May 24, 1966 G. H. PEAKE 3,252,469

COLLAPSIBLE HYPERBOLIC PARABOLOID UMBRELLA

Filed Jan. 10, 1964 3 Sheets-Sheet 1

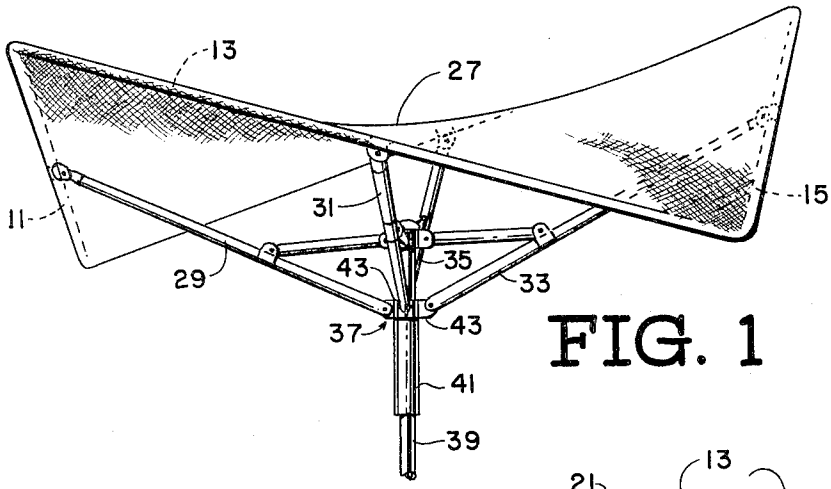


FIG. 1

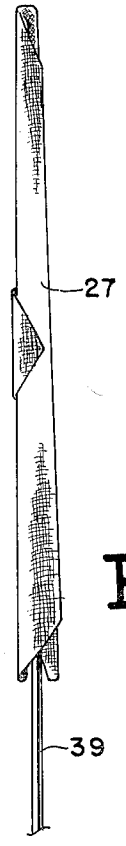


FIG. 4

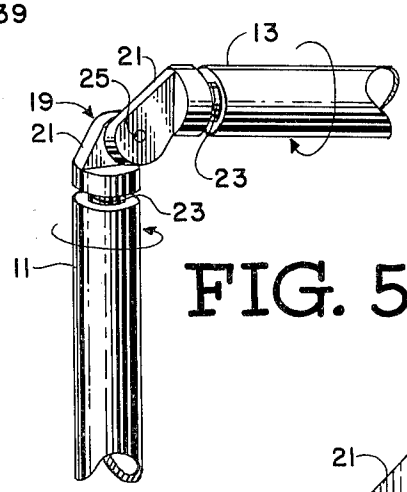


FIG. 5

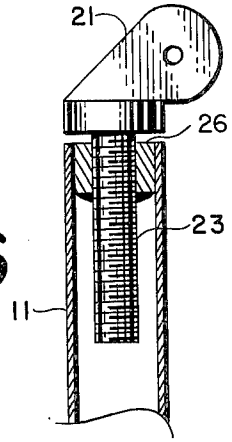


FIG. 6

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COLLAPSIBLE HYPERBOLIC PARABOLOID UMBRELLA

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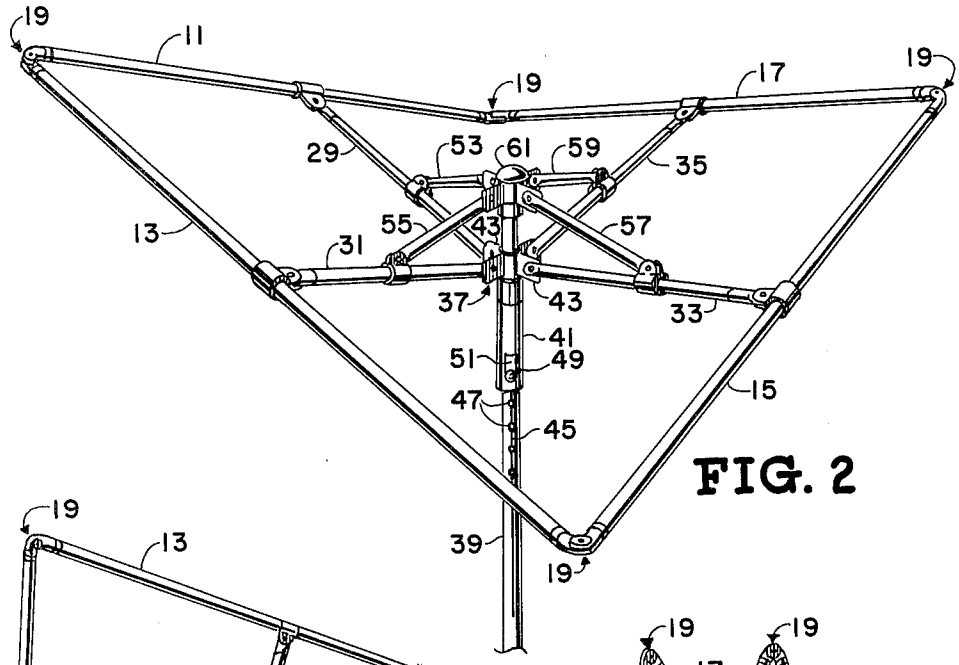


