING FLUID MEDIUM UNDER PRESSURE

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8 Claims. (Cl. 29—543)

The present invention relates to a method of making metallic containers for storing fluid media under pressure, such as compressed and/or liquefied normally gaseous materials; and, more particularly, relates to an improved method of making such containers which will either resist gunfire or will not shatter when pierced by a projectile.

Containers of the foregoing character are widely used on military craft or vehicles, and may be subjected to machine gunfire when in a combat area. The universal use of high-powered, high-caliber machine gun ammunition requires that such containers be reinforced, particularly at the side wall thereof, to prevent shattering or violent ripping apart when struck by the projectiles of such ammunition.

For example, as shown in my prior Patent No. 2,370,677, such reinforced containers generally comprise a one-piece, substantially rigid, seamlessly formed metallic cylinder which is inherently subject to ripping apart when pierced by a projectile and which is constructed to withstand the highest working pressures at which fluid media may be confined therein under normal conditions of use without further reinforcement; and a continuous winding of contiguous convolutions of steel piano wire of high tensile strength on the side wall of the container. While reinforced containers of the foregoing type will not shatter or rip apart when subjected to gunfire, the applied winding involves additional manufacturing operations which increase the cost of the containers.

Accordingly, an object of the present invention is to provide a simple, practical and economical method of making gunfire resistive containers.

Another object is to provide a method of making such containers which are so constructed that the application of additional reinforcing structure is not required.

A further object is to provide a method of making such containers wherein the thickness of the container walls is readily controlled to attain the desired reinforcement.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the present invention, the foregoing objects are accomplished by providing an improved method of making one-piece seamlessly formed cylindrical metal containers for confining fluid media under pressure which method comprises forming a generally circular metal blank with a generally circular central section of reduced thickness and a marginal band of reduced thickness, forming the blank into a cup having an end wall in which the central section is located and having a side wall provided with the band at the open end of the cup, drawing the cup to form a cylindrical shell of greater length and smaller diameter than the cup and to proportionately reduce the thickness of the end and side walls, the central section and the band, extending the end wall

axially outwardly and shaping the same into a generally hemispherical end wall of less thickness than the side wall, and necking the band to form a generally hemispherical dome provided with an axially outwardly extending spud.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:

Fig. 1 is a perspective view of a circular blank of sheet metal from which a container in accordance with the invention is formed.

Figs. 2, 2*a*, 2*b* and 2*c* are diametrical sectional views of the blank illustrating various ways of providing the blank with a central section and a marginal band of reduced thickness.

Fig. 3 is a sectional view of a cylindrical cup formed from the blank.

Fig. 4 is a sectional view of a cylindrical shell formed from the cup.

Fig. 5 is a sectional view of the shell after being further lengthened and reduced in diameter.

Fig. 6 is a sectional view of the shell shown in Fig. 5 with the end wall extended axially outwardly and shaped into a hemispherical wall.

Fig. 7 is an enlarged sectional view of a container formed from the shell shown in Fig. 6.

Referring to the drawing in detail, there is shown a circular blank **8** (Fig. 1) of sheet or plate steel of the type from which high pressure fluid media storage containers are generally formed. This blank is formed with a generally circular central section of reduced thickness and a marginal band of reduced thickness, in any suitable manner.

In Fig. 2, a central section **9** is formed by providing a generally circular recess at the upper side (as viewed) of the blank **8**, and a band **10** is formed by providing an annular recess at the lower side (as viewed) of the blank.

In Fig. 2*a*, a central section **9***a* is formed by providing a generally circular recess at the lower side (as viewed) of the blank, and a band **10***a* is formed by providing an annular recess at the same side of the blank.

In Fig. 2*b*, a central section **9***b* is formed by providing a shallow generally circular recess at both sides of the blank, and a band **10***b* is formed by providing a shallow annular recess at both sides of the blank. It will be appreciated that the blank can be formed with a central section **9***b* and a band **10** or **10***a*, and that the blank can be formed with a central section **9** or **9***a* and a band **10***b*.

In Fig. 2*c*, a central section **9***c* and a band **10***c* are shown which have an arcuate contour. It will be understood that the central section **9***a* and **9***b* and the band **10***b* may have a similar arcuate contour.

The thickness of the central section and the band is about the same, and preferably is not less than about one half the thickness of the blank. The width of the band and the diameter of the central section may vary in proportion to the thickness of these zones and to the diameter of the container produced in accordance with the present method.

As shown in Fig. 3, the blank **8** is then formed into a cup **11** having a generally flat bottom or end wall **12** in which the central section **9** is located, and having a cylindrical side wall **14** which is open at the end opposite the wall **12**. The band **10** is located in this side wall at the open end of the cup. The cup is formed in any conventional manner; but preferably the side and end walls are of substantially uniform thickness throughout, except for the regions in which the central section **9** and the band **10** are located.

