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MEANS FOR REINFORCING HOLLOW CONTAINERS FOR GASES UNDER PRESSURE

Filed July 2, 1942

FIG. 2

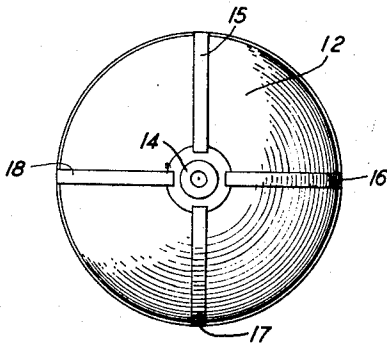


FIG. 3

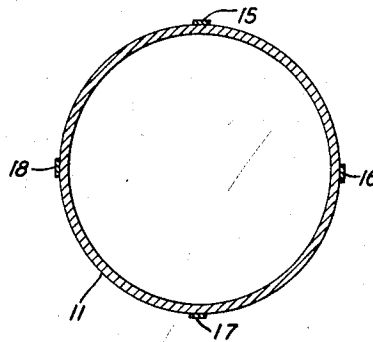


FIG. 1

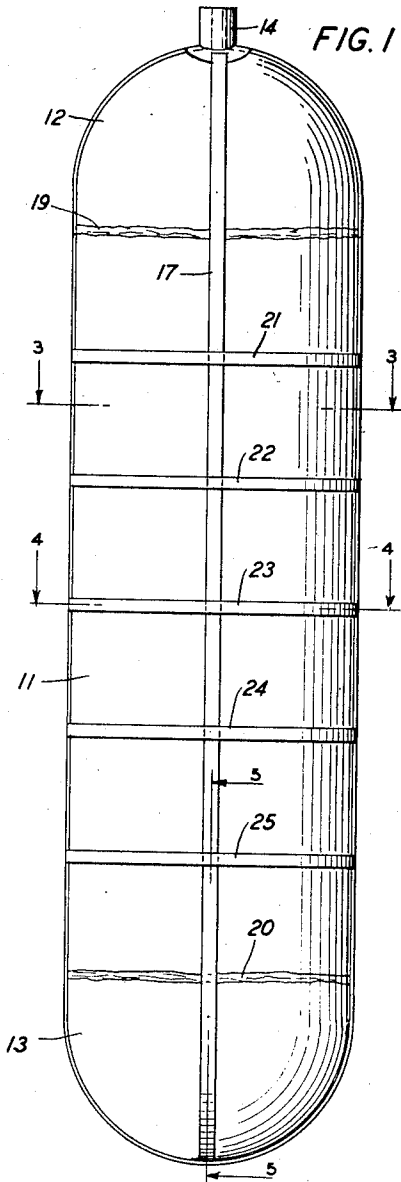


FIG. 4

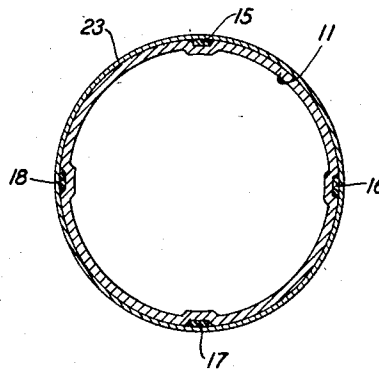


FIG. 5

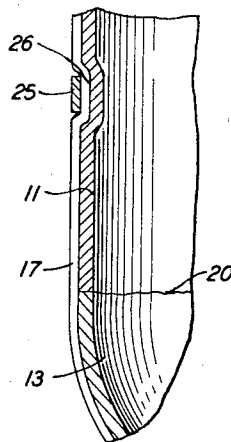
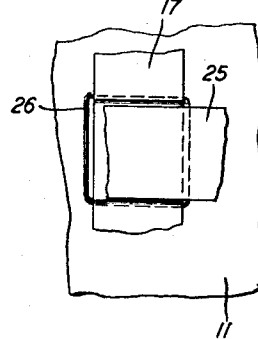


FIG. 6



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MEANS FOR REINFORCING HOLLOW CONTAINERS FOR GASES UNDER PRESSURE

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9 Claims. (Cl. 220—3)

This invention relates to the reinforcing of hollow metallic articles and more specifically to means for reinforcing hollow metallic containers for gases under high pressure.

