June 26, 1962 H. E. FROEHLICH 3,041,013

HIGH ALTITUDE BALLOON AND METHOD OF MAKING THE SAME

Filed June 30, 1959

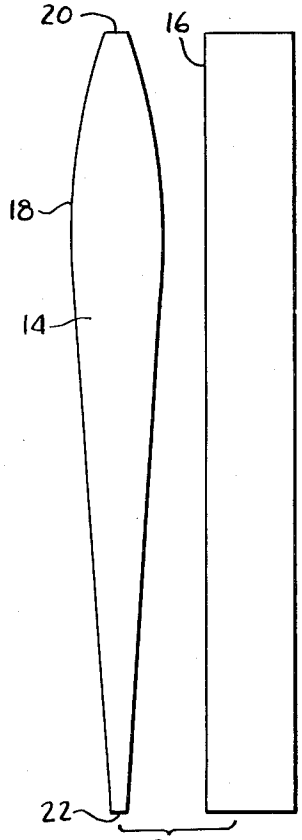


Fig. 3

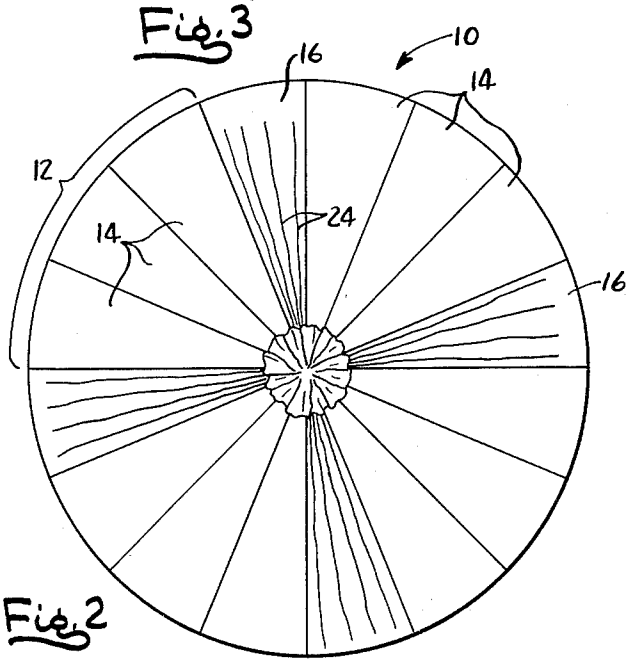


Fig. 2

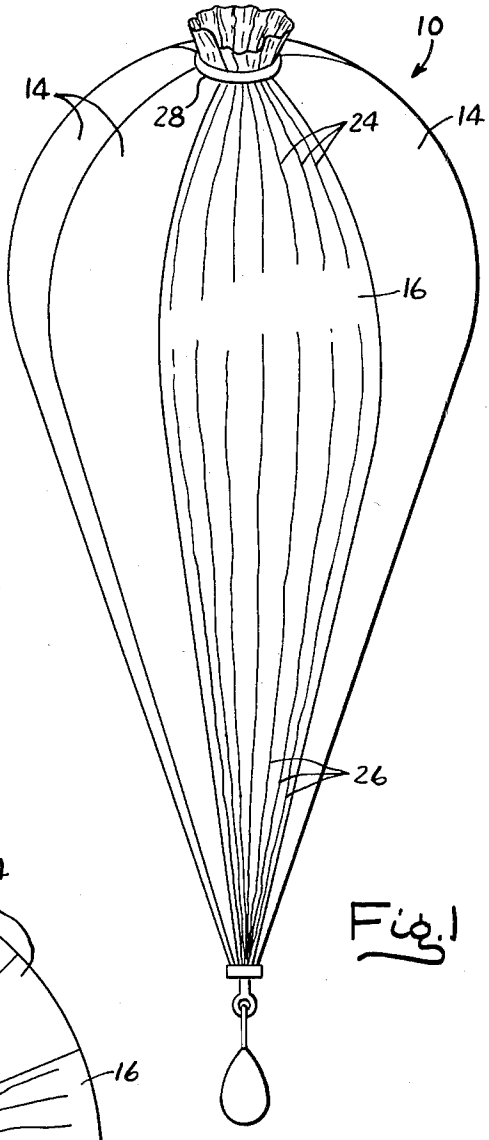


Fig. 1

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HIGH ALTITUDE BALLOON AND METHOD OF MAKING THE SAME

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1 Claim. (Cl. 244—31)

This invention relates to high altitude plastic film balloons and is concerned more particularly with those of the type made of a number of tailored gores.

In the manufacture of such a balloon, it is the practice to provide an elongated table one longitudinal edge of which is straight and the other convexly curved to the shape each longitudinal edge of each gore is to have, the part of maximum width being half the maximum width of the gore to be formed; provide a roll of the plastic film material with the material in the form of "lay flat" tubing whose circumference is usually the maximum width of the gores to be formed; draw the material off the roll and onto the table so that one fold extends along the straight edge of the table; cut the material to gore length from the roll; and, using the curved edge of the table as a template, cut the two plies of the material to the shape of the template. The result is a gore symmetrical about its longitudinal axis and converging in width toward its ends. The shape of the curve is related to the number of gores that are to be used so that, when the gores are longitudinally heat-sealed in a circumferential series, the balloon will have a "natural shape" upon inflation with lift gas. A natural shape balloon is one in which film stresses are primarily longitudinal. It is flatter on top than a sphere and fuller on the bottom than a cone. With a given table, only one size of natural shape balloon having a predetermined number of identical tailored gores of predetermined shape can be made. In such a balloon, therefore, each gore subtends an aliquot part of 360°.

