Aug. 23, 1938. B. BART 2,127,712

HIGH PRESSURE TANK

Filed Dec. 5, 1934

Fig. 1.

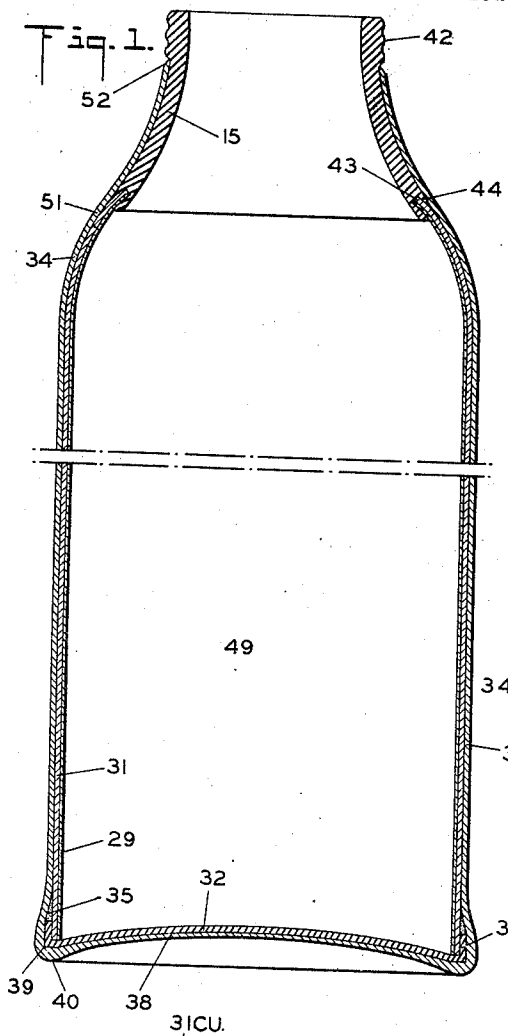


Fig. 2.

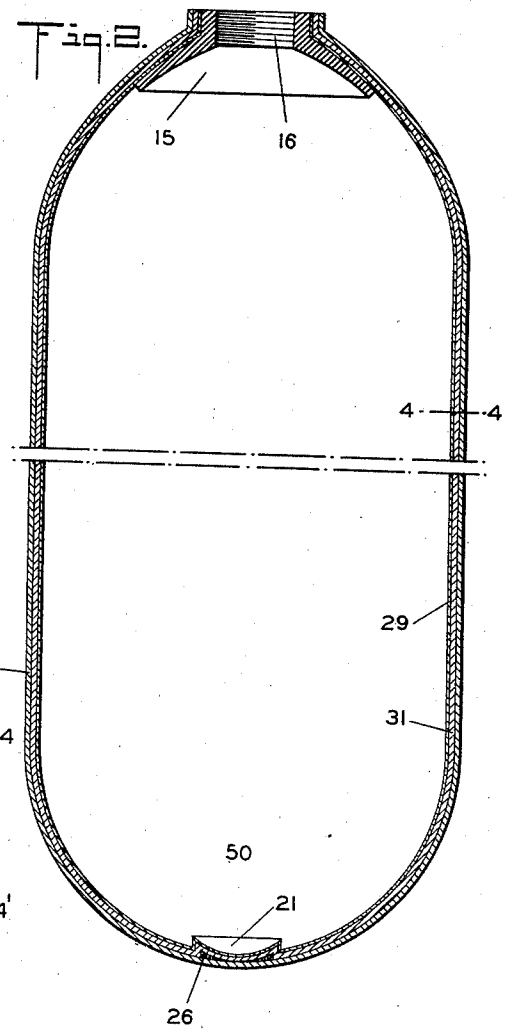


Fig. 3.

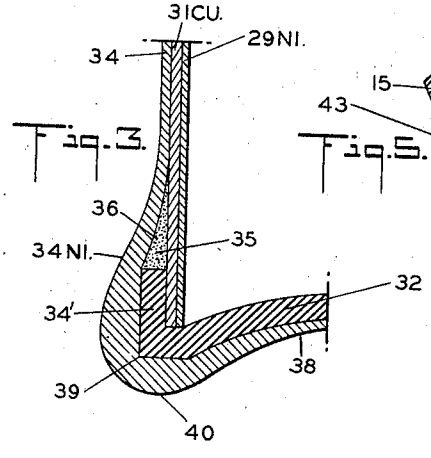


Fig. 5.

