Nov. 5, 1963 P. E. YOST 3,109,611

BALLOON SEAM STRUCTURE AND METHOD OF SEALING BALLOON MATERIALS

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FIG. 1

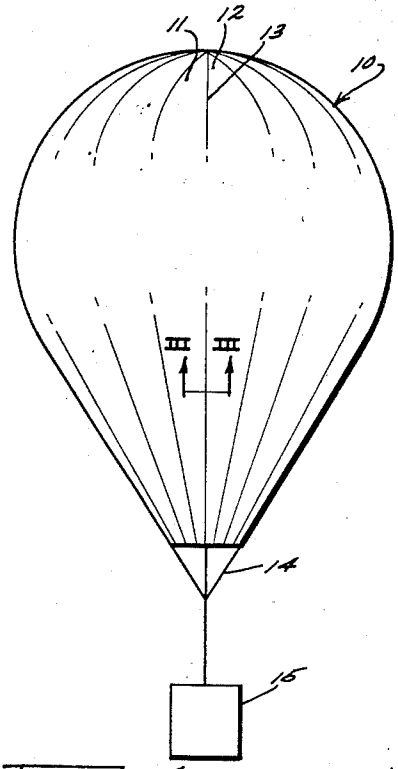


FIG. 2

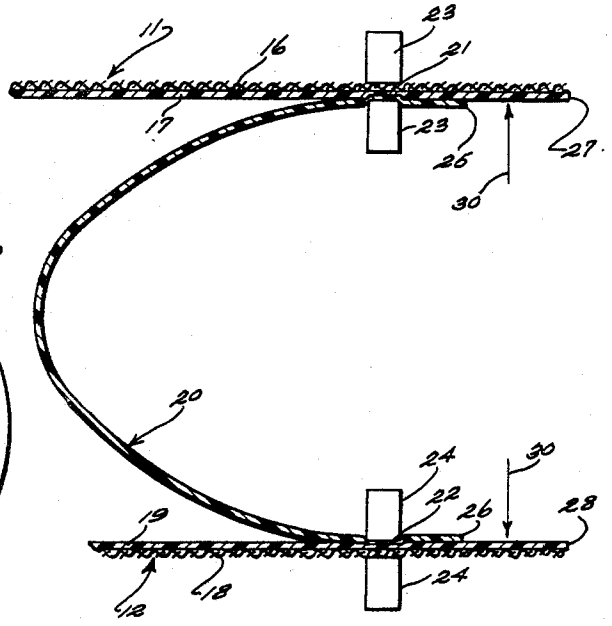


FIG. 3

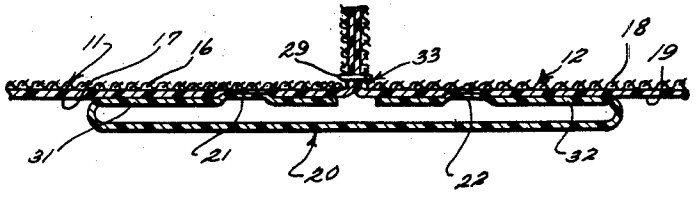
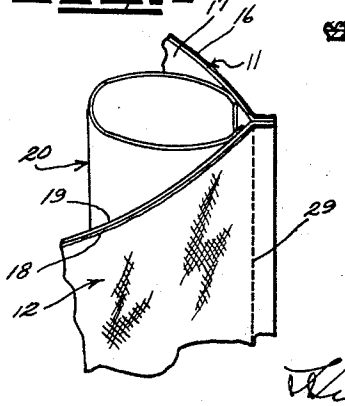


FIG. 4.



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BALLOON SEAM STRUCTURE AND METHOD OF SEALING BALLOON MATERIALS

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The present invention relates to improvements in balloons and more particularly to a ballon seam structure which permits the attachment of adjacent sheets or gores of a ballon by stitching without the leakage of gas through the stitched seam.

The present invention contemplates the provision of a balloon formed of a material which is resistant to scuffs and abrasions by contact with objects, has a good tensile strength, and yet is light in weight and impervious to the escape of gas. Thin lightweight plastics are desirable for balloon materials because of their gas impervious and lightweight properties, and because successful gas impervious seams can be easily made such as by using heat seals between gores or sheets of the balloon material. The materials are however easily punctured or torn. Fabric materials are scuff resistant and have a good tensile strength but are quite porous to gas and are not conveniently seamed to provide a joint which will not leak gas. A feature of the present invention is the provision of a ballon structure utilizing the advantageous properties of these different materials by combining them, and providing a seam of a unique nature which permits the adjacent sheets or gores of combined material to be simply and quickly joined to provide a strong but gas impervious seam.