In a plant for manufacturing this type of high altitude balloon there are tables in a sufficient number of sizes to manufacture those sizes of balloons for which there is frequent demand. There is occasionally a need for an off-size balloon, to carry a given load to a predetermined altitude. It would of course be most uneconomical to provide tables in all of the sizes needed to make all possible sizes of balloon that might possibly be needed, however rarely, or even to produce a special table whenever an off-size balloon is needed.

If all of the gores of a balloon are formed as above, the balloon will have an efficient structural shape. However, a balloon which has an excess amount of circumferential material will still take its "natural shape" and perform very satisfactorily. The provision of an off-size balloon which is nearly tailored to the "natural shape," without requiring a special table in its manufacture, is the salient object of the invention.

Further objects and advantages of the invention will appear as the description proceeds.

The invention will be better understood on reference to the following description and the accompanying drawing, wherein:

FIG. 1 shows an elevational view of a fully inflated balloon constructed in accordance with the invention.

FIG. 2 is a top plan view of the same.

FIG. 3 is an exploded view on a reduced scale showing in development two different shaped gores appearing next to each other in the finished balloon.

Referring now more particularly to the drawing, disclosing an illustrative embodiment of the invention, there is shown at **10** a fully inflated multi-gored balloon em-

bodying features of the invention. The balloon **10** is formed of identical sections or groups **12** of identical tailored gores **14**, and individual rectangular gores **16** of the same length as the gores **14**, the groups alternating with the gores **16**. Each gore **14** is symmetrical with respect to its longitudinal axis and of progressively reduced width from an intermediate portion **18** to its ends **20** and **22**, the shape and number of gores **14** being such that, if the gores **16** were replaced by gores **14**, the ensemble would form a structurally efficient "natural shape" balloon. The gores **16** being rectangular, however, the balloon **10**, instead of being of perfect "natural shape" without folds, will assume its "natural shape" upon inflation, the rectangular gores being gathered in generally longitudinal folds as indicated at **24** and **26** so that each rectangular gore has the same projected shape as a gore **14**, the rectangular gores thus providing increasing circumferential fullness from the equatorial plane of the balloon, i.e., from the plane of maximum diameter of the balloon, toward the top of the crown and toward the apex of the conical portion. The top of the balloon may be gathered in the form of a tube which is extended through and clamped in any suitable fashion against the collar **28** of an end fitting.

The fullness provided by the excess material at **24** and **26** renders the material and seams substantially free of circumferential stress, so that substantially all of the stress is oriented longitudinally, in which direction the material is normally strongest. The shape of the balloon will be altered very slightly due to the excess material.

If desired, an off-size balloon in accordance with the invention could be made in which the gores **16** are replaced by off-shaped gores each of which converges like a gore **14** toward either end and is rectangular toward its other end. If such replacement gores are made with the upper portions rectangular, the resulting balloon at the top will appear as indicated in FIG. 2. Each such replacement gore can be laid out on the same table used in shaping the gores **14**, and cut like the gores **14** but only to the extent to impart the desired rectangular-convergent shape. The resulting balloon will thus have less excess material than the balloon having fully rectangular replacement gores and therefore will weigh slightly less.

One or more off-shaped (rectangular or rectangular-convergent) gores may be employed in any balloon, so that a number of off-size balloons of different volumes can be made with the same table.

While preferred embodiments have been described in some detail, they should be regarded as examples of the invention and not as restrictions or limitations thereof as changes may be made in the materials, construction and arrangement of the parts without departing from the spirit and scope of the invention.

I claim:

In a method of making a substantially natural shape balloon for carrying a load whose weight is greater than the weight to be carried by a natural shape fully tailored multi-gore stock size balloon having a predetermined number of gores and less than the weight to be carried by the next larger stock size natural shape fully tailored multi-gore balloon, the steps of forming a majority of said predetermined number of elongated tailored gores of which the smaller stock size balloon would be made, forming identical rectangular gores of the same length as the tailored gores and each of a width equal to the maximum width of each of the tailored gores, the total number of said majority of tailored gores and said rectangular gores being equal to said predetermined number, heat-sealing the longitudinal margins of said rectangular gores and said majority of tailored gores in a circumferential series to thereby provide an envelope having the same

maximum diameter as the smaller stock size balloon, circumferentially shirring the end portions of each rectangular gore of the envelope to the same width as each tailored gore end portion, and so securing each end portion of the envelope that the shape and area of each rectangular gore of the envelope will be substantially the same as the shape and area of each tailored gore of said majority in projection when the resulting off-size balloon is fully inflated, whereby the off-size balloon may be made with the same supply roll of film and the same tailored gore pattern used in the making of the smaller stock size balloon and will have a substantially natural shape when carrying a predetermined off-weight load greater than that which the smaller stock size fully tailored natural shape balloon is designed to carry.

References Cited in the file of this patent

UNITED STATES PATENTS

2,703,769	Stinger et al.	Mar. 8, 1955
2,880,946	Froehlich	Apr. 7, 1959