

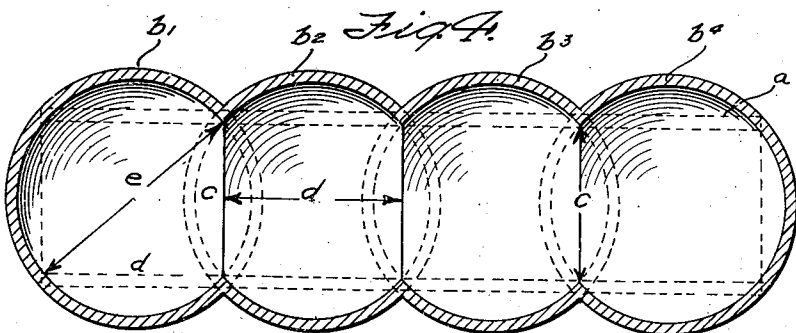
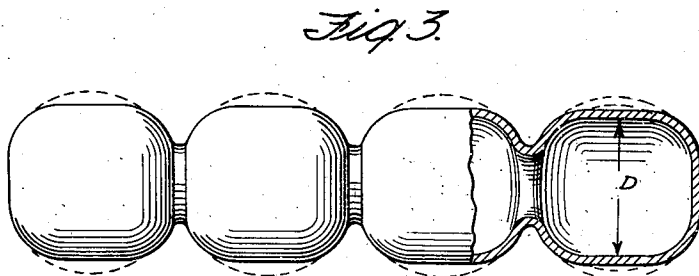
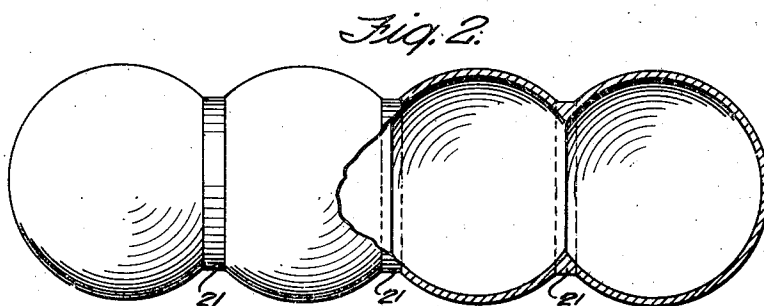
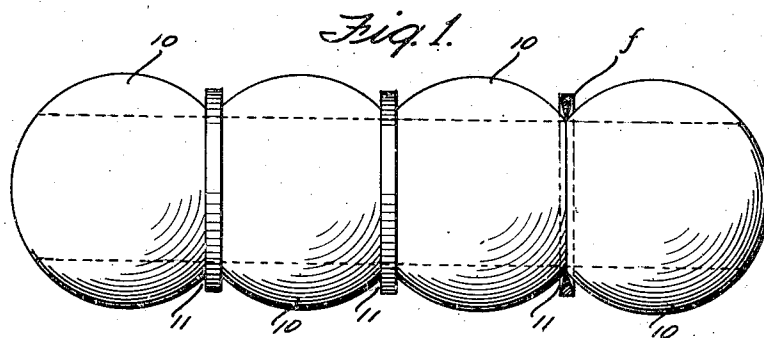
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METHOD OF MAKING CONTAINERS

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METHOD OF MAKING CONTAINERS

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15 Claims. (Cl. 29—148.2)

The present invention relates to methods of making vessels or containers such as steel flasks, steam boilers, and the like, which are adapted to withstand high pressures.

5 The present application is a division of U. S. patent application Serial Number 458,435 filed May 31, 1930 by Hermann Debor, which is directed to hollow vessels or containers for high pressures. Objects of this invention are to provide

10 manufacturing methods adapted to increase the capacity of containers or pressure vessels without increasing their weight and/or to decrease their weight without decreasing their capacity.

In accordance with this invention these objects 15 may be accomplished, in one embodiment, by subjecting a cylindrical metallic blank or shell (of suitable sheet metal) to a suitable contracting or constricting force, at properly spaced intervals, or by surrounding it with suitable tight collars or frets, at intervals, whereupon the volume of the portions intermediate the constrictions or 20 collars is enlarged by causing these portions to assume a dome-shaped or spheroidal shape, for example, by internally applying a fluid expanding medium under high pressure. This dilata- 25 tion results in an increase in capacity of the container, a reduction in the wall thickness of the spheroids, and a consequent reduction in the weight per unit of volume of the completed container.