FIG. 2

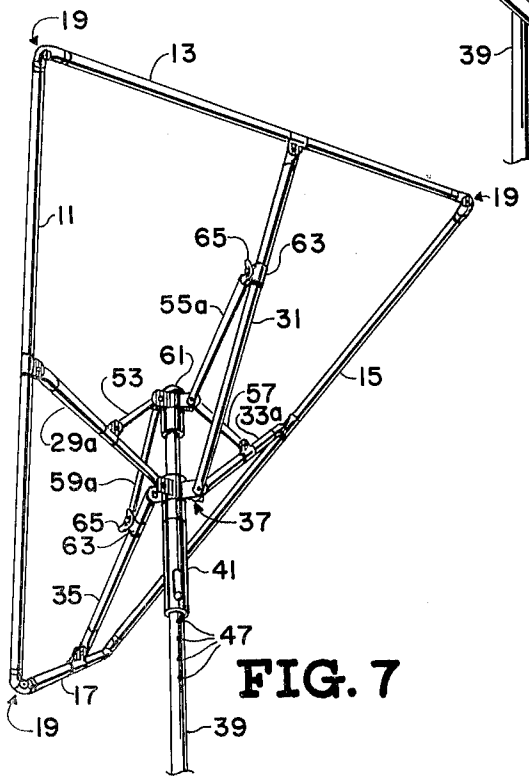


FIG. 7

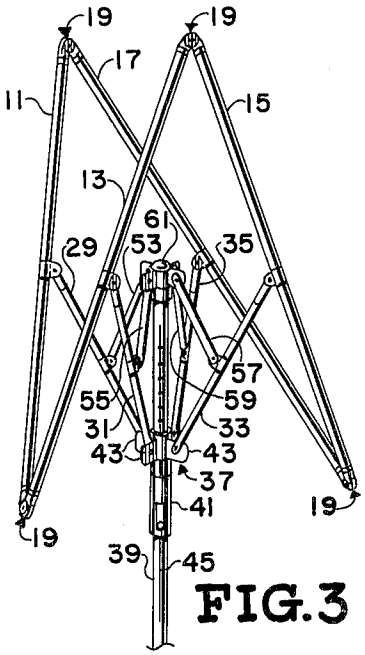


FIG. 3

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COLLAPSIBLE HYPERBOLIC PARABOLOID UMBRELLA

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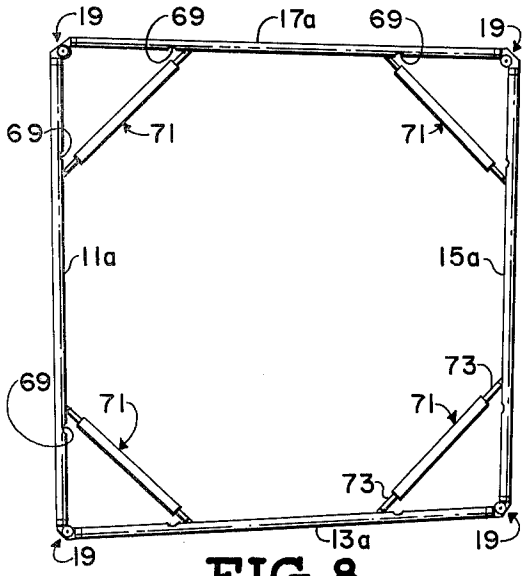


FIG. 8

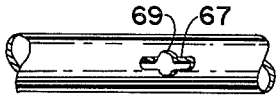


FIG. 10

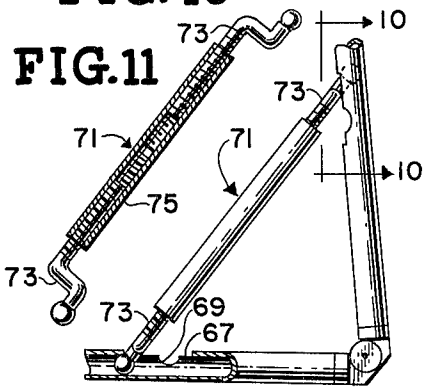


FIG. 11

FIG. 9

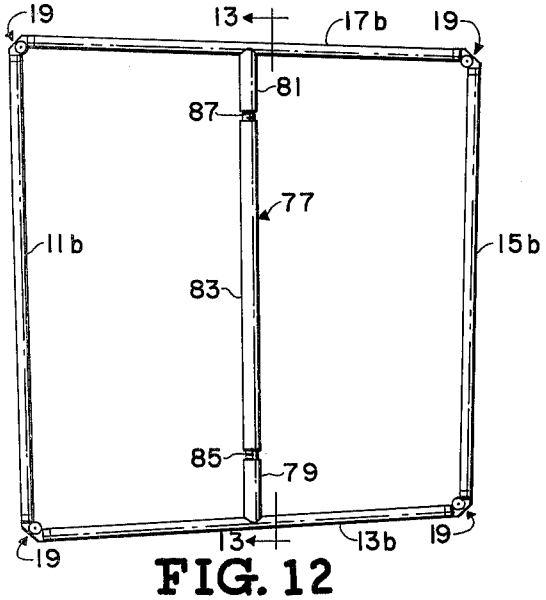


FIG. 12

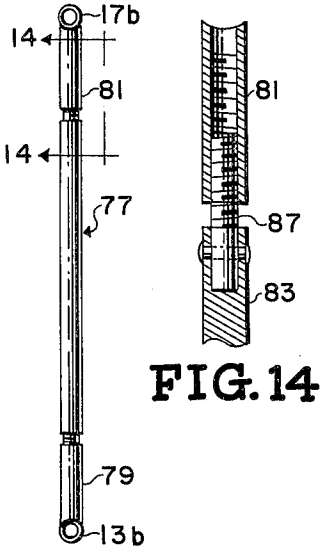


FIG. 13

FIG. 14

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United States Patent Office 3,252,469 Patented May 24, 1966

3,252,469 COLLAPSIBLE HYPERBOLIC PARABOLOID UMBRELLA

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Filed Jan. 10, 1964, Ser. No. 336,931
9 Claims. (Cl. 135—20)

This invention relates to umbrellas and more particularly to umbrellas of the collapsible type and still more particularly to such umbrellas having the configuration of a hyperbolic paraboloid.

