The present invention pertains to an inflatable fabric segment or structural element and the process for making the same. More particularly, the invention is concerned with a method of fabrication as well as a form of inflatable structure made in accordance with the method entirely from fabric which has been coated or treated to render it impervious to gas and which is capable of assuming a curved configuration upon inflation.

For certain specific uses of more or less temporary nature, structures fabricated from water-proofed canvas or rubberized fabrics and having the ability to be quickly and easily constructed and disassembled have proven highly advantageous. Such conventional structures, however, usually require some means by which the canvas or fabric is suspended or supported in the form which it is to assume, depending upon the use to which it is put. These supports are usually rigid and often quite bulky, as a result of which they are difficult to handle, store, and transport. In addition, such supporting or suspension means present obstructions whether disposed interiorly or exteriorly of the structure when constructed.

The present invention contemplates a form of structural element which will incorporate not only the framework or supporting structure, but also the confining walls well in a single unit. This novel construction provides a structural member which eliminates virtually all of the problems encountered in the aforementioned conventional structures. Moreover, the product of the present invention possesses the features of rigidity and ease of storage and erection not found in the ordinary forms of structure.

There are many places where not only avoidance of rigid supporting means is desirable, but also curved or cylindrical surfaces can be employed to better advantage than flat or planar surfaces which must necessarily be angularly joined together to form most structures. The curved configuration of the fabric segment or structural element disclosed herein is highly advantageous in avoiding sharp or angular joints. The curved configuration of the fabric segment moreover affords a highly advantageous structural shape which possesses greater strength characteristics. Thus, it is an object of the present invention to provide a form of inflatable fabric segment or structural element which possesses the aforementioned attributes by reason of its ability to assume a curved configuration upon inflation.

It is a further object of the present invention to provide a method of forming an inflatable fabric segment or structural element characterized by a curved configuration on inflation.

Other objects and advantages of the invention will become apparent as a detailed description of one embodiment of the invention proceeds.

Fig. 1 of the drawings represents a vertical cross-section through an inflated flat fabric segment illustrating a form of conventional structural element.

Fig. 2 illustrates a vertical section through a typical curved fabric segment embodying the teachings of the present invention.

Fig. 3 is an enlarged fragmentary section corresponding generally to that shown in Fig. 1.

Fig. 4 is a fragmentary plan view of the top ply of the fabric segment.

Fig. 5 corresponds to Fig. 4, but illustrates the bottom ply of the fabric segment.

In Fig. 1 of the drawings is shown one form of fabric segment, indicated generally by the reference numeral 1, constructed from two spaced plies of fabric 2 and 3 which are joined together in the weaving operation by means of a plurality of drop or tie threads 4. The fabric segment 1 is conveniently formed into an envelope by joining the ends and edges of the fabric plies 2 and 3 by means of the tapes 5 and 6 which are securely cemented in place about the entire periphery of the fabric segment 1.

The outer or exposed surfaces of the fabric plies 2 and 3 are customarily coated with some suitable gas-impermeable coating such as, for example, natural or synthetic rubber and the like. The tapes 5 and 6 which cooperate with the fabric plies 2 and 3 to form an envelope are made from a fabric which has been previously coated with rubber or impregnated with a material which will serve to retain gas under pressure in the chamber 7 of the fabric segment 1. Although, many other coating and impregnating materials are known and could be used for the purpose of rendering the walls of the fabric segments impervious to gas under pressure, the coating which possesses all the desired characteristics and which has been chiefly employed is rubber and may be of either natural- or synthetic origin.

For many purposes, the flat form of fabric segment 1 has certain disadvantages as we have already seen. To overcome these disadvantages, the fabric segment 8 of Fig. 2, comprising a top fabric ply 9 and a bottom fabric ply 10, has been devised. The fabric segment 8 allows for extensibility of the top ply 9 along the larger radius of the curved section and is characterized by a smoothly curved configuration upon inflation with the degree or extent of curvature being readily controllable. Herefore, in order to produce a curvature in a flat fabric segment such as the segment 1, it has been the practice to take a series of folds or tucks in the fabric ply 3 along the smaller radius of the desired curved section. Such folding or tucking creates a break line in the fabric segment 1, tending to weaken it and frequently interferes with the freedom of the tie threads 4 and, as a result, does not produce a satisfactorily unimpeded fabric segment 8.

