Oct. 18, 1966 R. C. GRIFFIN, JR 3,279,511

FLEXIBLE PACKAGING SYSTEM

Filed Aug. 28, 1962 2 Sheets-Sheet 1

Fig 1.

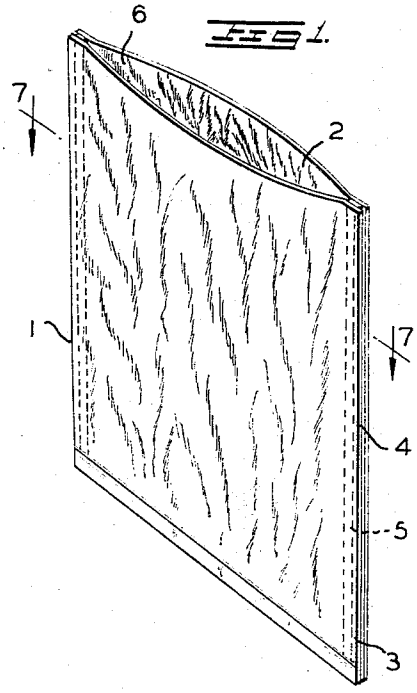


Fig 2.

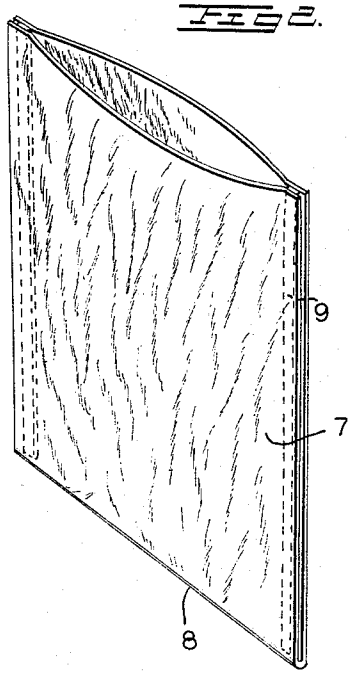


Fig 3.

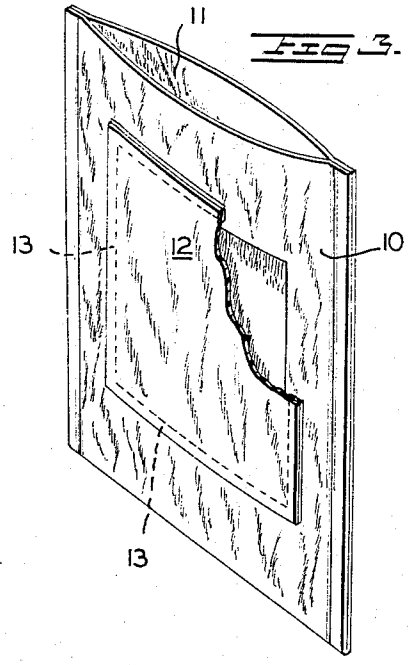
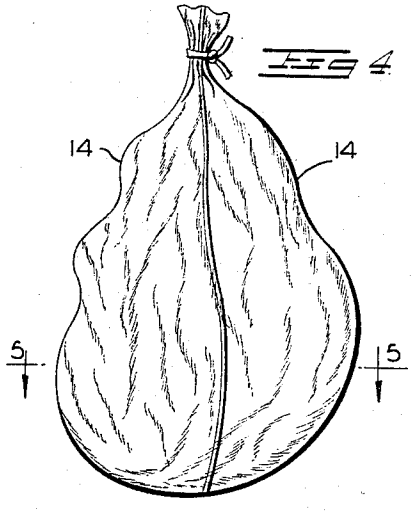


Fig 4.



INVENTOR
ROGER C. GRIFFIN, JR.

BY Glenn, Palmer & Matthews
ATTORNEY

Oct. 18, 1966 R. C. GRIFFIN, JR 3,279,511

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Filed Aug. 28, 1962 2 Sheets-Sheet 2

Fig 5.

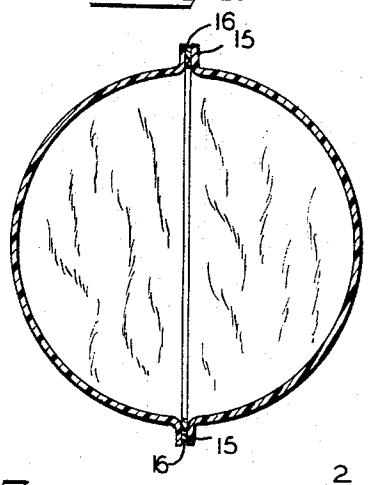


Fig 6.

