Oct. 25, 1938. L. P. FRIEDER 2,134,362

PARACHUTE

Filed June 22, 1935

Fig. 1

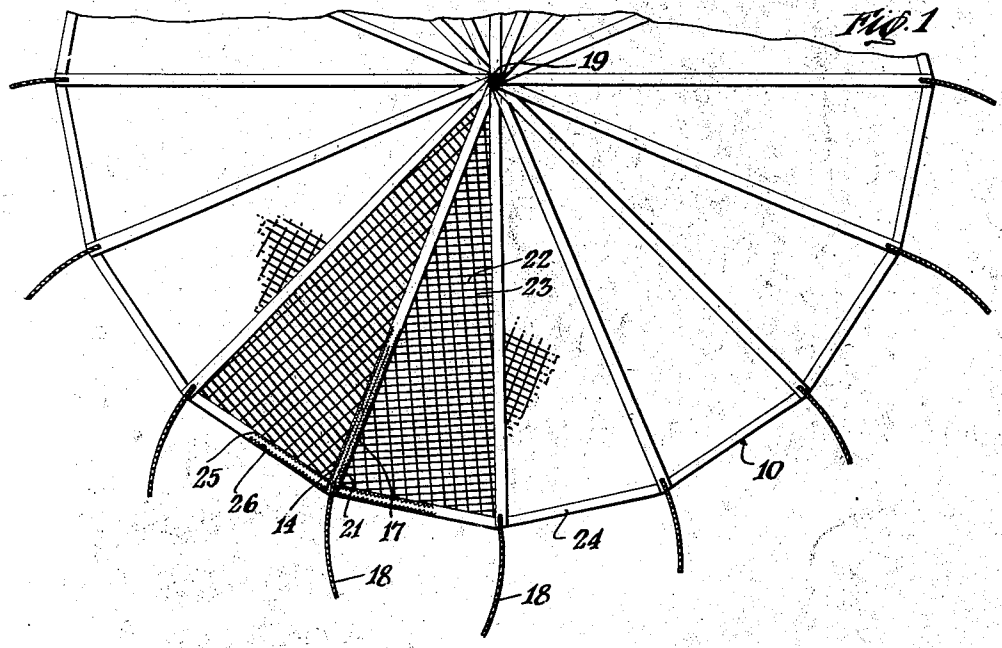


Fig. 2

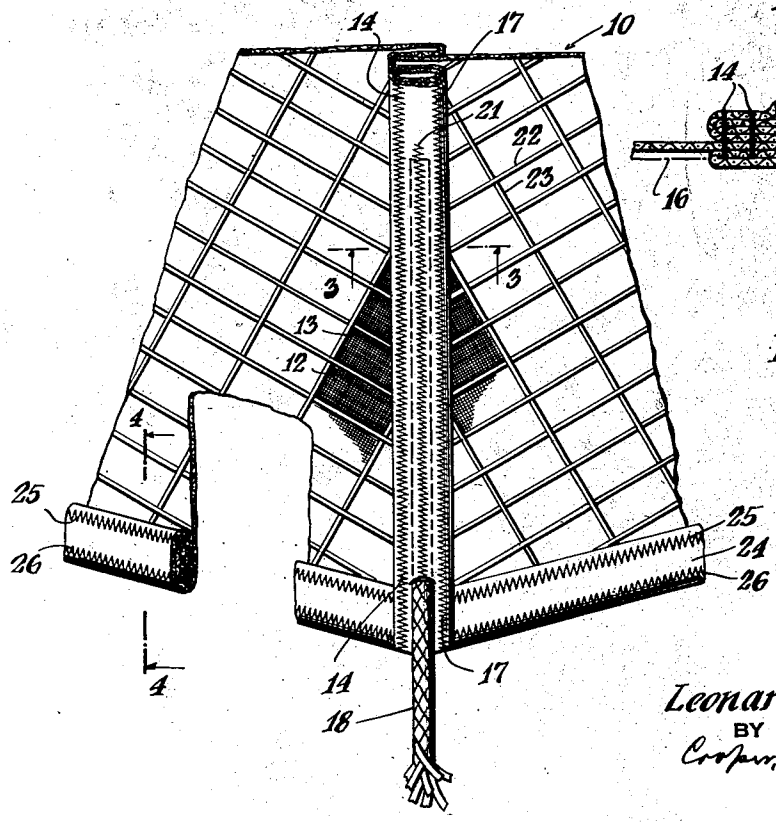


Fig. 3

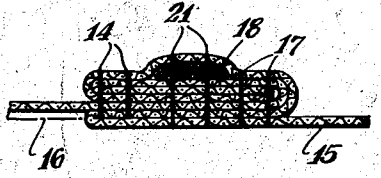
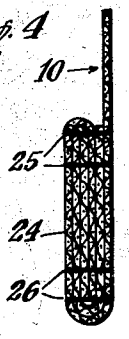


Fig. 4



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Patented Oct. 25, 1938

2,134,362

UNITED STATES PATENT OFFICE

2,134,362

PARACHUTE

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Application June 22, 1935, Serial No. 27,958

5 Claims. (Cl. 244—145)

This invention relates generally to parachutes, and has for its broad object the provision of a higher safety factor for size and weight of the parachute than any prior device of the kind known to the applicant.

Another and incidental object is to provide a construction in which, when the parachute is supporting a load, the load stresses are so distributed, particularly on the sail, that the danger of bursting the material of the sail is materially reduced. This is accomplished by so constructing the sail that it affords an elastic or yielding opposition to stresses in substantially all directions, as distinguished from prior constructions in which the stresses are opposed by substantially non-elastic or unyielding seams, hems and shroud lines, or in which the fabric is so disposed that radial and circumferential stresses are imposed upon the warp and weft of the fabric from which the parachute sail is made.

The foregoing objects are obtained by employing the sail fabric disclosed in copending application Serial No. 5,200 filed January 6, 1935, by the present applicant, to make a parachute sail composed of any desired number of gores, and cutting and sewing the gores together in such relative positions and in such a way that both the warp and the weft of the fabric run at a bias to any radius or to any truly circumferential line of the sail; the seams connecting the gores being so constructed that they can yield in substantially all directions up to rather high limits. As a result, stresses and strains are not localized upon any particular threads or cords, but all parts of the construction are available to absorb and distribute such stresses and strains through larger supporting areas than has heretofore been possible.

