Oct. 15, 1957 E. R. CORNEIL 2,809,749

SODIUM CONTAINER

Filed June 30, 1955

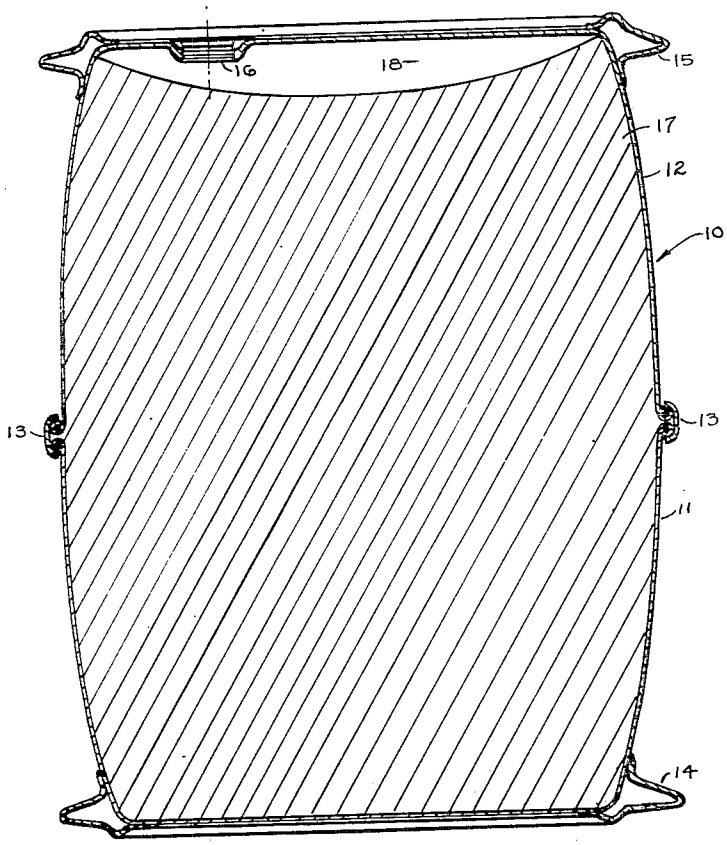


FIG. 1

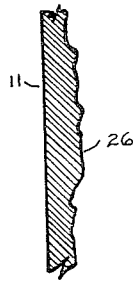


FIG. 4

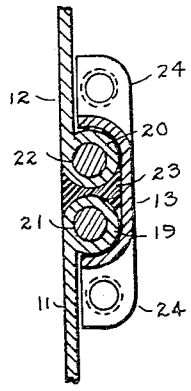


FIG. 2

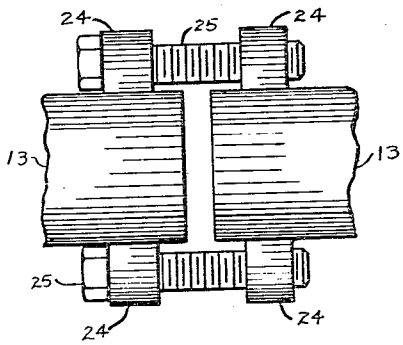


FIG. 3

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United States Patent Office 2,809,749 Patented Oct. 15, 1957

2,809,749

SODIUM CONTAINER

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Application June 30, 1955, Serial No. 519,089

3 Claims. (Cl. 206—84)

This application relates to a container for storing and shipping metallic sodium and is a continuation-in-part of my copending application Serial Number 311,939, filed September 27, 1952, and issued as U. S. Patent 2,712,384 on July 5, 1955.

Unlike most metals of commerce sodium is extremely reactive towards the oxygen of the atmosphere. When this element is stored or shipped, it must, therefore, be kept from contact with air. Closed containers are usually adopted to minimize the undesired contact. Since it melts at around 97.5° C., sodium may readily be melted and transferred to the container in the liquid state. Facilities are generally available at the packaging shop or warehouse to handle molten sodium. Similar facilities frequently do not exist at the point of use of the material. In addition, experience indicates that the melting process is slow although the proper equipment is at hand. A container from which metallic sodium can easily be removed in the solid state is, therefore, greatly desired.

