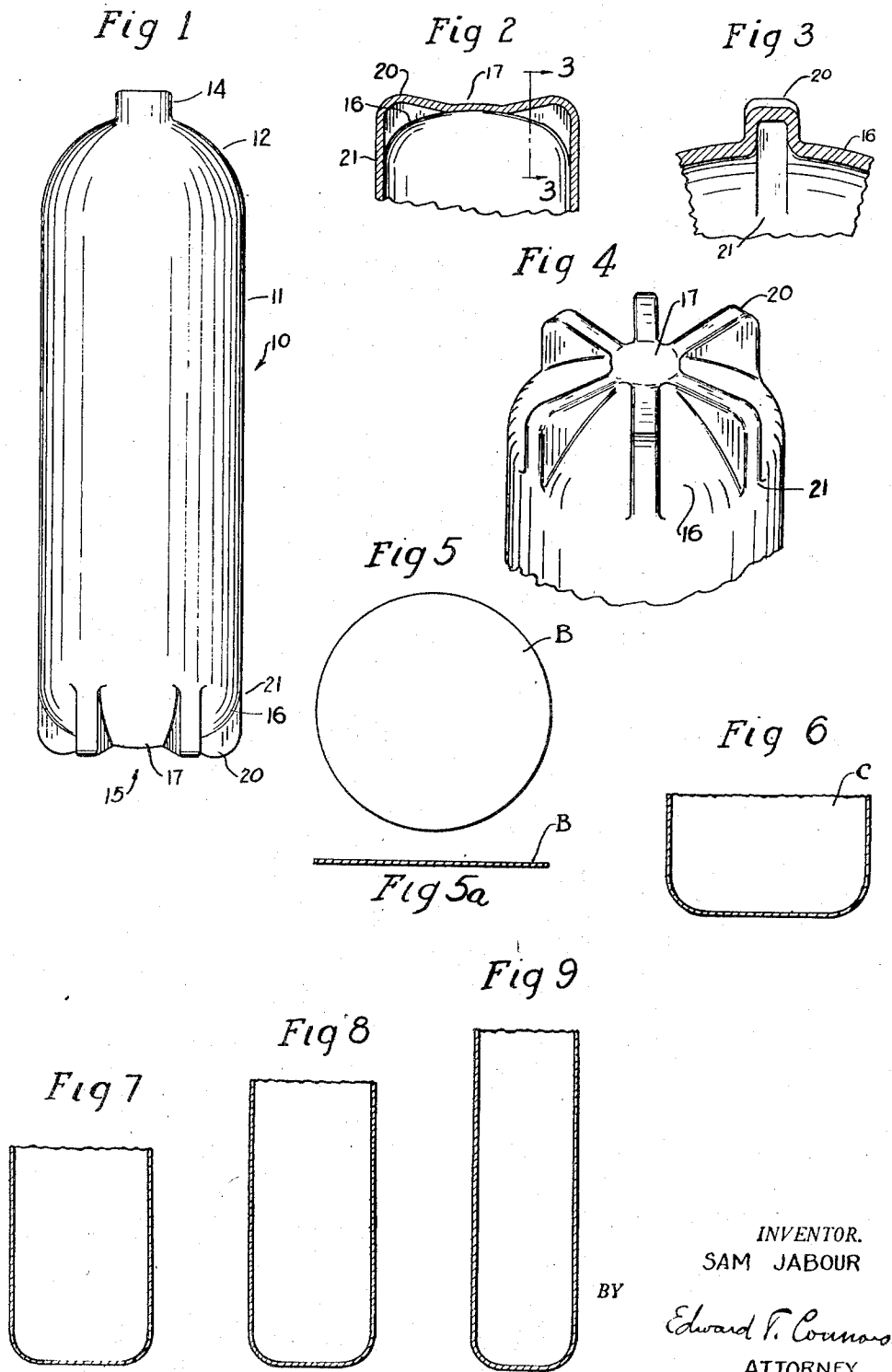


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HIGH-PRESSURE CONTAINER

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HIGH-PRESSURE CONTAINER

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The present invention relates to containers, and, more particularly relates to metallic containers for high pressure fluid media such as carbon dioxide or oxygen and the like.