It has been common for years to move gases, such as compressed air, oxygen, hydrogen, and nitrogen, from place to place in hollow metal containers. These gases are customarily placed at a high pressure, frequently reaching several hundred pounds per square inch, thus requiring that the walls be of one of the heavy metals and very strong. It has been found that many situations arise where it is advisable to make the containers of lighter material and still retain even more strength in the containing means for gases under pressure than that usually provided in containers for ordinary commercial use. A specific example of one such situation is the case of a light weight container which may be subjected to the fire of bullets and other projectiles, such as an oxygen tank for a warplane. A bullet piercing the side of the tank causes the metal of the container to shatter causing immediate danger to the personnel from flying particles. Various arrangements for reinforcing these tanks or containers have been suggested. One of these makes use of a plurality of circumferential steel bands contained in grooves extending completely around the container and crossed over by longitudinal bands. This does not solve the problem, however, as there is a weakness around the grooves which encourages tearing. While other reinforcing means have been tried none of them has been completely satisfactory.

It is accordingly the principal object of the present invention to provide novel means for reinforcing hollow metallic articles and particularly for reinforcing metallic containers for high pressure gases.

In accordance with the present invention, this object is attained by providing a first group of metallic bands each being in contact with the outer surface of the container and a second group of bands also in contact with the outer surface of the container over substantially all of the length of each band, the bands of the second group crossing those of the first group at an angle which is preferably a right angle. The bands of one of the groups are indented at intervals to under pass the bands of the second of the groups.

In a specific embodiment of the invention, shown by way of example to illustrate the principles of novelty thereof, there is provided a casing to enclose gases under pressure comprising a metallic cylinder having two end cups fas-

tened thereto, as by butt welding, and two groups of crossed bands for strengthening or reinforcing the casing. The bands of the first group are each indented at intervals to nest into indentations at corresponding intervals in the surface of the cylinder. The bands of the second group are placed so that they cross the bands of the first group at the indented portions thereof, the indented portions of the cylinder occurring at regular intervals so as to permit this. The bands are preferably welded, soldered or annealed together at the crossover points and to the cylinder at other points for added strength. The bands, or some of them, are also preferably welded to the ends. In a form of the invention where the "indented" bands are longitudinal and the "crossover" bands are circumferential, each longitudinal band is in contact with the casing throughout the full length of the band and each circumferential band is in contact with the casing throughout its full length except for the places where it crosses the longitudinal bands. Thus any tear which starts in the casing soon reaches a band and is halted.

In a modification, both of the groups of bands are crossed in a spiral around the cylinder and the bands of one group cross those of the other at the indented portions of the cylinder, the construction being otherwise similar to the preferred arrangement.

The hemispherical ends are also held to the cylinder in either case by welding the bands to the hemispherical ends. Of course the ends may be of other shapes without affecting the scope of the invention. The hemispherical ends may be indented or not as desired.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which:

Fig. 1 is a longitudinal view of a casing member for high pressure gases reinforced in accordance with this invention;

Fig. 2 is an end view of the casing shown in Fig. 1;

Fig. 3 is a cross-sectional view taken in a plane indicated by the line 3—3 in Fig. 1;

Fig. 4 is a cross-sectional view taken in a plane indicated by the line 4—4 in Fig. 1;

Fig. 5 is an enlarged partial cross-sectional view taken in a plane indicated by the line 5—5 in Fig. 1; and

Fig. 6 is an enlarged view, with portions broken away, of a portion of the casing and two crossed bands.

Referring more particularly to the drawing, Fig. 1 is a longitudinal view of a specific embodiment of the invention showing, by way of example, a casing member for high pressure gases reinforced in accordance with the invention. Fig. 2 is an end view of the casing while Fig. 3 is a cross-sectional view taken in a plane transverse to the longitudinal axis. The casing comprises a cylindrical member 11 of a strong metal such as 24 gauge stainless steel and two end members 12 and 13, shown, for example, as hemispherical cups, which also may be of steel. The cups 12 and 13 are attached to the member 11 by any suitable means such as by butt-welding. The seams are indicated by the reference characters 19 and 20. A plug 14 is fitted in the end 12 to permit the entrance and egress of gas under pressure.

Fastened to the cylinder 11 and the ends 12 and 13 by any suitable means, such as by welding, are longitudinal bands 15, 16, 17 and 18. While four longitudinal bands have been shown, more or less than this number may be provided, if desired. Bands 15 and 17 may comprise one continuous band passing around the end 13 or may be two bands, each attached to the end 13 as well as to the end 12 and the cylindrical portion 11.

