(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 January 2008 (24.01.2008)

PCT

(10) International Publication Number
WO 2008/011375 A2

(51) International Patent Classification:
A47F 10/02 (2006.01)

(21) International Application Number:
PCT/US2007/073601

(22) International Filing Date: 16 July 2007 (16.07.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/831,884 19 July 2006 (19.07.2006) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

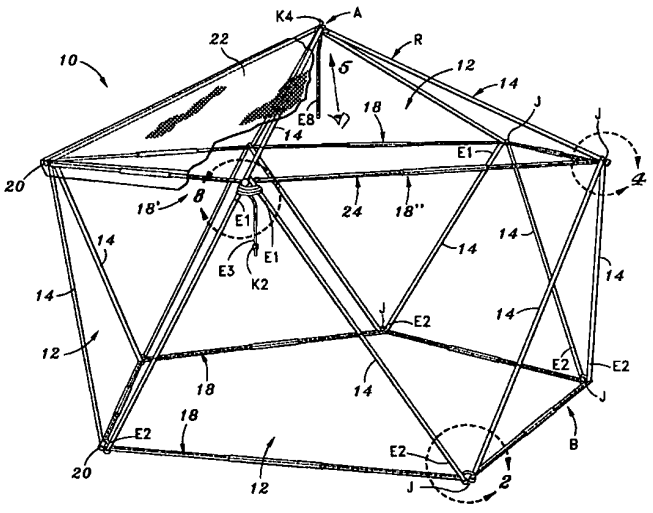
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: COLLAPSIBLE SUPPORT STRUCTURE



(57) Abstract: A collapsible support structure comprises a plurality of interconnected substantially triangular frame sections connected by flexible joints at corners thereof. At least some of the interconnected frame sections share a collapsible tubular member as one side of the interconnected triangular frame sections and at least some of the ends of rigid tubular members of the interconnected frame sections are disposed between adjacent shared collapsible tubular members. An elongated flexible tensioning member extends through the shared collapsible tubular members and between the ends of the rigid tubular members disposed between adjacent shared collapsible tubular members. The rigid tubular members of some of the interconnected frame sections form a frame roof with ends thereof tied to form a flexible joint at the apex frame roof.

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COLLAPSIBLE SUPPORT STRUCTURE
(Docket No. 9634a)

RELATED PATENT APPLICATIONS & INCORPORATION BY REFERENCE

This application is a PCT application which claims the benefit under 35 USC 119(e) of U. S. Provisional Patent Application No. 60/831,884, entitled "COLLAPSIBLE SUPPORT STRUCTURE," filed July 19, 2006. This related application is incorporated herein by reference and made a part of this application. If any conflict arises between the disclosure of the invention in this PCT application and that in the related provisional application, the disclosure in this PCT application shall govern. Moreover, the inventor incorporates herein by reference any and all U. S. patents, U. S. patent applications, and other documents, hard copy or electronic, cited or referred to in this application, including U. S. Patent No. 6,748,962 and pending U. S. Serial No. 10/726,003, filed November 12, 2003.

DEFINITIONS

The words “comprising,” “having,” "containing," and “including,” and other forms thereof, are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items.

BACKGROUND

U. S. Patent No. 6,748,962 discloses a collapsible support structure of the inventor's. The invention disclosed herein is an improvement in this collapsible support structure.

SUMMARY

My collapsible support structure has one or more of the features depicted in the embodiments discussed in the section entitled "DETAILED DESCRIPTION OF SOME ILLUSTRATIVE EMBODIMENTS." The claims that follow define my collapsible support structure, distinguishing it from the prior art; however, without limiting the scope of my collapsible support structure as expressed by these claims, in general terms, some, but not necessarily all, of its features are:

One, my collapsible support structure includes a plurality substantially triangular frame sections each having corners connected by flexible joints. Each frame section has a pair of elongated rigid tubular members having at opposed ends a pair of openings adjacent the ends of the tubular members. The rigid tubular members may be one-piece. The individual openings of each pair of openings may be in substantial alignment. Each frame section also includes a collapsible elongated tubular member having a rigid state and a collapsed state, so the support structure is foldable when the collapsible member is collapsed. An elongated flexible tensioning member passing through the tubular members forms the flexible joints interconnecting adjacent frame sections. The frame sections may be interconnected to form a portion of a geodesic structure, a portion of a truncated icosahedron, or other geometrical three-dimensional structures. Some of the ends of

the rigid tubular members and the collapsible tubular members may be beveled.

Two, at least some of the interconnected frame sections may share the collapsible tubular member thereof as one side of the interconnected triangular frame sections and at least some of the ends of the rigid tubular members may be disposed between adjacent shared collapsible tubular members of the interconnected frame sections. The elongated flexible tensioning member may extend through the shared collapsible tubular members and outward from the opposed open ends thereof and through the pair of openings in the ends of the rigid tubular members disposed between adjacent shared collapsible tubular members of the interconnected frame sections.

Three, my collapsible support structure may include a frame roof formed from a predetermined number of the frame sections. The frame roof may include a flexible line passing through the pairs of openings in tubular members forming the frame roof to provide a flexible joint at an apex. This enables the frame roof to fold inward without untying the flexible line when the collapsible tubular members are collapsed. A substantially annular configured connector member may be used through which the flexible line is wound and past through openings of the pairs in ends of the tubular members nearby the apex.

Four, my collapsible support structure may also include a frame sidewall formed from a predetermined number of the frame sections. The sidewall may have a top segment including the collapsible tubular member of each frame section forming the frame roof and a bottom segment including the collapsible tubular member of alternate frame sections forming the frame sidewall. The collapsible tubular members of each frame section forming the frame roof and frame sidewall may

be oriented from end to end and through which extends the elongated flexible tensioning member.

Five, the flexible tensioning member is within the collapsible elongated tubular members of each triangular frame section, extending outward from their opposed open ends and through the openings in the ends of an adjacent rigid tubular member, and into and through a collapsible elongated tubular member of an adjacent frame section. The elongated flexible tensioning member may have opposed ends that are tied, one of which normally remains tied and one of which is untied and loosened when the support structure is an upright state to collapse the support structure. A portion of the tensioning member may include a pair of knots straddling outer extremities of collapsible elongated tubular member so a pair of axially aligned rigidizing tubular members of the collapsible member do not move a substantial distance laterally along the tensioning member upon the collapse of the collapsible elongated tubular.

These features are not listed in any rank order nor is this list intended to be exhaustive.

DESCRIPTION OF THE DRAWING

Some embodiments of my collapsible support structure are discussed in detail in connection with the accompanying drawing, which is for illustrative purposes only. This drawing includes the following figures (Figs.), with like numerals indicating like parts:

Fig. 1 is a perspective view of one embodiment of the collapsible support structure of this invention.

Fig. 1A is a fragmentary perspective view of the collapsible support structure shown in Fig. 1 in a partially collapsed state.

Fig. 2 is an enlarged fragmentary perspective view taken along line 2 of Fig. 1.

Fig. 3 is an enlarged fragmentary perspective view similar to that of Fig. 1 showing a collapsible tubular member about to be collapsed.

Fig. 4 is an enlarged fragmentary perspective view taken along line 4 of Fig. 1 showing one corner of the collapsible support structure of this invention.

Fig. 4A is an enlarged fragmentary perspective view similar to that of Fig. 4 showing the corner in a collapsed state.

Fig. 5 is a plan view of the underside of the apex of the frame roof of the collapsible support structure shown in Fig. 1.

Fig. 5A is cross-sectional view taken along line 5A-5A of Fig. 5.

Fig. 6 is a plan view of the underside of the apex similar to that of Fig. 5 showing a flexible line partially threaded through ends of the tubular members forming the apex.

Fig. 7 is a plan view similar to that of Fig. 6 showing the flexible line almost completely threaded through ends of the tubular members forming the apex.

Fig. 8 is an enlarged fragmentary perspective view taken along line 8 of Fig. 1 showing opposed ends of flexible tensioning member tied together.

Fig. 9 is an enlarged fragmentary perspective view similar to that of Fig. 8 showing the opposed ends of flexible tensioning member untied.

Fig. 10 is a perspective view of the collapsible support structure depicted in Fig. 1 in a partially collapsed state.

Fig. 11 is a perspective view showing the collapsible support structure depicted in Fig. 1 in a completely collapsed state and folded into a compact assembly.

DETAILED DESCRIPTION OF SOME ILLUSTRATIVE EMBODIMENTS

One embodiment of the collapsible support structure of this invention is identified by the numeral 10. This collapsible support structure 10 has an upright state shown in Fig. 1, a collapsed state shown in Fig. 11, and a partially collapsed state is shown in Fig. 10. The collapsible support structure 10 comprises a plurality of interconnected substantially triangular frame sections 12, each having corners connected by flexible joints J (Fig. 1). Some of the interconnected frame sections 12 form a frame roof R and others form a frame sidewall SW (Fig. 10). Each frame section 12 includes a pair of rigid tubular members 14 and a collapsible tubular member 18 having a rigid state and a collapsed state. The tubular members 14 and 18 may be hollow cylinders made, for example, of a metal such as aluminum or steel having an outside diameter of substantially from 1/2 to 2 inches, and a length substantially from 3 to 15 feet. The support structure 10 is foldable into a compact assembly, as shown in Fig. 11, when the collapsible tubular members 18 are collapsed and all the tubular members 14 and 18 are folded inward.

The frame sections 12 are essentially equilateral triangles. The rigid members 14 and the collapsible members 18 of each frame section 12 are joined at the flexible joints J (Figs. 1 and 2) by an elongated tensioning member 26 along a junction 24 or an elongated tensioning member 26' along a base B (Figs. 2 and 3), as the case may be. The tensioning members 26 and 26' may be, for example, a cord,

cable, rope, etc. The elongated tensioning members 26 and 26' passes through axially aligned collapsible members 18. Portions of the tensioning members 26 and 26' passing from one triangular frame sections 12 to an adjacent frame section at the corners form the flexible joints J, which act as a hinge. Consequently, no other mechanism is required to form the hinges or joints J. Thus, the tensioning members 26 and 26' serve the dual function of connecting the triangular frame sections 12 at corners and of acting as hinges at the corners upon collapse of the collapsible support structure 10.

All the rigid tubular sidewall members 14 are essentially identical, and each has an upper end E1 and a lower end E2. Each upper end E1 has an open terminal tip T and is beveled, and each upper end has a single opening 16c (Fig. 4A) in a sidewall of the tubular member 14 adjacent the open terminal tip T. Thus, as illustrated in Figs. 4 and 4A, a line such as, for example, the flexible tensioning member 26, may pass through the opening 16c and another opening formed by the open terminal tip T. In the lower ends E2 there are a pair of substantially aligned openings 16a and 16b adjacent these ends E2 (Figs. 2 and 3). The ends E2 may be covered by a cap 20 that may, for example, be made of a plastic. The cap 20 functions as a guard minimizing any damage to a tent awning 22 (Fig. 1) supported by the support structure 10, or otherwise avoiding injury to a user.

All the collapsible tubular members 18 are essentially identical. As best illustrated in Figs. 2 and 3, each collapsible tubular member 18 includes a rigidizing sleeve member18c and pair of tubular rigidizing members 18a and 18b extending along a portion of one elongated flexible tensioning member 26 or 26', as the case may be. As shown in Fig. 2, the rigidizing members 18a and 18b are essentially axially aligned when the tubular member 18 is in a rigid, non-collapsed state.

In this rigid state, an outer open end E5 of the rigidizing members 18a and 18b bear against an adjacent rigid member 14 and their respective right angle cut inner ends E6 (Fig. 3) abut each other. The tensioning member 26 passes through the hollow interiors of the rigidizing members 18a and 18b and out opposed outer ends E5 of the rigidizing members 18a and 18b. The outer ends E5 may be beveled. The rigidizing sleeve member 18c is slideably mounted on the rigidizing members 18a and 18b. The inside diameter of the sleeve member 18c is slightly greater than the outside diameters of the rigidizing members 18a and 18b, which have essentially the same outside diameters. Thus, the sleeve member 18c is sized to engage slideably both rigidizing members 18a and 18b to form the collapsible elongated tubular member 18.

At least some of the interconnected frame sections 12 share as a common one side of their triangular configuration a tubular member 14. Other interconnected frame sections 12 share as a common one side of their triangular configuration a collapsible tubular member 18. The frame roof R and frame sidewall SW meet at a common segment that forms the junction 24. This junction 24 comprises the collapsible tubular members 18 of alternate frame sections 12 forming the frame roof R and frame sidewall SW that are aligned and oriented from end to end (Figs. 1 and 10). The one elongated flexible tensioning member 26 extends lengthwise through the hollow interiors of each of the collapsible tubular members 18 forming the junction 24, and it has opposed ends E3 and E4 that are tied when the structure 10 is upright as depicted in Figs. 8 and 9.

As depicted in Fig. 10, the collapsible support structure 10 is collapsed as the rigidizing sleeve members 18c are moved laterally to allow the rigidizing members 18a and 18b to be folded were their ends

meet, collapsing the tubular members 18. A bottom segment of the frame sidewall SW forming the base B comprises the collapsible tubular member 18 of alternate frame sections 12 forming the frame sidewall SW. The collapsible tubular members 18 of the base B are aligned and oriented from end to end. As illustrated in Figs. 2 and 3, the elongated flexible tensioning member 26' extends lengthwise through the hollow interiors of each of the collapsible tubular members 18 forming the base B. The opposed ends E3' and E4' of the tensioning member 26' are tied in a knot K1 and remain so regardless of the upright or collapsed state of the structure 10. The tensioning member 26 extends through each of the collapsible tubular members 18 forming the junction 24 and, as shown in Fig. 9, has its opposed ends E3 and E4 connected in a manner so the end E3 may be disconnected when the collapsible support structure 10 is to be collapsed.

Referring to Figs. 8 and 9, this manner of connecting and disconnecting the ends E3 and E4 of the tensioning member 26 is illustrated. One rigid tubular member identified by the numeral 14c of the frame roof R is disposed between the beveled ends E1 of the rigid tubular members respectively identified by the numerals 14a and 14b of adjacent frame sections 12 forming a portion of the sidewall SW. A portion P1 of tensioning member 26 near the end E3 is secured as shown in Fig. 8 when the support structure 10 is upright (Fig. 1) and unloosened as shown in Fig. 9 to allow the support structure to be folded up as shown in Fig. 11. The portion P1 of tensioning member 26 passes through a ring 30, and an enlarged knot K2 near the tip of the end E3 acts as a stop to prevent the end E3 from passing through the ring 30 when the collapsible support structure 10 is being collapsed.

As depicted in Fig. 9, the adjacent collapsible tubular members identified by the numerals 18' and 18" of the junction 24 provide a space S where the end E4 of the tensioning member 26 is tied to the ring 30 in the knot K3 (Fig. 8). The end E4 remains so tied regardless of the upright or collapsed state of structure 10. As depicted in Fig. 8, when the portion P1 of the tensioning member 26 is wrapped around the rigid tubular members respectively identified by the numerals 14a and 14b of adjacent frame sections 12 forming the portion of the sidewall SW nearby the space S, the end E3 is tied and secured in position and the collapsible support structure 10 is upright as shown in Fig. 1. This imparts rigidity to the structure 10 because the all the tubular members 18, including members 18' and 18", are aligned with adjacent ends abutting, not allowing the structure to come down on itself until the end E3 is unloosened or untied. Upon unloosening the end E3, the ring 30 slides along the portion P1 until meeting the knot K2 near the end E3, which acts as a stop.