An object of the invention is to provide improved containers for high pressure fluid media.

Another object is to provide such containers having maximum strength and minimum wall thickness and minimum weight.

Another object is to provide a container of the foregoing character having a cylindrical side wall and a closed end wall of substantially uniform minimum thickness throughout, wherein the closed end wall is provided with formations shaped to serve as base portions to facilitate standing the container in upright position.

Another object is to provide a cold drawn container of the foregoing character wherein the base formations are pressed from a closed end wall of generally ellipsoidal contour and maintain the strength of the closed end wall without the provision of portions of increased thickness.

Another object is to provide a container of the foregoing character which is adapted to pass a prescribed hydrostatic pressure test without deformation of its walls.

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.

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:

Figure 1 is a side elevational view of a container illustrating the present invention.

Figure 2 is an enlarged fragmentary longitudinal sectional view of the lower or closed end of the container.

Figure 3 is a sectional view taken along the line 3—3 on Figure 2.

Figure 4 is an enlarged fragmentary perspective view of the lower or closed end of the container.

Figures 5 and 5a, respectively, are plan and sectional views of a blank from which the container is made.

Figures 6 to 9 are longitudinal sectional views illustrating some of the steps utilized in making the container.

Referring to the drawing, and more particularly to Figure 1, there is shown a container 10, generally known as a cylinder, for storing high pressure fluid media such as liquefied or gase-

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ous carbon dioxide, oxygen, air, nitrogen or other gases. Such containers usually are required to be subjected to a hydrostatic test pressure of about 3500 pounds per square inch without deformation thereof.

The container 10 comprises a cylindrical side wall 11, a hemispherical upper end wall 12 provided with a restricted outlet or opening in the form of a short neck 14 for receiving a suitable valve or other discharge control device (not shown), and a closed lower end wall 15 in accordance with the present invention.

The end wall 15 is illustrated in Figures 2 and 3, and, as shown, has a generally spherical contour or curvature as depicted by the portions 16 radiating from the central circular portion 17 also of generally ellipsoidal shape, whereby the end wall 15 has maximum strength for a minimum thickness of material.

In order to support the container on a substantially horizontal surface, the end wall has formations 20 extending outwardly thereof. These formations, as shown, may be in the form of a plurality of radially extending ribs or channel portions of U-shaped cross-section (Figure 3) and of increasing depth as they approach and join the peripheral portion of the cylindrical side wall at 21. In the embodiment illustrated, six of such ribs are provided and these ribs cooperate to prevent upsetting of the container in the same manner as a flat closed end wall.

An important advantage of forming the closed end wall 15 in the manner just described is that the ribs do not impair the strength of the closed end wall and thereby provide an end wall having at least the same strength of the hemispherical end wall 12. This is accomplished without increasing the thickness of portions of the end wall whereby increase in weight or material is avoided. In practice, it has been found that containers in accordance with the invention pass the hydrostatic pressure test to which containers of similar shape, capacity and thickness and provided with hemispherical closed end walls are subjected. The side wall 11, the upper end wall 12 and the lower end wall 15 have a uniform thickness substantially throughout, whereby the container is adapted to be formed by an improved, simplified and rapid method.

The containers in accordance with the invention are adapted to be made as will now be described in connection with Figures 5 and 5a to 9 of the drawing.