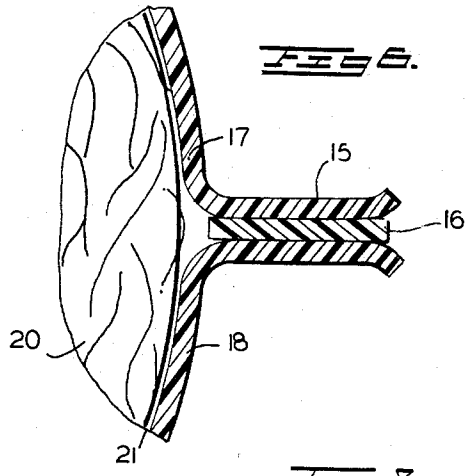


Fig 7

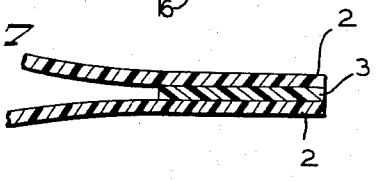


Fig 8

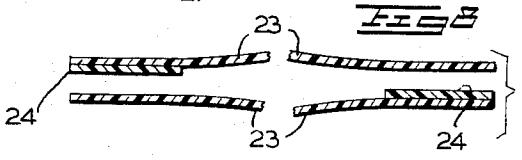
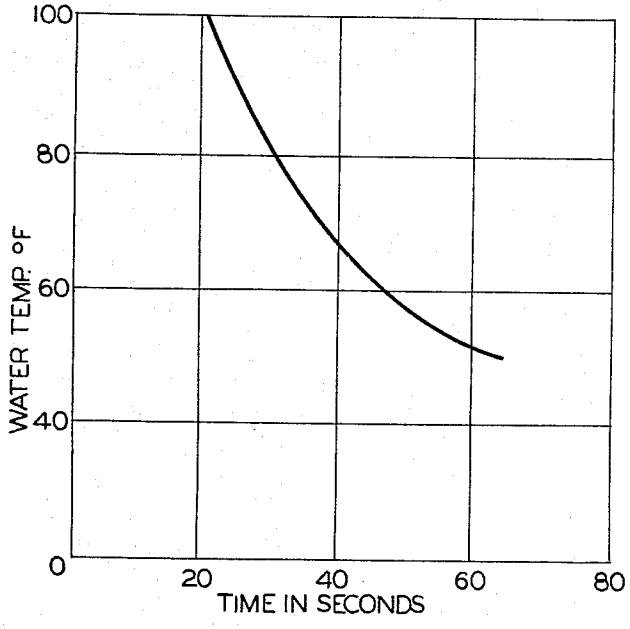


Fig 9.



INVENTOR
ROGER C. GRIFFIN, JR.

BY Glenn, Palmer, Matthews
ATTORNEY

United States Patent Office 3,279,511 Patented Oct. 18, 1966

3,279,511

FLEXIBLE PACKAGING SYSTEM

Roger C. Griffin, Jr., Henrico County, Va., assignor to Reynolds Metals Company, Richmond, Va., a corporation of Delaware

Filed Aug. 28, 1962, Ser. No. 219,833
3 Claims. (Cl. 150—1)

This invention relates to novel water soluble flexible packaging material. More particularly, the invention concerns a water soluble plastic film laundry bag for use in hospitals and similar institutions in which the control of infection is important, and the method of making and using the same.

It is known that soiled hospital bed linens, garments, towels, diapers, and the like, are contaminated with pathogenic organisms. In accordance with prevailing practice, soiled laundry is placed in cloth bags, which are porous and permit bacteria to escape through the bag walls. During the handling of these bags via laundry chutes and other means of transportation, pathogenic bacteria are disseminated by currents of moving air, finding their way into clean linens, food utensils, personnel uniforms, buildings and equipment, giving rise to serious problems of infection control. It has been proposed to reduce the spread of bacteria by employing bags made of impervious plastic films such as polyethylene. Such bags are effective in controlling bacteria spread in hospital wards and laundry chutes, but their protection is lost when the laundry is dumped out of the bags prior to placing the laundry in the baskets of the washing machines. Furthermore, disposal of the bacteria-laden bag itself becomes a major problem. If the polyethylene bags are placed in an incinerator, they tend to melt and clog the burning mass against the passage of air. If combustion is inefficient, many of the organisms can escape into the atmosphere, or remain in the ashes which in turn require special disposal.

