Oct. 13, 1964 A. J. WEATHERHEAD, JR 3,152,718

CYLINDER BOSS

Filed March 8, 1962 2 Sheets-Sheet 1

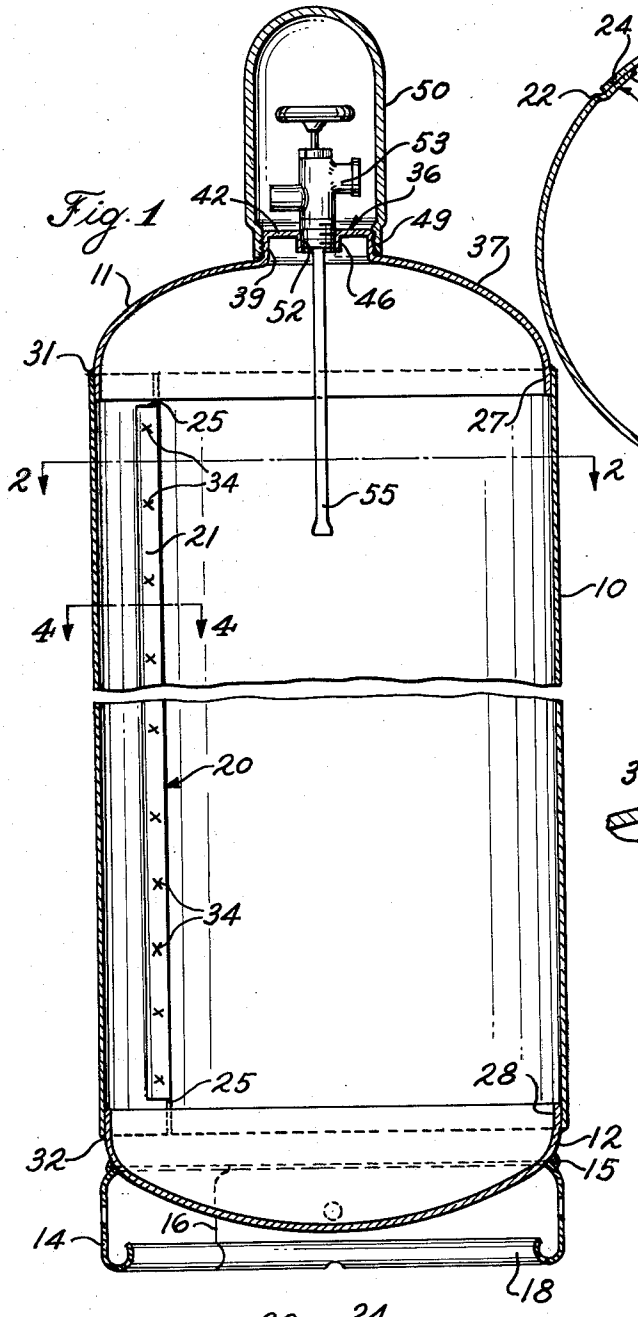


Fig. 1

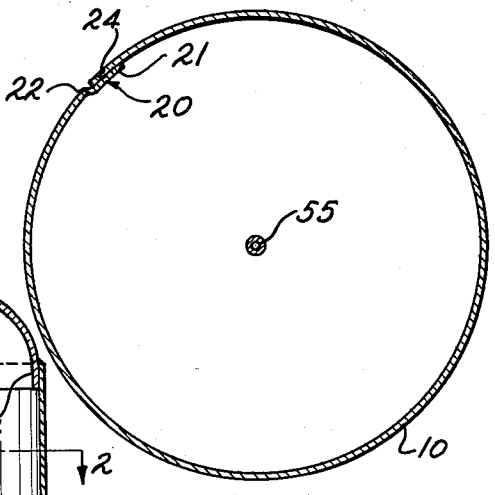


Fig. 2

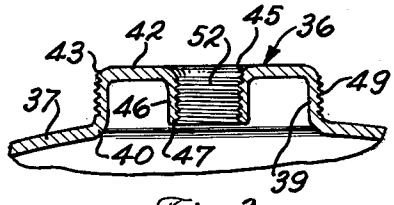


Fig. 3



Fig. 4

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CYLINDER BOSS

Filed March 8, 1962 2 Sheets-Sheet 2

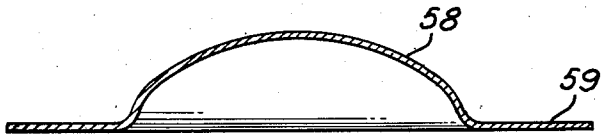


Fig. 5

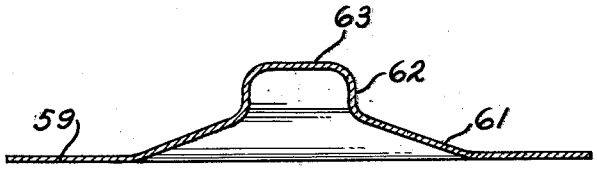


Fig. 6

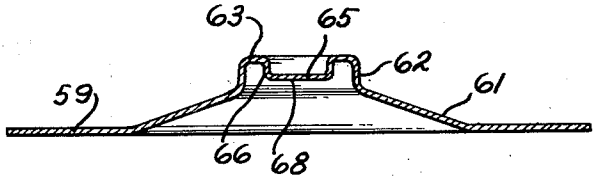


Fig. 7

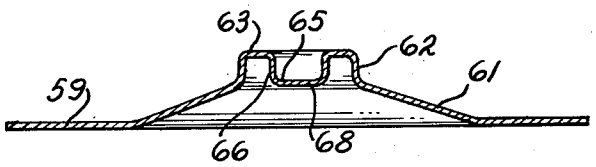


Fig. 8

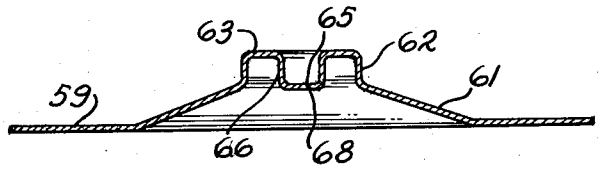


Fig. 9

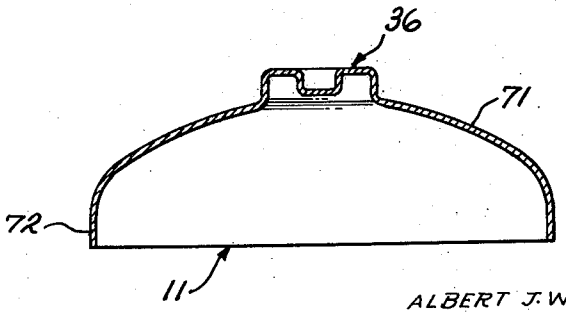


Fig. 10

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CYLINDER BOSS

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2 Claims. (Cl. 220—66)

This invention relates generally to metal containers for compressed or liquified gases and more particularly to portable cylinders made from sheet metal for storing and dispensing liquified petroleum gas.

Containers for transporting and storing compressed gases, particularly liquified petroleum gas, are generally formed as an elongated cylinder having substantially hemispherical caps on each end of the cylindrical center section. The top end cap is formed with a raised boss on its central portion which is provided with a threaded opening to receive the valve for controlling the flow of gas from the tank. In addition, this boss has a cylindrical outer wall portion which is threaded to receive a protective cap or guard which fits over the valve in order to prevent damage in transit. In addition to this, the boss generally has an annular portion which is stamped with the cylinder weight, and the manufacturer's name and serial number, which are required by ICC regulations to identify the particular cylinder and its manufacturer.

Heretofore, pressure cylinders have generally been made in two different ways. In one of these methods, the threaded end opening is hot spun integrally with the cylindrical body which is fabricated by piercing and drawing from a steel billet. With this method the cylinder boss portion can be made with extremely thick walls to give the necessary strength after the boss has been machined to provide the internal opening and interior and external threads. This method, which is generally used on extremely high pressure, thick walled heavy cylinders requires relatively complex and expensive equipment and therefore has been replaced for liquified petroleum gas cylinders by methods of fabricating the cylinder body and end caps from sheet steel. However, it has not been previously possible with drawn steel end caps to provide sufficiently thick material at the cylinder boss location to allow the cutting of the threads and the stamping of the necessary information on the boss while still maintaining the wall thickness required for strength and to comply with applicable regulations. Therefore, the end cap has generally been formed as a hemisphere having a centrally located opening about which is welded a cylinder boss assembly which is either machined from a heavier piece of metal or fabricated from a plurality of steel stampings. While this method has produced a cylinder boss having the necessary burst strength and other properties necessary to pass safety tests, it represents an undesirably complex manufacturing process to produce the separate cylinder boss structure and weld it in place on the formed end cap.

