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W. H. MOSS

2,374,372

BUOYANT MATERIAL

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FIG. 1

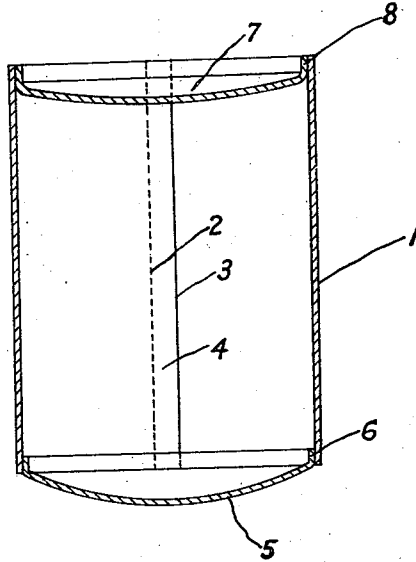
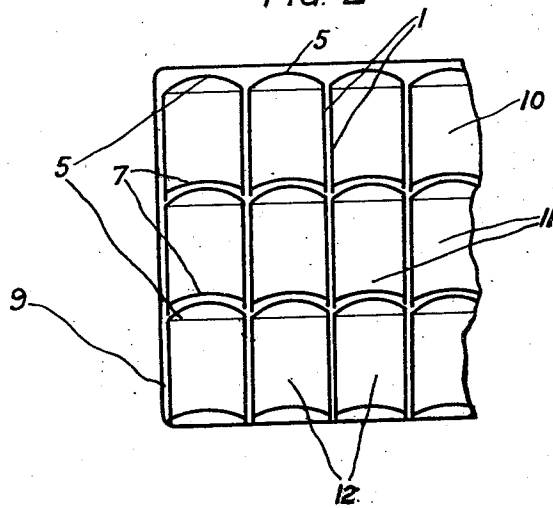


FIG. 2



W. H. MOSS

Inventor

J. Helgren & C. O. Swanson
Attorneys

UNITED STATES PATENT OFFICE

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BUOYANT MATERIAL

William Henry Moss, London, England, assignor
to British Celanese Limited, London, England,
a company of Great Britain

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8 Claims. (Cl. 9—8)

It is often desired to provide boats with a reserve of buoyancy so that they will remain afloat in spite of damage to the hull. This reserve of buoyancy is commonly provided in the form of closed tanks filled with air. In the case of craft which are likely to be exposed to gunfire however, such tanks are not satisfactory since they become ineffective if pierced.

I have now found that a suitable material for imparting reserve buoyancy to water-borne craft which are likely to be exposed to gunfire can be provided in the form of a number of closed containers full of air and constructed of a textile fabric or other fibrous sheet material, e. g., paper rendered water-tight and stiffened by a coating of a cellulose ester or ether or other artificial organic water resistant polymer. Such containers can be packed into suitable compartments in the boat or other craft in numbers sufficient to provide the reserve buoyancy required. The containers may be simply and economically made and the amount of polymer needed in their production is less than if they were moulded or formed from sheet material of the polymer.

A suitable material from which to form the containers is a woven cotton fabric having a weight of about 2 ozs. per square yard. This may be coated with a dope comprising cellulose acetate in solution in a volatile solvent or solvent mixture, so that after drying-off the solvent the coated fabric has a weight of about 8 ozs. per square yard.

Suitable volatile solvents or solvent mixtures include: acetone, dioxane, and mixtures of methanol or ethanol with benzene or with a chlorinated paraffin such as ethylene dichloride or methylene dichloride. The cellulose acetate may be of the ordinary acetone-soluble kind, e. g., having an acetyl value (calculated as acetic acid) of 52 or 53 to 54 or 55%; or a more highly water resistant cellulose acetate, having an acetyl value between 55 and 62%, e. g., 56–58 or 59% may be used.