Hospital laundry includes wet as well as dry soiled linens, and any plastic film laundry bag designed for general hospital use would have to be resistant to the action of wet linens at body temperature or colder. Cold water soluble plastic film commonly used for packaging purposes would be suitable only for containing dry or almost dry linens, since it would fall apart or develop holes when in contact with normal hospital wet linens, prematurely releasing the contents.

Hot water soluble plastic film would be more suitable to hold damp or wet linens, but hospital laundry practice employs initial rinsing steps which are carried out with water at body temperature or colder in order to loosen and flush away stains from blood and body discharges. The laundry must be fully wet by these initial flushing rinses if it is to be washed clean in subsequent hot water sudsing cycles and rinses which are customarily run at temperatures in excess of about 145° F.

In accordance with the invention, a laundry bag is provided which will hold wet linens at body temperature or colder, yet permit these linens to be contacted almost immediately by the cold flush when the bag and its contents are placed in the washing machine. Thus, the contents are exposed to the action of the blood and stain removing cold water flushes in the machine; and when the hot water containing various soaps, detergents, bleaches, and the like are introduced into the washing cycle, the laundry bag in its entirety is dissolved and flushed away into the sewage disposal system.

These and other objects, advantages and details will become apparent as the description proceeds, and from the accompanying drawings, in which

FIGURE 1 is a perspective view of a laundry bag constructed in accordance with the invention;

FIGURE 2 is a similar view of another embodiment;

FIGURE 3 is a perspective view of a third embodiment;

FIGURE 4 is a side view showing a filled and closed bag;

FIGURE 5 is a sectional view taken on the line 5—5 of FIGURE 4;

FIGURE 6 is an enlarged view of the seam construction shown in FIGURE 5;

FIGURE 7 is a section taken on the line 7—7 of FIGURE 1, showing a detail of the side seam;

FIGURE 8 is a sectional view illustrating a method of assembly of the bag panels;

FIGURE 9 is a graph illustrating releasing characteristics of the bag of the invention at temperatures up to 100° F.

The container **1** is formed from a pair of superimposed hot water soluble flexible plastic sheets **2** of generally rectangular configuration. A thin layer of cold water sensitive flexible plastic material **3** is interposed between the panels adjacent the exterior longitudinal edge **4**, the panels and the interposed plastic layer being bonded to form seam portion **5**. The seam structure is shown in more detail in FIGURE 7, which illustrates the junction of panels **2** and interposed cold water soluble layer **3**. The sheets are bonded along their lower edges to form a bottom seam, and the upper margins **6** of the panels are separable to provide an opening for filling the container. While the bag in FIGURE 1 is depicted as rectangular in shape, it will be understood that it may be made in any desired shape. It will be appreciated, furthermore, that a generally tubular body may be provided with such a seam; that the seam may be transverse as well as longitudinal; and that the seam need not extend completely to the bottom edge of the bag.

In the embodiment shown in FIGURE 2, the bag is formed by bending a single continuous piece **7** of hot water soluble film back upon itself so that the bottom **8** of the container is integral therewith, but not necessarily folding or creasing the bottom portion **8**. The superimposed panel portions of the plastic film are formed into side seams having interposed strips of cold water sensitive plastic material **9** running adjacent to the longitudinal edges. In FIGURE 3 there is illustrated still another embodiment in which a bag body portion **10** made of hot water soluble plastic film material is provided with an access opening **11**, and with a releasable panel **12**. In the construction shown, panel **12** is hot water soluble film bonded to the body portion **10** with cold water sensitive material **13** interposed in the manner of the side seams shown in FIGS. 1 and 2.

In FIGURE 4 there is shown a side view of a laundry bag filled with material to be washed so as to distend the walls **14** of the bag. This figure illustrates the preferred means for closure of the open top of the bag which is the use of a tie tape around the gathered throat of the bag, the tape being made of cold water soluble plastic material. FIGURE 5 shows an enlarged cross-section of the distended bag of FIGURE 4 along the line 5—5, depicting the side seams **15** and the interposed cold water sensitive plastic layer **16**. FIGURE 6 shows the side seam **15** in greater detail, depicting the front bag panel **17** and rear panel **18**, the interposed water soluble plastic layer **16**, contained laundry **20**, and a space **21** lying between the wet laundry and the bag walls.