A general object of the present invention is, consequently, provision of improvements in the packaging of sodium.

A further object is provision of a sodium package from which the metal can be easily removed in the solid state.

The above-mentioned and yet other objects are achieved in accordance with this invention by placing liquid sodium in a specially prepared drum which can be opened at its center, sealing the drum and allowing the liquid to freeze. The shrinkage of the sodium upon freezing creates a small region in the closed drum above the sodium free both of air and of metal. The sodium is thus in effect "vacuum-packed" and sealed off from contact with the atmosphere.

Details of preferred embodiments of the invention will be evident from the drawings, in which:

Figure 1 is a longitudinal section of a sealed drum containing "vacuum-packed" sodium;

Figure 2 is an enlargement of part of Figure 1 at the mid-section of the drum to show the method of joining the two halves thereof;

Figure 3 is a plan view showing a preferred method of closing the resilient metallic belt holding the halves of the drum together; and

Figure 4 is an enlargement of part of the section of Figure 1 showing the rough nature of the interior surface of the drum in one embodiment thereof.

In Figure 1 is seen a drum **10** formed of two substantially identical sections **11** and **12** held together, when assembled, by steel belt or band **13**. Each of the identical sections is provided with a hoop, **14** or **15**, as the case may be, to facilitate rolling the barrel in transit. Each section is preferably provided with a bung **16** although only one is shown. Within drum **10** is a body of solid sodium **17** which has shrunk in cooling to leave a vacuum space **18** at the top of the drum.

As noted above, the drum is preferably formed of two identical halves. Each half should be tapered from an open end to a flat closed bottom containing a bung and,

if desired, a vent for use while the barrel is being filled. The taper facilitates easy removal of solid sodium from the barrel halves. A preferred form for each half is frusto-conical although other tapered forms may be used as well. The bung can, of course, be omitted altogether from one of the halves. Other minor differences between the sections can be tolerated as long as the two possess the same diameter at the respective open ends. If, however, the two sections are identical, there is complete interchangeability of parts and assembly of the complete drum is very simple.

The method of closing the assembled drum at its mid-section is best seen in Figure 2. Sections **11** and **12** terminate in chimes **19** and **20** respectively. Within the chimes are preferably positioned steel strengthening rings **21** and **22** although these can be omitted. The chimes of the two sections are seated in the symmetrical gasket **23** which extends completely around the barrel at its greatest diameter. Preferably the gasket possesses the cross-section of the letter H and may, therefore, be referred to as an H-gasket. The gasket should be resilient in nature and may be formed from rubber or other resilient material substantially nonreactive to metallic sodium.

Snugly fitting around the outside of the chimes as shown in Figures 1 and 2 is steel belt **13**. This belt should be just large enough to extend completely around the barrel and strong enough to effect closure under the most severe conditions of shock to which the barrel may be subjected. The cross-section of the belt should be that of a symmetrical capital C for ease in encompassing the chimes. The belt should also possess some resiliency enabling it to be easily positioned lengthwise around the barrel and in breadth, i. e., across the C-section, around the chimes. A preferred material of construction for the belt is steel although other materials having the necessary strength and resiliency can also be used.

A preferred method of joining the two ends of the belt is shown in Figure 3. Projecting lugs **24** are welded or otherwise united with the belt at the ends. These have holes through which bolts **25** can be inserted and tightened as desired or necessary. It will be noted that disposition of the bolts on the ends of the C of the cross-section permits the belt to be tightened both in length and in width around the chimes.

The method of assembling the barrel is evident from the description given. Upon the chime of one of the identical sections is first placed the H-gasket. The chime of the section is then placed in the unoccupied side of the gasket. The belt is then slipped around the chimes and the ends of the belt joined.

