L. R. NESTOR
DISINTEGRABLE LABEL AND WASHABLE
CONTAINER LABELED THEREWITH
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Fig. 1
Fig. 2.

LABEL COMPRISING
DIMENSIONALLY STABLE FIBERS
AND ALKALI-SOLUBLE, WATER-
INSOLUBLE, ORGANIC FILM-
FORMING BINDER THEREFOR

DOE'S BEER

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This invention relates primarily to removable water-resistant labels for returnable containers such as beverage bottles. Bottled beverages are commonly conditioned and temporarily stored in ice-chests, in contact with cold water, before being sold to consumers. Printed labels, generally having a paper base, are adhered to such bottles as a means of identification. These labels are required to remain in place and in good condition under the conditions existing in the ice-chest, in order to fulfill their intended purpose of identifying and maintaining a demand for the bottled product. They must be firmly adhered to the bottle, and must have sufficient "wet strength" to keep from being torn and mutilated as they are jostled about in the ice-chest.

A primary and obvious requirement in the beverage-bottling industry is that the bottles must be clean and sanitary before filling. On being returned to the bottling-works, bottles are therefore carefully and thoroughly washed. A common requirement is that this washing be performed with hot 5% aqueous caustic soda solution, followed by efficient rinsing.

An object of the present invention is the provision of a disintegrable label for beverage bottles. The label must be desirably decorative and attractive in appearance, and must remain in good condition during active storage of the bottled beverage in an ice-chest. The label must also have the ability to come away from the bottle, and to disintegrate, when passed through a warm 5% caustic cleaning solution in a bottle-washing machine.

A further object is the provision of fibrous, dimensionally stable disintegrable labels which are substantially completely disintegrated, under the action of bottle-washing machines, to a loose and free-flowing pulp capable of being sluiced or washed from the machine through 2-inch drain-pipes. Increasing the efficiency and economy of the bottle-washing process by providing bottles labeled with disintegrable labels is an ancillary object. Another object is the provision of labeled bottles which remain attractively labeled during ice-chest conditioning and active storage, and which when passed through the typical bottle-washing process herein described are rapidly and completely freed of labels or portions thereof. Other desirable features and objects of the invention will become apparent on consideration of the specification and the appended claims.

In the drawing, Figure 1 represents a beverage bottle labeled with a neck label and a body label made in accordance with my invention; Figure 2 represents a cross-section of the neck label of Figure 1 taken along line ——. The labels remain intact even after prolonged active storage of the bottles in ice-water. They are sufficiently water-resistant so that the conventional water-soluble label adhesives provide adequate bonding. On passing the bottle through weak (5%) caustic in a bottle-washing machine, the label disintegrates, exposing the adhesive, and remains dispersed in the solution in a form requiring no hand-shoveling or analogous inefficient methods for removal from the bottle-washing machine. The residue is easily rinsed from the bottle and washed from the machine.

Several ways in which I have prepared labels having the above-described as well as other advantageous characteristics will now be described.

Example 1

In this example, pre-formed paper was employed as the base. The particular paper used was a white sulphite flat stock saturating paper having a basis weight of 36 lbs. per ream of 320 square yards. Lengthwise tensile strength was 8-10 lbs. per inch width; porosity (Gurley Densometer reading, 400 cc. of air through two thicknesses of paper) was 16 seconds. Lengthwise capillarity, measured on a one-inch strip suspended with the bottom portion dipping into water at 70° F., was such that the water was drawn upward one inch in 2 minutes. In the dry state, this paper was sufficiently strong to be treated, printed, and adhered to bottles without breakage. On the other hand, the paper was exceedingly low in wet strength. A narrow lengthwise strip of the paper was dipped into water, allowed to stand for 2 minutes, and tested for tensile strength; the strength was found to be only 35 grams per inch width. Prior to my invention, this type of paper has never, as far as I am aware, been suggested as a base for labels, since ordinary soaking would be expected to render it so weak as to be immediately torn from the bottle in the ice-chest. On the contrary, I have found that even the weakest of paper primarily employed for labels has a wet strength, in the same test, of at least about 1000 grams.

I have now discovered that, in accordance with my invention, fibrous base sheets having a wet strength no higher than the above-described paper may be converted into sturdy and attractive, yet readily disintegrable labels.