The cup **11** is shaped into a shell **15** of greater length

and smaller diameter than the cup, preferably by progressively either hot or cold drawing the cup in several steps as illustrated in Figs. 4 and 5. In so forming the shell 15, the flat shape of the bottom or end wall 12 is maintained, and the thickness of the section between the central recess of the end wall and the recess at the upper end of the side wall is reduced but is maintained substantially uniform, while the diameter of the central section 9 and the width of the marginal band 10 is proportionately increased and the thickness of the central section 9 and the marginal band 10 is proportionately reduced.

The end wall 12 is then bulged or extended axially outwardly while shaping the same into a substantially hemispherical end wall 16 (Fig. 6). This may be accomplished in a number of different ways. For example, the end wall could be cold worked or coined in a press by means of a punch and die. However, the end wall preferably is heated to facilitate flow of the metal and a punch or gas pressure may be applied to extend it outwardly while shaping the same. In completing the shell, the marginal band 10 is converted into a cylindrical zone 17 which has a thickness about equal to the end wall 16.

The length of the zone 17 is such that the zone can be shaped into a substantially hemispherical dome 19 (Fig. 7) adapted to be provided with an outlet spud 20. The dome may be formed by spinning or press necking the zone 17 inwardly, preferably while hot, to close the open end of the container.

The container, shown in Fig. 7 and made in accordance with the method of the present invention just described, comprises a cylindrical side wall 21 of substantially uniform thickness throughout, a hemispherical bottom or end wall 16 having a thickness about half that of the side wall, and a hemispherical dome 19 having a thickness about equal to that of the end wall 16. The thickness of the end wall and dome is about equal to the side wall thickness of a container constructed to safely withstand the highest working pressures at which fluid media may be confined therein under normal conditions of use without further reinforcement, while the thickness of the side wall 21 is about double the side wall thickness of such a container.

It has been found that the double thickness of the wall 21 provides a container which will either resist gunfire or will not shatter when this wall is pierced while fluid media under pressure is stored therein. The end wall 16 and dome 19 of reduced thickness, by reason of their generally hemispherical shape, are equally as strong as the thick cylindrical side wall 21 and are thus also capable of resisting gunfire and/or preventing shattering or ripping apart of the container.

From the foregoing description, it will be seen that the present invention provides a simple, practical and economical method of forming containers for storing fluid medium under pressure which do not require any additional reinforcing structure.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. The method of making a one-piece, seamlessly formed cylindrical metal container for confining fluid medium under pressure and having a cylindrical side wall of a predetermined substantially uniform thickness and having substantially hemispherical end walls of a thickness about equal to about half of that of the side wall and about equal to the side wall thickness of a cylindrical container of equal capacity constructed to withstand the highest working pressures at which fluid medium may be safely confined therein under normal conditions of use without further reinforcement, which method comprises forming a generally circular metal blank with a generally circular central section of reduced thickness and a marginal band of reduced thickness, forming the blank into a cup having an end wall in which the central section is located and having a side wall provided with the band at the open end of the cup, drawing the cup to form a cyindrical shell of greater length and smaller diameter than the cup and to proportionately reduce the thickness of the end and side walls, the central section and the band, extending the end wall axially outwardly and shaping the same into a generally hemispherical end wall of less thickness than the side wall, and necking the band to form a generally hemispherical dome provided with an axially outwardly extending spud.

2. The method according to claim 1, wherein the central section is formed by providing a generally circular recess in the blank and the marginal band is formed by providing an annular recess in the blank.

3. The method according to claim 1, wherein the central section is formed by providing a generally circular recess at one side of the blank and the marginal band is formed by providing an annular recess at the other side of the blank.

4. The method according to claim 1, wherein the central section is formed by providing a generally circular recess at one side of the blank and the marginal band is formed by providing an annular recess at the same side of the blank.

5. The method according to claim 1, wherein the central section is formed by providing a generally circular recess at each side of the blank and the marginal band is formed by providing an annular recess at each side of the blank.

6. The method according to claim 1, wherein the central section is formed by providing a generally circular recess in the blank having an arcuate cross-sectional contour and the marginal band is formed by providing an annular recess in the blank.

7. The method according to claim 1, wherein the central section is formed by providing a generally circular recess in the blank and the marginal band is formed by providing an annular recess in the blank having an arcuate cross-sectional contour.

8. The method according to claim 1, wherein the central section is formed by providing a generally circular recess in the blank having an arcuate cross-sectional contour and the marginal band is formed by providing an annular recess in the blank having an arcuate cross-sectional contour.

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