In Figure 5a, circular blank B is shown which is cut out of suitable metal plate or sheet stock of a predetermined uniform thickness for a container of a given ultimate wall thickness and capacity. This blank B is cold pressed into a

cup-shaped blank C (Figure 6) which is elongated by a plurality of successive cold redrawing operations, intermediate shapes being illustrated by Figures 7 and 8, until an open ended container having a cylindrical side wall 11 and a closed end wall 15 of predetermined dimensions is provided (Figure 9). During the redrawing operations the thickness of the walls is maintained uniform substantially throughout.

The closed end wall of the partly formed container shown in Figure 9 is then cold pressed by means of a cooperating die and plunger to provide the formations 16, 17 and 20 illustrated more particularly in Figures 2, 3 and 4. This is accomplished without altering the thickness of the end wall 15.

Thereafter, the upper portion of the side wall adjacent the opening is heated and is necked inwardly to form the upper end wall 12. The neck 14 constitutes an outlet for the container whereby the container shown in Figure 1 is provided.

The foregoing pressing and cold drawing steps can be effected in a simple and rapid manner whereby the foregoing described method readily lends itself to mass production.

From the foregoing description, it will be seen that the present invention provides an improved lightweight high pressure container. The container is constructed of a minimum amount of material to safely withstand a predetermined internal pressure, and the closed end wall thereof is constructed to provide for maximum strength while facilitating standing the container in upright position.

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.

It is also to be understood that the following claims are intended to cover all the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. A container constructed for confining a high pressure fluid medium comprising a one-piece substantially rigid, seamlessly formed metallic cylinder having a cylindrical wall of substantially uniform thickness throughout adapted to safely confine the pressure medium at high pressures and having a generally ellipsoidal outwardly formed closed end wall provided with radial formations extending axially outwardly out of said end wall a relatively short distance beyond the center portion of said end wall, said end wall having a thickness at least equal to the thickness of said cylindrical wall whereby the strength thereof, due to its shape and thickness, is at least equal to said cylindrical wall in resisting internal pressure and whereby a container of maximum strength is provided having the lightest possible weight for a given diameter and volume and material and having a minimum overall length for a given volume and diameter, said formations serving as base portions for standing the container in upright position.

2. A container constructed for confining fluid medium under pressure comprising a metallic cylinder having a cylindrical wall adapted to safely confine the pressure medium within the

range of positive pressures up to and including 3500 pounds per square inch and having a generally ellipsoidal outwardly formed closed end wall provided with radial formations extending axially outwardly out of said end wall a relatively short distance beyond the center portion of said end wall, said end wall having a thickness at least substantially equal to the thickness of said cylindrical wall whereby the strength thereof, due to its shape and thickness, is at least equal to said cylindrical wall in resisting internal pressure and whereby a container of maximum strength is provided having the lightest possible weight for a given diameter and volume and material and having a minimum overall length for a given volume and diameter, said formations serving as base portions for standing the container in upright position.

3. A metallic cylindrical container capable of confining fluid medium under pressure and provided with an outlet opening, said container comprising: a cylindrical wall of a substantially uniform thickness throughout and adapted to safely confine the pressure medium; a generally ellipsoidal outwardly formed end wall at the bottom of and integral with said cylindrical wall; and an end wall at the top of said cylindrical wall; said bottom end wall being provided with a central portion and with interiorly hollow, radially and axially outwardly extending formations surrounding the central portion, said formations having their outermost axially extending portions positioned outwardly beyond the exterior of the central portion a relatively short distance to serve as base portions for standing the container in upright position and said formations being substantially equally spaced circumferentially about said bottom end wall with the base portions of adjacent formations considerably less than ninety degrees apart to provide stable support for such container adapted to resist toppling upon application of a force applied in any direction laterally of the longitudinal axis of the container; said bottom end wall having a thickness approximately equal to the thickness of said cylindrical wall whereby the strength thereof, due to its shape and thickness, is at least as strong as said cylindrical wall in resisting internal pressure and whereby a container of maximum strength is provided having the lightest possible weight for a given diameter, a given volume, and material of which it is constructed, and having a minimum overall length for a given volume and diameter.

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