Accordingly, it is an object of the present invention to provide an improved balloon structure with a balloon envelope material that is puncture and tear resistant so that it can be used in adverse circumstances and is rugged and durable for reuse, and is impervious to the leakage of gas.

A further object of the invention is to provide an improved seam for joining adjacent sheets or gores of balloon material formed of layers of scuff resistant fabric and gas impervious thermoplastic wherein the seam has a tensile strength approaching the strength of the fabric and has the gasproof integrity of the thermoplastic material.

A still further object of the invention is to provide an improved seam structure wherein adjacent sheets of balloon material can be sewn together and wherein an inner seam strip is provided opposite the sewn seam to prevent leakage of gas between the layers at the seam, to prevent gas from penetrating the seam gap, and to readily accommodate seams of different shapes.

A feature of the invention is to provide a seam for joining adjacent sheets or gores of balloon material having an outer fabric layer and an inner thermoplastic layer by sewing the sheets together to form a seam, providing an inner thermoplastic seam strip layer within the balloon heat sealed at its edges at each side of the sewn seam.

A still further object of the invention is to provide an improved method of forming a seam at the edges of ballon sheets or gores utilizing a seam strip.

Other objects, advantages and features will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiment thereof in the specification, claims and drawings, in which:

FIGURE 1 is an elevational view of a balloon of the type embodying the principles of the present invention;

FIGURE 2 is a greatly enlarged sectional view shown in somewhat schematic form illustrating a step in forming a seam between the gores of the balloon;

FIGURE 3 is a horizontal sectional view shown greatly enlarged and taken substantially along line III—III of FIGURE 1; and

FIGURE 4 is a fragmentary perspective view of a seam formed at the edge of gores, constructed in accordance with the invention.

As shown on the drawings:

FIGURE 1 illustrates a balloon 10 of the free floating type filled with a lifting gas wherein the balloon envelope is formed of a series of shaped gores 11 and 12 joined to each other by seams 13 at their edges. While in the preferred example a shaped gored balloon is shown, it will be understood that the balloon seam may be employed in various other ballons joining the edges of adjacent sheets of balloon material, such as in a balloon formed of non-shaped rectangular strip gores. The features of the seam also may be used to advantage in captive balloons as well as free floating balloons and can be used in balloons employed basically for load carrying functions such as for carrying scientific instruments aloft or can be used for man flight balloons.

Extending downwardly from the base of the balloon envelope are tapes or load lines 14 supporting a pay load 15.

The sheets or gores of the balloon, as illustrated by the two gores 11 and 12 in FIGURES 2 and 3 are formed of plural layers with the outer layer being a scuff resistant fabric 16 and 18 for the respective gores. The cloth or fabric may be various suitable materials, having a scuff resistance and tensile strength and being of a light weight, such as nylon, Dacron, Orlon, polypropelene or other plastic or cotton materials. The inner layers 17 and 19 of the gores are of a gas barrier film preferably thermoplastic such as polyethylene, Mylar or other suitable lightweight gas impervious material. The layers 16 and 17, and 18 and 19 are preferably joined such as by a thermoplastic cement but need not be firmly bonded, although they may be laminated so as to be non-separable or in some instances can be formed of separate sheets superimposed upon each other. The inner layer forms a gas barrier and need not contribute tensile strength and therefore can be very thin and lightweight, while the outer layer provides the tensile strength and abrasion resistance for the balloon envelope, thereby avoiding the vulnerability to punctures and rips that is present with a balloon envelope made solely of thermoplastic material.

For seaming the edges of the gores, they are positioned as illustrated in FIGURE 2, and a narrow seam strip 20 is positioned therebetween.

The seam strip is doubled so that it edges 25 and 26 project in the same direction as the edges 27 and 28 of the gores. The seam strip is a lightweight thin gas impervious film such as a thermoplastic, and can be polyethylene, Mylar or conveniently of the same material as the inner layers 17 and 19 of the balloon gores.