A convenient way of coating the fabric is to draw it through a bath containing the dope. Other methods may be employed, however, for instance the fabric may be coated by spreading, or by spraying methods. The coated fabric is dried, for instance, by passage over heated rollers or by means of a current of warm air. The dried fabric may then be cut into blanks from which the containers of the invention are formed. A very suitable form for such containers is that of a closed cylinder some two or three inches in

height and having about the same diameter as height. The ends are preferably dishd to give greater strength. The two ends may be oppositely dishd, i. e., both concave or both convex, but it is preferable for one end to be convex and the other concave so as to facilitate close packing, the convex end of one cylinder fitting into the space provided by the concave end of the next. Long cylinders of several inches in diameter could also be formed having transverse partitions at intervals of a few inches, but this is a less satisfactory arrangement since the cells so formed cannot so readily be tested for water tightness as can individual cylinders. Moreover the cellular construction is less simply made and is less strong than individual cylinders with dishd ends. Instead of the cylindrical shape, other regular shapes may be adopted. Thus, for example, containers in the shape of tetrahedra, cubes, or prisms of triangular, rectangular, hexagonal or octagonal section, may be formed. Such shapes are, however, less strong than the cylindrical. For ease of manufacture, strength and convenience in use, the cylindrical form is to be preferred.

The containers of the invention may be assembled to form slabs or blocks of buoyant material. Thus, for instance, a number of cylinders, preferably cemented together by their curved surfaces, may be packed into an outer casing of the coated fabric, preferably also cemented to the cylinders. In this way slabs of buoyant material are formed. Blocks of this material can be formed in a similar way, using several layers of cylinders one upon another. Units built up of cylindrical containers each united to its neighbours are easier to handle and transport than the individual cylindrical containers. Such units may with advantage be made large enough to support the weight of a man or even several men in the water. Instead of forming the material into individual cylinders, cubes or the like, slabs or blocks of cellular material may be built up from the coated fabric, for instance by cementing between two flat parallel sheets of coated fabric spaced apart, flanged partitioning walls of the same material, but this cellular form of construction is subject to the disadvantages referred to above, of which the most important is the virtual impossibility of testing the water-tightness of an interior cell. It is important that each container, or in the case of cellular material, each cell, should be water-tight and capable of withstanding the

pressure of a head of water of at least several feet.

In forming the containers or similar materials of the invention, the joints necessary may be made by cementing the overlapping surfaces with a dope such as is employed in coating the fabric, or with any other cement which is water-resistant and adherent to the cellulose acetate or other water-resistant polymer with which the fabric is coated. Thus, for fabrics coated with cellulose acetate, suitable cements include solutions in volatile liquids of cellulose acetate or other esters or ethers of cellulose, or of polyvinyl acetate. The joints may be made at ordinary temperature or at higher temperatures.

As indicated above, the fabric to be coated is preferably a woven fabric of cotton having a weight of about 2 ozs. per yard. Other fabrics which can be provided with an adherent water-proof coating of an artificial film-forming polymer can also be employed. Useful results for instance have been obtained with a plain woven cotton fabric of weight about 1 oz. per yard. Instead of cotton other textile materials of cellulose or regenerated cellulose can be used. Thus, for example fabrics of linen or of regenerated cellulose made by the viscose process, the cuprammonium process or by the saponification of cellulose esters can be used, including fabrics composed of or containing yarn made by the complete saponification of cellulose acetate yarn of high tenacity. Such high tenacity yarn can be obtained by stretching cellulose acetate yarn of ordinary tenacity in the presence of steam or hot water. In this way regenerated cellulose yarns of tenacity in excess of 2 gms. per denier or more can be obtained. These high tenacity yarns produce fabrics which in addition to being stronger are of greater water resistance than fabrics made from regenerated cellulose yarns of lower tenacity.

Instead of cellulose acetate other water resistant artificial organic film-forming polymers can be employed, e. g., cellulose propionate, cellulose butyrate, cellulose acetate-propionate, cellulose acetate-butyrate, cellulose acetate-nitrate, cellulose acetate-stearate, ethyl cellulose, benzyl cellulose, ethyl hexyl cellulose and other esters and ethers of cellulose, especially those containing a relatively high proportion of ester or ether groups. Water resistant polymerised vinyl compounds can also be employed for example, polyvinyl acetate, polyvinyl chloride, polymethyl acrylate, polymethyl methacrylate and co-polymers of two or more of such unsaturated substances. A further class of polymer which can be employed is that of the solid polymerisation products of butadiene or its alkyl or halogen derivatives, including co-polymers of butadiene and its derivatives with other unsaturated substances, for example, vinyl compounds.