Initially during assembly, neither end E3 or E4 of the tensioning member 26 is tied in any fashion, and the end E4 is fed through the aligned collapsible tubular members 18 and tied to the ring 30. The end E4 is fed through the open beveled end E5 of the collapsible tubular member 18" and past through the opening 16c in the rigid member 14b and then out the tip T of the open beveled end E1 of the rigid member 14b, then through the aligned pair of openings 16a and 16b in the rigid member 14c and into the tip T of the open beveled end E1 of the rigid member 14a and out the opening 16c in the end E1 of the rigid member 14a and finally tied to the ring 30 as the knot K3.

The ring 30 including the knot K3 acts as a stop when the tensioning member 26 is placed in tension. As shown in Fig. 8, when the collapsible support structure 10 is placed in the upright state (Fig.

1), the end E3 is pulled downward through ring 30 and the portion P1 is wound over the tubular member 14c, down and around the tubular members 14a and 14b, and cinched up tightly, wrapping the portion P1 around these abutting members as illustrated in Fig. 8. This holds securely the tensioning member 26 in tension and the portion P1 and the one end E3 of the tensioning member 26 hangs loose in a generally vertical orientation. When the structure 10 is to be collapsed, the end E3 is unwound and the portion P1 is loosened and slid through ring 30 until the knot K2 contacts the ring 30.

As depicted in Figs. 5, 6 and 7, the rigid tubular members of the frame sections 12 forming the frame roof R, and identified by the numeral 14c, 14d, 14e, 14f, and 14g, are essentially identical, being of the same length as the rigid tubular members 14 forming the sidewall SW. Each of the respectively ends E1 of rigid tubular members 14c, 14d, 14e, 14f, and 14g are not beveled, and are tied together to form an apex A. A connector member 31 having a substantially annular configuration and a flexible line 32 are used to connect these ends E1 together. The line 32 passes through the pair of openings 16a and 16b and each open end E1 of each tubular member 14c through 14g, as the case may be, of the frame sections 12 forming the frame roof R to provide a flexible joint or hinge at the apex A. This enables the frame roof R to fold inward (Fig. 10) without untying the flexible line 32 when the collapsible tubular members 18 of the frame sections 12 along the junction 24 are collapsed. The line 32 is sequentially threaded through the ends E1 of the tubular member 14c through 14g and wrapped around the connector member 31.

For example as depicted in Fig. 6, the one end E7 of the line 32 extends through the one opening 16b of the pair of openings 16a and 16b in the rigid member 14e, then through the open end E1 of this

rigid tubular member 14e and around the connector member 31, and then back through the open end E1 and finally out the other opening 16a. This procedure is repeated as illustrated in Fig. 7 until the ends E7 and E8 of the line 32 are respectively threaded through the opening 16b and 16a of the rigid member 14f and out its open end E1. The end E7 is passed under the connector member 31 and out the top of the apex A and tied into a knot K4 (Figs. 1 and 5A). The end E8 is passed over and around the connector member 31, hanging loose out the bottom of the apex A in a vertical orientation.

As depicted in Fig. 1A, the collapsible tubular member 18' provides a terminal end member along the junction 24 that is prevented from slipping off tensioning member 26 by a pair of knots K5 and K6. A portion P2 of the tensioning member 26 passes through the tubular member 18' and each knot K5 and K6 abuts one outer extremity X or Y of this tubular member 18', as the case may be. The knots K5 and K6 are sufficiently large to prevent the portion P2 of the tensioning member 26 passing through the tubular member 18' from moving laterally. Thus, with these knots K5 and K6 straddling the terminal end member 18' and each abutting one of the outer extremities X and Y of the terminal end member, the pair of axially aligned rigidizing tubular members 18a and 18b do not move a substantial distance laterally along the tensioning member 26 upon the collapse of the terminal end member 18' when the sleeve 18c is moved laterally. Consequently, all the rigidizing members 18a and 18b remain more or less in the same relative position along the tensioning member 26, but are foldable relative to each other upon moving the sleeve members 18c laterally.

These benefits include, but are not limited to, a collapsible support structure using (a) tubular members having flexible tensioning members passing along hollow interiors of the tubular members or through ends of the tubular members to provide a simplified and low cost way to connect these tubular members into a plurality of substantially triangular frames that are interconnected at flexible, hinged, joints at corners formed by the tensioning members and (b) forming a frame roof by connecting ends of the tubular members with a flexible line to provide a flexible apex in the frame roof.

SCOPE OF THE INVENTION

The above presents a description of the best mode I contemplate of carrying out my collapsible support structure, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains to make and use my collapsible support structure. My collapsible support structure is, however, susceptible to modifications and alternate constructions from the illustrative embodiments discussed above which are fully equivalent. Consequently, it is not the intention to limit my collapsible support structure to the particular embodiments disclosed. On the contrary, my intention is to cover all modifications and alternate constructions coming within the spirit and scope of my collapsible support structure as generally expressed by the following claims, which particularly point out and distinctly claim the subject matter of my invention:

CLAIMS

1. A collapsible support structure comprising

a plurality substantially triangular frame sections each having corners connected by flexible joints,

each frame section including

a first elongated rigid tubular member having opposed first and second ends and adjacent each end of the first member a pair of openings,

a second elongated rigid tubular member having opposed first and second ends and adjacent each end of the second member a pair of openings, and

a collapsible elongated tubular member having opposed first and second open ends, said collapsible tubular member having a rigid state and a collapsed state so the support structure is foldable when said collapsible member is collapsed,

a first predetermined number of the frame sections forming a frame roof of the support structure and a second predetermined number of the frame sections forming a frame sidewall of the support structure,

said sidewall having a top segment including the collapsible tubular member of each frame section forming the frame roof and a bottom segment including the collapsible tubular member of alternate frame sections forming the frame sidewall,

the first ends of said first and second tubular members of the frame sections forming the frame roof being open and tied to form an apex by a flexible line passing through the pair openings and open end in each of said first ends of said first and second tubular members of the frame sections forming the frame roof to provide a flexible joint at

the apex, enabling the frame roof to fold inward without untying the flexible line when said collapsible tubular members of the frame sections forming the frame roof are collapsed.

2. The collapsible support structure of claim 1 where the individual openings of each pair of openings are in substantial alignment.

3. The collapsible support structure of claim 1 including a connector member near the first open ends of the first and second tubular members forming the apex, and at each said first open end nearby the apex, the flexible line first passes through one of the openings of said pair in said open end nearby the apex, then out said open end nearby the apex and around the connector member, and then back into said open end nearby the apex and out the other opening of said pair in said open end nearby the apex.

4. The collapsible support structure of claim 3 where the connector member has a substantially annular configuration.

5. The collapsible support structure of claim 1 where

the collapsible tubular members comprising the top segment are aligned from end to end and the first and second tubular members of the frame sections forming the frame roof have their respective second ends alternately disposed between adjacent pairs of said aligned collapsible tubular members comprising the top segment, and

the collapsible tubular members comprising the bottom segment are aligned from end to end and the second ends of both the first and second tubular members of adjacent frame sections forming the frame

sidewall are disposed between adjacent pairs of collapsible tubular members, and

a first elongated flexible tensioning member passing through the aligned collapsible tubular members comprising the top segment, exiting a first open end of one of the collapsible tubular members of an adjacent pair of collapsible tubular members of the top segment and then passing through openings in the rigid tubular members disposed between said adjacent pair, and then into the second open end of the other collapsible tubular member of the adjacent pair in the top segment, and

a second elongated flexible tensioning member passing through the aligned collapsible tubular members comprising the bottom segment, exiting a first open end of one of the collapsible tubular members of an adjacent pair of collapsible tubular members of the bottom segment and then passing through openings in the rigid tubular members disposed between said adjacent pair in the bottom segment, and then into the second open end of the other collapsible tubular member of the adjacent pair in the bottom segment.

6. The collapsible support structure of claim 5 where the first elongated flexible tensioning member has opposed terminal ends, one of which is permanently tied to a ring and the other end is loosened through said ring. when said collapsible tubular members forming the top segment are collapsed.

7. The collapsible support structure of claim 1 where the collapsible tubular members each include

a first tubular rigidizing member extending along a portion of an elongated flexible tensioning member,

a second tubular rigidizing member extending along another portion of the elongated flexible tensioning member, and

a rigidizing sleeve member mounted to slide over the rigidizing members when both rigidizing members are essentially axially aligned, and

said elongated rigid members and said collapsible elongated member all being hingedly joined in flexible joints by said elongated tensioning member, said flexible joints interconnecting at least some adjacent frame sections at corners thereof.

8. The collapsible support structure of claim 1 where one the collapsible tubular members provides a terminal end member, said terminal end member including

a pair of axially aligned rigidizing tubular members through which extends a portion of an elongated flexible tensioning member and a slideable sleeve member positioned to slide over said rigidizing members to form the terminal end member,

said elongated rigid members and said collapsible elongated members of adjacent frame sections being joined at corners thereof by said elongated tensioning member passing through the corners of said adjacent frame sections to form flexible joints at said corners,

a portion of said tensioning member including a pair of knots straddling outer extremities of the terminal end member so the pair of axially aligned rigidizing tubular members do not move a substantial distance laterally along the tensioning member upon the collapse of the end member.

9. The collapsible support structure of claim 1 where the interconnected frame sections each form a portion of a geodesic structure.

10. The collapsible support structure of claim 1 where the interconnected frame sections form a portion of a truncated icosahedron.

11. The collapsible support structure of claim 1 where at least some of the ends of the rigid tubular members and the collapsible tubular members are beveled.

12. A collapsible support structure comprising

a plurality of substantially triangular frame sections interconnected by flexible joints, each frame section comprising

a first elongated one-piece rigid tubular member having opposed first and second ends with openings in each said end,

a second elongated one-piece rigid tubular member having opposed first and second ends with openings in each said end, and

a collapsible elongated tubular member having opposed open ends, and

an elongated flexible tensioning member within the collapsible elongated tubular member and extending outward from said opposed open ends and between the openings in second ends of the first and second members, and into and through a collapsible elongated tubular member of an adjacent frame section to form a flexible joint interconnecting adjacent frame sections.

13. The collapsible support structure of claim 12 where the interconnected frame sections each form a portion of a geodesic structure.

14. The collapsible support structure of claim 12 where the interconnected frame sections form a portion of a truncated icosahedron.

15. A collapsible support structure having a configuration substantially of a truncated icosahedron and comprising

a plurality of substantially triangular frame sections interconnected by flexible joints at corners thereof to form a frame roof and a frame sidewall, each frame section including a pair of rigid members each with openings in ends thereof and one collapsible elongated tubular member including opposed first and second open ends and having a rigid state and a collapsed state so the support structure is foldable when said collapsible member is collapsed,

said frame roof and sidewall joined together by alternately the collapsible elongated tubular members of the frame sections forming the frame roof and the sidewall,

said collapsible elongated tubular members being adjacent and aligned end to end, and disposed between ends of said adjacent collapsible members a first end of one rigid member of one frame section comprising the frame roof and a first end of one rigid member of each adjacent frame sections comprising the frame sidewall, said first end of the frame roof rigid member being disposed between the first ends of the frame sidewall rigid members,

an elongated flexible tensioning member passing through the adjacent pairs of the collapsible tubular members, exiting an open end

of one of the collapsible tubular members of an adjacent pair and passing through the openings in the rigid members disposed between said adjacent and aligned collapsible tubular members, and then into the second open end of the other collapsible tubular member of the adjacent pair.

16. A support structure having an upright state and a collapsed state and comprising

a plurality of interconnected substantially triangular frame sections with adjacent frame sections connected at corners thereof to form a frame roof and a frame sidewall,

each said frame section including a pair of rigid tubular members with a pair of substantially aligned openings in at least one end thereof and a collapsible tubular member,

the collapsible tubular members of each frame section forming said frame roof and frame sidewall oriented from end to end and through which extends an elongated flexible tensioning member,

at least some of said ends of the rigid tubular members of adjacent frame sections forming the frame roof and frame sidewall positioned between said collapsible tubular members of each frame section forming said frame roof and frame sidewall,

said elongated flexible tensioning member passing through the openings in said ends to form flexible joints and having opposed ends that are tied, one of which is permanently tied and one of which is untied and loosened when the support structure is an upright state and untied to collapse the support structure.

17. The collapsible support structure of claim 16 where one the collapsible tubular members provides a terminal end member, said terminal end member including

a pair of axially aligned rigidizing tubular members through which extends a portion of the elongated flexible tensioning member and a slideable sleeve member positioned to slide over said rigidizing members to form the terminal end member,

said elongated rigid members and said collapsible elongated members of adjacent frame sections being joined at corners thereof by said elongated tensioning member passing through the corners of said adjacent frame sections to form flexible joints at said corners,

a portion of said tensioning member including a pair of knots straddling outer extremities of the terminal end member so the pair of axially aligned rigidizing tubular members do not move a substantial distance laterally along the tensioning member upon the collapse of the end member.

18. A collapsible support structure comprising

a plurality of interconnected substantially triangular frame sections connected by flexible joints at corners thereof,

each frame section comprising a pair of rigid tubular members each having opposed ends and a collapsible tubular member having opposed open ends,

at least some of said interconnected frame sections sharing the collapsible tubular member thereof as one side of the interconnected triangular frame sections and at least some of the ends of the rigid tubular members disposed between adjacent shared collapsible tubular members of said interconnected frame sections, and

an elongated flexible tensioning member extending through said shared collapsible tubular members and outward from said opposed open ends thereof and between said ends of the rigid tubular members disposed between adjacent shared collapsible tubular members of said interconnected frame sections.

19. The collapsible support structure of claim 18 the rigid tubular members of some of the interconnected frame sections form a frame roof with ends thereof being open and tied to form an apex by a flexible line passing through the said open end to provide a flexible joint at the apex, enabling the frame roof to fold inward without untying the flexible line when said collapsible tubular members are collapsed.

20. The collapsible support structure of claim 18 where each collapsible tubular member includes

a pair of axially aligned rigidizing tubular members through which extends a portion of the elongated flexible tensioning member, said rigidizing tubular members slideable along the tensioning member and one of said rigidizing tubular members having a diameter greater than the other rigidizing member and positioned to slide over said other the rigidizing member to form the collapsible elongated tubular member.

