Sept. 25, 1956 D. F. MELTON 2,764,369

BALLOON WITH ATTACHED INFLATION TUBE

Filed Oct. 15, 1953 2 Sheets-Sheet 1

Fig 1

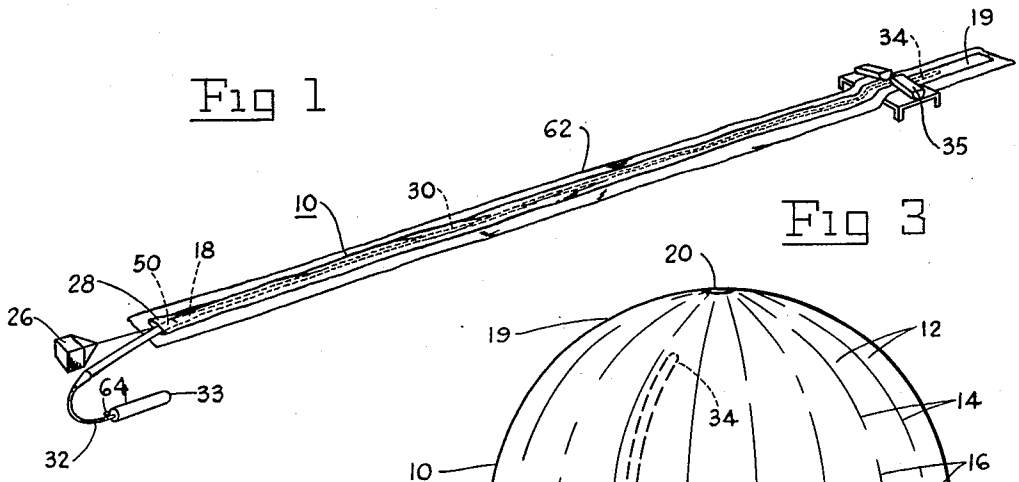


Fig 3

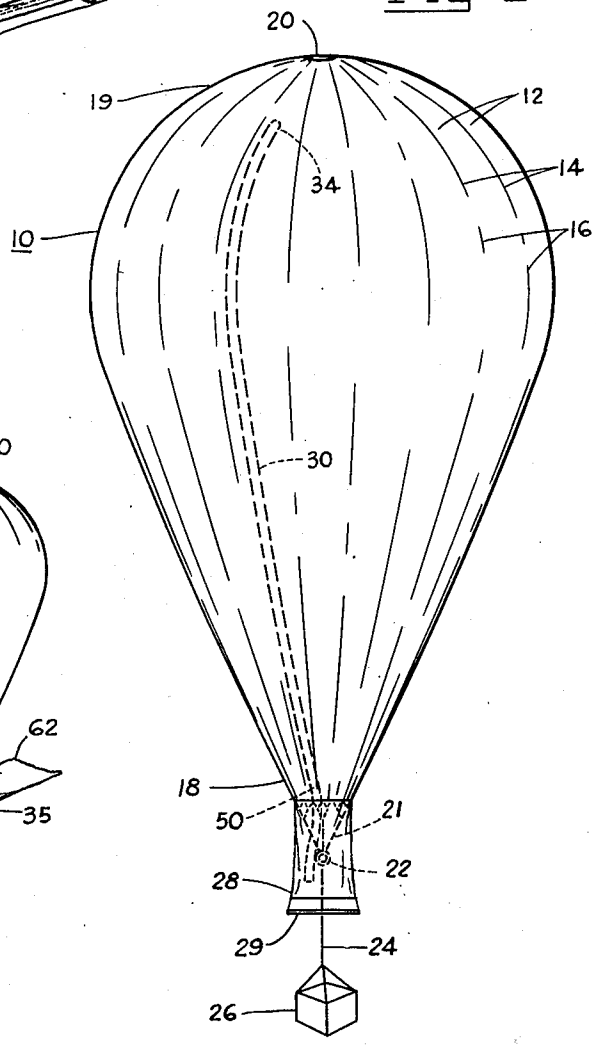
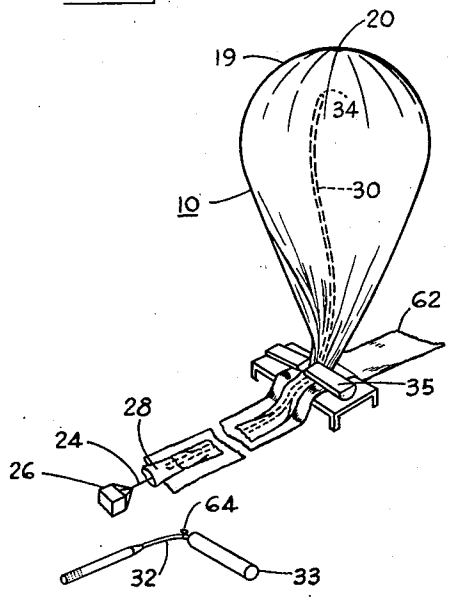