With the foregoing and other objects in view, the invention consists in a novel construction and assemblage of parts, the novel features of which are pointed out in claims appended hereto, and a satisfactory embodiment of which is illustrated in the drawing accompanying and forming a part of this specification.

In said drawing:

Fig. 1 is a diagram illustrating in top plan view the construction of the parachute sail and associated parts.

Fig. 2 is a diagram illustrating in detail the construction of one of the gore seams, the way in which a shroud line may be connected, the bias of the gore material and the construction of the hem of the sail.

Fig. 3 is a section along the line 3—3 of Fig. 2.

Fig. 4 is a section along the line 4—4 of Fig. 2.

Owing to the nature of the construction, all of the features are shown in diagrammatic form in the drawing. The material employed is thin and light in weight, and the seams and method of forming them from such material cannot be shown in actual size or even on an accurate scale in such drawing. The drawing is, therefore, to be considered as explanatory only and not as limiting the construction in any way except as stated in the claims.

As appears from Fig. 1, the sail 10 of the parachute is made up of a plurality of segments or gores. Any desired number of gores may be employed. It is preferred to use the fabric disclosed in the above mentioned application Serial No. 5,200, although other fabrics may be used if the advantages of that fabric are disregarded.

In cutting the fabric into gores the cutting is done on lines which cross both the warp threads 12 and the weft threads 13 at such angles that when the gores are secured together at their edges there will be no threads running either radially or circumferentially of the completed sail. This arrangement is illustrated in Fig. 2. As a result strains in any direction upon the sail gores will be opposed by both sets of threads without localized endwise strain upon the threads of either set. As a result the gores have great elasticity and stress absorbing capacity in all directions.