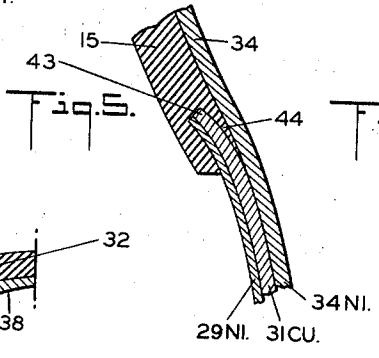
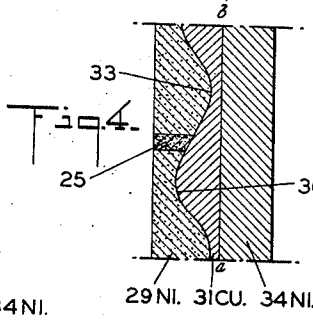


Fig. 4.



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HIGH PRESSURE TANK

Blasius Bart, East Orange, N. J.

Application December 5, 1934, Serial No. 756,041

2 Claims. (Cl. 220—3)

The invention relates in general to hollow seamless articles formed of a shell of laminated, electrolytically deposited layers of different metals, and the invention specifically relates to tanks of high tensile strength designed to withstand high pressures.

The present disclosure constitutes in part a continuation of my three copending applications filed February 2, 1931, being Serial No. 512,990 entitled "Method of forming high pressure tanks", Serial No. 512,991 entitled "Electrolytically formed tank", and Serial No. 512,992 entitled "Seamless tank".

In the manufacture of receptacles, tanks, containers and the like designed to withstand high internal or external pressures on the walls thereof, it has been necessary heretofore to make the walls with an amount of material necessary to give the requisite tensile strength and rigidity to maintain the configuration of the article under the distorting strains to which they are intended to be subjected. This necessity for structural strength has required the use of a large amount of metal in forming the walls and this in turn has made them heavy in weight and, of course, expensive to manufacture.

The primary object of this invention is to provide a high pressure tank or other hollow structure having a high degree of tensile strength and which at the same time will be light in weight and which can be manufactured economically both in labor cost and in the amount of material used.

The invention features primarily the formation on a suitable mold or pattern of alternate layers of a shell comprising electrolytically deposited metals formed and assembled to give to the resulting shell a tensile strength greater than would be obtained by following conventional methods.

Heretofore in forming hollow articles by electrolytic deposition on molds and patterns, it has been a usual practice to form the first deposit or layer on a mold covered with some form of deposit receiving material such as graphite, or to form this initial deposit on a metal mold of some readily fusible or meltable material. Such surfaces are rough, or perhaps more accurately defined, are porous or coarse grained and react on the deposited layer to give to it a rough texture necessitating the formation of a layer of material thickness in order to give the requisite strength required of the shell forming the completed article. Continuing the deposition following known practices, there results a development of positive granulation in the succeeding layers with resulting lack of cohesion between the particles and a resulting weakness in tensile strength. The present invention features in the methods described in the above identified parent applications the formation of the electrolytic depositions on surfaces which are smooth, even high polished, which are homogeneous, nonporous and otherwise capable of forming in the finished product therein claimed fine grained, adhesive layers of high tensile strength in distinction from the layers of low tensile strength formed heretofore when the same metals have been deposited on the usual metal mold and other surfaces.

Another object of the invention is to provide a neat appearing tank designed to contain fire extinguishing and other chemical fluids under high pressure; which will be resistant to any chemical reactions with such fluids, which will be light in weight and which will possess certain economical factors in design and construction contributing to low manufacturing costs.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawing and in part will be more fully set forth in the following particular description of one form of tank embodying the invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the accompanying drawing:

Fig. 1 is a view in axial cross section of a tank illustrating a preferred embodiment of the invention with parts broken away to reduce the length of the tank, but it is to be understood that the layers are shown in enlarged cross sectional dimensions, with the upper part of this figure taken from application Serial No. 512,992 and the lower part taken from Serial No. 512,991;

Figure 2 is a view similar to Fig. 1 showing a modified form of the invention and taken from application Serial No. 512,990;

Figure 3 is a fragmentary view in vertical section enlarged from the similar showing in Fig. 1 with the parts greatly enlarged and not necessarily in proper proportion and taken from Fig. 6 of Serial No. 512,991;

Fig. 4 is an enlarged cross sectional view taken on the line 4—4 of Fig. 2, greatly enlarged to show the relation in an exaggerated form of the deposited layers and taken from Fig. 3 of Serial No. 512,990; and

Fig. 5 is a detailed enlarged showing in axial

vertical section of the joint between the collar and shell shown at the upper right side of Fig. 1.