The method of filling the assembled barrel with sodium will also be evident from the description above. The barrel is stood on end and one of the bungs is opened. The barrel is then flushed with nitrogen, helium, argon or other inert gas and liquid sodium run thereinto. When the barrel is full and while the sodium is still liquid, the open bung is closed. As the sodium cools it shrinks and creates the vacuum at the top of the barrel. The pressure of the air forces the top section of the barrel further into the gasket and contributes to the closure at the mid-section. It may, in fact, be necessary to tighten the bolts at the belt for a second time after the sodium has cooled. The sodium is, however, vacuum-packed and free from contact with oxygen, carbon dioxide, water vapor or other reactive gases.

In addition to its reactivity towards the atmosphere and its low melting point, sodium possesses another property of great importance with respect to its packaging. This property is its tendency to wet and adhere to or even to react with the majority of materials of construction it

contacts. Parent application 311,939 discusses the adherence of sodium to other materials at length and the disclosure of that application is accordingly incorporated by reference herein.

The adherence of sodium to other materials, of course, raises a major problem with respect to the container of the present invention. If the barrel is of a common material such as steel or aluminum and prepared in the normal manner the sodium could not directly be pulled therefrom. It thus would be impossible to open the barrel at its center and remove the sodium as a solid. Some treatment of the inner surface of the barrel is, therefore, essential.

The treatment of the parent application can be used if it is so desired. That is, the container can be lined with solid polyethylene, a substance towards which sodium is essentially passive. Insertion of the polyethylene lining, however, introduces a large quantity of a third material into the container and additional complications into filling the same and is, for that reason, not preferred.

It has now been found that some metallic surfaces to which sodium normally adheres can be made nonadherent in another manner. This alternative, and preferred, treatment consists basically of rendering the surface very rough by forming many small or microscopic pores therein. Sodium does not adhere to such a surface even when frozen in contact therewith. This result is quite surprising since smooth surfaces are frequently roughened to increase the adherence of various materials, paints especially. The pores can be filled with oil, if it is so desired. The oil, however, is unnecessary and is actually less preferred since it also introduces an additional step into the process and may soil or contaminate the sodium.

Surfaces suitably roughened to avoid adherence to sodium can be prepared in a variety of ways. One way is by phosphatizing the base metal by any of the methods shown, for example, in U. S. Patent 2,515,934. Thus thin phosphatized layers containing many microscopic pores can be formed on such metals as steel, zinc and cast iron by dipping the metal in or spraying it with a hot aqueous solution containing phosphoric acid.

Aluminum cannot readily be phosphatized. It is found, however, that anodizing this metal by conventional methods produces a surface nonadherent to sodium. The anodization of aluminum can readily be accomplished by passing an electric current from a cathode to the aluminum article or anode through an aqueous solution of sulfuric, chromic, oxalic, boric or like acids.

Figure 4 illustrates an enlargement of a metallic surface **26** nonadherent to sodium. In its preferred embodiment the barrel should possess such a surface, the metal of the wall being roughened to contain many microscopic pores. In this manner iron, steel and aluminum can readily be adapted for use with sodium.

Various advantages of my invention will be evident from the specification. Generally these advantages parallel the objects but some may be specifically mentioned. Thus forming the container in two identical halves facilitates manufacture and assembly thereof. Furthermore, the use of curved surfaces in the halves is a source of strength not interfering with the easy removal of the sodium in the solid state. Use of the center opening permits this easy removal. The necessity of corrugations or rolled hoops, clearly undesirable with malleable sodium, is concomitantly eliminated by these curved surfaces. In addition, an unlined container has been provided which does not adhere to sodium.

It will be appreciated that various minor changes can be made in the container described without departing from the spirit of the invention. Thus the configuration of the halves of the container can be altered within wide limits as long as nothing interfering with the free removal of the sodium is introduced. Consequently I propose to be bound solely by the appended claims.

Having described my invention, I claim:

1. An article of manufacture comprising a ferrous metal container, a phosphatized surface integral with the inner wall of said container, and metallic sodium disposed within the container, the phosphatized surface preventing the adhesion of the sodium to the ferrous metal.

2. The invention of claim 1 in which the container is formed of steel.

3. The invention of claim 1 in which the container is formed of cast iron.

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