This characteristic is supplemented by so constructing the seams between the gores that they also can yield under load and with the material of the gores so that there is no localization of strain in the gore fabric at or adjacent to the seams. This is preferably done in the manner illustrated in Fig. 3. The material of two gores is placed face to face with their edges in alignment and the edges are then given a double fold as illustrated. One side of the fold is then stitched, as at 14, in a way to be described later, and the material 15 of one gore then folded back to the position shown in full lines (the previous position being shown by the dotted line 16) and the other side of the fold stitched as shown at 17. This completes the flat multiply seam which is preferred, with the stitches 14 and 17 separated for a purpose hereinafter made clear.

The stitches 14 and 17 are zig zag stitches penetrating through the material at the points represented by the points of the zig zag line representing each seam in the drawing. If the sewing is done by machine the lower or shuttle part of the stitch will present substantially the same appearance as the upper thread. The sew-

ing may, of course, be done by hand. Regardless of how it is done, the stitching forms a flat helix in the material which will yield lengthwise and laterally with the material while, at the same time, securing the edges together in such a way that the seam cannot rip.

Any desired number of shroud lines 18 may be used. If, as illustrated in the drawing, a number of narrow gores are used, some of the shroud lines may be omitted, for example, for every other gore seam. The shroud lines may extend the full length of the gore seams and be secured to a grommet or in any other desired way at the center 19 of the sail, or a single shroud line may extend from one edge of the sail, across the center of the sail to the other edge of the sail, as the shroud lines used are so constructed that they will stretch or yield with the seams. Where a minimum weight is desired the construction illustrated in the drawing may be employed, as it does away with a part of each shroud line, thereby reducing the total weight, and without impairing the safety factor for most uses. In the construction referred to one end of the shroud line is inserted as far as desired between two plies of the gore seam and then fastened in position by zig zag stitches 21 having substantially the same pitch as the zig zag stitches 14 and 17. The stitches 21 may run the full length of the gore, or they may run only from the end of the shroud line to the outer margin or edge of the sail, the latter construction being preferred. The opening to give access between plies of the gore seam for insertion of the end of the shroud line may be made in any desired way.

The cord or rope used for the shroud lines is of a loosely braided multi-strand construction capable of elongation under pull to about the same extent as the gore seams. This elongation is not interfered with by the stitches 21 holding the lines in place, as the zig zag stitch permits such elongation (and recovery when the pull is released) and with no danger of breaking the stitches. In addition, the braiding of the shroud lines is loose enough to permit flattening them when fastening them in position. This may be facilitated (and the stretching capacity regulated) by adjusting the cord endwise to loosen the mesh of the braid, although in a cord braided properly for the purpose such adjustment should not be necessary. Any desired material may be used for braiding the shroud lines, although silk is preferred because of its greater strength for a given size and weight, and because it is better adapted for applicant's purpose than stiffer or harder materials such as cotton, linen and the like. The individual strands used in braiding are preferably in the form of ribbons instead of round cords, the ribbon arrangement being less liable to cutting action within the braid and giving greater strength with greater capacity for elongation under stress.

As so far described, the parachute construction is extremely elastic in all directions and in all parts, so that stresses are not localized or concentrated in small areas or along sharply defined lines. As a result, the sail of this invention will safely support a heavier load than prior sails; or, to state it in another way, because of the much higher safety factor, danger of bursting under any reasonable load is substantially eliminated. In addition, the preferred fabric, with its woven in reinforcements 22 and 23, prevents accidental tears of sufficient length to interfere with the functioning of the parachute.