The method of manufacture of the containers of the invention may be performed in several ways. Thus, to make the embodiment shown in FIGURE 1, a sheet of a hot water soluble plastic film may be coated over selected areas with a layer of a cold water sensitive plastic material, and a second sheet of hot water soluble

plastic film may be superimposed thereon and the edge portions heat sealed to form side seams.

In accordance with a variation of the foregoing method, a strip of a cold water sensitive plastic material may be inserted between two hot water soluble plastic sheets adjacent the opposing edges thereof to define a side seam, or several side seams, and the junction bonded by heat sealing. Or, the strip and the panel edge portions may be bonded together by a suitable adhesive.

Alternatively, the bag may be formed with or without releasable seams, employing a composite flexible plastic sheet for the body portion. Such a sheet may comprise a relatively thick exterior layer of the cold water sensitive material backed with a protective layer of the hot water soluble flexible plastic material. The latter material isolates the exterior layer from the wet linens, but is sufficiently thin to be ruptured in the washing machine once the exterior layer becomes softened.

In FIGURE 8 there is illustrated still another method wherein opposing body panels **23** of hot water soluble plastic sheet material, having attached at one edge thereof a strip **24** of cold water sensitive plastic material, are brought into juxtaposition so that the respective strips are positioned, one at each set of panel edges, and the panels are bonded by heat sealing or adhesive application.

The containers of the invention, particularly laundry bags, have been tested in hospital applications and have been found to possess numerous advantages not previously obtainable using known types of containers. Among these advantages are a significant reduction in the incidence of airborne bacteria and other organisms. The filled bags can be dropped through multistoried laundry chutes without damage or loss of contents. The invention permits the use of a single type of bag for dry, damp, wet or soiled hospital linens, and reduces labor costs in the laundry by eliminating the unpacking steps previously required, and by speeding loading time of the washing machines. At the same time the new bags do not interfere with the use of the cold flush in the washing machines to eliminate setting of blood stains and the like, in accordance with standard hospital procedure.

The laundry bags of the invention may readily be filled by suspending them from a ring stand or even over the back of a chair. Wet or dry hospital linens may be inserted up to the normal capacity of the bag. The bag is then closed by gathering the throat and tying it with a cold water soluble plastic tape, as shown in FIGURE 4. The bag is transported to the laundry room on a cart or via a laundry chute. In the laundry room the filled bag is thrown directly into the washing machine without being opened or loosened. In the wash wheel of the machine, the first flush of water at body temperature or colder is introduced to avoid the setting of stains from blood and other body discharges. This first flush acts upon the cold water soluble tape at the throat of the bag and upon the seam tapes or layers of cold water sensitive plastic. The weakened tape and side seams rupture under the impact of the wash load and the front and rear panels fall apart, allowing the soiled linen contents to spill out into the water. After several cold rinses, the hot water sudsing and rinsing cycles are performed, during which the entire laundry bag dissolves, including both the hot water soluble panel sheets and the cold water soluble tapes, and is removed in the discharge from the washing machine.

The water sensitive flexible plastic material employed for the fabrication of containers in accordance with the presently preferred practice of the invention is polyvinyl alcohol sheet or film, of varying thickness, and of varying types, depending upon the water sensitivity or solubility characteristics desired.

For the container panels, there are two film characteristics of importance: (a) hot water solubility, and (b) damp stability. The criterion of hot water solubility which has proven desirable is that the panel must dissolve completely in 170° F. water within a period of 5 minutes, with agitation. At the same time, the panel material must be substantially insoluble in supply water. Accordingly, the expression "hot water soluble" is used herein to designate materials which are soluble in water at higher temperature but are substantially insoluble in water at about 10° F. or lower. Damp stability is defined as the ability of the film to maintain its integrity as a film while in contact with damp linens.

It has been found advantageous to prepare the hot water soluble panel material from polyvinyl alcohol formulations which has a relatively low glycerol content in order to reduce sensitivity to moisture. Generally, between about 10 and about 18 pounds of glycerol, and preferably between about 13 and about 16 pounds of glycerol, per 100 pounds of resin, are desirably included in the formulation. Thus, there may be employed for the bag panel material, polyvinyl alcohol film material having the general range of hot water solubility desired, but with their damp stability controlled by the glycerol content. Such hot water soluble, cold water insoluble polyvinyl alcohol films are well known and are described, for example, in U.S. Patent 2,413,789 (Example I) and 2,642,419 (Example 1).