The tank herein disclosed comprises primarily a preformed threaded brass collar 15 which forms part of the finished tank or the fire extinguishing device herein featured and which tank as a whole is formed almost entirely of a multiple layer shell 49 of two electrolytically deposited metals. The shell may have the integrally formed rounded or semi-spherical bottom 50 shown in Fig. 2, or may be formed in part of a preformed bottom member 32 as shown in Fig. 1.

The shell 49 is formed in the illustrated instance of three layers of electrolytically deposited metals, an inner layer 29 of nickel, an intermediate layer 31 of copper, and an outer layer 34 of nickel. The collar 15, either with or without the bottom member 32, is assembled on a suitable mold of the type which can be either removed bodily from the interior of the completed or partly completed shell, or which can be dissolved out of the shell, as is more fully described in the above identified parent applications.

The mold is positioned in an electrolytic bath containing nickel and the layer 29 of nickel is formed thereon. In the practicing of this method, certain refinements are observed in that preferably the temperature is maintained between 110° F. and 140° F. It has been found that where the temperature was materially below 110° F., the deposit tended to become brittle, and at temperatures materially greater than 140° F., the resulting layer tended to lack the requisite tensile strength.

This deposition of nickel is continued until there is a layer formed of about fifteen thousandths of an inch and this is best attained with a current density of about twenty-five to thirty amperes per square foot. While the nickel layer thus formed is characterized by a much smoother outer face than would be the case if it were formed on the relatively rough mold surfaces heretofore known in this art, it is still true that the outer surface is not strictly smooth and under the microscope would show irregularities, indentations, ridges and the like, shown in an exaggerated form by the line 30 in Fig. 4. Any recesses or joints in or between the parts of the nickel layer 29 are filled with a tin solder 25, or 26.

For the purpose of filling up any imperfections, pores and other minute recesses exposed in the nickel layer, the assemblage is then inserted in an electrolytic tank containing copper and the copper layer 31 is deposited thereon. In general, the outer surface of the copper layer will conform at the termination of this step at least substantially to the configuration of the outer face 30 of the nickel layer. This electric deposition of copper takes place under substantially the same conditions as are indicated above in the deposition of nickel except that the current strength is usually somewhat higher being about 30 to 40 amperes per square foot.

The assemblage is then removed from the copper bath and the copper surface is ground down to provide a smoother surface indicated by the line *a—b* in Fig. 4. Preferably the grinding is continued substantially until the high points 33 of the nickel begin to show or are about to show. This outer surface of the copper is polished to provide a smooth, continuous, homogeneous and non-porous surface.

The assemblage with its polished exposed copper surface is again positioned in the electrolytic tank containing nickel, and the third layer 34 is formed on the smooth polished outer face of the copper layer 31. It is noted from the construction shown in Fig. 4 that there is formed in effect two relatively thick layers 29 and 34 of nickel and a thin filling layer 31 of copper positioned between the two nickel layers. There is therefore formed in effect the shell 49 composed largely and primarily of alternate layers of electrolytically deposited nickel with just enough copper in an intermediate layer to cover imperfections and close up pores which may be formed in the inner nickel deposition. In the final analysis, there is formed practically a nickel shell formed of extremely thin laminations of the order of about twenty-five thousandths of an inch, with the laminations separated by even a thinner film of copper electrolytically deposited and which copper is used primarily for the purpose of providing smooth deposit receiving surfaces for the succeeding nickel layer rather than to add structural strength to the nickel.

For ordinary purposes, the tank with two layers of nickel and an intermediate layer of copper is sufficient to give the requisite rigidity to tanks designed to withstand pressures of 700 to 1000 pounds, but it is obviously within the scope of the disclosure to position a succeeding layer of copper on the nickel layer 34 to grind down this next copper layer as suggested for the layer 31 and to then deposit a succeeding layer of nickel on the copper layer, and to continue this alternate deposition of copper and nickel until any desired or requisite thickness of shell has been obtained.

In the form of the disclosure shown in Fig. 1 the two inner layers 29 and 31 are intruded into a recess or groove 43 formed at the lower edge of the collar 15 and which groove is formed on its outer side by a bendable lip 44. The shell 49 is cylindrical for the major portion of its length and in the form shown in Fig. 1 the layer 34 rounds at its upper end into a smooth double curve 51 and into encircling engagement with the collar 15. The upper edge of the layer 34 terminates in a bevel 52 merging into the outer surface of the collar 15 just below its threads 42. In both cases the external effect is that of a single homogeneous layer of metal, specifically nickel, which extends without external evidences of joints from adjacent the upper end of the collar about the entire surface of the article. The collar 15 is of brass and is made sufficiently rugged to provide both the external threads 42 of Fig. 1, or the internal threads 16 in Fig. 2, used to secure a cover, as in the case of fire extinguishers, or to provide a mounting for a pump and have sufficient structural strength to co-operate with the electrolytically formed parts to resist distortion of the article as a whole. The seat 21 and the internal threads 16 in the form shown in Fig. 2 may be utilized to mount a pump or other conduit in position in the tank.