Generally speaking, umbrellas of the prior art have been in the shape of an inverted saucer or bowl wherein pliable material is stretched over a plurality of struts, the struts providing the shape of the umbrella itself. While such umbrellas have received much commercial success in the past, they are clearly plagued with certain disadvantages. Among these disadvantages is the fact that the prior art umbrella takes the shape of an air foil such that during gusts of high wind the umbrellas are frequently inverted. Moreover, due to the shape of the umbrella the run-off of rain occurs about the entire periphery such that any portion of the user's body extended beyond this periphery is subjected not only to the normal rain but also to the run-off from a substantial portion of the umbrella area. Another disadvantage of the prior art umbrella is in the necessity of a plurality of projections at the peripheries for maintaining the fabric material on the struts. These projections are hazardous to other persons in the vicinity of the umbrella user and frequently cause serious damage when thrust into the face or eyes of another person.

It is, therefore, a general object of this invention to provide an improved umbrella structure.

It is a more particular object of this invention to provide an umbrella structure having the configuration of a hyperbolic paraboloid.

It is another object of this invention to provide an umbrella structure of the aforementioned character in which the shape of the hyperbolic paraboloid is maintained by applying tension between the edges of a rectangular membrane of pliable resilient material.

It is still another object of this invention to provide an umbrella structure of the aforementioned character which is collapsible.

It is still another object of this invention to provide an umbrella structure of the aforementioned character which may be mounted in an adjustable position about a vertical mast secured thereto.

It is still another object of this invention to provide an umbrella structure of the aforementioned character which is further adjustable to vary the depth of the hyperbolic paraboloid configuration.

These and other objects and features of the invention will become more clearly apparent upon a review of the following description in conjunction with the accompanying drawing, in which:

FIGURE 1 is an elevational view of an umbrella structure in accordance with one embodiment of the invention;

FIGURE 2 is a perspective view of the frame, mast and strut members of the umbrella structure shown in FIGURE 1;

FIGURE 3 is a view similar to FIGURE 2 but showing the frame in partially collapsed position;

FIGURE 4 is an elevational view of an umbrella structure of FIGURE 1 shown in fully collapsed position with the membrane wrapped about the frame;

FIGURE 5 is a perspective view of the articulated coupling means employed between the various frame members of the umbrella structure shown in FIGURE 1;

FIGURE 6 is an elevational view of one portion of the coupling member and a sectional view through its associated frame member;

FIGURE 7 is a perspective view similar to FIGURE 2 but showing an alternative embodiment of the invention;

FIGURE 8 is a plan view of a frame showing still another embodiment of the invention;

FIGURE 9 is a detailed plan view showing means for coupling the ends of the frame members of the embodiment shown in FIGURE 8;

FIGURE 10 is a view taken along the lines **10—10** of FIGURE 9;

FIGURE 11 is a detailed view partly in section, showing means for urging the frame members outwardly apart from each other in the embodiment shown in FIGURE 8;

FIGURE 12 is a plan view of a frame for still another embodiment of the invention;

FIGURE 13 is a view taken along the lines **13—13** of FIGURE 12; and

FIGURE 14 is a detailed sectional view of the area encircled by the line **14—14** of FIGURE 13.

Referring to the drawing, FIGURES 1 to 6 show a first embodiment of the invention wherein like members are designated by like reference numerals throughout. The embodiment of FIGURES 1 to 6 includes four frame members **11**, **13**, **15** and **17**, each comprising elongated rods or tubes. The various frame members **11**, **13**, **15** and **17** are coupled together at their ends one to the other by a fully articulated coupling **19**. The coupling **19** includes a pair of hinge knuckles **21** but instead of the usual hinge leaves, there are included a pair of threaded studs **23**. The knuckles **21** are pivotally joined by means of a pintle **25** and the studs **23** are received by internally threaded collars **26**. The collars in turn are secured at the ends of the frame members **11** as best seen in FIGURE 6.

Thus it is seen that the articulation of the coupling member not only permits the usual hinge coupling movement provided by the pintle **25** but also permits the various frame members **11**, **13** and **17** to rotate with respect to each other. While rotation of the frame members with respect to each other will, of course, cause some longitudinal extension or contraction of the knuckles **21** with respect to their associated frame members, it should be clear that this axial movement will be relatively slight when the rotation of the frame members is limited to something less than 90°.