It is therefore a principal object of the present invention to provide an end cap for a relatively light weight pressurized gas cylinder in which the complete cylinder boss structure is integral with an end cap and formed from a single metal blank.

It is another object of this invention to provide a novel and improved method of making pressurized gas cylinders.

It is another object of this invention to provide a pressurized gas cylinder in which the end cap and cylinder boss are formed from a single blank of drawn steel in which the metal around a raised cylinder boss has a thickness at least as great as that of the remainder of the end wall and is provided with machined threads on its outer periphery and central aperture to receive the guard cap and valve, respectively.

It is another object of this invention to provide a one piece pressure gas cylinder end cap and cylinder boss which is at least as strong as end caps having welded cylinder boss inserts for the guard and valve receiving portions.

It is another object of this invention to provide a novel and improved seam for joining together adjacent portion of metal which provides maximum strength and freedom from leakage.

It is another object of this invention to provide a method of forming lapped joints between adjacent portion of sheet metal using a combination of resistance welding and copper brazing techniques.

It is still another object of this invention to provide a pressure cylinder for liquified petroleum gas which is simpler in construction and of lower cost in manufacture.

The foregoing and additional features and advantages of this invention will readily become apparent to those skilled in the art from the following detailed description of the preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a longitudinal cross-sectional view of a pressurized gas cylinder according to the present invention;

FIGURE 2 is a cross-sectional view through the cylindrical center section of the tank taken on line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary cross-sectional view of the cylinder boss;

FIGURE 4 is a fragmentary sectional view of the seam taken on line 4—4 of FIGURE 1; and

FIGURES 5 through 10 are cross-sectional views of the top end cap of the cylinder showing the successive drawing operations employed in forming the end cap and cylinder boss as an integral unit.

Referring now to the drawings in greater detail, and more particularly to FIGURE 1, the pressure cylinder shown therein is formed completely from sheet steel and includes a cylindrical center section **10**, a top cap **11**, and a bottom cap **12**. The bottom cap **12** is generally convex in shape and carries a foot ring **14** which is secured to the bottom cap **12** along a continuous welded joint **15**. The foot ring **14** serves as a support for the cylinder to hold it in an upright position, and is formed by bending from a strip of steel and welding the ends together along a butt joint **16**. The lower edge of foot ring **14** has an inwardly and upwardly turned rimmed portion **18** to give the necessary strength at this point.

The cylindrical center section **10** is formed by bending a sheet of steel into a cylindrical form and joining the edges together along a longitudinal seam indicated at **20**. As shown in greater detail FIGURES 2, 4 and 5, the longitudinal seam **20** is of the lapped type in which one edge has a portion **21** which is offset by the thickness of the steel sheet toward the inside of the cylinder along the line **22**. The other edge **24** therefore makes abutting contact along the offset line **22** and over-lapping contact along the offset portion **21**. At the ends of the longitudinal seam **20**, the offset portion **21** is cut away to form notched portions **25** so that the inner periphery of the cylindrical center section **10** is perfectly smooth at this point and the two edges make contact only along the offset line **22**. Top cap **11** and bottom cap **12** have cylindrical portions **27** and **28**, respectively, which fit within the cylindrical center section for a depth substantially equal to that of the notched portion **25**. The caps **11** and **12** are thus joined to the cylindrical center section **10** along continuous welds **31** and **32**, respectively, and this weld is continued down toward along the offset edge **21** for a distance equal to the depth of the notched portion **25**. Thus, the assembly of the center section **10** with the two end caps **11** and **12** produces a rigid and leak free cylinder.

A longitudinal seam **20** is preferably formed by a combination of welding and brazing techniques. Although this seam could be formed with a continuous weld from end to end along the offset line **22**, such a weld requires special holding fixtures because the localized heating of the metal would cause the formed cylindrical section to distort during welding and result in a non-cylindrical section which would prevent proper fitting of the end caps.

