Feb. 26, 1963 W. F. ROSSI ETAL 3,079,038

CONTAINER

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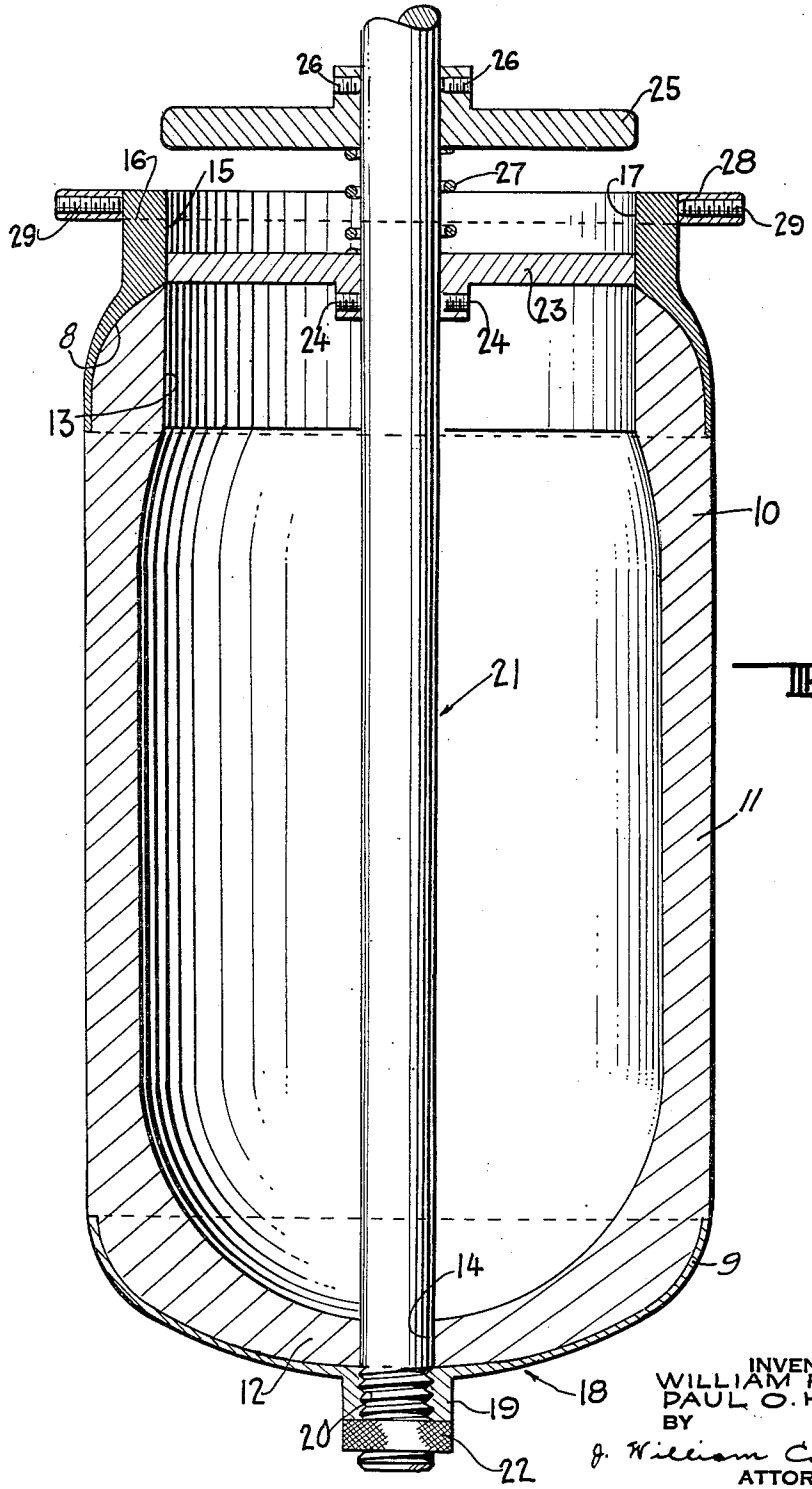