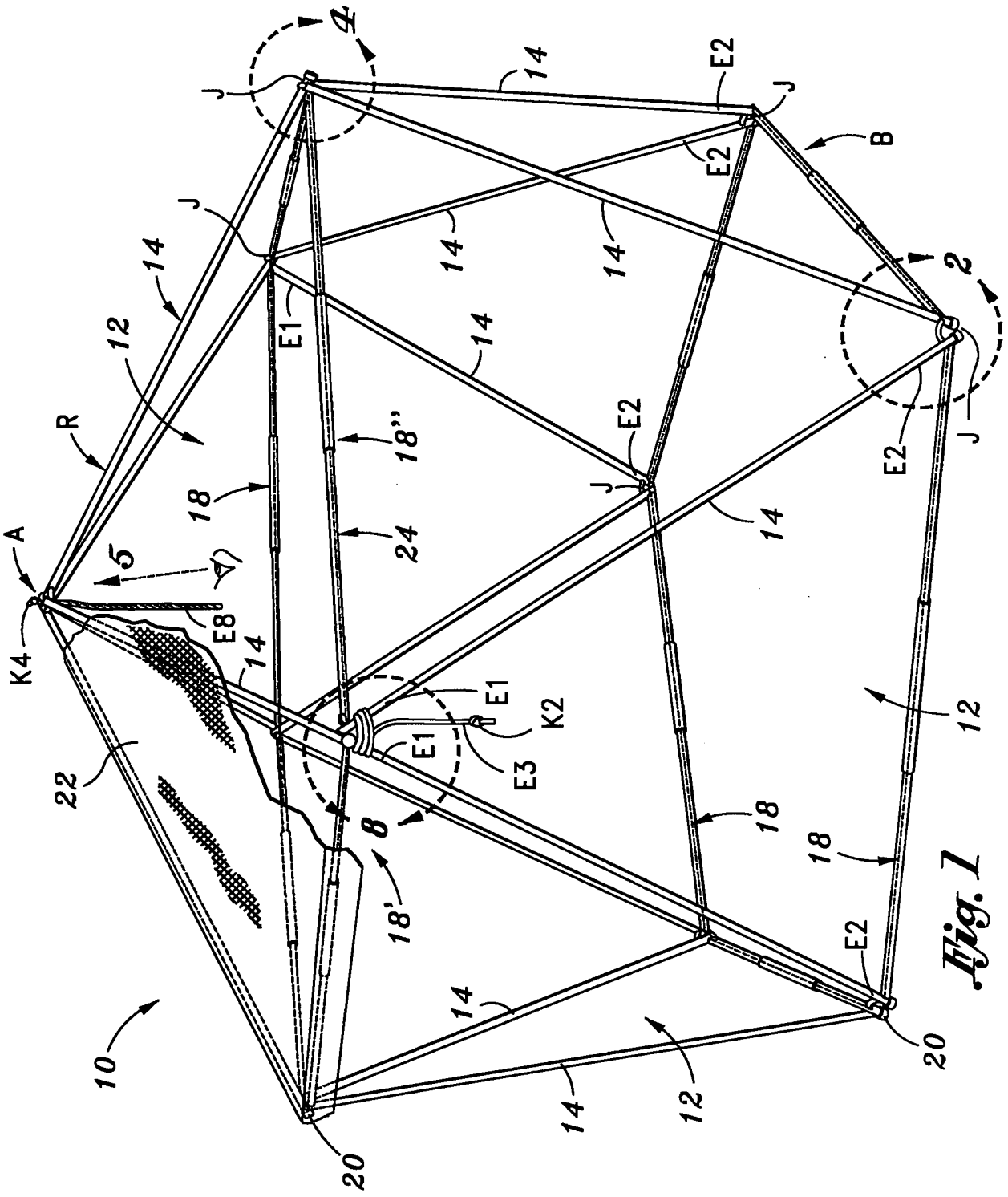

Fig. 1

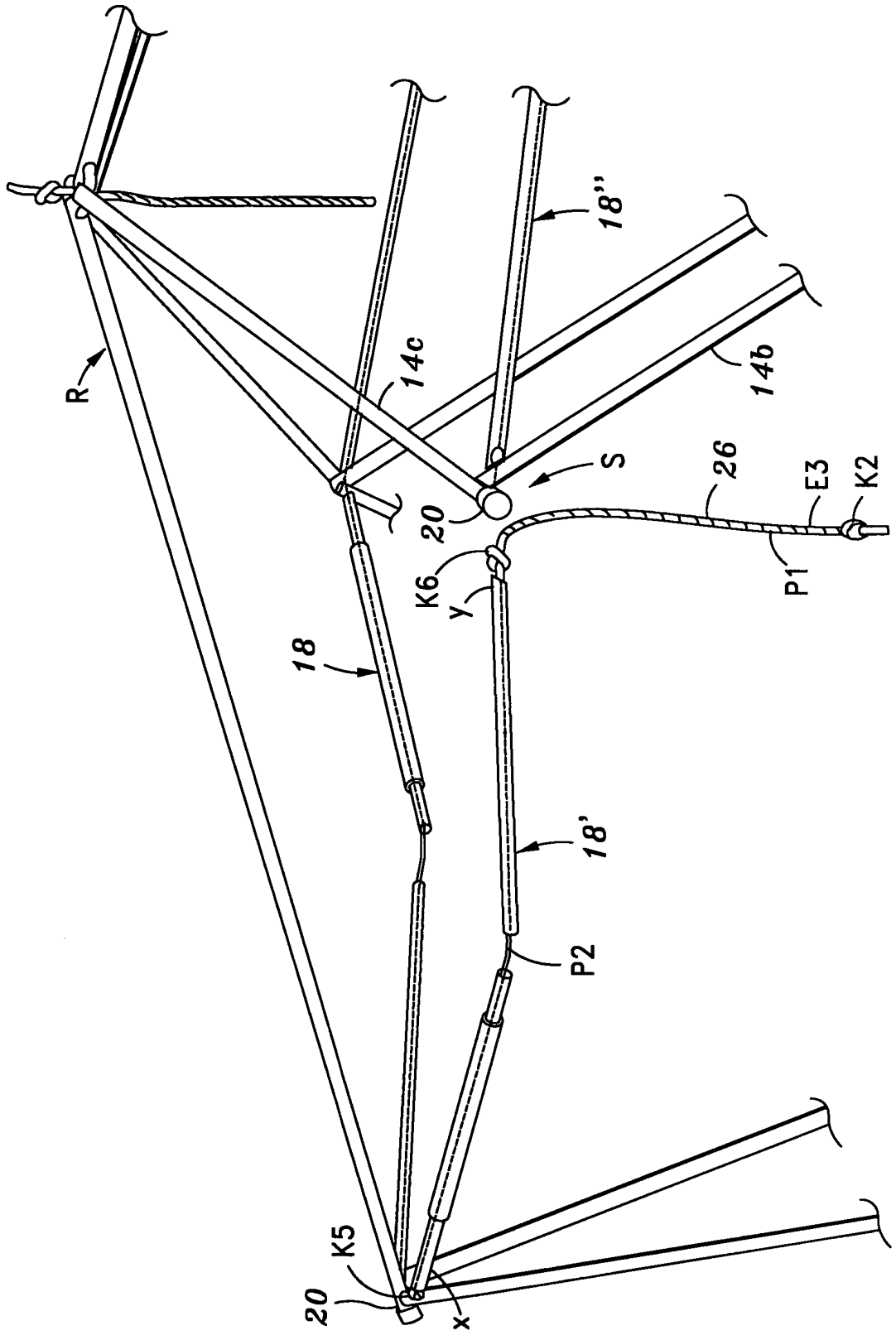

Fig. 1A

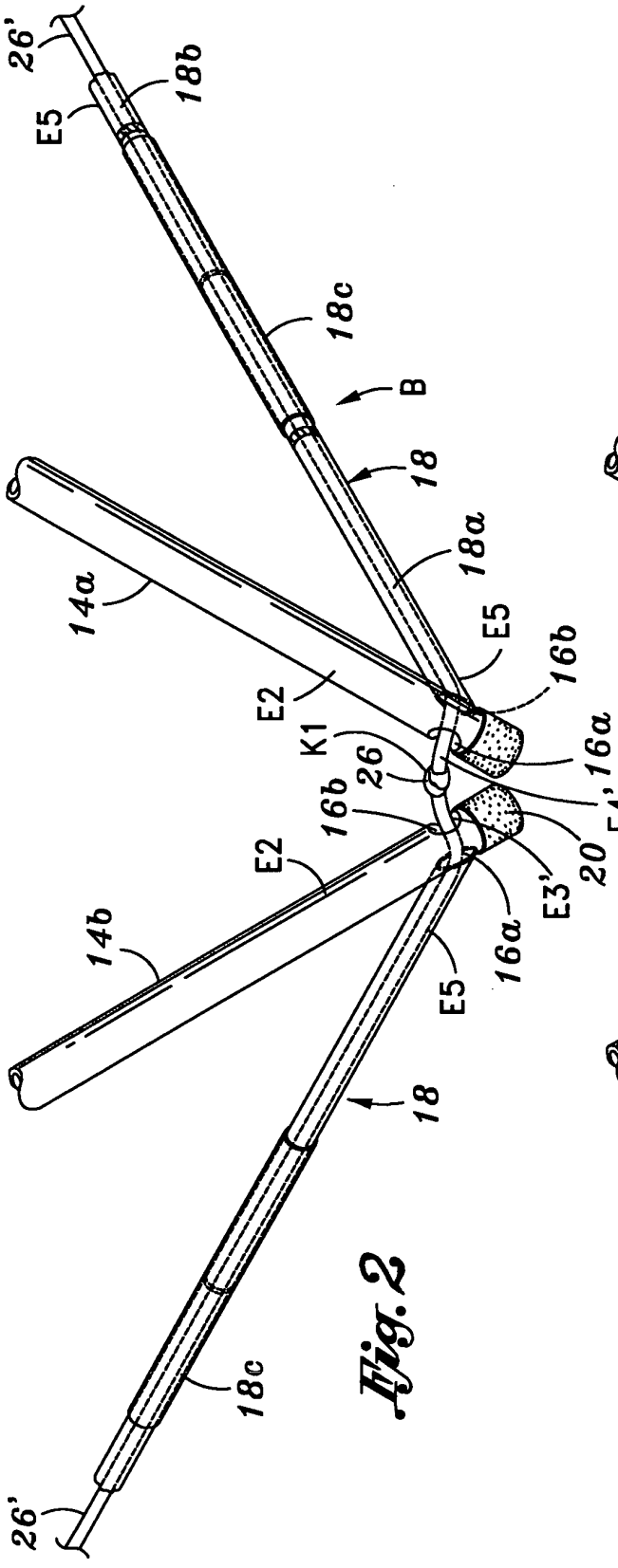
26'
E5
18b
18c
B
18
18a
14a
E5
16b
E2
K1
26
16b
E4'
16a
E2
20
E3'
14b
16a
E5
18
18c
26'

Fig. 2

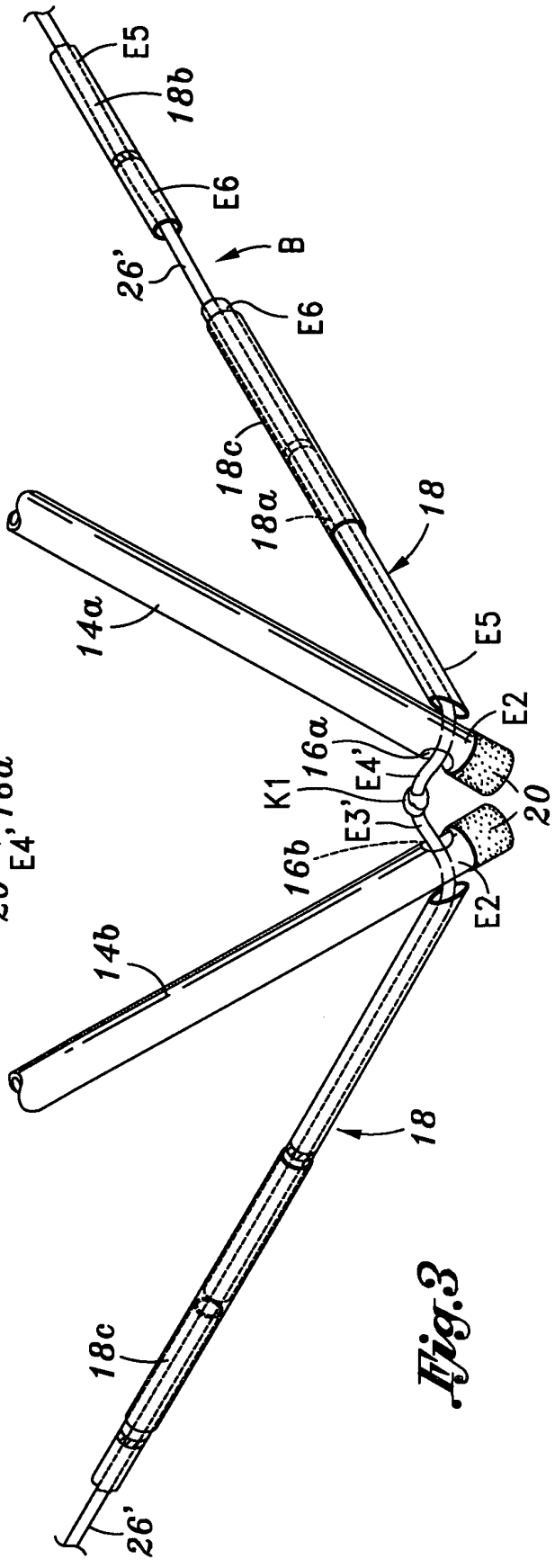
E5
18b
E6
B
26'
E6
18c
18a
18
14a
E5
E2
16a
K1
E4'
E3'
20
16b
E2
14b
18
18c
26'

Fig. 3

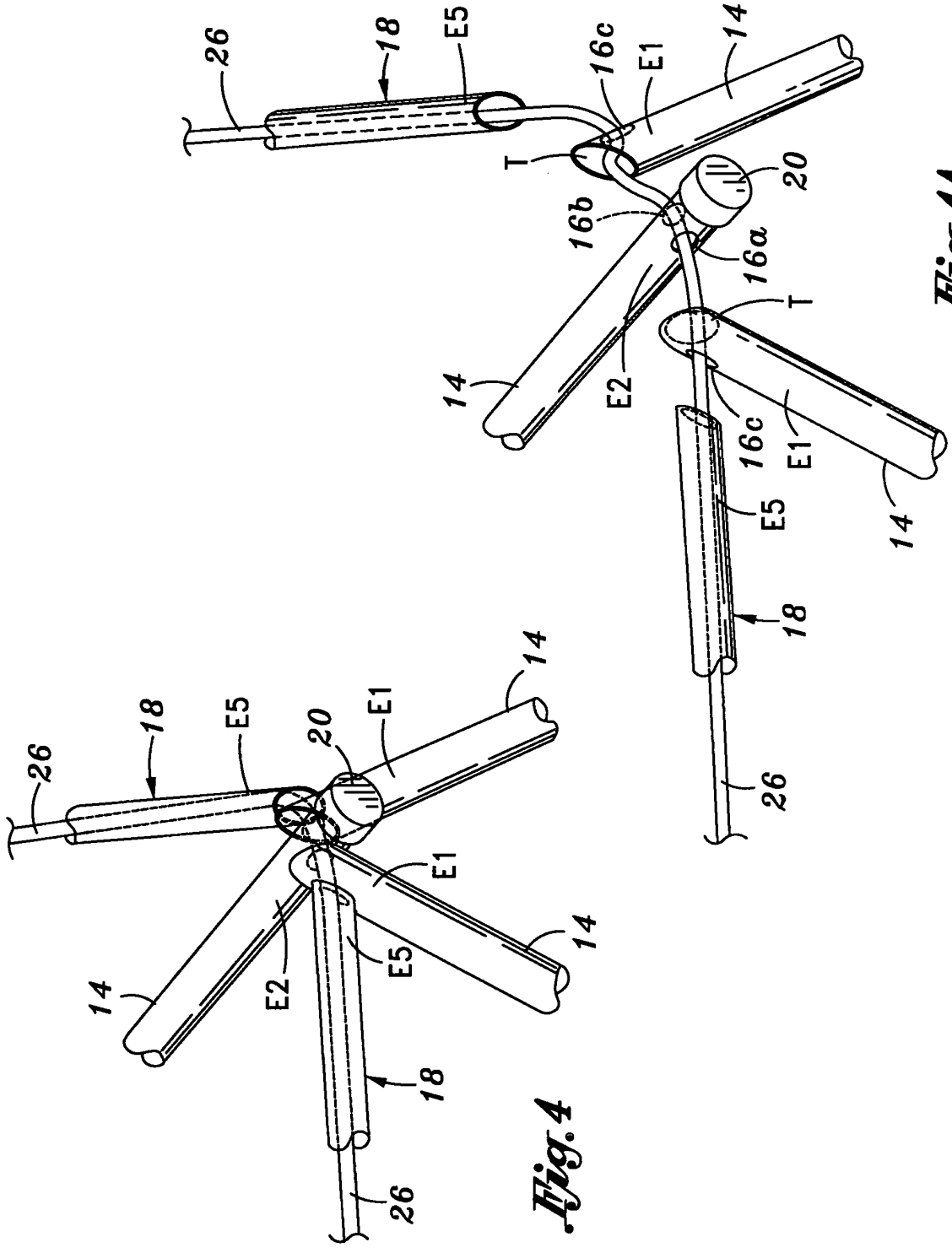
26
18
E5
16c
E1
14
T
20
16b
16a
T
14
E2
16c
E1
E5
14
18
26
18
E5
20
E1
14
26
E1
14
E2
E5
14
18
26