With the configuration of frame members and coupling devices as above described, it is apparent that opposite frame members **11** and **15**, as well as opposite frame members **13** and **17** may be skewed with respect to each other as shown in FIGURES 1 and 2. It should likewise be apparent, that in plan view the dimensions of the frame member and coupling device configuration will be somewhat smaller when opposite frame members are skewed than would be the case if all members were in the same plane.

To the configuration of frame members **11**, **13**, **15** and **17** and coupling means **19**, is attached a membrane of pliable resilient material such as fabric, plastic or rubber sheeting. The dimensions of this membrane **27** are selected to be smaller than configuration defined by the various frame members **11**, **13**, **15** and **17** and the coupling means **19** when these members all lie in a common plane and the membrane itself is in relaxed condition. The membrane **27** is affixed to the frame members **11**, **13**, **15** and **17** such as by sewing a deep hem at the edges of the membrane to provide a tubular opening for each of the frame members. The frame members may be inserted into the tubular openings prior to connecting the coupling means **19** or alternatively, may

be sewn to the frame members in place after the couplings have been connected.

In a device as thus far described, including only the frame members, the coupling means and the pliable membrane, the frame members will be urged into an intensively skewed relationship to the point that the membrane **27** is completely relaxed. Thus it is necessary to provide means for urging the frame members outwardly apart from each other to place the membrane **27** in tension. Such means in the embodiment shown in FIGURES 1 to 6 include strut means such as the rods **29, 31, 33** and **35**. Each of the rods **29, 31, 33** and **35** are pivotally connected to the centers of one of the frame members **11, 13, 15** and **17**. The other ends of the rods are connected to pivot means **37** slidably engaged on a mast **39**. The pivot means **37** incorporates an elongated collar **41**. These rods are not only pivotally connected to the frame members **11, 13, 15** and **17** but are also rotated about the axis of the rods **29, 31, 33** and **35** themselves. Such a rotatable connection may be of the same type shown in FIGURE 6 with respect to the frame member connector **19**. Secured to the top of the elongated collar **41** are four radially extending wings **43**. The ends of the rods **29, 31, 33** and **35** are each pivotally secured to one of the wings **43**. Thus each of the rods **29, 31, 33** and **35** are permitted to rotate about their pivotal connection at the wings **43** in planes defined by each of the respective rods themselves together with the mast **39**. Moreover, the pivotal coupling between the rods **29, 31, 33** and **35** and the various frame members **11, 13, 15** and **17** are such that each of the frame members are pivoted about their connection in a plane defined by their respective frame member and rod.

While the elongated collar **41** is permitted to slide axially of the mast **39**, means are provided to prevent rotation of the collar with respect to the mast. Such means may take the form of an elongated axial slot **45** on the mast **39** together with an internally extending detent (not shown) on the inner surface of the collar **41**. Any alternative means for permitting axial movement of the collar **41** while preventing rotation with respect to the mast may be employed.

Means are also provided for releasably locking the elongated collar **41** and thus the entire pivot means **37** at various positions axially extended along the mast **39**. Such means are preferably in alignment with the elongated slot **45**. A matching pin **49** may be resiliently urged toward the mast such that when the pin is in registry with one of the openings **47** it extends therethrough to prevent axial movement of the collar. A lever **51** may be provided to urge the pin **49** out of engagement with any of the openings **47** to selectively permit slidable movement of the collar **41** and the entire pivot means **37**.

Four braces **53, 55, 57** and **59** are pivotally secured to the top of the mast **39** from a stationary wing-type pivot member **61**. The other ends of each of these braces is pivotally secured to one of the rods **29, 31, 33** and **35**.