Fig. 1

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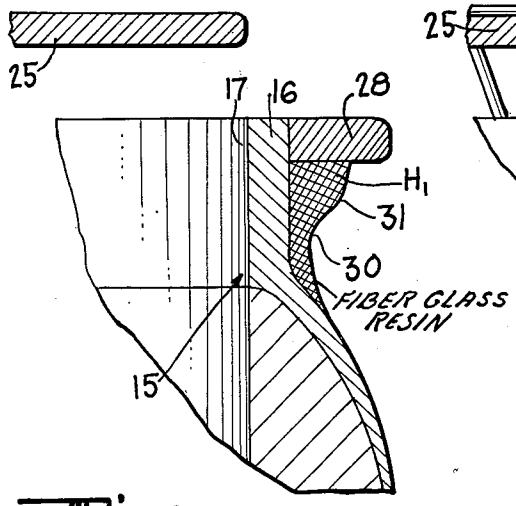


Fig. 2

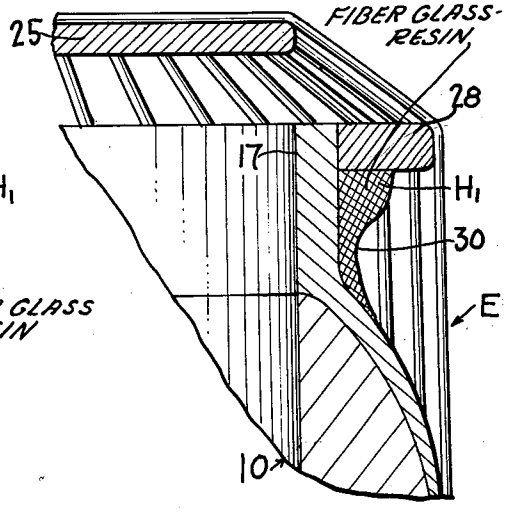


Fig. 3

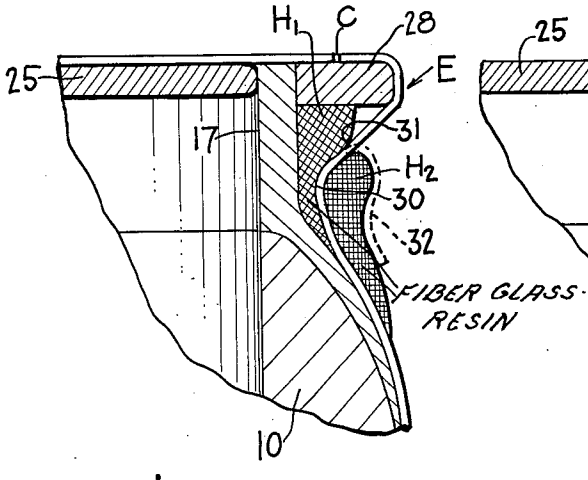


Fig. 4

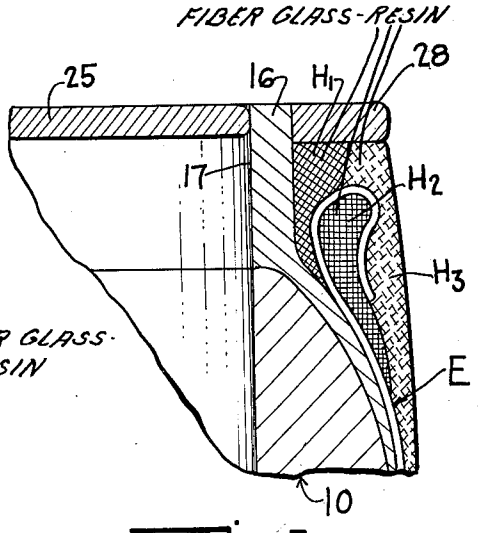


Fig. 5

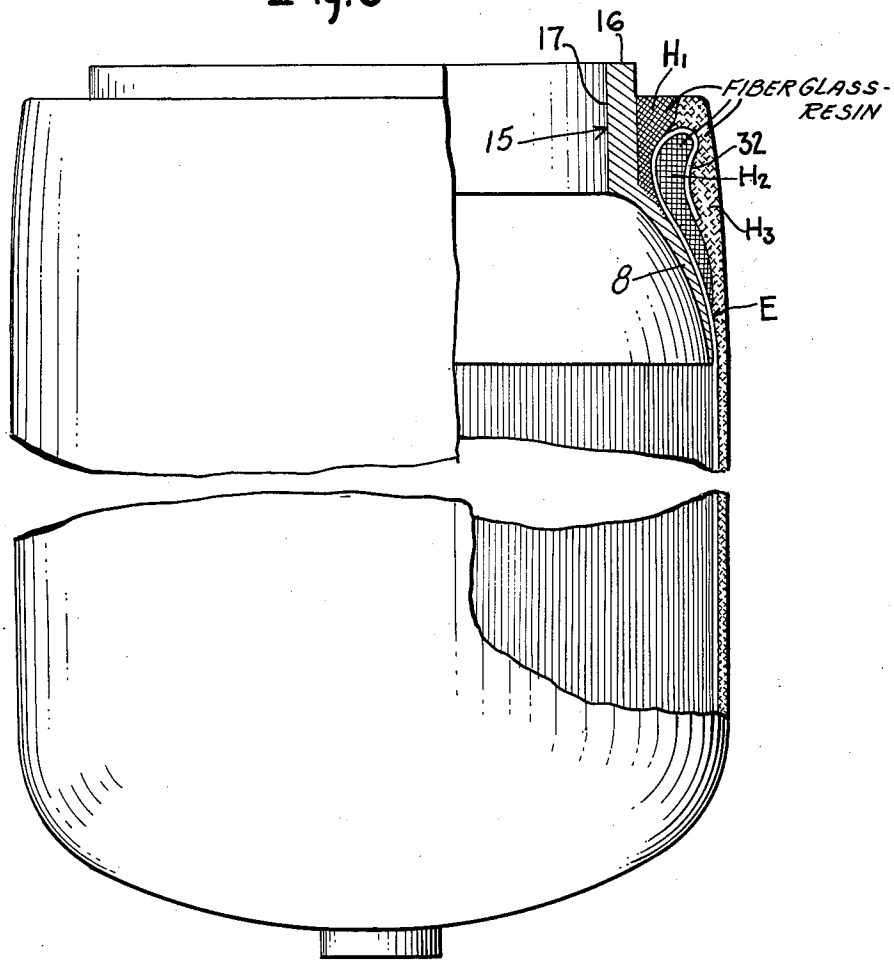
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Fig. 6



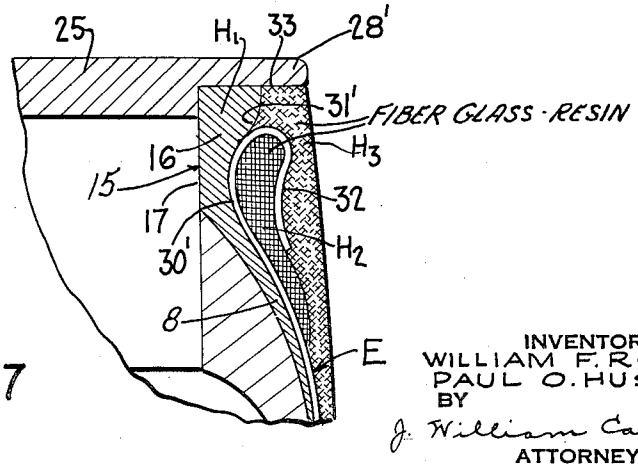


Fig. 7

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CONTAINER

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4 Claims. (Cl. 220—83)

The present invention relates to containers, and, more particularly, to general cylindrical containers formed of a plurality of windings of resin impregnated yarn.

Heretofore, attempts have been made to construct generally cylindrical containers comprising a fitting at one end of connecting a valve or pipe, a wall member or another fitting at the other end, and windings of resin impregnated yarn such as fiber glass for building up the side wall structure of the container and to secure the fitting and the wall member to the side wall structure to provide a unitary, pressure resisting container. These atempts have not been completely successful because of the difficulties in securing the fitting and wall member and providing the side wall with longitudinal tensile strength to resist the service pressure of the medium confined in the container without resorting to a wall thickness which would increase the weight of the container beyond a permissible value.

Accordingly, an object of the present invention is to provide an improved container of the foregoing type.