In the above example, the pre-formed paper was first impregnated with a solution of an alkali-
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soluble film-forming composition, and was then coated with a decorative pigmented surface sizing comprising an alkali-soluble binder. The impregnating solution consisted of 30 parts by weight of zein (alcohol-soluble corn protein) and 10 parts of triethylene glycol, dissolved in 120 parts of ethylene glycol monoethyl ether. The triethylene glycol plasticizer could be omitted if desired. The sizing composition was prepared by adding 3.8 parts of aluminum lake pigment to the above formula. The sheet was dried after each application, and was then converted to labels by printing on the sized surface and cutting to shape. For test purposes, the labels were adhered to a boric or other conventional water-soluble starch base adhesive. In active storage, in the ice-chest, the labels remained in place on the bottles and attractive in appearance. During subsequent washing in warm 5% caustic solution in a bottle-washing machine or equivalent, these labels did not soften or pull away from the bottles, and were substantially completely disintegrated, as noted hereinafter.

Example 2

In a modification of the above, I impregnate the low-wet-strength paper base with a pigmented composition consisting of the following ingredients, in parts by weight:

Solution of urea resin .......................... 40
Heavy buffed castor oil .......................... 20
Pale wood rosin ................................. 20
Ethylene glycol monoethyl ether ............... 7.2
Titanium dioxide ............................... 52.8

The urea resin is a reaction product of urea, formaldehyde and butyl alcohol dissolved in a mixture of butyl alcohol and xylol. On evaporation at 105° C., the resin solution is found to lose approximately 50% of its original weight. Such a resin is commercially available, at the time of filing of this application, as "Beetle Resin No. 227-8."

After impregnation, the coated web is dried at elevated temperature, to produce a white label stock which can be printed, cut to size, and applied to bottles. The labeled bottle is not affected by active storage in an ice-chest, but the label is rapidly removed and substantially completely disintegrated when the bottle is subjected to washing in warm dilute caustic.

Preferably, the alkali-soluble organic resinous film-forming materials which are insoluble in water but are readily soluble (e.g., as the sodium salt) in aqueous sodium hydroxide are found to be useful in the production of my novel disintegrable labels. Preferably, they are applied as an adhesive coating of low wet strength, as in the preceding examples, to form label stock which is printable and has high strength both in the dry form and in the presence of water, but which rapidly loses its strength and disintegrates under the influence of the caustic solution and the moderate agitation employed in bottle-washing machines. Another way in which such materials have been applied by me in the production of useful disintegrable labels will now be described.

Example 3

In this modification, a film of the resinous organic material is first formed by coating the material from solution on to a temporary carrier. For example, a film of a highly acidic resinous copolymer of styrene and maleic anhy-

dride dissolved in a volatile organic solvent is formed on a polished steel panel. After partial drying, sufficient to increase the viscosity of the resinous film to the required consistency, a quantity of loose alpha-cellulose fibers or flock is uniformly distributed over the coated surface, and drying is continued. The fibers become more or less completely and haphazardly immersed in the resin. After drying is completed, the sheet is stripped from the surface. It is then suitably surface-sized to provide an attractive printable surface, and converted to labels. Where solvents cannot be used, the same resin may be dissolved in aqueous ammonia; on drying, the ammonia is volatized and the acidic resin film remains.

The resinous films alone are also useful as a base for an improved label, for example where the film is subsequently laminated to aluminum foil or the like. However, and particularly in the absence of such surface-reinforcing member I have found that the inclusion of unbonded or lightly bonded fibers either as pre-formed low wet strength paper or as free fibers in or in various other ways provides improved results in reducing or eliminating the degree of stretch or dimensional instability normally associated with the non-fibrous film, thus providing for improved register during multiple-color printing. Introduction of the fibers as preformed low-wet-strength paper, as previously described, or as unbonded or lightly bonded felted web or batt, is in general more economical and efficient, and is preferred. Application of fibers to a preformed partially dried film, as in the above example, or by mixing the loose fibers with the film-forming composition coincident with spreading and drying, or in any other way, is also contemplated as coming within the scope of my invention so long as there is produced an attractive label which is resistant to water but disintegrable in caustic as herein specified. Paper-making fibers are required for the label comprising a pre-formed paper but other dimensionally stable fibers including cellulose fibers such as rayon, cellulose acetate, ethyl cellulose, etc., as well as numerous non-cellulosic fibers including nylon and vinylidene chloride fibers are useful in providing dimensionally stable labels by one or more of the alternative processes herein indicated. In all cases, fiber length must be restricted in order that the sheet may disintegrate readily; thus, fibers as long as about 7/8 inch or even slightly longer have provided sheet materials which were readily disintegrable, whereas fibers about one inch or more in length were found to remain matted together even though not adherently attached to each other after agitation of the sheet in the caustic solution.

Among other water-insoluble, alkali-soluble organic film-forming materials which I may employ, in addition to the plasticized or unplasticized zein, the urea resin-resin oil combination, and the styrene-maleic anhydride copolymer already specifically mentioned, may be noted casein, carbamoyl cellulose, "Petree" resin (the highly acidic resinous adduct of maleic anhydride and terpenes), etc. It will frequently be found desirable to incorporate plasticizers, pigments, small amounts of other film-forming materials, and other modifiers. In limited amounts, these additives, even if themselves unaffected by the caustic cleaning solutions, do not prevent disintegration of the film or coating, and fre-
quently impart desirable properties to the label product.