30 Alternatively, a multi-spherical cylindrical container of increased capacity and increased resistance to internal pressures may be produced, and the use of the above-mentioned collars or 35 necks around the constricted portions may be avoided, by casting metal into a suitable mold which is patterned or shaped in such a manner that there results a concentration or excess of metallic material at the peripheral intersections 40 of the spherical zones, that is, an enlargement of the wall thickness of the container at the peripheral intersections or necks between the spherical zones. If desired, a container thus obtained may have its spheroids further expanded and/or 45 its cross-section further reduced at the points of constriction.

In the various embodiments of this invention, the relative internal dimensions of the spherical zones and of the constrictions between said zones 50 may preferably be such that the radius of the spherical zones has a numerical value which is intermediate the radius and the diameter of the constrictions.

55 The several types of containers thus obtained may be subjected to a heat treatment for the

purpose of normalizing the crystal structure of the metallic shell.

The invention may be better understood by referring to the accompanying drawing which shows various modifications thereof.

Fig. 1 shows one particular form of a high-pressure vessel;

Figure 2 shows another form of a high pressure container, partly in longitudinal section;

Figure 3 represents a third form, partly in lon- 10 gitudinal section;

Figure 4 shows a longitudinal axial section of another embodiment of a pressure vessel.

The embodiment of the invention shown in Fig. 1 comprises a cylindrical hollow metal body 10, 15 closed at its ends, which is constricted at uniform intervals 11 and whose volume is enlarged by expanding the zones between the strictures to a substantially spherical shape. Pressure-resisting reinforcing rings *f*, which may preferably have a triangular shape in cross-section, are placed circumferentially around the strictures prior or subsequent to the expanding operation, for the purpose of compensating for any excessive stresses and strains to which the strictures may be subjected when the container is in service. Preferably these rings or collars are applied in such a manner that the apex of the triangle makes contact with the outer surface of the container in the groove of the constriction. 30

Figure 2 shows a view, partly in longitudinal axial section, of a hollow vessel or container which has been made by the casting of metal into a suitably shaped mold. In this method of manufacture, the constricted portions or necks 21 are 35 reinforced by the provision of a surplus of cast metal around the circumference of the necks, in order to avoid the use of the special pressure-resisting rings shown at *f* in Fig. 1.

Figure 3 represents a view, partly in longitudinal axial section, of a hollow cylinder or container in course of fabrication in accordance with a modification of the process of manufacture shown in Fig. 1. The original inner diameter *D* of the cylindrical blank is shown by the vertical 45 distance between the solid horizontal lines as shown. At suitable intervals this diameter is reduced by compression, whereby the cylindrical blank assumes the necked or constricted shape shown in full lines. In order to increase the 50 capacity of the hollow spheroids thus formed, the zones intermediate the strictures may subsequently have their volume enlarged by outward expansion, whereupon they assume the shape shown by the dotted lines. To facilitate this en- 55

largement of the volume of the spheroids, the composite hollow body may be heated, and fluid pressure may be applied to its interior, the spheroidal portions being free to dilate under the effect of the pressure. During this operation, enlargement of the necks or strictures may be prevented, either by the increased resistance to outward enlargement imparted to them by the previous compression, or by clamping them into suitably shaped dies.

Figure 4 represents a longitudinal axial cross-section of a container which has been produced by another modification of this invention. The vessel or container shown in this figure may be formed, for example, by placing a metal cylinder, such as shown by the dotted lines *a*, in a suitable die or matrix, and by internally applying high pressure such as fluid pressure. A container thus produced comprises several spherical zones *b1*, *b2*, *b3* and *b4* the walls of which are dome-shaped in cross-section; these spherical zones or spheroids are integrally united to the adjoining zones in the planes of the constrictions. In this embodiment of the invention the diameter *c* of the constrictions (i. e. the circular planes of intersection of the spherical zones *b1* to *b4*) is substantially equal to the inner diameter of the original cylinder *a*, and also equal to the axial length *d* of a spherical zone (i. e. equal to the distance between successive planes of intersection). The diameter *e* of each zone *b1* to *b4* thus forms the hypotenuse of a right isosceles triangle having catheti or sides *c* and *d*.

To complete the several containers, the end zones may be suitably closed, as illustrated.