Certain chemicals have a tendency to attack rough or relatively rough surfaces but are not so liable to attack the same surface provided it is highly polished. As the mold surface on which the layer 29 was formed can be given any degree of polish, the resulting lining 29 will possess the same high degree of polish on its inner surface.

In some of the tanks the rounded bottom illustrated in Fig. 2 is not desirable and in such cases it is suggested that a bottom of a flat or rather concave type be used. Accordingly in Fig. 1 there is disclosed the heavy separate bottom forming

member 32 for closing the open bottom of the shell 49. This member is in the form of a flat disc having an upwardly curved concaved portion outlined by an upstanding flange 34[1] designed to have a snug fit on the open bottom of the two inner layers 29 and 31 of the shell. The shoulder or annular reentrant angle formed between the top of the flange 34[1] and the adjacent side of the outer layer 34 is filled with solder 35 and this filler is ground to provide a smooth curve 36, joining the side of the flange with the outer side of the copper layer 31, thus eliminating any breaks in the surface. The bottom member 32 as illustrated is a plate copper stamping, but it is obviously within the scope of the disclosure to make the member 32 either as a stamping, a pressing or a casting and it may be formed of nickel or a coating of nickel with its inner face polished to meet those situations where it is desired that the entire inner surface of the tank be outlined by a polished nickel surface.

The nickel layer 34 will not be of uniform thickness at all its parts. The depositions will be less dense, that is, of reduced thickness, on the concaved surfaces than on the straight or slightly curved portions. The mid portion 38 of the part which extends across the concaved portion of the bottom member 32 will be relatively thin so that dependence has to be made primarily on the rugged member 32 itself to provide the requisite tensile strength to the bottom portion of the completed article. On the contrary it has been found that the density of the deposition, that is the thickness of the deposited layer, will be increased and of greater thickness as it passes around and about the outer edge 39 of the member 32 than it is on the side of the shell. Massing the deposit about the bottom of the flange 34[1] has the effect of providing a rather rugged ring 40 which provides structural strength at the bottom of the tank. In this way there is compensated any weakening effect in the tank at the point of junction between the shell and the bottom member. The entire exposed surface of the tank has a beautiful silver appearance of electrolytically deposited nickel and the surface is continuous without there being visible from the outer side any joints or breaks in the continuity of the surface.

Pressure tanks as thus formed are capable of withstanding high pressures and in the illustrated instance a tank weighing seven and one-half pounds and having a capacity of twelve quarts was subjected to an internal pressure of one thousand pounds, without becoming distorted or leaky. The tank thus formed under test showed greater tensile strength than was the case where the article was formed on a fusible metal form following conventional practices and where no particular care was taken to polish the surface of the mold or to polish the surface of the copper deposits as they were formed on the nickel layers. While the invention has been described, particularly with reference to the combination of nickel and copper, these metals have been selected primarily due to the high tensile strength of nickel and to the ease with which the copper could be used as a filler and due to the ease with which it could be highly polished, but it is obvious that other equivalent metals might be utilized and as one illustration, it is suggested that cobalt and cadmium be substituted for the nickel and copper. Sheet aluminum has been selected as the material from which the mold was formed due to the ease with which it could be subsequently dissolved without affecting the electrolytically deposited metals and due to the fact that it could be easily provided with a high lustre or polish. It is obvious, however, that other homogeneous, fine grained and non-porous metals might be used, as one illustration it is suggested that zinc may be substituted for the aluminum mold or frame on which the inner polished surface of layer 29 is formed.

I claim:

1. A tank comprising a preformed collar having a groove in its external periphery adjacent its lower end, and a multiple layer shell of metal, with an inner layer having its upper edge inset in said groove, and an outer layer projecting above the groove and enclosing the lower portion of the collar, said collar being funnel shaped with its wider end intruded into the shell, and said outer layer of the shell rounding from the upper portion of the collar downwardly and outwardly with a smooth reverse curve into the body portion of the shell.

2. A tank comprising a preformed collar having a groove in its external periphery adjacent its lower end, and a multiple layer shell of metal, with an inner layer having its upper edge inset in said groove, and an outer layer projecting above the groove and enclosing the lower portion of the collar.

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