The edges of the seam strip 20 are joined to the inner surfaces of the gores by strip seams 21 and 22, FIGURES 2 and 3. This can conveniently be done by heat sealing devices shown at 23 for the seam 21 and at 24 for the seam 22. The heat sealing devices may be of known types such as rollers or heated air sealers such as used for joining thermoplastic balloon materials.

The edges of the gores are next joined by sewing with a thread to form stitching 29, to form an envelope seam, as illustrated in FIGURES 3 and 4 in the finished form with the stitching being applied at the locations indicated by the arrows 30 in FIGURE 2. The stitching can be easily accomplished by a sewing machine after the edges 27 and 28 are brought together, and the entire seam may be formed in a single operation, in a single pass through a machine. Also, for long balloon gores, a carriage may be provided supporting heat sealing equipment ahead of

a sewing machine with the carriage running along the edges of the gores.

The thread for forming the stitches 29 may be any suitable thread, light in weight and having adequate tensile strength so that the sewn seam holds together the adjacent fabric gores with a strength approaching the original strength of the fabric. Lateral pulling on the seam may tend to spread the threads and separate the layers at the seam, but this is of no consequence insofar as the gas integrity of the seam is concerned inasmuch as the escape of gas is positively prevented by the inner seam strip 20 which lies along the inside of the balloon in the manner shown in FIGURE 3.

FIGURE 3 illustrates the condition of the seam in the balloon when the balloon is inflated to form the balloon envelope. The flexible seam strip 20 will conform to the shape of the seam and the doubled over ends 31 and 32 and seams 21 and 22 will form a gas barrier. The extra strip material against the gores aids in maintaining the integrity of the seals 21 and 22 and the spreading of the gores is not acting to separate the seals 21 and 22. Therefore no leakage will occur and a gastight joint is provided.

While the preferred structure is illustrated, it is possible to use other means for supporting and sealing the envelope seam strip 20 in place over the seam 33 formed by the stitching 29. In some instances, it is also possible to lay the seam strip flat against the inner surface of the balloon envelope without the doubled over arrangement illustrated in FIGURE 3. While not essential, it is advantageous to use an abundance of strip material between the seams 21 and 22 so that the material can bulge and fold freely against the seam 33 without stress. In other words, the width of seam strip material 20 between the seams 21 and 22 is greater than the distance between the seams 21 and 22 to provide a bulging of material preventing stresses on the materials.

It will be noted that in addition to providing a seal at the seam 33 the seam strip 20 prevents gas from directly penetrating between the threads. In some instances the seam strip will provide insulation if the outer skin is hot or cold relative to the gas within the balloon envelope.

Thus it will be seen that I have provided an improved balloon and balloon seam structure which meets the features, objectives and advantages above set forth. The seam is rapidly and easily made, and permits full utilization of the advantages of balloon material formed of combined fabric and gas impervious thermoplastic.

It will be understood that the sewn seam is not to be limited to the precise arrangement illustrated, although advantages are obtained in a strong seam which is simply made, but other seams of different sewn structures or seams not sewn may be employed.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

I claim as my invention:

1. A balloon construction comprising a balloon envelope having an outer layer of fabric material with a relatively high tensile strength, an inner layer of non-porous gas impervious material coextensive with the outer layer, a thread-stitched seam joining adjacent edges of the combined inner and outer layers to form a balloon envelope, a strip of non-porous gas impervious material within the balloon over said seam inhibiting the leakage of gas therethrough, and gas impervious strip seams joining the strip to the inner layer at each side of said stitched seam.

2. A balloon construction comprising a balloon envelope having an outer layer of fabric material with a relatively high tensile strength, an inner layer of a thermoplastic non-porous gas impervious material coextensive with the outer layer, a stitched seam joining adjacent edges of the combined inner and outer layers to form a balloon envelope, a strip of lightweight thin thermoplastic material within the envelope over said seam inhibiting the leakage of gas therethrough, and vertical gas impervious continuous heat seals forming strip seams attaching the strip to the inner layer at each side of the stitched seam.

3. The method of forming a seam between adjacent sheets of balloon envelope material with a seam strip comprising positioning one sheet over the other with the edges projecting outwardly in the same direction, doubling the seam strip and positioning it between the sheets with the edges projecting outwardly, forming first and second strip seams joining the edges of the strip to the sheets, and subsequently joining the edges of the sheets.