I claim:

1. The method of making a metallic container adapted to withstand internal pressures, said container consisting of a plurality of metallic spheroidal hollow bodies in intersecting relation, the wall thickness of said container being enlarged at the peripheral intersections, and the major axes of the planes of intersection of said bodies being considerably less than the greatest internal diameter of said bodies, whereby the surface of said spheroidal bodies tends to approximate that of a sphere, which method includes the step of casting metal into a suitable mold which is shaped in such a manner that there results a concentration of metallic material at the peripheral intersections of said hollow bodies, whereby the resistance of the peripheral intersections to the effects of internal pressure is caused to substantially approximate the resistance inherent in the spheroidal portions.

2. The method of fabricating an elongated pressure vessel which comprises pressing a metal tube into a series of interconnected and intercommunicating hollow spheroids having the centers of curvature of all elements thereof located in the main longitudinal axis of said tube.

3. The method of making a container adapted to withstand high pressure, which comprises circumferentially and radially constricting a tubular metal shell at intervals lengthwise thereof, the diameter of each constriction so formed being not substantially greater than the distance between any two successive constrictions; and expanding to spheroidal form the portions of said shell between such constrictions, thereby providing a pressure container comprising a series of interconnected and intercommunicating hollow spheroids having the centers of all points thereof located in the main longitudinal axis of said container.

4. The method of making a container adapted to withstand high pressure, which comprises circumferentially and radially constricting a tubular metal shell at intervals lengthwise thereof, the diameter of each constriction so formed being not substantially greater than the distance between any two successive constrictions; and applying fluid pressure internally to such shell to expand the portions of said shell between said constrictions to the form of spheroids having their centers located in the main longitudinal axis of said shell, thereby providing a pressure container comprising a series of interconnected and intercommunicating hollow spheroids.

5. The method of making a container adapted to withstand high pressure, which comprises circumferentially and radially constricting a tubular metal shell at intervals lengthwise thereof, the diameter of each constriction so formed being not substantially greater than the distance between any two successive constrictions; reinforcing the walls of the shell at the constricted zones; and expanding to spheroidal form the portions of said shell between such constrictions, thereby providing a pressure container comprising a series of interconnected and intercommunicating hollow spheroids having their centers located in the main longitudinal axis of said container.

6. A method of making a container adapted to withstand high internal pressure, which comprises forming a series of interconnected hollow spheroidal zones of metal along a common axis while disposing the center of curvature of every element of each zone in said axis.

7. A method of making a container adapted to withstand high internal pressure, which comprises forming a series of hollow spheroidal zones along a common axis, integrally uniting successive zones by constrictions having a diameter larger than the radius of said zones, and disposing the centers of said constrictions and the center of curvature of every element of each zone in said common axis.

8. A method of making a container as claimed in claim 7, including the step of reinforcing said constrictions.

9. A method of making a container adapted to withstand high internal pressure, which comprises radially and circumferentially constricting an elongated hollow metal shell at intervals lengthwise thereof, and expanding the portions of said shell between such constrictions to form hollow spheroidal zones having the centers of curvature of all elements thereof located in the main longitudinal axis of said shell.

10. A method of making a container as claimed in claim 9, and providing hollow spheroidal portions to close the opposite ends of said shell.

11. A method of making a container as claimed in claim 9, including the step of circumferentially reinforcing said constrictions.

12. A method of making a container as claimed in claim 9, in which the internal diameter of each constriction is greater than the distance between the planes of any two successive constrictions.

13. A method of making a container as claimed in claim 9, in which the container is subjected to heat treatment subsequent to the forming operation, for the purpose of normalizing its crystalline structure.

14. A method of making a container adapted to withstand high internal pressure, which comprises radially and circumferentially constricting a hollow substantially cylindrical metal shell at intervals lengthwise thereof while expanding

portions of said shell between such constrictions to form hollow spheroidal zones having the centers of curvature of all elements thereof located in the main longitudinal axis of said shell.

- 5 15. A method of making a container adapted to withstand high internal pressure, which comprises disposing constricting and reinforcing metal rings circumferentially about and at

spaced intervals along a hollow substantially cylindrical metal shell, and expanding the portions of said shell between said rings until such portions form hollow spheroidal zones having the centers of curvature of all elements thereof located in the main longitudinal axis of said shell. 5

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