Thus it is apparent that as the pivot means **37** is raised upon the mast **39**, the rods **29, 31, 33** and **35** diverge tending to place them in a horizontal plane thereby urging the frame members **11, 13, 15** and **17** outwardly apart from each other and placing the membrane **27** in tension. While the outward movement of the frame members is sufficient to place the membrane **27** in tension it is insufficient to urge the frame members to an outward extension comparable to their position if all were in a common plane. Thus the configuration formed with the pivot member **37** in its uppermost position is such as shown in FIGURE 1 with the frame members askew with respect to each other and the membrane **27** formed into a hyperbolic paraboloid.

With the umbrella structure in such a configuration as shown in FIGURE 1, it is apparent that the above mentioned disadvantages of the common umbrella of the prior art are obviated. Thus run-off from rain captured by the umbrella is dispensed only at the two lowermost corners of the hyperbolic paraboloid configuration. Moreover, the configuration can be rotated such that the upwardly extending corners are faced into the wind whereby the forces exerted by the wind will tend to urge the umbrella downward rather than into an inverted position as is common with the prior art umbrella. In addition, only four relatively smooth corners are formed by the structure whereby the umbrella is far less hazardous to those in its vicinity.

Moreover, the umbrella may be collapsed by merely lowering the pivot member **37** along the mast **39**, as shown particularly in FIGURE 3. As the member **37** is lowered even further than is shown in FIGURE 3, the frame members **11, 13, 15** and **17** assume substantially parallel relationship to the mast **39** such that the membrane **27**, which upon collapse of the umbrella is completely relaxed, may be wrapped about the frame members as shown in FIGURE 4.

As the frame member is collapsed in the position shown in FIGURE 3, the coupling means **19** permits the individual frame members to fold upon themselves. Moreover, since the rods **29, 31, 33** and **35** are connected to the respective frame members **11, 13, 15** and **17** to permit rotation only in a plane defined by the respective rods and frame members, the individual frame members also rotate with respect to each other at the articulated coupling means **19**. Thus, referring to FIGURE 5 as the umbrella structure is collapsed the frame members **11** and **13** will not only close upon each other but will also rotate upon each other in a direction generally indicated by the arrows.

While the embodiment shown in FIGURES 1 to 6 employs a rod urging each of the frame members **11, 13, 15** and **17** in an outward direction, it should be apparent that merely rods urging only two opposite ones of the frame members would be sufficient. The additional rods in the embodiment of FIGURES 1 to 6 serve primarily to stabilize the hyperbolic paraboloid structure on the mast.

If it is desired to vary the depth of the hyperbolic paraboloid, either of two adjustments are possible. The most obvious adjustment is in the degree in which the pivot means **37** is raised along the mast. A second adjustment is provided by the threaded studs **23** of the coupling means. By extending the coupling means the membrane **27** is placed in greater tension thereby deepening the hyperbolic paraboloid configuration.

Referring to FIGURE 7, an alternative embodiment of the invention is shown wherein elements similar to those expressed earlier employ like reference numerals. Generally speaking, the embodiment shown in FIGURE 7 is identical to the embodiment shown in FIGURES 1 to 6 with the exception that the braces **55*a*** and **59*a*** are not merely pivotally connected to their associated rods **31** and **35** but are also slidably connected by means of a slidable sleeve **63**. In addition, wing nuts **65** serve to lock the slidable sleeve in any position axially along the rods **31** and **35**.

Thus in the embodiment shown in FIGURE 7 the angle of the hyperbolic paraboloid structure may be varied with respect to the mast **39** such for example, as shown in FIGURE 7 wherein one side of the umbrella structure is pitched upwardly while the other side is pitched substantially downwardly with respect to the top of the mast **39**.

Referring to FIGURES 8, 9, 10 and 11, still another embodiment of the invention is shown. In this instance each of the frame members **11*a***, **13*a***, **15*a*** and **17*a*** are joined each to the other by coupling means **19**. Means different from that shown in the embodiment of FIGURES 1 to 6 are provided to urge the individual frame members apart from each other. In the present instance each of the frame members includes a pair of elongated slots **67** provided with enlarged openings **69**.