The surface of my disintegrable labels may be made printable in a variety of ways, the term "printable" involving opacity, uniformity and general attractiveness of appearance as well as the provision of a suitably receptive base for the ink to be applied. One method involves the incorporation of suitable metallic pigments, e.g. titanium dioxide, in the film-forming composition with which the low-wet-strength paper is to be impregnated. In another method, pigment is added in a surface coating. In this case either the film-forming component, or the pigment, or both, must be water-insoluble and alkali-soluble. For example, the surface coating may comprise a metallic film such as may be provided by employing aluminum flake as the pigment in the surface coating, or by adhesively laminating an aluminum foil to the surface of the sheet, or by applying a porous or reactive metallic coating directly to the surface by vacuum deposition, sputtering, or the like. Where aluminum foil is laminated to the backing, the laminating adhesive may be a water-insoluble, alkali-soluble binder of the type previously mentioned. Low-melting wax may be used for the lamination; in the washer, the wax melts and permits access of the caustic solution to the treated paper base. Plasticized resin provides another effective alkali-soluble laminating adhesive.

Aluminum foil is particularly desirable for making laminated labels. The aluminum provides an attractive and distinctive background for printing; it is completely impermeable to, and unaffected by, cold water during active storage in the ice-chest, yet is quickly removed in the caustic washing solution to expose the underlying disintegrable base to the action of the caustic. Zinc foil is also sufficiently reactive but is less economical and somewhat less attractive in appearance than the aluminum foil.

Although considerable variation in thickness may be tolerated in my disintegrable sheet material, labels as employed for bottled beverages are normally standardized at about 2-4 mils, or somewhat greater in the case of laminated multiple-layer labels. Extremely thin labels are undesirably flimsy, deficient in strength, difficult to print, and difficult to apply to the bottles. Much heavier labels are stiff, and tend to spring away from the bottle when first adhered thereto and before the adhesive has dried. They are not as economical, requiring larger quantities of raw materials and producing larger quantities of residue in the washer. My preferred labels are within the approximate thickness range indicated. They are sufficiently rigid and sturdy, but also sufficiently flexible, for all requirements in connection with printing and application. They disintegrate rapidly, under washing conditions, without requiring an undue large amount of caustic and without producing undue quantities of residue.

I provide by means of my invention a novel and useful disintegrable label. My new label retains its original appearance even after prolonged contact with cold or room-temperature water in an ice chest, yet is rapidly removed from the bottle and disintegrated during the cleansing process in the bottle-washer. Containers such as beverage bottles, carrying my improved labels, retain their identity under active conditioning and storage, yet are easily and completely freed of all traces of the identifying labels when run through the conventional bottle-washing processes.

What I claim is:

1. A washable container carrying an adherently attached label and being substantially unaffected in appearance by active conditioning and storage in an ice-chest, said label being capable of rapid removal and substantially complete disintegration on washing of said container with warm dilute caustic under moderate agitation, and said label comprising in printable sheet form an alkali-soluble, water-insoluble organic film-forming binder and dimensionally stable fibers distributed therein.

2. A refillable bottle carrying an adherently attached label and being substantially unaffected in appearance by active conditioning and storage in an ice-chest, said label being capable of rapid removal and substantially complete disintegration on washing of said labeled bottle with warm dilute caustic under moderate agitation, and said label comprising a low-wet-strength paper impregnated with an alkali-soluble, water-insoluble organic film-forming binder.

3. A refillable bottle carrying an adherently attached label and being substantially unaffected in appearance by active conditioning and storage in an ice-chest, said label being rapidly removable and substantially completely disintegrable on washing of said labeled bottle with warm dilute caustic under moderate agitation, and said label comprising a treated paper base and an opaque printable surface covering, said base comprising a low-wet-strength paper impregnated with an alkali-soluble, water-insoluble organic film-forming binder, and said opaque surface covering being removable with warm dilute caustic.

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References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,965,693</td>
<td>Dunham</td>
<td>July 10, 1934</td>
</tr>
<tr>
<td>1,998,506</td>
<td>Jones</td>
<td>Apr. 23, 1935</td>
</tr>
<tr>
<td>2,362,884</td>
<td>Clark</td>
<td>Nov. 14, 1944</td>
</tr>
<tr>
<td>2,446,414</td>
<td>Ferrell et al.</td>
<td>Aug. 3, 1948</td>
</tr>
</tbody>
</table>

OTHER REFERENCES