Another object is to provide such a container which is practically entirely composed of windings of resin impregnated yarn.

Another object is to provide such a container wherein the windings are so arranged that the container is light in weight and has the required structural strength for its intended purpose.

A further object is to provide such a container which is simple, practical and economical.

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 the drawings:

FIG. 1 is a longitudinal sectional view of a form supported on winding apparatus and having end fittings thereon over which the windings of resin impregnated yarn are applied.

FIG. 2 is an enlarged fragmentary sectional view of an end fitting having a pad winding applied thereto.

FIG. 3 is a view similar to FIG. 2 illustrating a longitudinal or end-over-end winding which is applied over the end fittings and the form.

FIG. 4 is a view similar to FIG. 3 illustrating a trap winding for securing a portion of the longitudinal winding over the pad winding.

FIG. 5 is a view similar to FIG. 4 illustrating a finishing hoop winding which is applied onto a portion of the pad winding, a folded over portion of the longitudinal winding, and the form to provide side wall structure.

FIG. 6 is a longitudinal sectional view of the finished container apart from the winding apparatus with the form removed therefrom.

FIG. 7 is a fragmentary sectional view of a container similar to that shown in FIG. 6 wherein an end fitting is contoured to simulate the pad winding.

Referring to the drawings in detail and more particularly to FIG. 1 thereof, there is shown a hollow, generally cylindrical form or mandrel **10** made of a low melting point alloy. The form has a cylindrical side wall **11**, a generally hemispherical wall **12** at its lower end formed with a small opening **14**, and has a large opening **13** at its

upper end. An end fitting **15** has a depending flange **8** which is applied to the upper end of the wall **11**, and has a cylindrical section **16** provided with an opening **17** which matches the opening **13** of the form. An end fitting **18** which is applied to the end wall **12** has an interiorly threaded outwardly extending spud **19** formed with a threaded opening **20** which matches the opening **14** of the form, and has an upwardly facing flange **9**. If desired, the spud may extend inwardly and be disposed in the opening **14** of the form. The end fittings and the form are secured to and supported for rotation with a rotable spindle or winding post **21** threaded into the spud **19** and having a nut **22** thereon and by a guide disc **23** inserted into the opening **17** of the cylindrical section **16** and secured to the spindle **21** by set-screws **24**.

The drive mechanism for the spindle and the apparatus for applying hoop windings and end-over-end winding referred to hereinafter need not be shown herein because such mechanism and apparatus may be constructed in accordance with the teachings and suggestions found in United States Patent 2,858,992, Nov. 4, 1958.

In order to carry out the present invention, the spindle **21** is equipped with a plate **25** secured thereon by set-screws **26** to position the same adjacent and spaced from the opening **17** of the cylindrical section **16**. This plate is adapted to be inserted into the opening **17** upon loosening the set-screws **26** to control the tensioning of a winding as described hereinafter. Movement of the plate **25** toward the opening may be resisted by a light spring **27** disposed between the disc **23** and the plate **25** when the set screws are loosened. Also, a flat ring **28** is placed on the cylindrical section adjacent its free end and is secured thereto by set-screws **29** which serve to confine windings on the cylindrical section as described hereinafter.

In FIG. 2, a portion of the fitting **15** is shown with a continuous hoop winding H_1, applied to the cylindrical section **16** extending from the ring **28**, to the upper portion of the flange **8** of the fitting. This winding is built up in layers to serve as a pad constituting a portion of the fitting **15** for ultimately receiving portions of end-over-end windings, as will be described hereinafter, and for this purpose the pad winding is contoured to provide an annular recess **30** adjacent the lower end and an annular bulge **31** adjacent the upper end. This winding is evenly tensioned and preferably comprises epoxy resin impregnated fiber glass yarn.

In FIG. 3, an end-over-end winding E of longitudinally extending, substantially parallel strands is shown at the commencement of the winding thereof. The strands are wound under tension over the plate **25** and sufficient layers are wound to form generally hemispherical end wall structure over the end wall **12** and the side wall of the form **10** as shown in FIG. 6. This winding preferably comprises epoxy resin impregnated fiber glass yarn.