4. In a balloon envelope having a seam joining adjacent portions of balloon material, a strip of gas impervious material positioned over the envelope seam, and strip seams attaching the strip to the balloon material at each side of said envelope seam with said strip having a greater width between the strip seams than the width of balloon material between said strip seams for an excess of strip material over said envelope seam so that the strip will fold when pressed against the envelope seam, said width of strip material between said strip seams being sufficient so that space exists between the inner surface of the envelope seam and the strip when the strip is not pressed against the seam from pressure within the balloon envelope and so that the strip is not stressed in the direction of balloon material when forces on the balloon material stress said envelope seam.

5. The method of forming a seam between adjacent first and second sheets providing layers of balloon envelope material having inner and outer surfaces and a length of strip material comprising positioning first and second layers formed by the edges of the strip material adjacent the respective edges of the sheet layers against said inner surfaces of the sheet layers with the edges of the strip layers extending in the same direction as the edges of the sheet layers and joining the layers to form an envelope seam so that the strip will straddle said envelope seam when the sheet layers are drawn apart to be coplanar.

6. A balloon construction comprising a plurality of gores of material each joined to an adjacent gore by a stress sustaining gas pervious envelope seam to form a balloon envelope, and seam strips within the balloon envelope positioned over the envelope seams and each joined to the gores by a gas impervious seam to lie against the inner surface of the stress sustaining envelope seam and inhibit the leakage of gas through the envelope seam, said seam strips being substantially relaxed so that no stress is placed on the gas impervious seams when forces are applied on the gores and the envelope seams are stressed, and the strips are freely pressed against the inner surface of the balloon envelope with gas pressure therein.

7. In a balloon envelope having a gas pervious stress sustaining balloon envelope seam joining adjacent portions of balloon material, a layer of gas impervious seam barrier material positioned over the balloon envelope seam, and a supporting means for supporting said layer in place over the seam so that said barrier material forms a gas barrier against the inner surface of the balloon material at the sides of the envelope seam to inhibit the leakage of gas through the envelope seam, said layer being substantially relaxed so that no stress is placed on the supporting means when the envelope seams are stressed and the layer is freely pressed against the inner surface of the balloon envelope with gas pressure therein.

8. A balloon envelope having a longitudinal balloon envelope seam joining adjacent portions of balloon material, a layer of seam barrier material positioned over

said balloon envelope seam, portions at the edges of said seam barirer material turned under and free of attachment to the envelope material adjacent the edges of the turned under portions so that the barrier material is free of stresses in a lateral direction, and means for supporting said layer of barrier material in place over the envelope seam to inhibit the leakage of gas through the seam, said layer being free of stress in said lateral direction along the balloon material when forces are applied to said adjacent portions and the seam is under stress, and said layer freely pressed against the inner surface of the balloon envelope with gas pressure therein.

9. A balloon construction comprising a plurality of vertically extending balloon gores each joined to an adjacent gore by a gore seam to form a balloon envelope for containing a lifting gas, a vertical horizontally narrow strip over each of said seams within the balloon to prevent leakage through the seam, and means for supporting said vertical strip on the inner surface of the balloon, said narrow strip being free of stress in the direction of balloon gores when the balloon seam is stressed and said strip being freely pressed against the inner surface of the ballon with gas pressure within the balloon.

10. In a balloon envelope, adjacent sheets of balloon material joined by a balloon seam capable of withstanding tensile stresses on said sheets, and a layer of material positioned over said seam joined to said sheets by gas proof seams incapable in itself of sustaining said tensile stresses and being impervious to gas, said layer being relaxed and unstressed and said gas proof seams being unstressed when said balloon seam is stressed and said layer freely pressed against the inner surface of the balloon envelope with gas pressure therein.

11. In a balloon envelope, a seam structure comprising adjacent sheets of balloon material joined by stitching forming an envelope seam securing the edges of the sheets together, and a seam strip against said seam on the inner surface of the balloon having side edges turned inwardly beneath the strip against the balloon material with said seam strip held against the envelope seam by pressure within the balloon, said turned under side edges providing excess material so that said strip is unstressed in the direction of balloon material when said envelope seam is stressed.

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