Fig. 4A

Fig. 4

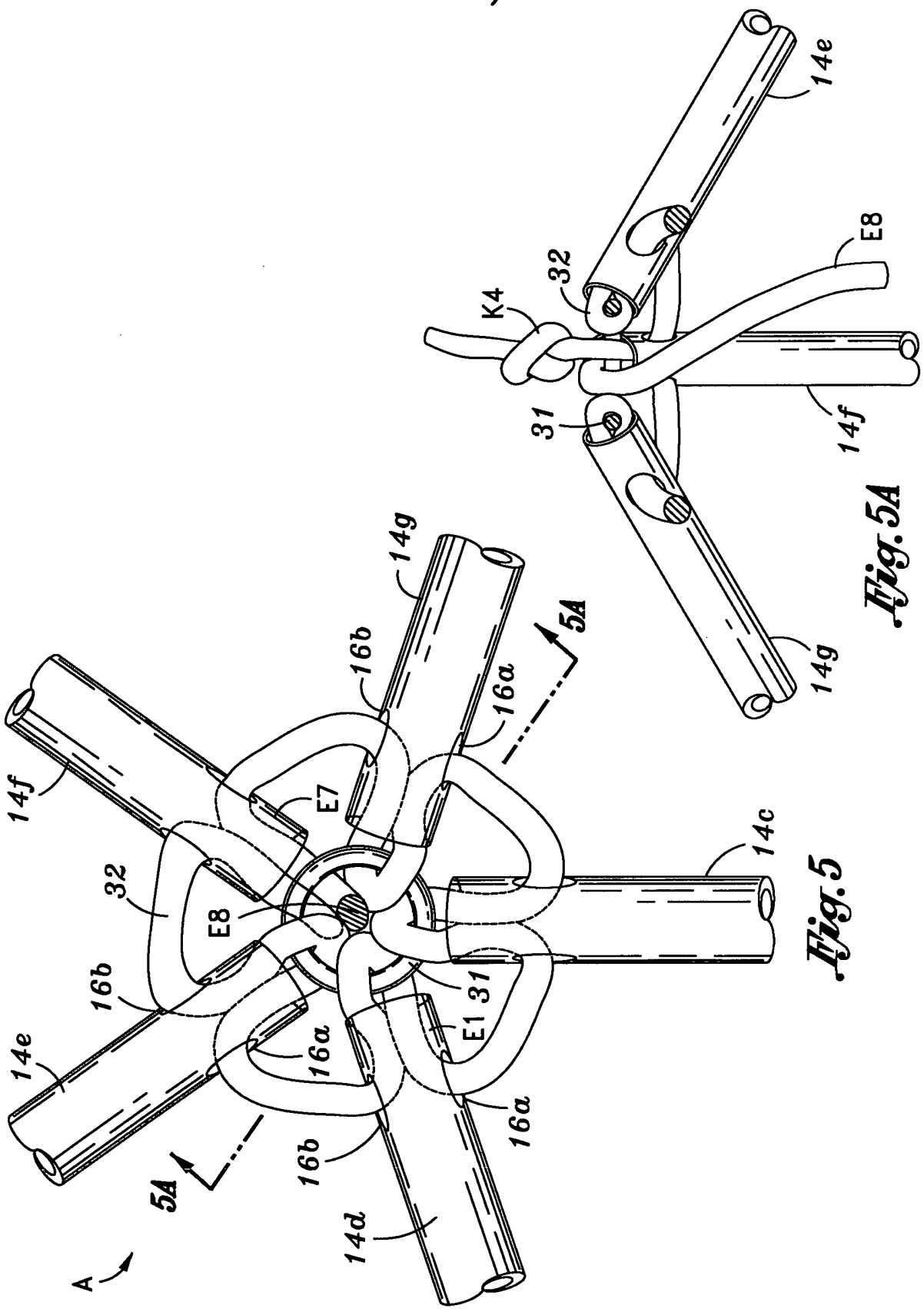
14e
E8
32
K4
31
14f
14g
14g
16b
16a
5A
14f
E7
32
E8
16b
14e
16a
5A
16b
14d
A
16a
E1
31
14c

Fig. 5A

Fig. 5

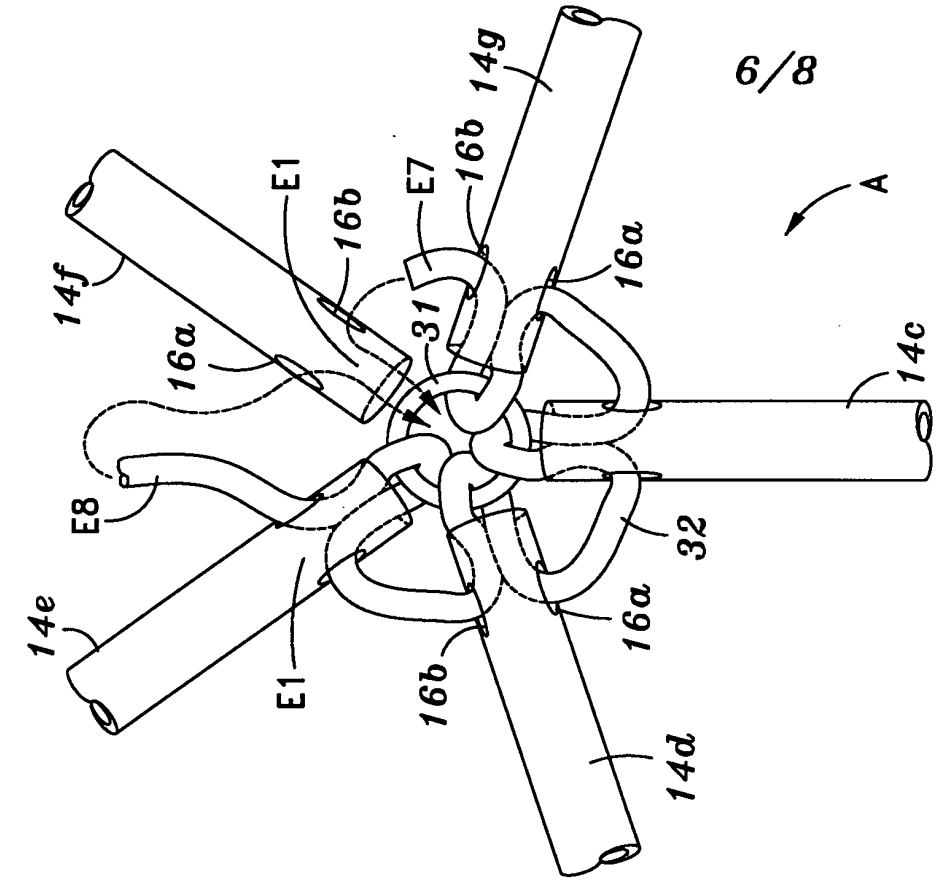
14f
14g
16b
E1
E7
16a
A
31
14c
E8
32
14e
16a
16b
E1
14d

Fig. 7

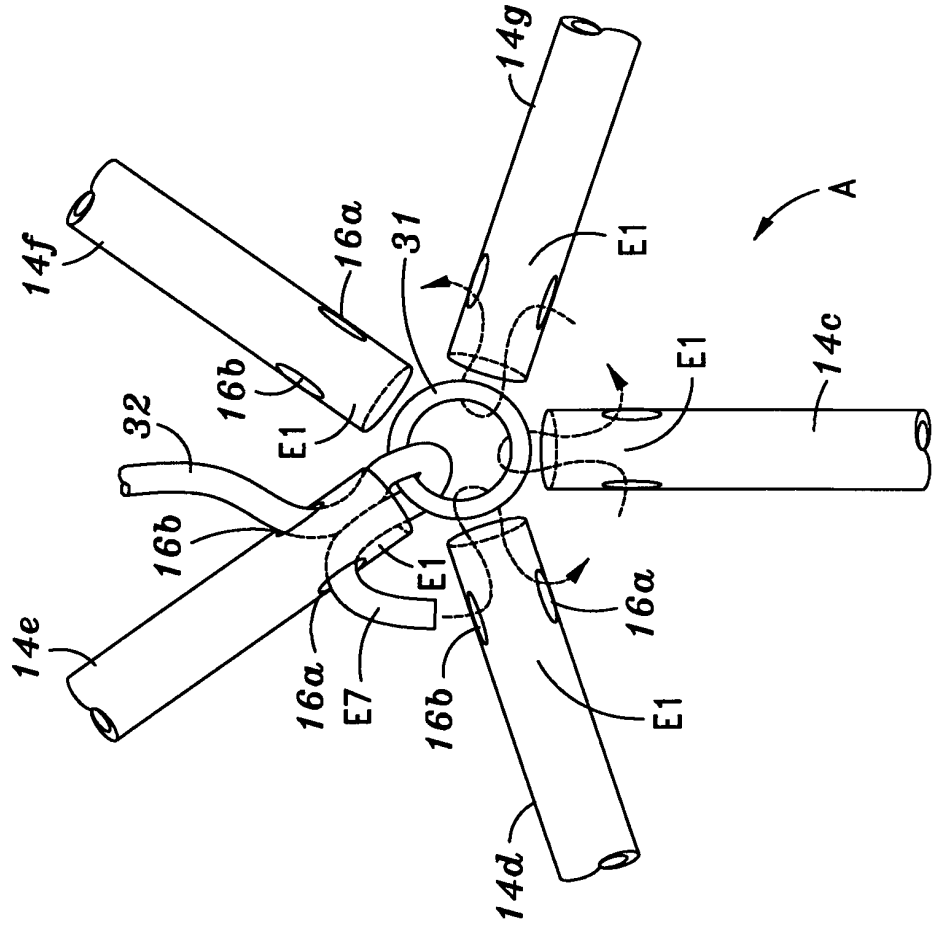
14f
14g
16a
31
E1
A
16b
E1
14c
32
16b
E1
16a
14e
16a
E7
16b
E1
14d

Fig. 6

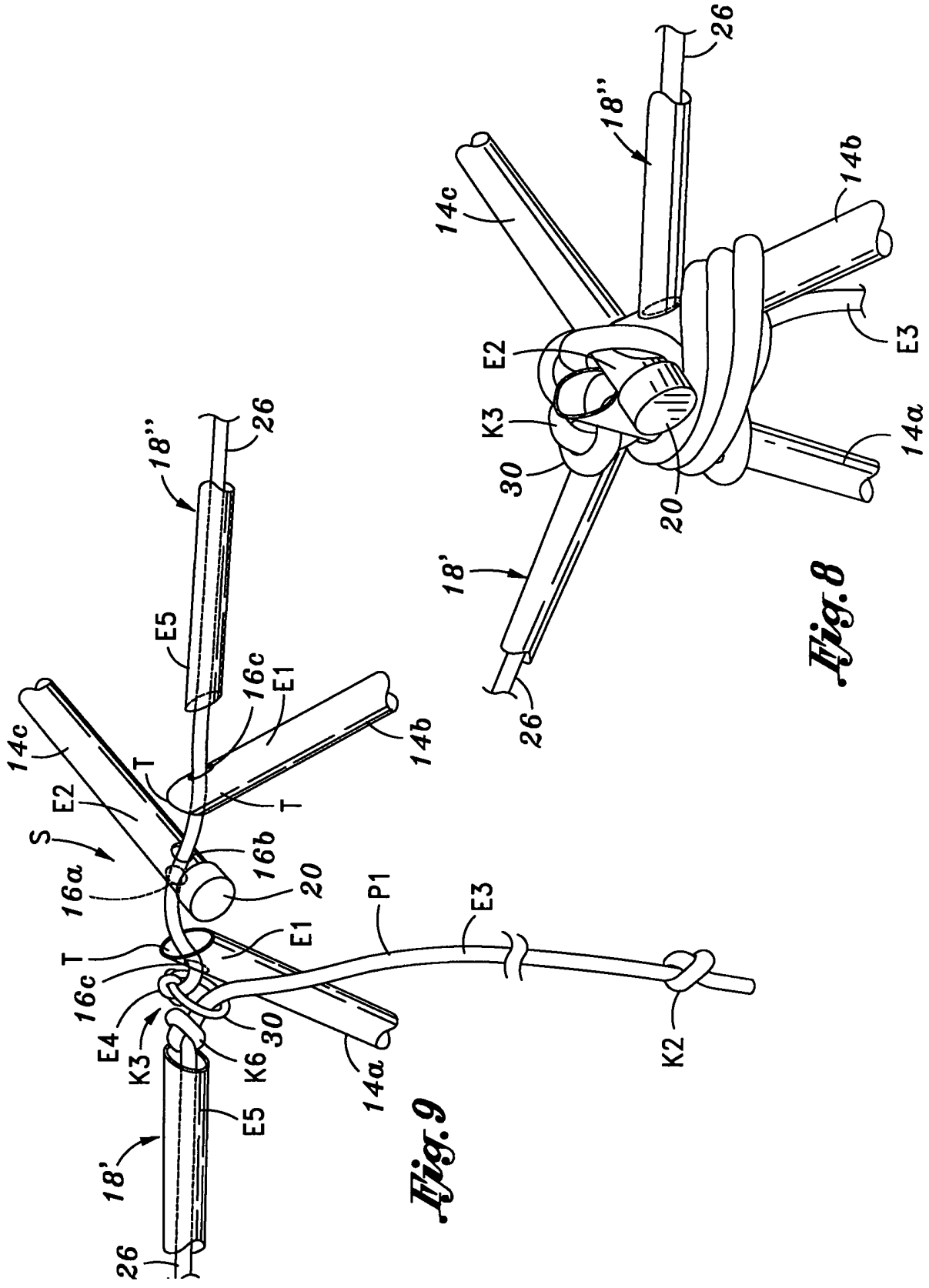
26
18''
14c
14b
E2
E3
K3
14a
30
20
18'
26
E5
16c
E1
T
S
16a
16b
P1
E4
K6
K2