Around the circumference of the cylinder 11 at convenient points are circumferential bands 21, 22, 23, 24 and 25. As shown in Fig. 4, which is a cross-sectional view taken in a plane transverse to the longitudinal axis of the tube through the band 23, each of the circumferential bands is ring shaped, the outer and inner surfaces intersecting the plane of the drawing in perfect circles. The inner diameter of the circumferential band 23 is substantially the same as the outer diameter of the cylinder 11.

In accordance with the present invention, the circumferential bands can keep their circular shape (or elliptical, if the cylinder 11 has an elliptical cross-section) and at the same time cross the longitudinal bands and still make contact throughout substantially their entire length because of the indentations in the cylinder 11 under each of the crossover "points" of the longitudinal and circumferential bands. One such indentation (under the "crossover" of the bands 17 and 25) is indicated by the reference character 26 in Figs. 5 and 6. Fig. 5 is an enlarged partial cross-sectional view taken through the longitudinal band 17 and the longitudinal axis of the cylinder 11 while Fig. 6 is a fragmentary view, with portions broken away, of a portion of the wall of the cylinder 11 and adjacent the crossover of the bands 17 and 25. As shown in these two figures, the indentation 26 (and the others like it) is only slightly larger than an area which has for its dimensions the width of a longitudinal band and the width of a circumferential band. The depth of the indentation 26 is substantially the same as the thickness of one of the longitudinal bands. As shown in Figs. 1 and 6, the longitudinal and circumferential bands cross each other at right angles. The longitudinal bands, at the portions thereof over the indentations in the wall of the cylinder 11 are also indented to nest into these indentations. The circumferential bands thus pass over the indentations in the longitudinal bands and still maintain their circular shape and contact the wall of the cylinder 11.

The wall of the cylinder 11 may be indented as it is being made, or later, by forging or roll-

ing or by shaping with a punch press. The longitudinal bands are indented by any suitable forming means, such as by a press, and fastened in place by spot or gas welding, for example. The circumferential bands are formed by welding together the ends or by forging or by any other suitable means and spot or gas welded or sweated around the cylinder. The circumferential and longitudinal bands are preferably spot welded to each other at all cross-overs. The casing's strength is greatly reinforced because the closed circumferential bands hold the longitudinal bands in place, snug against the surface of the cylinder.

In the arrangement of the present invention, great strength is imparted to the casing by having all bands contact its surface throughout substantially their entire lengths. No ridges, such as would be produced by one set of bands overlapping the other, are present in the present structure, thus preventing the disadvantages inherent in such a ridged arrangement, which disadvantages are effective increase in diameter of the structure caused by elevation of certain of the bands and separation of these bands from the casing with its consequent disadvantages.

In a modified arrangement, both groups of bands may spiral around the casing, one group having indentations which nest into indentations in the cylinder wall and the other group crossing the first group over these indentations. The angle of intersection may then be a right angle of any other convenient angle. In another modification, the bands may be woven over and then under other bands, in a basket weave manner, although such construction is difficult with steel bands of an appreciable thickness.

Various other modifications are possible in the embodiments described above without departing from the spirit and scope of the invention, as indicated by the appended claims.

What is claimed is:

1. In combination, a hollow metal receptacle having an indentation in the outside surface thereof, a metallic band fastened to the outside of said receptacle in such a manner that it passes over said indentation, said band being indented throughout its width in the portion thereof over said indentation, and a second metallic band fastened to the outside of said receptacle in such a manner that it crosses the indented portion of said first-mentioned band, the dimension of said indentation longitudinally of said first band being substantially equal to the transverse dimension of the second band, and the surface of the receptacle surrounding the indentation being relatively smooth.

2. In combination, a hollow metal receptacle having an indentation in the outside surface thereof, a metallic band fastened to the outside of said receptacle in such a manner that it passes over said indentation, said band being indented throughout its width in the portion thereof over said indentation, a second metallic band fastened to the outside of said receptacle in such a manner that it crosses the indented portion of said first-mentioned band, and means for fastening said first band to said second band at said crossing, the dimension of said indentation longitudinally of said first band being substantially equal to the transverse dimension of the second band, and the surface of the receptacle surrounding the indentation being relatively smooth.