To overcome this problem, the longitudinal seam **20** is formed by bending the metal blank until the edge **24** overlaps the offset edge portion **21** and is in alignment with the offset line **22**, after which the blank is held in this position by clamps at each end. The seam can then be secured in a strong, rigid, but not leak free manner by a number of spaced spot welds indicated at **34** in FIGURE 1. The seam **20** is then finished and sealed by means of a brazing operation which provides a brazed joint for the full width of the longitudinal seam **20** and prevents any leakage at this point. This is done preferably by placing a thin strip or foil of copper or other suitable brazing material between the edge **24** and the offset portion **21** prior to the spot welding operation. This strip of brazing material is of the same width as the finished joint and preferably has a thickness between .002 and .006 inch. The spot welding at the points **34** is done after the foil is in place and the application of the spot welding current creates an arc through the foil which results in a localized melting and physical displacement of the copper in the area between the electrodes. Thus the thin copper or brazing metal foil is substantially removed from the spot weld area to permit a direct steel to steel weld of high strength as if the copper were not present. The spot welds rigidly secure the edges of the seam together without further clamping and the center section is then placed in a furnace at a temperature high enough to melt the brazing metal and allow it to adhere to the joint edges and secure them together in a strong and leak-free manner. Alternatively, the brazing can be accomplished after spot welding by placing a bead of brazing metal along the joint between the edge **24** and the offset line **22** so that when the center section is heated in a furnace, the brazing metal will flow into the space along the offset portion **21**.

As shown in greater detail in FIGURE 3, the top cap **11** has a centrally located boss structure **36** which is formed integrally with the top cap. Top cap **11** is generally convex in shape so that the wall portion **37** is curved to extend substantially normal to the longitudinal axis of the tank at a point adjacent the boss structure **36**. Boss structure **36** includes a cylindrical outer wall portion **39** which merges into wall portion **37** at its lower edge **40** and into a flat annular top wall portion **42** at the upper edge **43**. At its inner edge **45**, a top wall portion **42** merges into an inner cylindrical wall section **46** which extends inward into the tank where it terminates at a lower edge **47**.

The outer cylindrical wall portion **39** is formed with threads **49** which receive a protective cap **50** of the usual kind adapted to extend over and cover the tank outlet valve. The inner cylindrical wall portion **46** is likewise provided with tapered pipe threads **52** to receive the outlet valve **53** from which a dip tube **55** extends downward toward the center portion of the tank.

Since the threaded portions **49** and **52** have the threads formed directly into the wall of the top cap, the wall at these points must be at least as thick as it is over the hemispherical portion **37** to give the tank the necessary burst strength. It is well known that when a flat blank is drawn into a cup the thickness of the sheet is thinned by the stretching that takes place over the face of the punch. This stretching and thinning of the wall is particularly pronounced in the drawing of hemispherical or conical cups, and the wall is thinned to the greatest extent at the center of the punch. Thus, if the top cap **11** were drawn directly to the final shape the wall of the boss structure **36** would be considerably thinner than the outermost wall portions and would therefore be too thin to allow forming of the threads **49** and **52**.

For the above reason, applicant employs the drawing process shown in FIGURES 5 through 10 to avoid this thinning and stretching of the metal at the center of the blank. The blank is first cut to have an initial diameter approximately 25% greater than the finished diameter of the tank. This flat blank is then given a first draw to the shape indicated in FIGURE 5 having convex center section **58** and a radially extending flange **59**. The second operation shown in FIGURE 6 draws the radially outer portion of the center section **58** of FIGURE 6 inward toward the plane of radial flange **59** to give a structure having a conical wall **61** sloping upward from flange **59**, which remains unchanged, to a cylindrical wall portion **62** which terminates in a flattened top portion **63**.