Fig. 8

Fig. 9

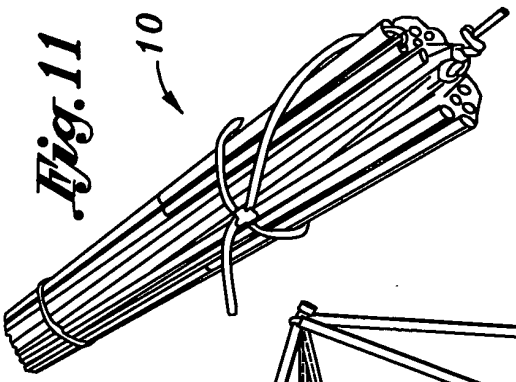

Fig. 11

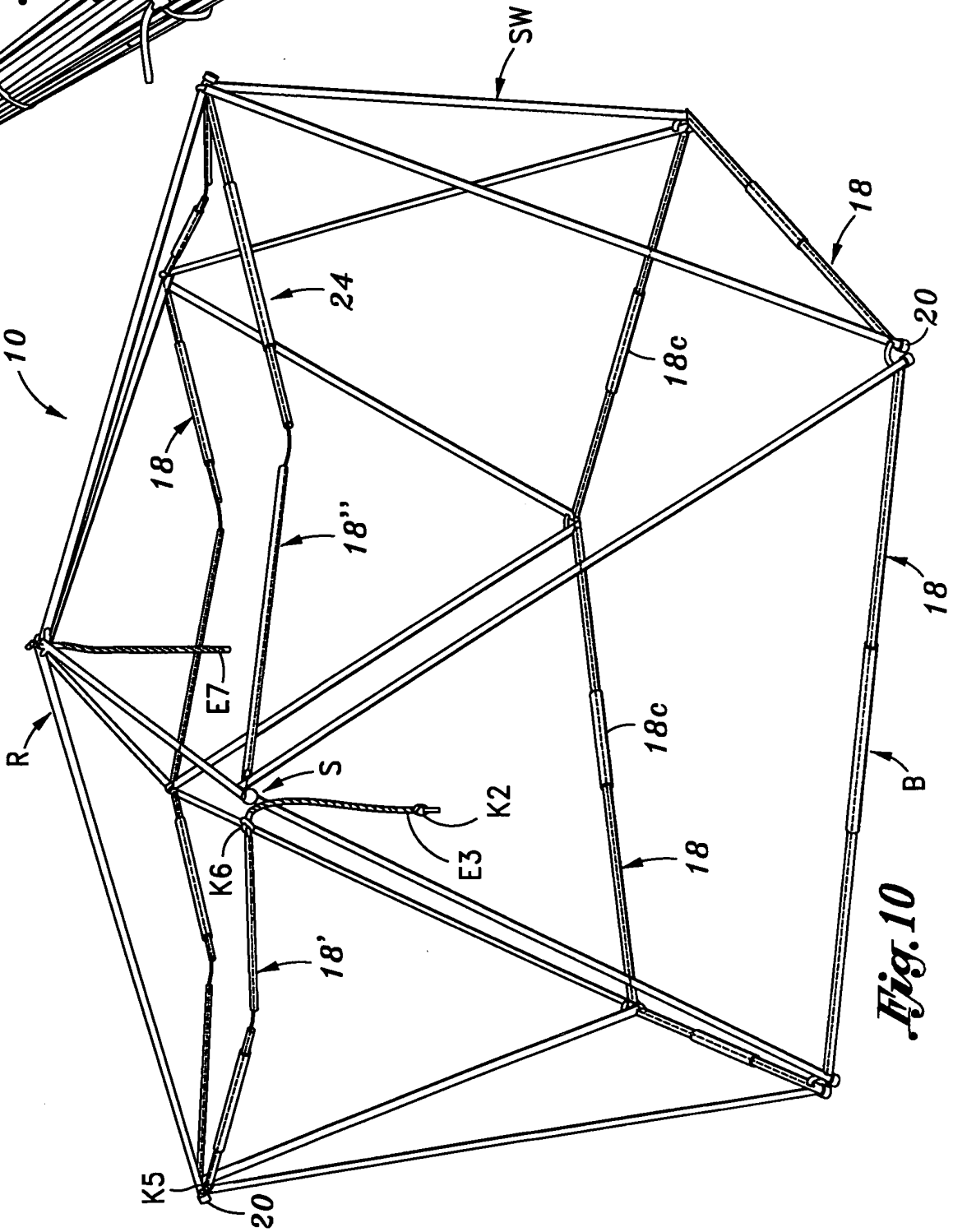

Fig. 10

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
E04H 15/48 (2006.01)
E04B 7/10 (2006.01)

[12] 发明专利申请公布说明书

[21] 申请号 200780034577.2

[43] 公开日 2009 年 9 月 2 日

[11] 公开号 CN 101523003A

[22] 申请日 2007.7.16
[21] 申请号 200780034577.2
[30] 优先权
[32] 2006. 7.19 [33] US [31] 60/831,884
[86] 国际申请 PCT/US2007/073601 2007.7.16
[87] 国际公布 WO2008/011375 英 2008.1.24
[85] 进入国家阶段日期 2009.3.18
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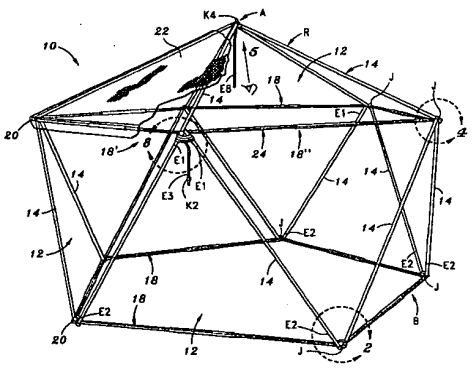
权利要求书 7 页 说明书 9 页 附图 8 页

[54] 发明名称

可折叠支承结构

[57] 摘要

一种可折叠支承结构包括多个互连的基本上三角形的框架部件，该框架部件在其角落处通过柔性连接部连接。 互连框架部件中的至少一些共用可折叠管状构件作为互连三角形框架部件的一条边并且互连框架部件的刚性管状构件中至少一些端设置在相邻的共用可折叠管状构件之间。 细长柔性张力构件穿过共用的可折叠管状构件并在设置在相邻共用可折叠管状构件之间的刚性管状构件的端之间延伸。 一些互连框架部件的刚性管状构件形成带有端的框架顶部，将其端打结以在框架顶部顶点处形成柔性连接部。



1. 一种可折叠支承结构，其包括：

多个基本三角框架部件，每一个所述框架部件包括由柔性连接部连接的角落，

每一个框架部件包括：

第一细长刚性管状构件，所述第一细长刚性管状构件具有相对的第一端与第二端以及邻近所述第一构件的每一端的一对开口，

第二细长刚性管状构件，所述第二细长刚性管状构件具有相对的第一端与第二端以及邻近所述第二构件的每一端的一对开口，以及

可折叠细长管状构件，所述可折叠细长管状构件具有相对的第一开口端与第二开口端，所述可折叠管状构件具有刚性状态与折叠状态因此当所述可折叠构件被折叠时所述支承结构是可折叠的；

形成所述支承结构的框架顶部的第一预定数量的所述框架部件以及形成所述支承结构的框架侧壁的第二预定数量的所述框架部件，

所述侧壁具有顶部区段以及底部区段，所述顶部区段包括形成所述框架顶部的每一个框架部件的可折叠管状构件，所述底部区段包括形成所述框架侧壁的可替换框架部件的可折叠管状构件；

形成所述框架顶部的所述框架部件的所述第一与第二管状构件的第一端是开口的并且通过柔性线材被系住从而形成顶点，所述线材穿过所述一对开口以及形成所述框架顶部的所述框架部件的所述第一与第二管状构件的每一个所述第一端内的开口端，从而在所述顶点处提供柔性连接部，这样使得当形成所述框架顶部的所述框架部件的所述可折叠管状构件被折叠时，所述框架顶部向内折叠而不解开所述柔性线材。

2. 根据权利要求 1 所述的可折叠支承结构，其中每一对开口中的各个开口基本上是对齐的。

3. 根据权利要求 1 所述的可折叠支承结构，其包括形成所述顶点的所述第一与第二管状构件的所述第一开口端附近的连接器构件，并

且在所述顶点附近的每一个所述第一开口端处，所述柔性线材首先穿过在所述顶点附近的所述开口端内的所述一对开口中的一个开口、然后从在所述顶点附近的所述开口端穿出并环绕所述连接器构件，并且然后回到在所述顶点附近的所述开口端内并从在所述顶点附近的所述开口端内的所述一对开口中的另一个开口延伸出来。

4. 根据权利要求 3 所述的可折叠支承结构，其中所述连接器构件具有基本环状结构。

5. 根据权利要求 1 所述的可折叠支承结构，其中

包括所述顶部区段的所述可折叠管状构件被端对端对齐且形成所述框架顶部的所述框架部件的所述第一管状构件与第二管状构件具有它们各自的第二端，所述各自的第二端可替换地设置在包括所述顶部区段的相邻一对所述对齐的可折叠管状构件之间，并且

包括所述底部区段的所述可折叠管状构件被端对端对齐并且形成所述框架侧壁的相邻框架部件的所述第一与第二管状构件的所述第二端设置在相邻一对可折叠管状构件之间，以及

第一细长柔性张力构件，所述第一细长柔性张力构件穿过包括所述顶部区段的所述对齐的可折叠管状构件、从所述顶部区段的相邻一对可折叠管状构件中的一个所述可折叠管状构件的第一开口端出来、然后穿过被设置在所述相邻一对之间的刚性管状构件内的开口并且然后进入在所述顶部区段内的所述相邻一对中的另一个所述可折叠管状构件的所述第二开口端内，以及

第二细长柔性张力构件，所述第二细长柔性张力构件穿过包括所述底部区段的所述对齐的可折叠管状构件、从所述底部区段的相邻一对可折叠管状构件中的一个所述可折叠管状构件的第一开口端出来、然后穿过被设置在所述底部区段内在所述相邻一对之间的刚性管状构件内的开口并且然后进入在所述底部区段内的所述相邻一对中的另一个所述可折叠管状构件的所述第二开口端内。

6. 根据权利要求 5 所述的可折叠支承结构，其中所述第一细长柔

性张力构件具有相对末端，当形成所述顶部区段的所述可折叠管状构件被折叠时，其中一个所述末端永久地系到环上且另一个所述末端松开地穿过所述环。

7. 根据权利要求 1 所述的可折叠支承结构，其中每个所述可折叠管状构件均包括

沿细长柔性张力构件的一部分延伸的第一管状刚性化构件，

沿所述细长柔性张力构件的另一部分延伸的第二管状刚性化构件，以及

刚性化套筒构件，所述刚性化套筒构件被安装成当两个刚性化构件基本轴向对齐时，所述刚性化套筒构件在所述刚性化构件上滑动，并且

所述细长刚性构件与所述可折叠细长构件均通过所述细长张力构件被铰接地连接在柔性连接部内，所述柔性连接部在其角落处与至少一些相邻框架部件互连。

8. 根据权利要求 1 所述的可折叠支承结构，其中一个所述可折叠管状构件提供末端构件，所述末端构件包括

一对轴向对齐的刚性化管状构件，细长柔性张力构件的一部分延伸穿过所述一对轴向对齐的刚性化管状构件；以及被定位成在所述刚性化构件之上滑动以形成所述末端构件的可滑动套筒构件，

相邻框架部件的所述细长刚性构件以及所述可折叠细长构件通过穿过所述相邻框架部件的所述角落以形成在所述角落处的柔性连接部的所述细长张力构件而在所述角落处被连接，

所述张力构件的一部分包括跨骑所述末端构件的外末端的一对结从而在所述端构件折叠时，所述一对轴向对齐的刚性化管状构件不沿所述张力构件横向移动一实质距离。

9. 根据权利要求 1 所述的可折叠支承结构，其中所述互连框架部件均形成测地线结构的一部分。

10. 根据权利要求 1 所述的可折叠支承结构，其中所述互连框架部件形成截二十面体的一部分。

11. 根据权利要求 1 所述的可折叠支承结构，其中所述刚性管状构件以及所述可折叠管状构件的至少一些所述端是斜面的。

12. 一种可折叠支承结构，其包括

通过柔性连接部互连的多个基本三角框架部件，每一个所述框架部件包括

第一细长单件式刚性管状构件，该第一细长单件式刚性管状构件具有在每一个所述端内带有开口的相对的第一端与第二端，

第二细长单件式刚性管状构件，该第二细长单件式刚性管状构件具有在每一个所述端内带有开口的相对的第一端与第二端，以及

具有相对开口端的可折叠细长管状构件，以及

在所述可折叠细长管状构件内的细长柔性张力构件，所述细长柔性张力构件从所述相对开口端向外并在所述第一与第二构件的第二端的所述开口之间延伸，并且再进入并穿过相邻框架部件的可折叠细长管状构件从而形成使相邻框架部件互连的柔性连接部。

13. 根据权利要求 12 所述的可折叠支承结构，其中所述互连框架部件均形成测地线结构的一部分。

14. 根据权利要求 12 所述的可折叠支承结构，其中所述互连框架部件形成截二十面体的一部分。

15. 一种具有基本上为截二十面体结构的可折叠支承结构，其包括

多个基本三角框架部件，所述框架部件通过在其角落处的柔性连接部互连以形成框架顶部与框架侧壁，每一个框架部件包括一对刚性构件，所述刚性构件在其端内均带有开口；以及一个可折叠细长管状构件，所述可折叠细长管状构件包括相对的第一开口端与第二开口端并具有刚性状态与折叠状态，从而当所述支承构件被折叠时，所述支

承结构是可折叠的，

所述框架顶部与侧壁通过形成所述框架顶部与所述侧壁的可替换地所述框架部件的所述可折叠细长管状构件被连接到一起，

所述可折叠细长管状构件端对端相邻且对齐，并且在所述相邻可折叠构件的端之间设置有包括所述框架顶部的一个框架部件的一个刚性构件的第一端以及包括所述框架侧壁的每一个相邻框架部件的一个刚性构件的第一端，所述框架顶部刚性构件的所述第一端设置在所述框架侧壁刚性构件的所述第一端之间，

细长柔性张力构件，所述细长柔性张力构件穿过相邻一对所述可折叠管状构件、从相邻一对所述可折叠管状构件中的一个的开口端穿出并穿过被设置在所述相邻且对齐的可折叠管状构件之间的所述刚性构件内的所述开口并且然后进入所述相邻一对中的另一个可折叠管状构件的第二开口端内。

16. 一种具有竖立状态与折叠状态的支承结构，其包括

多个互连的基本三角框架部件，其中相邻框架部件在其角落处连接以形成框架顶部与框架侧壁，

每一个所述框架部件包括一对刚性管状构件以及一个可折叠管状构件，其中所述一对刚性管状构件在其至少一个端内具有一对基本对齐的开口，

每一个框架部件的所述可折叠管状构件以端对端地定向而形成所述框架顶部与框架侧壁，并且穿过所述可折叠管状构件延伸有细长柔性张力构件，

相邻框架部件的所述刚性管状构件的至少一些所述端形成所述框架顶部与框架侧壁，所述刚性管状构件设置在形成所述框架顶部与框架侧壁的每一个框架部件的所述可折叠管状构件之间，

所述细长柔性张力构件穿过所述端内的所述开口从而形成柔性连接部并具有被系住的相对端，其中当所述支承结构在竖立状态下并被解开以折叠所述支承结构时，一个相对端永久地被系住而一个相对端被解开并松开。

17. 根据权利要求 16 所述的可折叠支承结构，其中一个所述可折叠管状构件提供了末端构件，所述末端构件包括

一对轴向对齐的刚性化管状构件，所述细长柔性张力构件的一部分延伸穿过所述刚性化管状构件；以及可滑动套筒构件，所述可滑动套筒构件设置成在所述刚性化构件之上滑动，从而形成所述末端构件，

相邻框架部件的所述细长刚性构件与所述可折叠细长构件通过所述细长张力构件在其角落被连接，其中所述细长张力构件穿过所述相邻框架部件的角落从而在所述角落处形成柔性连接部，

所述张力构件的一部分包括一对结，所述一对结跨骑所述末端构件的外末端从而当折叠所述端构件时，所述一对轴向对齐的刚性化管状构件不沿所述张力构件横向地移动一实质距离。

18. 一种可折叠支承结构，其包括

通过在其角落处的柔性连接部连接的多个互连的基本三角框架部件，

每一个框架部件包括具有相对端的一对刚性管状构件以及一个具有相对开口端的可折叠管状构件，

至少一些所述互连框架部件共用所述可折叠管状构件作为所述互连三角框架部件的一个侧面并且所述刚性管状构件的至少一些端被放置在所述互连框架部件的相邻共用的可折叠管状构件之间，以及

细长柔性张力构件，所述细长柔性张力构件穿过所述共用的可折叠构件并从所述其相对开口端向外并在被设置于所述互连框架部件的相邻共用的可折叠管状构件之间的所述刚性管状构件的所述端之间延伸。