Fig 2



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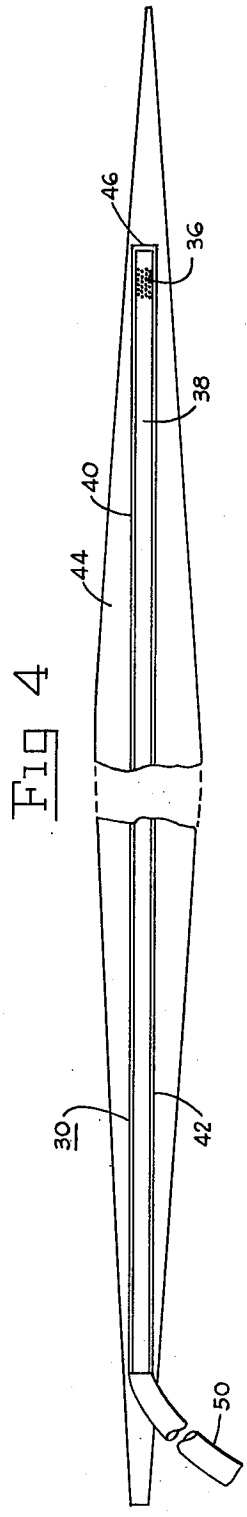


Fig 4

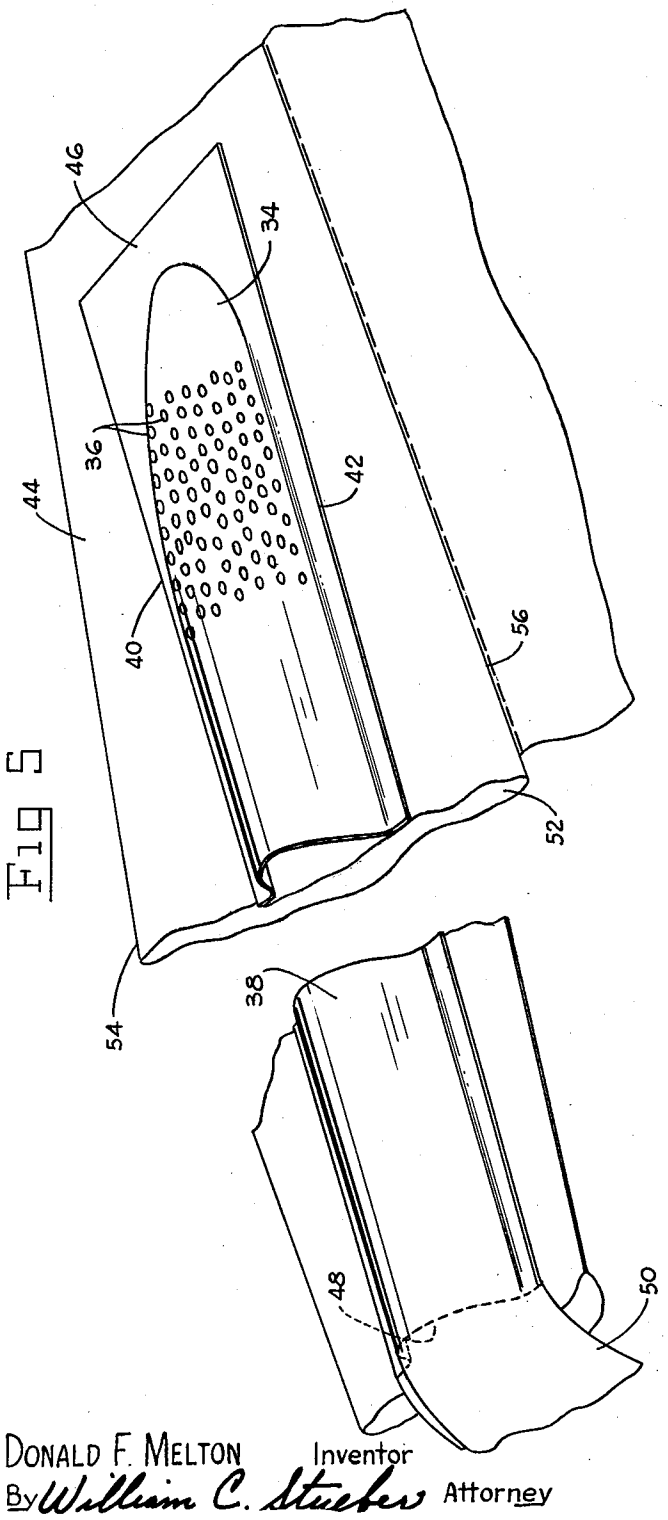


Fig 5

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BALLOON WITH ATTACHED INFLATION TUBE

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Application October 15, 1953, Serial No. 386,217

9 Claims. (Cl. 244—31)

The present invention relates to improvements in balloons and methods of inflating balloons.

Balloons which are capable of carrying large payloads and which have very high attainable altitudes are, of necessity, very large in size. These large balloons often become ponderous to handle during inflation and launching. Their size is especially inconvenient during inflation which usually must be done in the open and even small breezes cause shifting and displacement of the balloon stressing and twisting the anchoring and inflating apparatus.

In an effort to reduce the effect of winds and permit the balloon to be inflated properly, inflation tubes have been used which extend up through the length of the balloon to channel the inflation gas to the top end. With the balloon thus inflated, a bubble of gas is first formed at the top end thus permitting the remainder of the balloon to remain lying flat on the ground. A relatively small bubble of gas at the top end constitutes the full inflation of a high altitude balloon since when it ascends to the stratosphere the small bubble of gas will expand to completely fill the balloon due to decreased atmospheric pressure. For launching, the bubble of gas is released and it ascends picking up the remainder of the balloon from the ground.

This system of inflation with an inflating tube solved many of the problems of launching but was not without difficulties. Before launching the inflation tube normally had to be withdrawn from the balloon. This was often difficult in that the tube was extremely long and would catch in the folds of the balloon and was generally hard to handle. Further removal of the tube would consume time during which the inflated bubble had to be restrained against its lifting effort and against effects of winds. To leave the inflation tube in the balloon was impractical since during flight it would sag down and often clog the appendix.