3. In combination, a hollow metal receptacle

for gases at high pressure, a large portion at least of which is cylindrical, a first group of bands each fastened to the outside of said receptacle, and a second group of bands arranged to cross the bands of the first group, said receptacle having an indentation in the outside surface thereof under each of said crossings and each of the bands of the first group having an indentation throughout its width extending into the corresponding indentation in said receptacle, whereby each of said bands is in contact with the surface of said receptacle throughout substantially all its length, the dimension of each indentation longitudinally of each band in the first group being substantially equal to the transverse dimension of the band in the second group at that point, and the surface of the receptacle surrounding the indentation being relatively smooth.

4. In combination, a hollow metal receptacle for gases under high pressure, a large portion at least of which is cylindrical, a plurality of longitudinal bands each fastened to the outside of said receptacle, and a plurality of circumferential bands around said cylinder and crossing said longitudinal bands at substantially right angles, said receptacle having an indentation therein under each of said crossings and each of said longitudinal bands having an indentation at said crossing interfitted the longitudinal band in the corresponding indentation in said receptacle, whereby each of said bands is in contact with the surface of said receptacle throughout substantially all its length.

5. In combination, a hollow metal receptacle for gases under high pressure, a large portion at least of which is cylindrical, a plurality of indented bands each fastened to the outside of said receptacle, and a plurality of other bands around said cylinder and crossing said indented bands, said receptacle having an indentation therein under each of said crossings and each of said indented bands having an indentation at said crossing interfitted the longitudinal band in the corresponding indentation in said receptacle, whereby all of said bands are in contact with the surface of said receptacle throughout substantially all their length, each of the indentations in said receptacle being only slightly larger than an area equal to the width of the adjacent indented band times the width of the said other band crossing it.

6. In combination, a hollow metal receptacle for gases under high pressure, a large portion at least of which is cylindrical, a plurality of indented bands each fastened to the outside of said receptacle, and a plurality of other bands around said cylinder and crossing said indented bands, said receptacle having an indentation therein under each of said crossings and each of said indented bands having an indentation throughout its width extending into the corresponding indentation in said receptacle, whereby each of said bands is in contact with the surface of said receptacle throughout substantially all its length, each of the indentations in said receptacle being of substantially the same depth as the thickness of an indented band and the dimension of each indentation longitudinally of each of said indented bands being substantially equal to the transverse dimension of said other band at that point, and the surface of the receptacle surrounding the indentation being relatively smooth.

7. In combination, a hollow metal receptacle for gases under high pressure, a large portion at least of which is cylindrical, a plurality of indented bands each fastened to the outside of said receptacle, a plurality of other bands around said receptacle and crossing said indented bands, said receptacle having an indentation therein under each of said crossings and each of said indented bands having an indentation throughout its width extending into the corresponding indentation in said receptacle, whereby each of said bands is in contact with the surface of said receptacle throughout substantially all its length, and means for fastening each indented band to each of the other bands it crosses, the dimension of each indentation longitudinally of each of said indented bands being substantially equal to the transverse dimension of said other band at that point, and the surface of the receptacle surrounding the indentation being relatively smooth.

8. In combination, a hollow metal receptacle for gases under high pressure comprising a smooth surface cylindrical portion having a plurality of groups of aligned indentations therein, and two end portions welded to said cylindrical portion to form a gas tight container, a plurality of indented bands each of which is in contact with the surface of and is fastened to said cylindrical and end portions, each band being so positioned that it passes over a group of said indentations and is also indented so that it nests into each of the indentations in the aligned group, the indentations in each group being aligned with the indentations in the other groups, and a plurality of crossing bands around said cylindrical portion and over said indented bands at the indentations thereof, each of said crossing bands being in contact with the surface of said cylindrical portion for its entire length except for the portions thereof immediately over the indentations in said cylinder crossed by said crossing band, the dimension of each indentation longitudinally of each of said indented bands being substantially equal to the transverse dimension of the crossing band at that point, and the surface of the receptacle surrounding the indentation being relatively smooth.

9. In combination, a hollow metal receptacle for gases under high pressure, a large portion at least of which is cylindrical, a plurality of bands each fastened to the outside of said receptacle, and another band spiralled around said receptacle and crossing each of said first-mentioned bands, said receptacle having an indentation therein under each of said crossings and each of said first-mentioned bands having an indentation throughout its width at said crossing interfitted the first-mentioned band in the corresponding indentation in said receptacle, whereby each of said bands is in contact with the surface of said receptacle throughout substantially all its length, the dimension of each of said indentations longitudinally of said first-mentioned bands being substantially equal to the transverse dimension of the band spiralled around said receptacle and the surface of the receptacle surrounding the indentations therein being relatively smooth.

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