19. 根据权利要求 18 所述的可折叠支承结构，其中一些互连的框架部件的所述刚性管状构件形成框架顶部，且其端是开口的并通过柔性线材被系住以形成顶点，其中该柔性线材穿过所述开口端从而在所述顶点处提供柔性连接部，这样使得当所述可折叠管状构件被折叠时，所述框架顶部向内折叠而不解开所述柔性线材。

20. 根据权利要求 18 所述的可折叠支承结构，其中每一个可折叠管状构件包括

一对轴向对齐的刚性化管状构件，所述细长柔性张力构件的一部分延伸穿过所述刚性化管状构件，所述刚性化管状构件沿所述张力构件可滑动且所述刚性化管状构件中的一个具有比另一个刚性化管状构件更大的直径且被设置成在所述另一个刚性化管状构件上滑动以形成所述可折叠细长管状构件。

可折叠支承结构

相关申请的交叉引用

【0001】本申请是 PCT 申请，该 PCT 申请要求于 2006 年 7 月 19 日提交的标题为“可折叠支承结构”的美国临时专利申请 No.60/831,884 的在 35USC119（e）之下的权利。该相关申请在此并入以作参考并作为本申请的一部分。如果在本 PCT 申请中的发明公开内容与该相关临时申请的发明公开内容之间存在任何冲突，则应以本 PCT 申请中的发明公开为准。此外，发明人将硬拷贝或电子拷贝的、在本申请中引用或参考的、包括美国专利 No.6,748,962 以及于 2003 年 11 月 12 日提交的未决的美国公开文献序列号为 No.10/726,003 的任何且所有美国专利、美国专利申请以及其他文件在此并入以作参考。

定义

【0002】词汇“包括”（comprising）、“具有”（having）、“包含”（containing）以及“包括”（including）等，意为在含义上是同等的且开放的，跟随这些词汇中的任何一个词汇的一个或多个事项不意味这样一个或多个事项的全部的列举，也不意味着仅限于所列的一个或多个事项。

背景技术

【0003】美国专利 No.6,748,962 公开了本发明人的可折叠支承结构。在此公开的本发明是该可折叠支承结构的改进。

发明内容

【0004】我的可折叠支承结构具有在实施例中描述的一个或更多个特征，所述实施例在标题为“具体实施方式”部分中讨论。所附的权利要求将我的可折叠支承结构从现有技术区别开并对它进行了限定；但是，正如这些权利要求所表达的，其并未限制我的可折叠支承结构的范围，在一般意义上，如下特征是其一些但不必是所有特征：

【0005】第一，我的可折叠支承结构包括多个基本上三角框架部件，其每一个框架部件具有通过柔性连接部连接的角落。每一个框架部件具有一对细长刚性管状构件，该细长刚性管状构件在相对的端具有邻近管状构件端的一对开口。刚性管状构件可以是单件。每一对开口中的单个开口可以基本上对齐。每一个框架部件也包括具有刚性状态与折叠状态的可折叠细长管状构件，因此当可折叠构件被折叠时，该支承结构是可折叠的。穿过管状构件的细长柔性张力构件形成与相邻的框架部件互连的柔性连接部。框架部件可被互连以形成测地线(geodesic)结构的一部分、截二十面体的一部分或者其他几何三维结构。刚性管状构件与可折叠管状构件的一些端可以是呈斜面的。

【0006】第二，至少一些互连框架部件可共用其可折叠管状构件以作为互连三角框架部件的一个侧面并且刚性管状构件的至少一些端可设置在互连框架部件的相邻共用可折叠管状构件之间。细长柔性张力构件可穿过共用的可折叠管状构件并从其相对的开口端向外延伸并穿过设置在互连框架部件相邻的共用可折叠管状构件之间的刚性管状构件端内的一对开口延伸。

【0007】第三，我的可折叠支承结构可包括由预定数量的框架部件形成的框架顶部。该框架顶部可包括柔性线材，该柔性线材穿过形成框架顶部的管状构件内的一对开口从而在顶点提供柔性连接部。这使得当可折叠管状构件被折叠时，框架顶部向内折叠而不用解开柔性线材。基本环形构造的连接器构件可被使用，柔性线材缠绕穿过该连接器构件并穿过在顶点附近的管状构件端内的开口对。

【0008】第四，我的可折叠支承结构也可包括由预定数量的框架部件形成的框架侧壁。该框架侧壁可具有：顶部区段，该顶部区段包括形成框架顶部的每一个框架部件的可折叠管状构件；以及底部区段，该底部区段包括形成框架侧壁的可替换框架部件的可折叠管状构件。形成框架顶部与框架侧壁的每一个框架部件的可折叠管状构件可被定向为从端到端并且穿过该可折叠管状构件延伸有细长柔性张力构件。

【0009】第五，柔性张力构件在每一个三角框架部件的可折叠细长管状构件内、从它们相对的开口端向外延伸并穿过相邻刚性管状构件的

端内的开口并且进入并穿过相邻框架部件的可折叠细长管状构件。该细长柔性张力构件可具有被系住的相对端，当支承结构是竖立状态以折叠支承结构时，所述被系住的相对端中的一个端通常保持被系住而另一个端被解开并松开。张力构件的一部分可包括跨骑可折叠细长管状构件的外末端的一对结从而在可折叠细长管状构件折叠后可折叠构件的一对轴向对齐刚性化管状构件不会沿张力构件横向移动一实质距离。

【0010】这些特征没有以任何等级顺序被列出，并且这样的列举也不是全面的。

附图说明

【0011】我的可折叠支承结构的一些实施例将联系附图详细讨论，所述附图仅是出于示意性目的。附图包括以下图，并用相同附图标记表示相同部分：

【0012】图 1 是本发明的可折叠支承结构的一个实施例的透视图。

【0013】图 1A 是图 1 中所示可折叠支承结构在部分折叠状态下的局部透视图。

【0014】图 2 是沿图 1 的线 2 截取的放大的局部透视图。

【0015】图 3 是相似于图 1 的放大的局部透视图，其示出了将要被折叠的可折叠管状构件。

【0016】图 4 是沿图 1 的线 4 截取的放大的局部透视图，其示出本发明的可折叠支承结构的一个角落。

【0017】图 4A 是相似于图 4 的放大的局部透视图，其示出在折叠状态下的角落。

【0018】图 5 是从图 1 中所示可折叠支承结构的框架顶部的顶点的下面的平面图。

【0019】图 5A 沿图 5 的 5A-5A 截取的剖面图。

【0020】图 6 是相似于图 5 的顶点的下面的平面图，其示出了部分穿过形成顶点的管状构件的端的柔性线材。

【0021】图 7 是相似于图 6 的平面图，其示出几乎完全穿过形成顶点的管状构件的端的柔性线材。

【0022】图 8 是沿图 1 的线 8 截取的放大的局部透视图，其示出被系在一起的柔性张力构件的相对端。

【0023】图 9 是相似于图 8 的放大的局部透视图，其示出被解开的柔性张力构件的相对端。

【0024】图 10 是图 1 中示出的可折叠支承结构在部分折叠状态下的透视图。

【0025】图 11 是示出在图 1 中示出的可折叠支承结构在完全折叠状态并折叠成紧凑组件的透视图。

具体实施方式

【0026】本发明的可折叠支承结构的一个实施例被标示为标记 10。该可折叠支承结构 10 具有如图 1 中所示的竖立状态、如图 11 中所示的折叠状态以及如图 10 中所示的部分折叠状态。可折叠支承结构 10 包括多个互连的基本三角框架部件 12，每一框架部件 12 均具有由柔性连接部 J 连接的角落（图 1）。一些互连的框架部件 12 形成框架顶部 R 且另一些形成框架侧壁 SW（图 10）。每一个框架部件 12 包括一对刚性管状构件 14 以及具有刚性状态和折叠状态的可折叠管状构件 18。管状构件 14 与 18 可以是例如由诸如铝或钢的金属制成的空心圆筒，该空心圆筒具有基本上从 1/2 至 2 英寸的外直径以及基本上从 3 至 15 英尺的长度。如图 11 所示，当可折叠管状构件 18 被折叠且所有管状构件 14 与 18 被向内折叠时，支承结构 10 可折叠成紧凑组件。

【0027】框架部件 12 基本上是等边三角形。正如可能的情况，每一个框架部件 12 的刚性构件 14 与可折叠构件 18 通过沿接合件 24 的细长张力构件 26 或通过沿底边 B 的细长张力构件 26'（图 2 和 3）被连结在柔性连接部 J（图 1 和 2）处。例如，张力构件 26 与 26'可以是绳索、线缆、绳等。细长张力构件 26 与 26'穿过轴向对齐的可折叠构件 18。在角落处从一个三角框架部件 12 穿到相邻的框架部件的张力构件 26 与 26'的部分形成用作铰链的柔性连接部 J。因此，无需其它结构来形

成铰链或连接部 J。从而，张力构件 26 与 26'具有双重功能：即在角落处连接三角框架部件 12 以及当折叠可折叠支承结构 10 时用作在角落处的铰链。

【0028】所有的刚性管状侧壁构件 14 基本上是相同的，且每一个刚性管状侧壁构件 14 都具有上端 E1 与下端 E2。每一个上端 E1 具有开口的末端尖端 T 且是斜面的，且每一个上端在管状构件 14 的侧壁内邻近开口的末端尖端 T 处具有单一开口 16c（图 4A）。因此，如图 4 与 4A 中所示出的，例如柔性张力构件 26 的线材可穿过开口 16c 以及由开口的末端尖端 T 形成的另一个开口。在下端 E2 内，邻近这些端 E2 有一对基本对齐的开口 16a 与 16b（图 2 与 3）。端 E2 可由例如塑料制成的帽 20 覆盖。帽 20 用作防护件，从而最小化对于由支承结构 10 支承的帐篷遮篷 22（图 1）的损害或者避免其他的对于使用者的伤害。

【0029】所有可折叠管状构件 18 基本都相同。正如在图 2 与 3 中最好说明的，正如可能的情况，每一个可折叠管状构件 18 包括刚性化的套筒构件 18c 以及沿一个细长柔性张力构件 26 或 26'的一部分延伸的一对管状刚性化构件 18a 与 18b。如图 2 中所示，当管状构件 18 处在刚性、非折叠状态下时，刚性化构件 18a 与 18b 基本上是轴向对齐的。在这样的刚性状态下，刚性化构件 18a 与 18b 的外开口端 E5 挤向相邻的刚性构件 14 且它们各自的直角内切端（right angle cut inner end）E6（图 3）彼此邻接。张力构件 26 穿过刚性化构件 18a 与 18b 的空心内部并从刚性化构件 18a 与 18b 的相对外侧端 E5 穿出。外侧端 E5 可以是斜面的。刚性化套筒构件 18c 可滑动地安装在刚性化构件 18a 与 18b 上。套筒构件 18c 的内直径略微大于刚性化构件 18a 与 18b 的外直径，而刚性化构件 18a 与 18b 具有基本相同的外直径。因此，套筒构件 18c 被成尺寸为可滑动地与刚性化构件 18a 与 18b 接合以形成可折叠细长管状构件 18。

【0030】至少一些互连的框架部件 12 共用管状构件 14 作为它们三角构造的一个公共侧面。其他互连框架 12 共用可折叠管状构件 18 作为它们三角构造的一个公共侧面。框架顶部 R 与框架侧壁 SW 在形成接合件 24 的公共区段相遇。该接合件 24 包括可替换框架部件 12 的可折

叠管状构件 18，该可替换框架部件 12 形成对齐的且从端到端定向的框架顶部 R 与框架侧壁 SW（图 1 与 10）。一个细长柔性张力构件 26 纵向穿过形成接合件 24 的每一个可折叠管状构件 18 的空心内部延伸，且它具有相对端 E3 与 E4，当结构 10 如图 8 与 9 中所示竖立时，相对端 E3 与 E4 被系住。

【0031】如图 10 中所示，当刚性化套筒构件 18c 被横向移动以允许刚性化构件 18a 与 18b 被折叠时，如果它们的端相遇，则折叠管状构件 18，那么可折叠支承结构 10 被折叠。形成基底 B 的框架侧壁 SW 的底部区段包括形成框架侧壁 SW 的可替换框架部件 12 的可折叠管状构件 18。基底 B 的可折叠管状构件 18 对齐且从端到端被定向。如图 2 与 3 中所示，细长柔性张力构件 26'纵向穿过形成基底 B 的每一个可折叠管状构件 18 的空心内部延伸。张力构件 26'的相对端 E3'与 E4'在结 K1 处被系住且不论结构 10 的竖立或折叠状态均保持成这样。张力构件 26 穿过形成接合件 24 的每一个可折叠管状构件 18 延伸，且如图 9 中所示，以如下方式将它的相反端 E3 与 E4 连接：即当可折叠支承结构 10 要被折叠时，端 E3 可被拆开。

【0032】参照图 8 与 9，张力构件 26 的端 E3 与 E4 的连接与拆开的这种方式被说明。框架顶部 R 由标记 14c 标示的一个刚性管状构件被设置在分别由标记 14a 与 14b 标示的刚性管状构件的斜面端 E1 之间，该刚性管状构件是相邻框架部件 12 形成侧壁 SW 的一部分的刚性管状构件。当支承结构 10 是竖立（图 1）的时候，如图 8 所示，在端 E3 附近的张力构件 26 的 P1 部分被固定以及如图 9 所示其被解开以允许支承结构如图 11 中所示被折叠起来。张力构件 26 的 P1 部分穿过环 30 且在端 E3 的尖端附近的放大结 K2 用作止挡部从而当可折叠支承结构 10 正被折叠时防止端 E3 穿过环 30。

【0033】如图 9 中所示，接合件 24 的由标记 18'与 18"标示的相邻可折叠管状构件设置了空间 S，在该空间 S 处，张力构件 26 的端 E4 在结 K3 内被系到环 30（图 8）。端 E4 保持被这样系住而不论结构 10 的竖立或折叠状态。如图 8 中所示，当张力构件 26 的 P1 部分缠绕相邻框架部件 12 的分别由标记 14a 与 14b 标示的刚性管状构件（该相邻框

架部件 12 形成在空间 S 附近的侧壁 SW 的部分）时，端 E3 被系住并被固定就位且可折叠支承结构 10 如图 1 所示是竖立的。由于包括构件 18'与 18"的所有管状构件 18 都与相邻端对齐，而不允许结构自己倒塌直到端 E3 被解开或松开，因此这样给结构 10 赋予了刚性。一松开端 E3，则环 30 沿 P1 部分滑动直到与在端 E3 附近用作止挡部的结 K2 相遇。

【0034】最初在装配期间，张力构件 26 的端 E3 与 E4 都不以任何方式打结，且端 E4 穿过对齐的可折叠管状构件 18 进给并被系于环 30。端 E4 穿过可折叠管状构件 18"的开口斜面端 E5 进给并穿过在刚性构件 14b 内的开口 16c 并且然后从刚性构件 14b 的开口斜面端 E1 的尖端 T 出来，再穿过在刚性构件 14c 中的对齐的一对开口 16a 与 16b 并进入到刚性构件 14a 的开口斜面端 E1 的尖端 T 且从在刚性构件 14a 的端 E1 内的开口 16c 出来并且最后被系于环 30 作为结 K3。

【0035】当张力构件 26 处于张力状态时，包括结 K3 的环 30 用作止挡部。如图 8 所示，当可折叠支承结构 10 处于竖立状态（图 1）时，端 E3 穿过环 30 被向下拉并且 P1 部分在管状构件 14c 上缠绕、向下并绕管状构件 14a 与 14b 并且被捆紧，绕这些邻接构件缠绕 P1 部分，如图 8 中所示。这样在张力情况下牢固保持了张力构件 26 且 P1 部分与张力构件 26 的一端 E3 在一般垂直定向上呈松垂悬挂。当结构 10 要折叠时，端 E3 被松开且 P1 部分被解开并穿过环 30 滑动直到结 K2 接触到环 30。