Another difficulty encountered in using an inflation tube for inflating was that during handling the tube would become twisted or pinched and would not admit a flow of gas with the possibility of its bursting. It was virtually an impossibility to straighten out a twist within the flat balloon since the tube was covered with the multiple folds of the balloon which were difficult to handle and the twist in the tube was hard to locate.

Often during inflation the free end of the inflation tube emitting gas would develop oscillation and whip within the balloon possibly tearing the balloon. If the inflation tube were directed directly against the wall of the balloon, the impact of the escaping gas could also tear the balloon wall. This danger was enhanced by the fact that the gas, as it was released from the high pressure of its confining container, was chilled thus chilling the plastic material of the balloon which often lowered its strength.

An object of the present invention is therefore to present a balloon structure combined with an inflation tube and a method of inflating a balloon using an inflation

tube which will completely obviate the above inherent difficulties.

Another object of the invention is to create a balloon structure having an inflation tube which could be launched and flown with the balloon without danger to the balloon or without the possibility of the tube collapsing in the balloon during flight and stopping the appendix.

Another object of the invention is to create a combination balloon and inflation tube wherein the tube is always properly oriented within the balloon and cannot twist or double before or during inflation so as to create a stoppage to the flow of gas, or which cannot damage the balloon by the whipping of the free uncontrolled end during inflation.

A further object of the invention is to provide a method of manufacturing a balloon and inflation tube together, attaching the inflation tube to the balloon in such a manner that it will not unnecessarily stress the balloon wall either during inflation or during flight.