Strut means **71** are connected between adjacent ones of the arms of the various frame members and are connected to the frame members at the elongated slot **67** by means of shouldered pins **73**. Each of the pins are threaded in opposite directions and are received by the threaded tube **75** to operate in the manner of a turnbuckle. Thus upon rotating the tube **75** the shouldered arms **73** are spread apart thereby urging the associated frame members outwardly with respect to each other. While the embodiment of FIGURES 8 to 11 is shown employing four of the strut means **71** it is apparent that only two of the strut means will perform the function, any two of the strut means disposed in adjacent corners being adequate.

Referring to FIGURES 12 to 14 still another embodiment of the invention is shown wherein frame members **11***b*, **13***b*, **15***b* and **17***b* are joined together at their ends by coupling means **19**. The means for urging the frame members outwardly with respect to each other simply includes a single strut **77** having outward ends **79** and **81** secured to the frame members **13***b* and **17***b*, respectively, together with a central tubular member **83**. The members **79** and **81** are each connected by oppositely threaded members **85** and **87** to the central member **83**. Thus upon rotation of a central member **83** the frame members **13***b* and **17***b* may be spread apart. Upon spreading the members **13***b* and **17***b* apart it is apparent that the members **11***b* and **15***b* will likewise be spread when a membrane such as a membrane **27** is connected to the frame members. This is due to the fact that the tensioned membrane, seeking to reduce its size to its relaxed dimension will cause members **13***b* and **17***b* to become skewed with respect to each other thereby carrying the frame members **11***b* and **15***b* also in a skewed direction. Thus the membrane will conform with the shape of the hyperbolic paraboloid.

It is apparent that a new and improved structure has been provided which is suitable not only for the ordinary functions of an umbrella of the rain protection type but also as a beach umbrella or free standing structure. Moreover, it should be apparent that two or more of the umbrella structures described may be joined to form tent-like structures which are easily collapsible. The structure could also be used as a sail, a kite or other type of air foil due to its hyperbolic paraboloid shape.

I claim:

1. An umbrella structure comprising four rigid frame members, fully articulated coupling means connecting the ends of each of the frame members one to another for pivotal and rotational movement with respect to each other, a pliable resilient membrane secured along the length of each of the frame members, said membrane in relaxed condition being smaller in dimension than a planar quadrangle defined by said four frame members and the articulated coupling means and means secured intermediate the ends of at least two of said frame members for urging the frame members outwardly apart from each other.

2. An umbrella structure as defined in claim **1** together with a mast connected to said means for urging the frame members outwardly apart.

3. An umbrella structure as defined in claim **1** wherein said means for urging the frame members outwardly apart from each other comprises first strut means connected between a first and second one of said frame members for urging said first and second frame members apart, said first and second frame members being adjacent to each other, and second strut means connected between said second one and a third one of said frame members, for urging said second and third frame members apart, said second and third frame members being adjacent to each other.

4. An umbrella structure as defined in claim **1** wherein said means for urging the frame members outwardly apart from each other comprises strut means secured at the center of two opposite frame members, said strut means including means for enlarging the distance between the ends thereof to apply a force tending to spread said opposite frame members.

5. An umbrella structure as defined in claim **4** wherein said strut means comprises an extensible linear rod.

6. An umbrella structure as defined in claim **4** wherein said strut means comprises first and second rods, one end of each of said rods being connected to the center of one of said opposite frame members and pivot means connecting the other ends of each of said rods.

7. An umbrella structure as defined in claim **6** together with an elongated mast, first and second braces, each having one end pivotally connected to said mast, the other end of each of said braces being pivotally connected to one of said rods at points intermediate the ends of said rods, said pivot means being axially slidably received by said mast, and means for releasably locking said pivot means at least one axial position along said mast.

8. An umbrella structure as defined in claim **7** wherein the connection of said pliable resilient membrane to the umbrella structure is to said frame members only.

9. An umbrella structure as defined in claim **7** wherein said other end of each of said braces is pivotally and slidably connected to one of said rods at points intermediate the ends of said rods, and means for releasably locking said other ends of the braces to prevent sliding movement along their respective rods.

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