【0036】如图 5、6 以及 7 中所示，形成框架顶部 R 且用标记 14c、14d、14e、14f 以及 14g 标示的框架部件 12 的刚性管状构件基本上是相同的，其与形成侧壁 SW 的刚性管状构件 14 具有相同的长度。刚性管状构件 14c、14d、14e、14f 以及 14g 的每一个对应端 E1 都不是斜面的，并被系到一起以形成顶点 A。具有大致环状结构的连接器构件 31 以及柔性线材 32 被用于将这些端 E1 连接到一起。正如可能的情况，线材 32 穿过一对开口 16a 与 16b 以及形成框架顶部 R 的框架部件 12 的每一个管状构件 14c 至 14g 的每一个开口端 E1，从而在顶点 A 处提供柔性连接部或铰链。当框架部件 12 的可折叠管状构件 18 沿接合件 24 被折叠时，这使得框架顶部 R 向内折叠（图 10）而不解开柔性线材 32。线材 32

顺序穿过管状构件 14c 至 14g 的端 E1 并缠绕连接器构件 31。

【0037】例如如图 6 中所示，线材 32 的一端 E7 穿过在刚性构件 14e 内的一对开口 16a 与 16b 中的一个开口 16b 延伸，然后穿过该刚性管状构件 14e 的开口 E1 并绕连接器构件 31，并且然后向回穿过开口 E1 并且最后从另一个开口 16a 延伸出来。如图 7 中所示，这样的过程被重复直到线材 32 的端 E7 与 E8 分别穿过刚性构件 14f 的开口 16b 与 16a 并从它的开口端 E1 延伸出来。端 E7 在连接器构件 31 下方通过并从顶点 A 的顶部出来并系到结 K4 内（图 1 与 5A）。端 E8 在连接器构件 31 上方并绕连接器构件 31 穿过、在垂直方向内松弛地悬挂于顶点 A 的底部外。

【0038】如图 1A 所示，可折叠管状构件 18'提供了通过一对结 K5 和 K6 防止可折叠管状构件 18'从张力构件 26 滑脱的沿接合件 24 的末端构件。正如可能的情况，张力构件 26 的 P2 部分穿过管状构件 18'且每一个结 K5 和 K6 与该管状构件 18'的一个外末端 X 或 Y 邻接。结 K5 和 K6 足够大以防止穿过管状构件 18'的张力构件 26 的 P2 部分而横向移动。因此，通过跨骑在末端构件 18'的这些结 K5 和 K6 且每一个结与末端构件的一个外末端 X 和 Y 邻接，则当套筒 18c 横向移动时，当折叠末端构件 18'折叠时，一对轴向对齐的刚性化管状构件 18a 与 18b 不会沿张力构件 26 横向移动一实质距离。因此，所有的刚性化构件 18a 与 18b 沿张力构件 26 或多或少保持在相同的相对位置，但在横向移动套筒构件 18c 时，相对彼此是可折叠的。

这些优点包括，但不限于，一个可折叠支承结构，其利用（a）具有柔性张力构件的管状构件，该柔性张力构件沿管状构件的空心内部或管状构件的端穿过从而提供简化与低成本的方法以便将这些管状构件连接成多个基本三角框架，所述基本三角框架在由张力构件形成的角落处用柔性铰链连接部互连，（b）通过用柔性线材来连接管状构件的端以便在框架顶部提供柔性顶点从而形成框架顶部。

本发明范围

【0039】以上以这样完全、清楚、简明以及确切的方式公开了我所思考的实现我的可折叠支承结构以及制作与使用它的方式和过程的最

好模式的说明，以使所涉及的本技术领域的任何技术人员都能制作和使用我的可折叠支承结构。然而，我的可折叠支承结构易受改型与替换结构的影响，该改型与替换结构来自完全等同的以上讨论的示意性实施例，因此，本发明并不将我的可折叠支承结构限于所公开的具体实施例。相反，我的发明将涵盖落入我的可折叠支承结构的精神与范围内的所有改型与替换结构，正如通过所附权利要求所一般表达的，该权利要求具体说明与确切要求我的发明的主题。

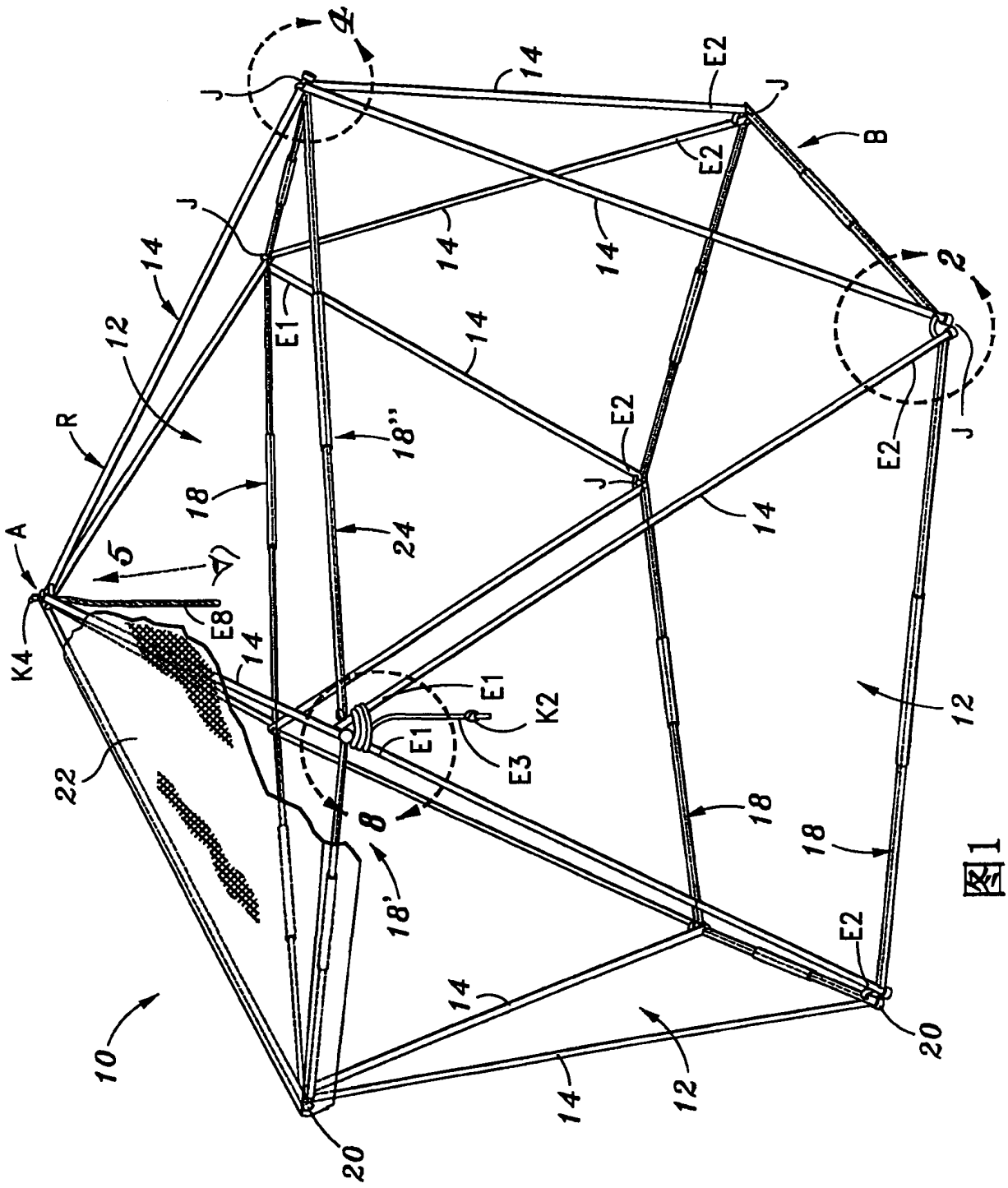


图1

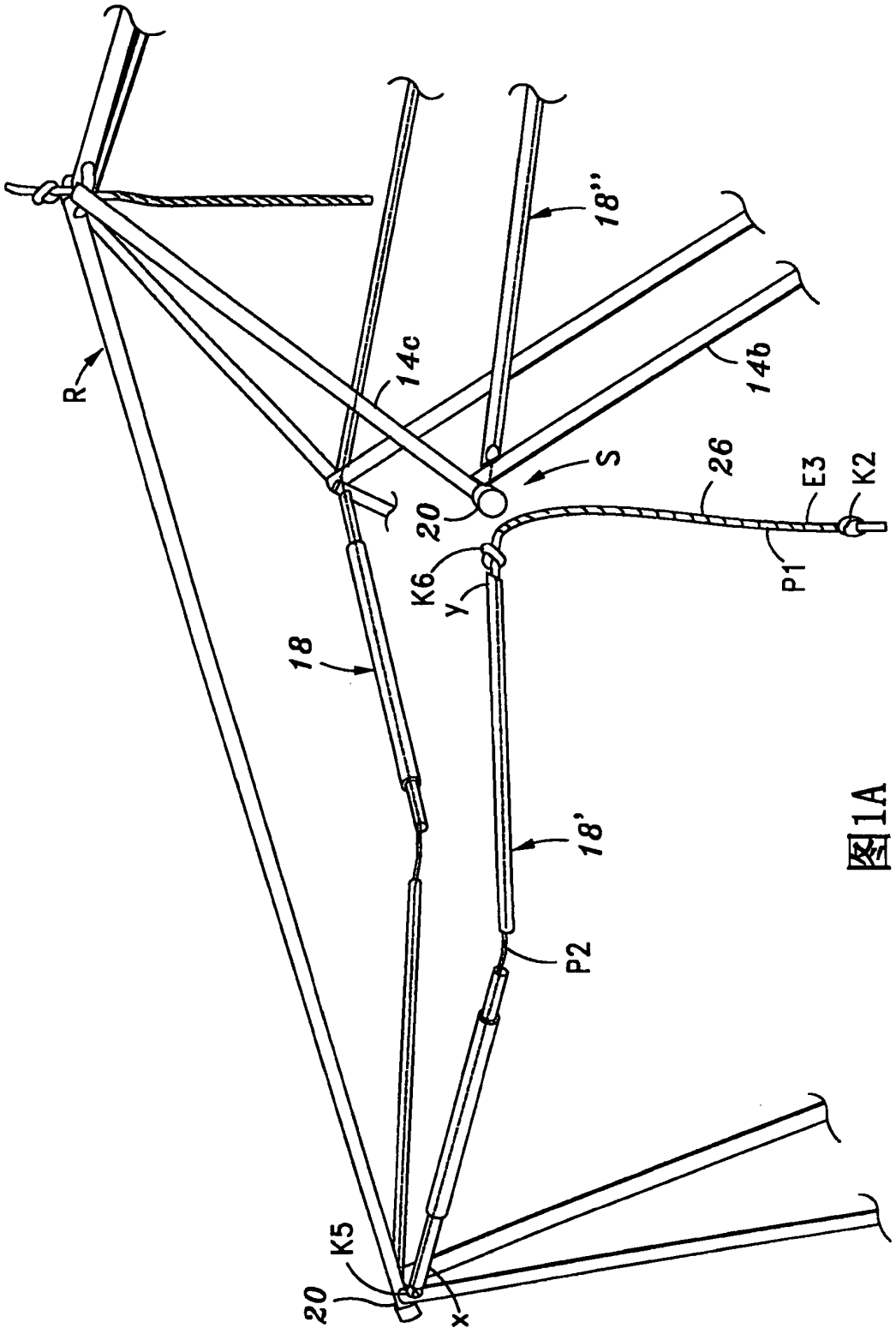


图1A

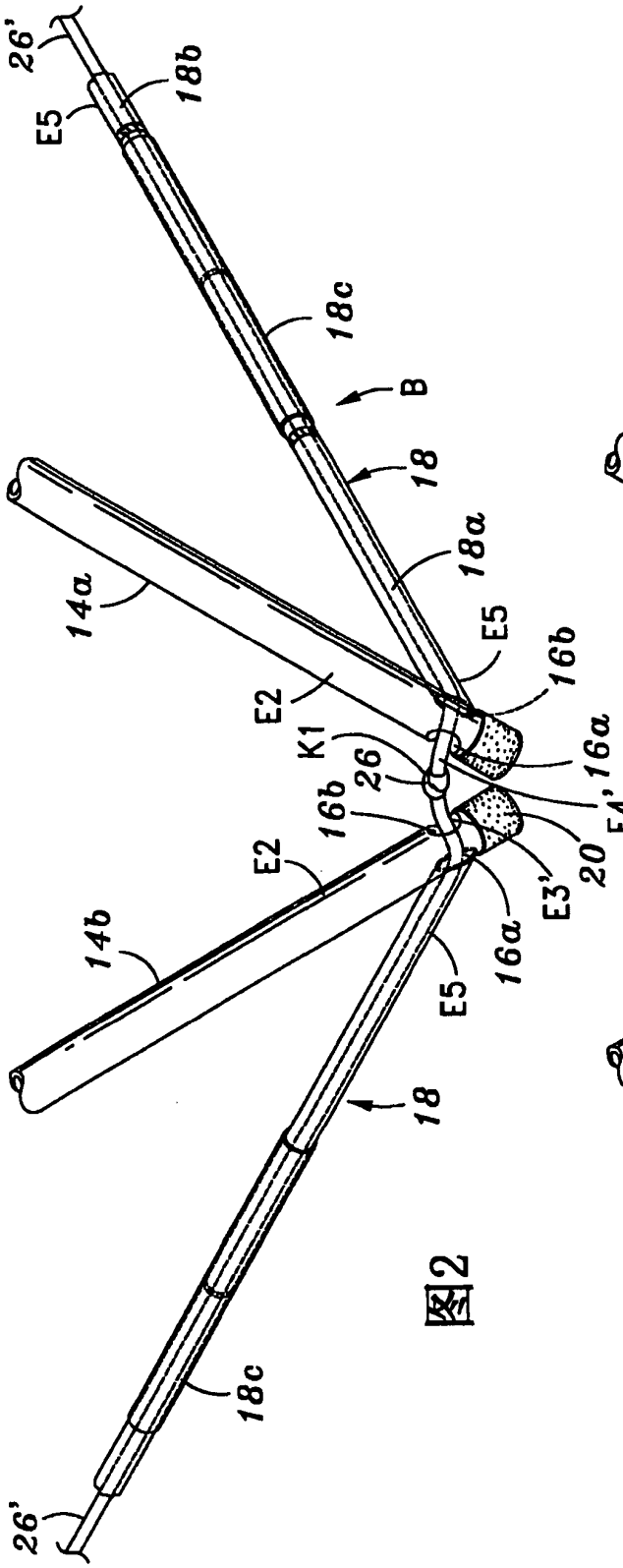

26'
18b
E5
18c
B
18
18a
14a
E5
16b
E2
K1
26
16a
16b
E4'
E2
20
14b
E3'
16a
E5
18
18c
26'