Other objects and advantages will become apparent in the following specification and appended drawings in which:

Figure 1 is a front elevational view illustrating the balloon before inflation;

Fig. 2 is a front elevational view illustrating the balloon on the ground after inflation and before launching;

Fig. 3 is a front elevational view illustrating the balloon having ascended to a high altitude;

Fig. 4 is a plan view showing the details of the attachment and construction of the inflation tube; and,

Fig. 5 is a perspective view showing the details of the arrangement of balloon gores and the inflation tube.

The balloon structure embodying the preferred form of the invention is illustrated as fully inflated in Fig. 3. In the figure the balloon is floating near its maximum altitude and has become fully inflated by the expansion of the gases within. Tht balloon **10** shown has a gas containing envelope formed of a series of shaped gores **12** which extend the length of the balloon from the lower end of the balloon to the top. The general shape of the gore is shown in Fig. 4, extending from a wide portion at the center and tapering to narrow portions at the ends. With this shape a plurality of gores positioned adjacent each other with their adjoining edges seamed will form a balloon with a spherical top tapering to a conical shaped bottom. By the proper shaping of the gores the desired shape of balloon envelope can be obtained and generally a teardrop shape, as described above and as shown in Fig. 3, is desired because of its low air resistance, and other considerations such as load supporting and strength factors.

For high altitude flights the balloons must have the quality of being light in weight without sacrifice of strength and must also have a low permeability to gas. Thin plastic sheet material suitably meets the above conditions. A thermoplastic material, for example, can form gores which may be readily joined to other gores by heat sealing and the gores **12** of the balloon are joined along seams **14** (covered by tapes **16**) formed by a heat seal or weld. Additional strength is imparted to these seams by the tapes **16** which cover the seams and extend down to the lower end **18** or apex of the balloon envelope to support the balloon although these tapes are principally employed to support and distribute the weight of the payload **26**. At the top end **19** of the balloon where the ends of the gores meet, a cap **20** is attached to join the ends of the gores.

The tapes may extend downwardly beyond the lower end **18** of the balloon or be joined by other tapes **21** to connect to a load ring **22**. A load line **24** extends from this load ring to support the payload **26**. At the apex or lower end of the balloon **18** is a valve **28** which closes

to retain the gas within the balloon and prevent the entrance of air but which permits the escape of the gas if the pressure rises above atmospheric. This valve is often referred to in the art as a "bronx cheer" appendix. The appendix may be of any desired design and a common appendix consists merely of a skirt or a tubular section of material held flat at its lower edge **29** to act as a valve permitting gas to escape but preventing air from entering. The appendix **28** is either taped or heat sealed to the balloon. The load line **24** must pass through the appendix but its lower flattened edge **29** presses tightly around the line to prevent the entrance of air into the balloon.

A high altitude balloon of the type shown may be extremely long in length extending for several hundred feet before inflation and when lying on the ground in the manner shown in Fig. 1. If inflation were accomplished by merely sending gas into the lower end **18**, the bubble of gas would lift up the lower end being wholly unsatisfactory since as it worked its way to the upper end **19** it would present broad target for the wind. Since the balloon is made of light weight material and is very large, it is relatively uncontrollable and damage may result from the wind. To avoid this, an inflation tube **30** is positioned within the balloon to carry the gas from the lower end **18** to the upper end **19**. To furnish a gas supply, a supply pipe **32** leads from a cylinder **33** of a compressed lifting gas. The supply pipe **32** is inserted in the lower end of the inflation tube **30** and the gas will be conducted through the tube along the length of the balloon to be discharged through the upper end **34** at the upper end of the balloon. The inflation tube is preferably larger than the supply tube to avoid any back pressure.

With inflation a bubble of gas will form at the upper end of the balloon lifting this end off the ground and the remainder of the balloon may remain flat on the ground unexposed to the wind. The inflated upper end is restrained by a launching device **35** which has arms which lock to hold the balloon and which are released for launching.

When the balloon is fully inflated for flight it has the appearance shown in Fig. 2. The total amount of gas is still small relative to the size of the balloon since this gas will expand to completely fill the balloon when it has risen to the lower air pressures of a high altitude.

The amount of gas in this small bubble is determined by the amount of free lift desired which determines the rate of rise. Too much gas cannot be used since there is a size limitation to the appendix valve **28** and if the gas must escape too rapidly during ascent after the balloon fills up, it may tear the end from the balloon.