The polyvinyl alcohol film to be used for the hot water soluble panels preferably has the following characteristics:

Thickness	0.5–10 mils.
Average yield	21,600 sq. in./lb./mil.
Specific gravity	1.21–1.31.
Tensile strength	6,000 p.s.i. (minimum).
100% modulus (force required to double the length)	2,500 p.s.i. (minimum).
Elongation	300–600%.
Internal tear resistance	500 gm./mil (minimum).
Heat sealing	260° F., 5–10 sec.
Flammability	Slow burning.

A suitable film formulation for container panels made of hot water soluble polyvinyl alcohol is as follows:

	Parts by weight
Polyvinyl alcohol	100
Glycerol	16
Surface-active agent (Triton X-100, a nonionic polyethenoxy ether)	0.75
Sodium metabisulfite (bleach)	0.2
Magnesium stearate (lubricant)	0.01

The cold water sensitive polyvinyl alcohol which is used for tying tape and for side seam sealing in accordance with the invention is one which tends to soften in cold water, although not necessarily to dissolve completely. By cold water is meant water at a temperature up to about 100° F. Thus, for practical purposes a suitable cold water sensitive tape or layer is one which will release the contents of the bag in cold water in less than 2 minutes, preferably less than 1 minute. This characteristic is illustrated in the graph of FIGURE 9, which shows the release time, with mild agitation, relative to water temperature, employing a suitable cold water sensitive tape (Reynolon PVA/WS–13) in the bag seams. Cold water sensitive or soluble polyvinyl alcohol has long been known and is disclosed, for example, in Patent 2,502,715 (Example 6) and 2,750,027 (col. 2, lines 55–60).

Cold water sensitive polyvinyl alcohol film for use as a seam material and for binding the bag mouth preferably has the following characteristics:

Thickness	About 0.015 in.
Average yield	21,600 sq. in./lb./mil.
Specific gravity	1.21–1.31.
Tensile strength	2,000 p.s.i. (minimum).
100% modulus (force required to double the length)	1,000 p.s.i. (minimum).
Elongation	250–600%.
Internal tear resistance	200 gm./mil (minimum).
Heat sealing	300° F., 1 sec.
Flammability	Slow burning.

Both the cold water soluble and hot water soluble types of polyvinyl alcohol are described in detail in "Water-Soluble Resins," by Davidson and Sitting (Reinhold), published early in 1962.

Extensive evaluation of these laundry bags in actual hospital use has demonstrated their suitability in general, pediatrics and nursery wards. In a test series at a 300 bed general hospital, furthermore, the soluble laundry bags of polyvinyl alcohol were found to reduce the total number of air-borne bacteria to as little as 10% of the number present when conventional techniques were employed.

While present preferred embodiments of the invention have been illustrated and described, the invention may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. A water soluble flexible container adapted to release its contents when immersed in water having a temperature up to about 100° F. and which is substantially completely soluble in hot water, comprising superimposed panels of hot water soluble flexible plastic material defining a body portion to receive such contents, the top margins of said panels being separable to provide an opening for filling the container, and a thin flat narrow layer of cold water sensitive plastic material bonded between the panels along substantially coterminous edges thereof to form a releasable seam in said body portion.

2. A water soluble plastic film laundry bag which is adapted to hold wet linens at body temperature or colder and which is adapted to release its contents when immersed in water having a temperature up to about 100° F., and thereafter to dissolve completely in hot water,

comprising superimposed panels of hot water soluble flexible plastic film having good damp stability, a thin flat narrow layer of cold water sensitive plastic material bonded between opposing panels to form a releasable seam in said body portion, the top margins of the panels being separable to provide an opening for filling the bag.

3. A water soluble plastic film laundry bag which is adapted to hold wet linens at body temperature or colder and which is adapted to release its contents substantially immediately when immersed in water having a temperature up to about 100° F., and thereafter to dissolve completely in hot water, comprising sheets of hot water soluble polyvinyl alcohol film having good damp stability superimposed with their longitudinal edges substantially coterminous, the top margins of said sheets being separable to provide an opening for filling the bag, a thin flat narrow layer of cold water soluble plastic material interposed between the sheets along said longitudinal edges, said sheets and interposed plastic layer being bonded to form a pair of releasable edge seams.

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THERON E. CONDON, *Primary Examiner.*

NORMAN G. TORCHIN, FRANKLIN T. GARRETT, *Examiners.*

D. LEVY, V. A. TOMPSON, J. M. CASKIE, *Assistant Examiners.*