The hem 24 around the edge of the sail may be reinforced with a cord or tape, but it is preferred to use an elastic or yielding construction comparable to or coordinated with the elasticity or yield of the rest of the sail. With this in view, the edge of the sail is folded as illustrated in Fig. 4 and then secured by two rows 25 and 26 of zig zag stitches. Such stitches are, as before explained, in the nature of flat helixes capable of endwise and lateral movement with the fabric of the seam without rupturing or breaking the stitches or without the stitches interfering with the stretch or recovery of the seam fabric. This characteristic prevents any sharp concentration of stress along or adjacent to the seam, while, at the same time, because of the peculiar multi-ply construction, the hem is very strong and resistant to tearing or other damage.

The pitch for the zig zag stitching need not be determined with great exactness, but a pitch should be selected which is in conformity with the stretch of the fabric and seams. It is preferred to have the pitch the same for all seams, although the pitch for one seam may be different from the pitch for another, where there is a difference in the stretch of the two seams.

The zig zag stitching is shown and described because, as at present advised, that form of stitching is best for the purposes stated. However, any form of stitching which will permit endwise and lateral movement of the seam material without localizing strain upon the stitches is suitable for the purpose and is deemed to come within the scope of the invention.

As stated above, the fabric used for making the gores is thin and light in weight. It may be as low as one-half of an ounce or less per square yard for certain purposes, but for heavier duty thicker and stronger material may be used, or two or more plies or thicknesses of the light material may be used to make each gore. These multi-plies may be connected together at recurring points in weaving or, in order to make it easier to handle the plies in fabrication, the plies may be secured together in other ways as by basting or by an adhesive. It is preferred to use an adhesive which can be washed out after the sail has been assembled and sewed, but this is not essential.

While the constructions above referred to are all admirably adapted to fulfill the purposes primarily set forth, it is apparent that changes may be made in different respects, all of such changes coming within the scope of the following claims.

What I claim is:

1. In a parachute, a sail composed of gores of woven fabric cut on such angles that the warp and the weft are both on a bias with respect to any radius of the sail, said gores being connected together by seams comprising interfolded margins of adjacent gores secured by a plurality of rows of zig zag stitching along the seams and through the folds which is co-ordinated with the extensibility of the seams under load stresses imposed on the seams.

2. In a parachute, a sail composed of gores of woven fabric cut on such angles that both the warp and the weft are on a bias with respect to any radius of the sail, said gores being secured together by seams comprising multi-ply folds along the margins of adjacent gores, shroud lines between the plies of each seam, said shroud lines being so constructed as to have an extensibility coordinated with the extensibility of the folded

material in the seams, and zig zag stitching through the shroud lines and folds coordinated with the extensibility of the folded material and shroud lines for securing the shroud lines in place and maintaining the folds.

3. In a parachute, a sail composed of gores of woven fabric cut on such angles that the warp and the weft are both on a bias with respect to any radius of the sail, said gores being secured together by seams consisting solely of inter-folded gore material along the edges of adjacent gores and longitudinally extending rows of elastic stitches through the inter-folded material, and a hem around the sail consisting solely of a multi-ply fold of the gore material and rows of zig zag stitching through the fold.

4. In a parachute, a sail composed of multi-ply gores of woven fabric cut on such angles that the warp and the weft are both on a bias with respect to any radius of the sail, the gores being connected together by seams comprising inter-folded margins of adjoining gores secured together by a zig zag stitching co-ordinated with the extensibility of the folds under load stresses on the sail, a hem for the sail consisting of a plurality of folds of the gore material and a zig zag stitching correlated with the extensibility of the folded hem, and shroud lines attached to the sail at points where the seams terminate in the hem.

5. In a parachute, a sail composed of gores of woven fabric cut on such angles that the warp and the weft are both on a bias with respect to any radius of the sail, the gores being connected together by seams consisting solely of inter-folded margins of adjoining gores secured together by zig zag stitching along each edge of the inter-folded margins, a hem for the sail consisting solely of a plurality of folds of the gore material and zig zag stitching along each edge of said folds coordinated with the extensibility of the folded hem and elastic shroud lines in the inter-folded material of the gore seams held by zig zag stitching through the shroud lines and interfolded material.

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