When the end-over-end winding E has been completed, the set-screws **26** are loosened and a continuous hoop winding H_2 is applied under tension about the annular zone of the end-over-end winding E adjacent the pad winding H_1 to draw this zone into the recess **30** and tension the same as the spring **27** yields and the plate **25** is moved into the opening **17**, as shown in FIG. 4. Sufficient layers of this winding are provided to securely trap the drawn-in portion of the winding E. As shown, this trap winding increases in thickness from below the pad winding and is built up across the recess **30** to the bulge **31**. Preferably, this winding comprises epoxy resin impregnated fiber glass yarn.

After the trap winding H_2 has been completed, as shown in FIG. 4, the end-over-end winding is cut along an annular path C to provide a tubular flap or sleeve **32** of a length sufficient to enable it to be folded back over the trap windings H_2 as shown in broken lines.

In the illustrative embodiment, the flap has the desired length if the path, along which the winding E is cut, is disposed at about the midpoint between the inner and outer edges of the ring **28**. The cutaway portions of the end-over-end winding are discarded.

As shown in FIG. 5, the flap **32** is secured over the trap windings H_2 by a continuous hoop winding H_3 which fills the space between the ring **28**, the bulge **31** and the fold of the flap; covers the flap; and extends over the end-over-end winding to the end wall structure (FIG. 6). This winding preferably comprises epoxy resin impregnated yarn.

In FIG. 6, the completely wound container is shown apart from the ring **28**, the plate **25** and the winding post **21**, and with the resin cured and the form **10** melted out to provide the finished container wall structure. By using the flat ring **28** to confine the upper end of the windings H_1, and H_3, a smooth, horizontal, annular surface **33** is provided just below the free end of the cylindrical section **16**.

As shown in FIG. 7, the pad winding H_1 may be dispensed with by utilizing a fitting **15** having a cylindrical section **16** formed with a recess **30'** and a bulge **31'**. Also, the ring **28** can be dispensed with by providing the tension plate **25** with an outer section **28'** of reduced thickness which overlies the free end of the cylindrical section **16** and extends outwardly thereof when the plate proper is inserted into fitting opening **17** upon completion of the trap winding H_2. The plate section **28'** is then positioned to serve as a means for confining the upper end of the finishing wind H_3 to provide a surface **33'** which is flush with the upper edge of the cylindrical section **16**.

If desired, both ends of the container could be provided with a large opening by modifying the winding post so that a disc **23** is in driving connection with the form **10** at both ends thereof, for example at the wall of the opening **13**, and having a fitting **15**, a plate **25**, a spring **27** and a ring **28** or **28'** at both ends.

The container as illustrated in its preferred form is particularly useful as a rocket case which has a high strength for weight ratio.

From the foregoing description, it will be seen that the present invention provides an improved container wherein the upper ends of an end-over-end winding are firmly secured under tension to withstand longitudinal stresses and the last hoop winding is arranged to bind in the end-over-end winding and withstand radial stresses. In this manner, a strong generally cylindrical container is provided which is particularly suitable where a large opening is required at one or both ends thereof.

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.

We claim:

1. A generally cylindrical container comprising a fitting at its upper end having a cylindrical section provided with a central opening and an annular recess on its exterior, and having a flange depending from said cylindrical section; a second fitting at the lower end having an upwardly extending flange facing said first mentioned flange; a plurality of filaments having a lower section supported by said lower end fitting and having a longitudinally extending section of substantially parallel strands positioned by said flanges to constitute inner side wall structure of the container, said longitudinally extending strands having an upper end eye formation including an inner annular zone disposed in said recess and an outwardly and downwardly extending outer annular zone providing a space between said zones; a hoop winding filling the space between said inner and outer zones; and a hoop winding covering said longitudinally extending strands and said outer zone and constituting outer side wall structure of the container.

2. A container according to claim 1, wherein said cylindrical section is provided with an annular bulge above said recess, and said last mentioned hoop winding covers said bulge.

3. A container according to claim 2, wherein said annular recess and said annular bulge on said cylindrical section are provided by a hoop winding.

4. A container according to claim 3, wherein said hoop windings and said filaments are formed of fiber glass impregnated with resin.

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