To prevent the upper end **34** of the inflation tube **30** from whipping about during inflation due to the gas that escapes from it, it is secured to the balloon wall. The gas is not discharged directly against the balloon but is directed inwardly away from the wall through a plurality of perforations **36** (Fig. 5) which face toward the inside of the balloon. The direction that these perforations will point is insured since the inflation tube is fixedly attached to the balloon wall.

These perforations diffuse the gas into a multiplicity of small jets none of them being large enough so that it could possibly damage the balloon even though the opposite wall of the balloon is lying against the inflation tube at the beginning of inflation.

Referring now to Figs. 4 and 5, the detailed construction of the inflation tube will be explained. The tube is formed of a long narrow strip **38** of material with the side edges **40** and **42** sealed to the balloon gore **44**. If the balloon is made of thermoplastic the strip of material may be heat sealed to the gore and is preferably made of the same material as the balloon. The end **46** of the strip is also heat sealed to the gore to close the end of

the tube in order that the gas will be allowed to escape through the perforations **36**.

The edge at the lower end of the strip is not attached to the balloon gore to leave an opening **48** which leads into a lower extension tube **50**. This lower extension of the inflation tube extends from the end of the inflation tube to the appendix opening so that the gas supply pipe may easily be attached to it by reaching into the appendix. The extension tube **50** is a short tubular length formed of the same material as the strip **38** and secured to the inflation tube by heat sealing its edges to the strip **38** and gore **44** in the manner shown in Figs. 4 and 5.

For inflating the balloon the supply pipe **32** leading from the cylinder **33** of lifting gas is inserted into the extension tube **50**. When inflation is completed the pipe is readily withdrawn from the tube extension **50** and the entire inflation tube **30** ascends with the balloon. Since the end of the tube extension **50** terminates short of the appendix edge **29**, the appendix closes sealing the opening of the balloon and the inflation tube does not interfere with the normal functioning of the balloon.

It will be seen that since the inflation tube is securely attached to the internal surface of the balloon, it remains in position during pre-inflation handling and during inflation, there are no opportunities for twists or doubled folds to occur.

The inflation tube, being securely attached to the inner surface of the balloon wall, remains in place during flight and has no opportunity to drop into the base of the balloon to clog the appendix. Since the inflation tube is made of the same material as the balloon, the additional weight added to the balloon and the additional expense of material consumed are relatively negligible.

A special construction is used to prevent any excessive stress and consequent damage to the balloon wall from the attachment of the inflation tube. To this end, a double wall is used in the balloon at the location where the inflation tube is attached, this being accomplished by the use of a double balloon gore.

As is shown in Fig. 5, the gore **44** to which the inflation tube is affixed is an inner gore, the main outer gore of the balloon being shown at **52**. The two gores are not attached except at their edges **54** and **56**, the edges **56** also being seamed to the edge of the adjacent gore **60**. The inner gore **44** which supports the inflation tube has free movement relative to the outer gore **52** and thus stresses which occur during inflation are not transmitted to the outer gore and its strength remains intact.

Reviewing briefly the steps of inflating and launching the balloon, the uninflated balloon is first stretched out flat on a protective ground cloth **62**. The pipe **32** leading from the gas cylinder **33** is inserted through the end of the appendix **28** and into the inflation tube extension **50**. The control valve **64** on the gas cylinder is opened and gas passes up through the inflation tube **30** being channeled the full length of the balloon to escape through the perforations in the upper end **34** of the inflation tube. As a bubble of gas begins to form in the upper end **19** of the balloon, it rises and is restrained by the arms of the launching machine **35**. When enough gas has been inflated into the balloon to give it the desired free lift, the gas pipe **32** is removed. The appendix **28** closes when the gas inflating pipe is withdrawn to prevent air from entering the balloon during flight. The arms of the launching machine are then released and the balloon ascends, the bubble at the upper end rising and picking up the uninflated portion of the balloon and payload. The inflation tube **30** remains in its fixed position all during the inflation and during launching and ascends with the balloon.

Thus it will be seen that I have provided an improved balloon structure which meets the objectives set forth earlier in the specification. The inflation tube which is attached to the balloon gore makes it unnecessary to

withdraw the tube after inflation and permits launching immediately after inflation has been accomplished.