The buoyant material of the invention has numerous applications. It may be used for instance in life-boats, launches and other self-propelled vessels, floats, rafts, barges, pontoons and seaplanes.

Buoyant material according to the invention is shown in the accompanying drawing wherein:

Figure 1 is a sectional elevation of one of the containers of the invention; and

Figure 2 is a sectional elevation on a smaller scale of a block of buoyant material formed from a number of containers, such as that shown in Figure 1, enclosed in an outer casing.

Referring to Figure 1 of the drawing, the container shown has a cylindrical body 1 formed of

cotton fabric doped with cellulose acetate, ethyl cellulose, or cellulose acetate-butyrate, the edges 2 and 3 being overlapped and cemented with a dope of the cellulose derivative dissolved in a volatile solvent together to form the seam 4. An outwardly dished end-member 5 of the same material is cemented to the inside of the cylindrical body portion by the flange 6. The pressure necessary to ensure good adhesion of the flange 6 to the inner surface of the cylindrical body 1 can be applied by means of a pressing member inserted from the open end of the cylinder, the end-member 5 being meanwhile supported in a suitably shaped jig. An inwardly dished end-member 7 is cemented to the body 1 by the flange 8. Owing to this flange being outside the space enclosed by the cylindrical wall and end-members, the pressure necessary to bond the flange 8 to the inner surface of the cylindrical body 1 can easily be applied, after the end-member 5 has been fixed in position, for instance by running a roller-pressing member round in contact with the exposed surface of the flange 8 while the cylinder is suitably supported, e. g., by a close-fitting external cylindrical casing or ring. The curvature of the end-member 5 is somewhat greater than that of 7 so as to facilitate the packing of the containers end to end with the minimum wastage of space. The container is full of air.

Referring now to Figure 2, the block of buoyant material shown comprises an outer casing 9 filled with containers of the construction shown in Figure 1. The outer casing 9 is of the same material as the containers. The containers are arranged in three tiers, 10, 11 and 12, the concave ends 7 of the containers 11 of the middle tier accommodating the convex ends of the containers of the lower tier 12 and the convex ends of the container 11 fitting into the space provided by the concave ends of the containers 10 of the upper tier.

This arrangement serves both to minimise the free space between containers in the outer casing and to locate the containers, so increasing the rigidity of the block. The containers of each tier are packed in the outer casing as closely as is possible without substantial distortion. Each container is preferably cemented to the other containers with which it is in contact.

Having described my invention, what I desire to secure by Letters Patent is:

1. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a textile fabric having a coating of an artificial organic water resistant polymer which stiffens the fabric and renders it impervious to water.

2. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a textile fabric having a coating of an artificial organic water resistant polymer which stiffens the fabric and renders it impervious to water, the cylinders being adhesively united one to another.

3. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full

of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a textile fabric having a coating of an artificial organic water resistant polymer which stiffens the fabric and renders it impervious to water, the assembly of cylinders being provided with an outer casing of the coated textile fabric.

4. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a textile fabric having a coating of an artificial organic water resistant polymer which stiffens the fabric and renders it impervious to water, the cylinders being adhesively united one to another and the assembly of cylinders being provided with an outer casing of the coated textile fabric.

5. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a cotton fabric having a coating of cellulose acetate which stiffens the fabric and renders it impervious to water.

6. Material suitable for imparting reserve buoyancy to water-borne craft, said material

comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a cotton fabric having a coating of cellulose acetate which stiffens the fabric and renders it impervious to water, the cylinders being adhesively united one to another.

7. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a cotton fabric having a coating of cellulose acetate which stiffens the fabric and renders it impervious to water, the assembly of cylinders being provided with an outer casing of the coated cotton material.

8. Material suitable for imparting reserve buoyancy to water-borne craft, said material comprising an assembly of closed cylinders full of air, each cylinder having one end convex and the other concave, the convex end of one fitting into the concave end of another, said cylinders being formed of a cotton fabric having a coating of cellulose acetate which stiffens the fabric and renders it impervious to water, the cylinders being adhesively united one to another and the assembly of cylinders being provided with an outer casing of the coated cotton fabric.

WILLIAM HENRY MOSS.