During the third, fourth and fifth operations shown in FIGURES 7, 8 and 9, respectively, the radial flange **59** and the conical wall **61** remain unchanged, as does the diameter of the cylindrical wall portion **62**. In the third operation shown in FIGURE 7, the top portion is drawn inward in the center to form a shallow depression indicated at **65**. At the same time, the top wall portion **63** is pressed downward to slightly thicken the cylindrical portion **62** and provide additional material for forming the depression **65** without substantially thinning the wall at that point. The fourth and fifth operations shown in FIGURES 8 and 9 show the depression **65** pressed progressively inward so that its depth is increased while its diameter decreases. The effect of this is to transfer some of the metal from the side walls **66** of depression **65** upward into the horizontal top portion **63**. As a result of this transfer, the thickness is reduced only in the center portion **68** of the depression **65**, and the thinning at this point is of no consequence because center portion **68** is subsequently punched out to provide the necessary opening to receive the valve.

The final operations are indicated in FIGURE 10 where the radial flange **59** and conical wall **61** are drawn downward and inward to form the curved wall portion **71** and cylindrical portion **72** of the finished top cap. At the same time, the cylindrical portion **62** is reduced slightly in a sizing draw to the proper diameter before the threads are formed, and the centrally depressed portion **65** is struck from the underside to decrease the depth and thicken its side walls **66**. After this has been done, the center portion **68** of the depression **65** is punched out and the top cap is ready for the threading operations.

The threads **49** on the outer cylindrical wall **39** are preferably rolled to avoid removal of any metal at this point, while the inner threaded portion **52** has the threads cut to form a tapered pipe thread to give a leak-free seal at the valve. Since the cutting of the threads **52** decreases the wall thickness, and since the inner cylindrical portion **46** has its lower edge **47** unsupported, the effect of fluid pressure within the cylinder is such as to cause a reduction in diameter of the inner cylindrical wall portion **46** and thereby press the threads more tightly into engagement with the valve. Thus, this construction provides a pressure assisted seal at this point and any slight thinning of the wall **46** is not detrimental to the burst strength of the cylinder.

After the top cap **11** has been completely formed as described above, it is pressed into the cylindrical center section **10** and is preferably formed to have a diameter such as to make this a relatively tight press fit. Subsequently, the bottom cap **12** is pressed into the other end of the cylindrical center section **10** in a similar manner and the welding completed around the portions indicated at **31** and **32** to form a pressure tight cylinder.

While the preferred embodiment of the pressure cylinder and the preferred method of making it have been shown and described in considerable detail, it is understood that this invention is not limited to such forms and

methods, and various modifications and rearrangements as will appear to those skilled in the art may be made without departing from the scope of the invention as set forth in the following claims.

What is claimed is:

1. An end structure for a pressurized gas cylinder comprising a convex end wall and an integral raised centrally positioned cylinder boss for receiving an outlet valve and a cover, said cylinder boss including a cylindrical outer wall projecting axially outward from said end wall, said outer wall being threaded on its outer surface to receive said cover, a flattened annular top extending radially inward from the outer edge of said cylindrical outer wall, and a cylindrical inner wall extending axially inward from the radially inner edge of said top wall and threaded to receive an outlet valve, said cylinder boss and said end wall being of substantially uniform wall thickness and being drawn from an integral piece of sheet metal, said cylinder boss walls having a thickness substantially greater than the depth of the threads on the threaded portion so that the inner surfaces of the said boss walls are smooth and the threads on the threaded portions do not substantially reduce the bursting strength of the cylinder.

2. An end structure for a pressurized gas cylinder comprising a convex end wall and an integral raised centrally positioned cylinder boss for receiving an outlet valve and a cover, said cylinder boss including a cylindrical outer wall projecting axially outward from said end wall, said outer wall being threaded on its outer surface to receive said cover, a flattened annular top wall extending radially inward from the outer edge of said cylindrical outer wall, and a cylindrical inner wall extending axially inward from the radially inner edge of said top wall and threaded to receive an outlet valve, said cylindrical inner wall having an axial length less than the axial length of said cylindrical outer wall whereby the inner edge of said inner wall is axially outward of the junction of said outer wall with said convex end wall, said cylinder boss and said end wall being of substantially uniform wall thickness and being drawn from an integral piece of sheet metal, said cylinder boss walls having a thickness substantially greater than the depth of the threads on the threaded portions so that the inner surface of said boss walls are smooth and the threads on the threaded portions do not substantially reduce the bursting strength of the cylinder.

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