The gas is channeled to the top of the balloon and is evenly distributed through the perforations at the end of the tube and no damage can occur to the balloon either by the free whipping action of the inflation tube or by the direct action of a large stream of cold gas against the balloon wall.

I have, in the drawings and specifications, presented a detailed disclosure of the preferred embodiment of my invention. It is to be understood that the invention is susceptible of modifications, structural changes and various applications of use within the spirit and scope of the invention and I do not intend to limit the invention to the specific form disclosed but intend to cover all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by my invention.

I claim as my invention:

1. A high altitude balloon comprising an elongated balloon envelope having an appendix opening and an elongated nonporous inflation tube situated within the balloon with one end being open and extending to the appendix opening for receiving lifting gas and with the other end being open and located at the top end of the balloon to discharge the lifting gas into the interior of the balloon, the inflation tube being secured to the balloon wall to prevent its displacement either during handling or inflating.

2. A high altitude balloon comprising an elongated balloon envelope with an appendix opening for accommodating the inflation and discharge of lifting gas, and a non-porous inflation tube extending from the appendix to the upper end of the balloon and attached to the balloon envelope wall with the upper end of the tube being provided with a plurality of gas diffusion holes for distributing the gas into the balloon interior.

3. A high altitude balloon comprising a balloon envelope with an appendix opening at its lower end for the inflation or discharge of lifting gas, and an elongated non-porous inflation tube extending from the appendix to the top of the balloon and being attached along its length to the interior of the wall of the balloon to hold it in place during handling and inflation of the balloon, the inflation tube having an opening at its upper end for distributing gas into the top of the balloon and an opening at its lower end for receiving a lifting gas supply.

4. A high altitude balloon comprising a balloon envelope with an appendix opening, and an elongated flat strip of material extending within the balloon from the appendix and attached at its side edges to the interior of the balloon wall, the elongated strip of material forming a conduit for channeling the gas from the appendix to the interior of the balloon and retaining its position within the balloon during inflation and flight by its attachment to the balloon wall.

5. A high altitude balloon comprising an envelope formed of a plurality of gores attached to each other at their adjoining edges to terminate at one end in a closed

end of the balloon and at the other end in an appendix, one of said gores being double consisting of two layers, and an inflation tube extending from the balloon appendix into the balloon interior to receive a lifting gas at the appendix end and distribute it within the balloon, said tube being attached along its length to the inner layer of the double gore to maintain the tube in position within the balloon and yet transmit no appreciable stress to the outer layer of the gore.

6. A high altitude balloon comprising a balloon envelope with an appendix opening at one end, and an inflation tube within the balloon formed of an elongated flat strip of material attached at its side edges to the interior of the balloon wall and extending from the balloon interior to terminate short of the appendix to form a conduit for conducting gas to the interior of the balloon, and a cylindrical tube connected at one end to the opening formed at the juncture of the lower end of said strip and balloon wall with the other end extending to the appendix opening for receiving a lifting gas supply during balloon inflation.

7. The method of making a balloon which comprises forming the balloon envelope of a gas-retaining thermoplastic material and providing an appendix opening in the envelope, and attaching an elongated inflation tube to the inner surface of the balloon wall by heat sealing the thermoplastic tube to the thermoplastic balloon wall.

8. The method of forming a balloon comprising shaping a series of elongated gores, positioning a series of the gores in edge to edge relationship for securing the adjoining edges, securing an inflation tube to a gore in a position substantially parallel to the gore so that the gore will support the tube, and doubling one of said series of gores by placing said supporting gore in juxtaposition to it to form a double gore with the inner gore supporting the inflation tube and both gores forming part of the balloon, and attaching the adjoining edges of the gores to form a completed balloon envelope.

9. The method of making a high altitude balloon which comprises forming a plurality of elongated balloon gores, attaching an elongated flat strip of material to the base of one of said gores to extend substantially parallel to the gore by securing its side edges to the gore surface to form a conduit for lifting gas, securing a tube to the opening formed by the juncture of the lower end of said strip of material and the balloon gore to form an extension of said conduit, and positioning the gores in edge to edge relationship and securing the gores to each other at their adjoining edges to form the balloon envelope.

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