Referring to the fabric segment 8 of Fig. 2, the fabric top ply 9 is woven from warp and weft threads 11 and 12, respectively, which are of untreated synthetic origin such as, for example, raw nylon which has not been tensilized, so that when subjected to heat and tension, will extend or stretch. The fabric bottom ply 10 is woven from threads 13 and 14 which are of tensilized nylon and have been rendered substantially inextensible before being converted into the fabric. The bottom ply 10 which is joined to the top ply 9 in the weaving operation by a large number of drop or tie threads 15 which are also substantially inextensible.

After the fabric top and bottom plies 9 and 10 joined by the tie threads 15 have been fabricated, the outer surfaces of the plies are coated with some suitable gas-impermeable coating 16, 17 such as, for example, natural or synthetic rubber and the like. Next, the edges and ends of the fabric segment 8 are joined together by the tapes 18 and 19 of coated or rubber impregnated fabric to form an gas-impermeable envelope enclosing the chamber 20 as shown in Fig. 2. Many different forms of coating and impregnating material may be used for the purpose of rendering the walls of the completed fabric segment 8 substantially completely impervious to gas under pressure.
Rubber of either natural or synthetic origin has proven most satisfactory as a coating material.

The completed fabric segment 8 is then inflated and subjected to heat in the range of approximately 275 to 300 degrees Fahrenheit, at which the coating material, in this instance, rubber, is set or vulcanized. This temperature range corresponds generally to the softening point for the untreated synthetic threads 11 and 12 from which the top ply 9 of the fabric segment is fabricated. Thus, the temperature and pressure cause to soften the untreated threads 11 and 12 and cause them to extend or stretch while the treated threads 13 and 14 in the bottom ply 10 of the fabric segment 8 remain unaffected.

With the anchoring effect produced by the fabric construction embodying the substantially inextensible threads 13 and 14 of the bottom ply 10 and tie threads 15, the extension of the top ply 9 will cause the fabric segment 8 to assume the smooth curved configuration illustrated in Fig. 2. The fabric segment 8 is capable of assuming the predetermined degree of curvature originally imparted to it. It may be originally formed into a cylinder or any intermediate arcuate form of structure, if desired. These forms of fabric segments afford greater rigidity and strength characteristics without sacrificing the adaptability of the material.

Whenever the gas is released from chamber 20 of the fabric segment 8 through a tube or conventional valve unit (not shown) which may take the form of a tire inflating valve, the entire element will collapse into a conveniently small and compact bundle. This structure with its curved configuration is capable of extensive use in all types of temporary buildings, shelters, forms, flotation elements, supporting structures, and the like.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

We claim:
1. An inflatable fabric segment capable of assuming a curved configuration upon inflation, said fabric segment comprising a double ply construction in which the plies are substantially superposed and joined together by a plurality of substantially inextensible tie threads woven partially into each of the plies for restricting the extent of separability of the plies, one of said plies being woven from untreated raw nylon threads and the other being woven from treated and prestressed nylon such that on being subjected to heat and pressure the first ply will be stretched and the other will remain unaffected; and a vulcanized rubber coating applied to the outermost surfaces of each ply.

2. The method of making an inflatable fabric segment capable of assuming a curved configuration upon inflation comprising the step of weaving a double ply fabric in which the plies are disposed in substantially superposed relation, being joined together by a plurality of substantially inextensible tie threads woven partially into each of the plies, one of said plies being formed of threads which, when subjected to heat and tension, will stretch to a predetermined extent and the other being formed from prestretched threads incapable of further extension; coating the outermost surfaces of each ply with a gas impervious coating; and inflating the double ply fabric segment and subjecting to heat while inflated to set the coating and simultaneously stretch the previously unstressed ply of fabric, whereby a segment of curved configuration is formed.

3. The method of making an inflatable fabric segment capable of assuming a curved configuration upon inflation comprising the step of weaving a double ply fabric in which the plies are disposed in substantially superposed relation, being joined together by a plurality of substantially inextensible tie threads woven partially into each of the plies, one of said plies being formed of untreated and unstretched nylon threads and the other being formed of prestretched nylon; coating the outermost surfaces of each ply with a vulcanizable rubber; and vulcanizing the coating and simultaneously subjecting the nylon to heat and tension, whereby a segment of curved configuration is formed.

References Cited in the file of this patent

UNITED STATES PATENTS

2,197,896 Miles Apr. 23, 1940
2,459,545 Schultz Jan. 18, 1949
2,474,124 Schultz June 21, 1949
2,637,716 Ford Nov. 3, 1953