图2

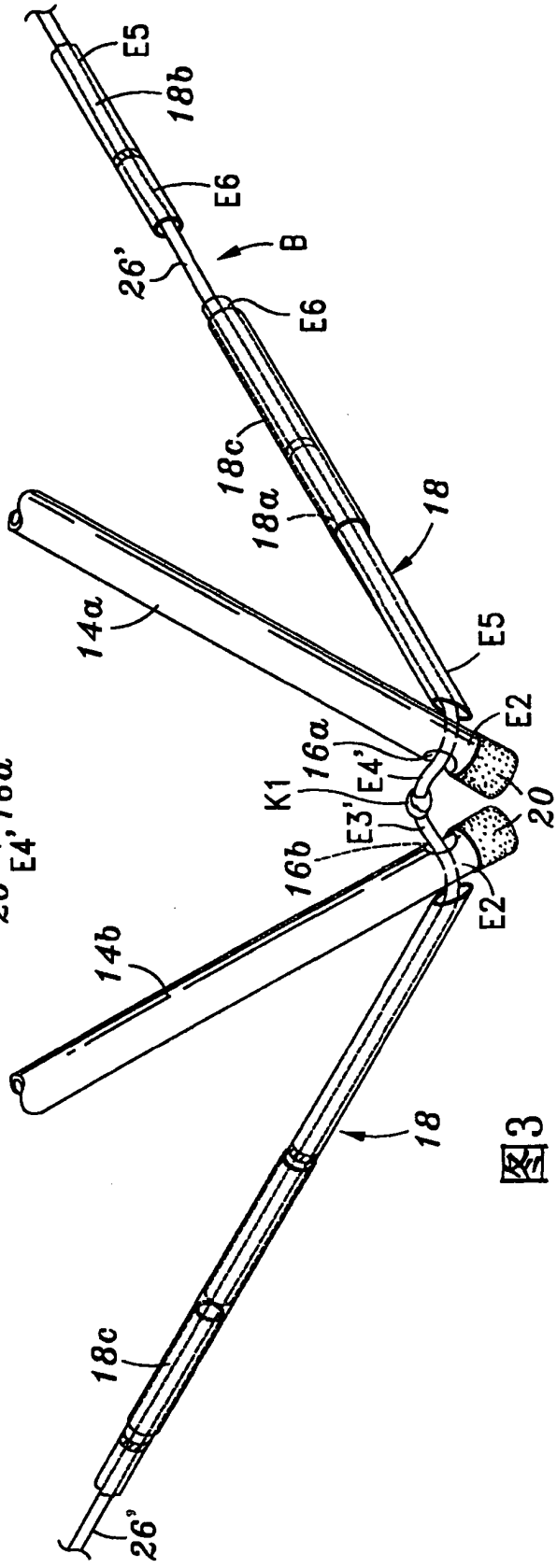

E5
18b
E6
B
26'
E6
18c
18a
18
14a
E5
E2
16a
K1
E4'
E3'
20
16b
E2
14b
18
18c
26'

图3

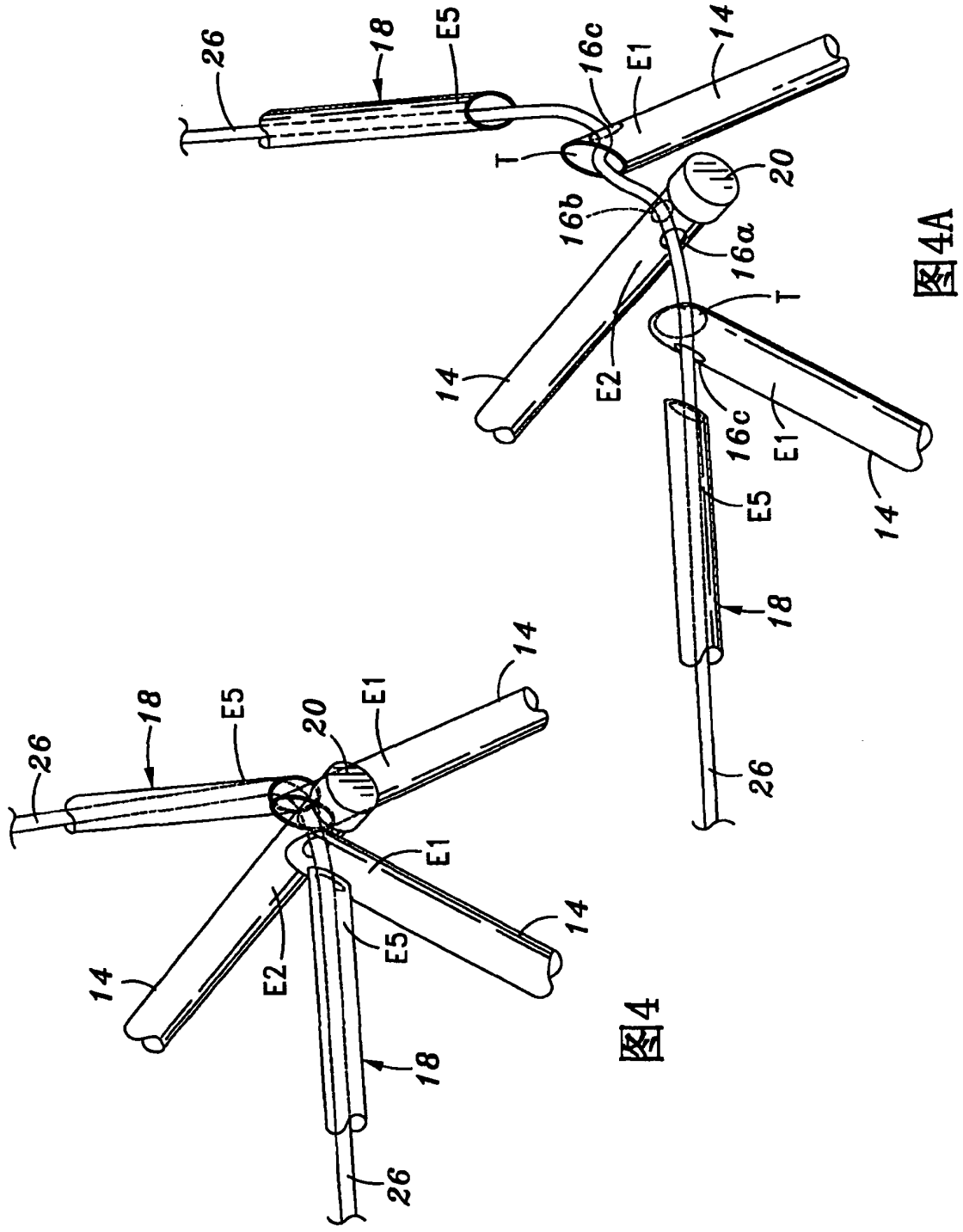

26
18
E5
16c
E1
14
T
20
16b
16a
T
14
E2
16c
E1
E5
14
18
26
18
E5
20
E1
14
26
E1
14
E2
E5
14
18
26

图4A

图4

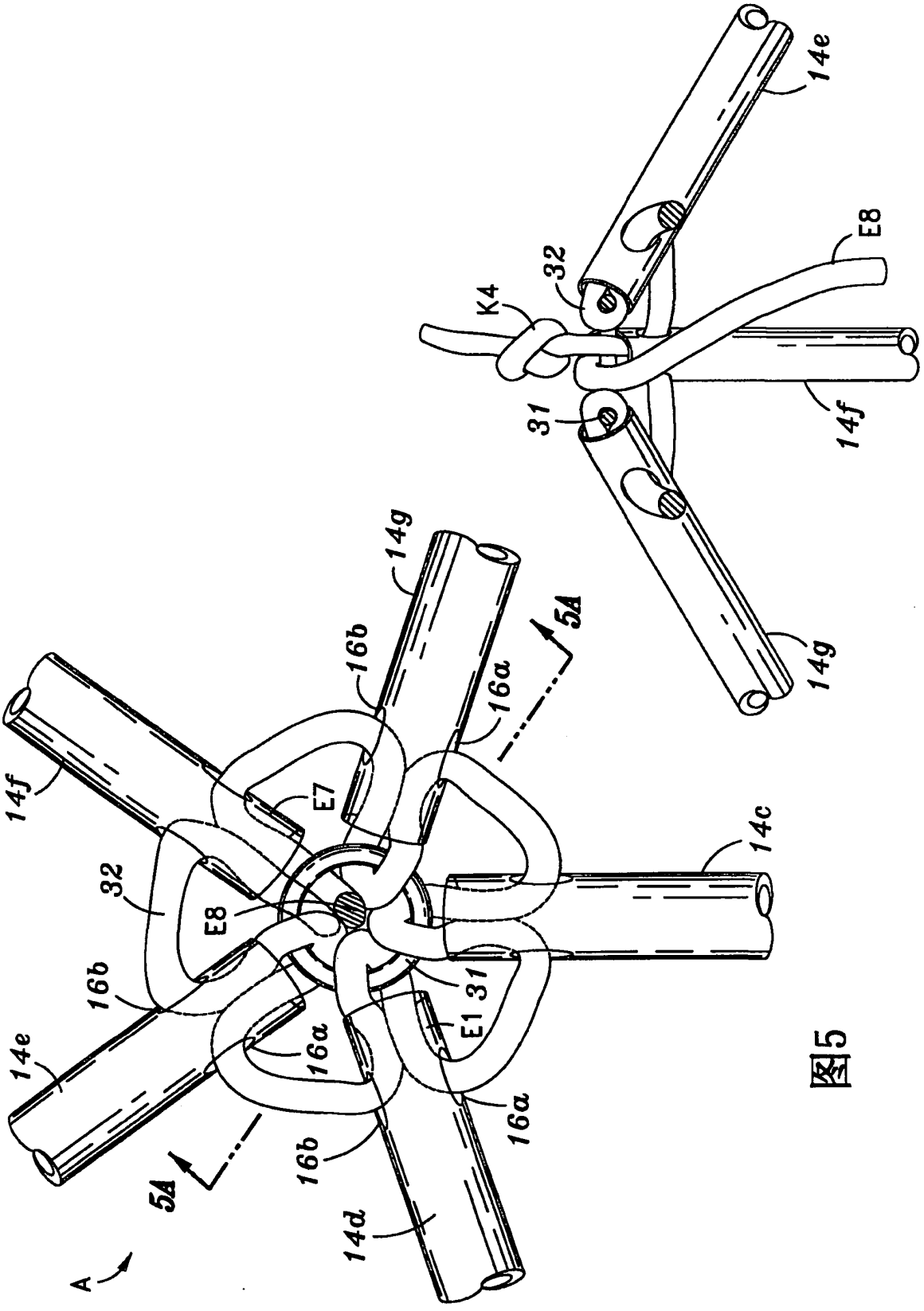

14e
E8
32
K4
31
14f
14g
16b
16a
5A
14f
E7
14g
14c
32
E8
16b
E1
31
14e
16a
16b
16a
5A
14d
A

图5A

图5

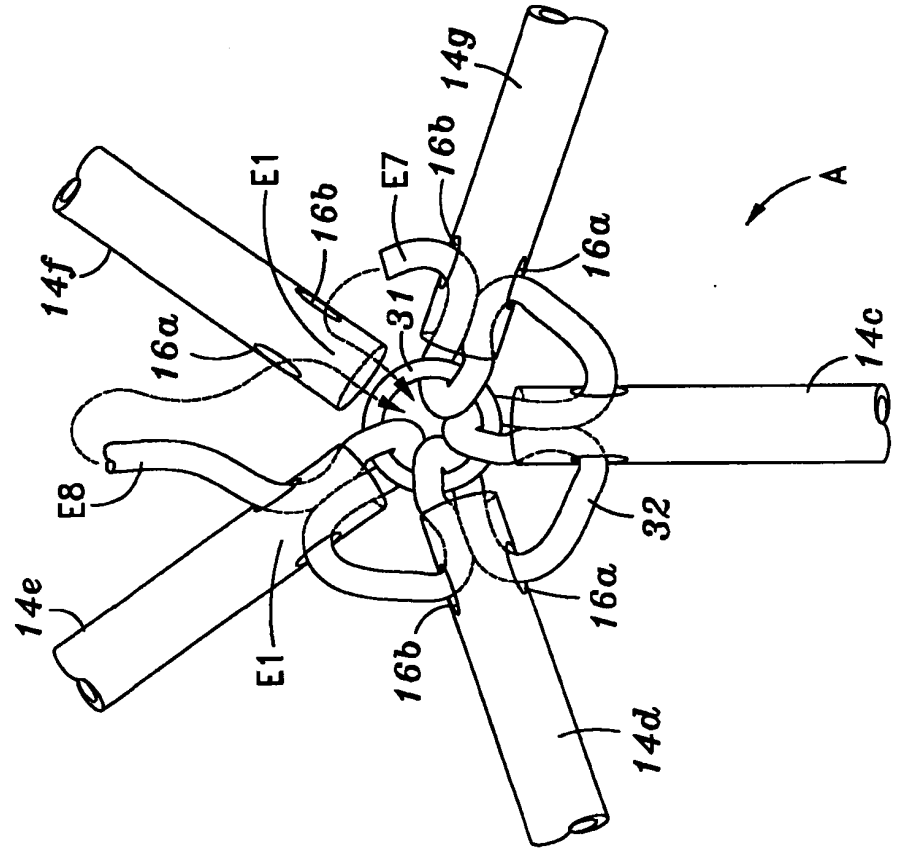

14g
16b
E7
E1
16b
14f
A
16a
31
16a
14c
16a
E8
32
14e
E1
16a
16b
14d

图7

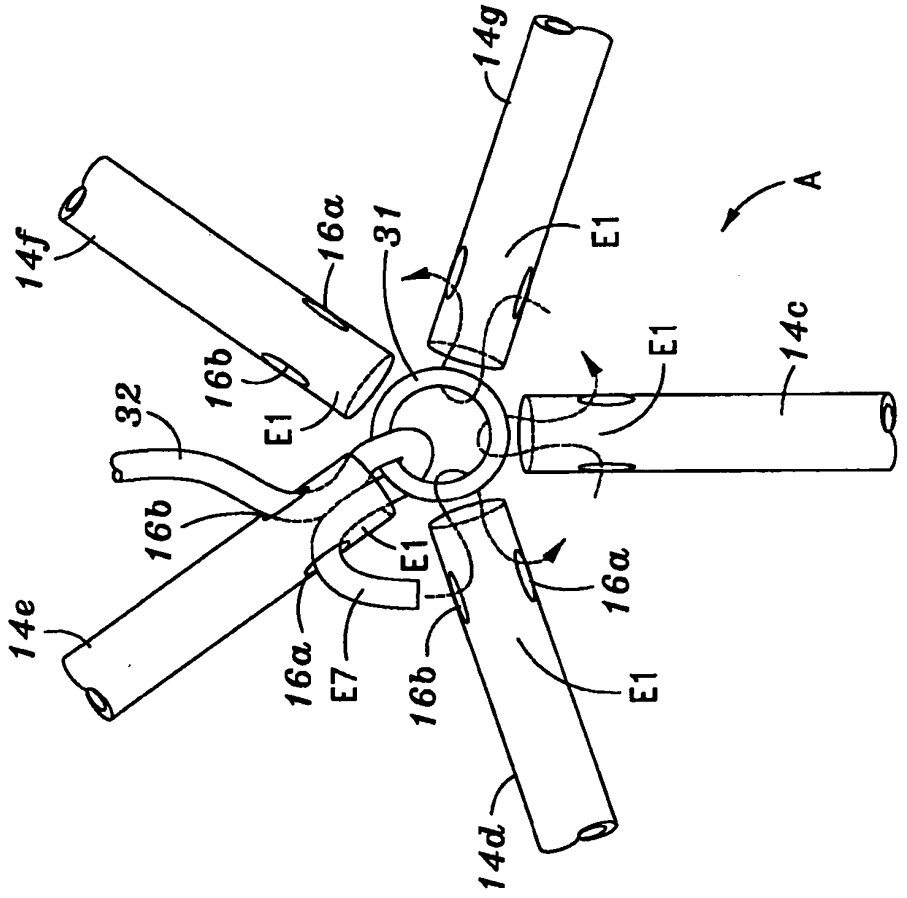

14g
14f
16a
31
E1
A
E1
14c
16b
32
E1
16b
E1
16a
14e
16a
E7
16b
E1
14d

图6

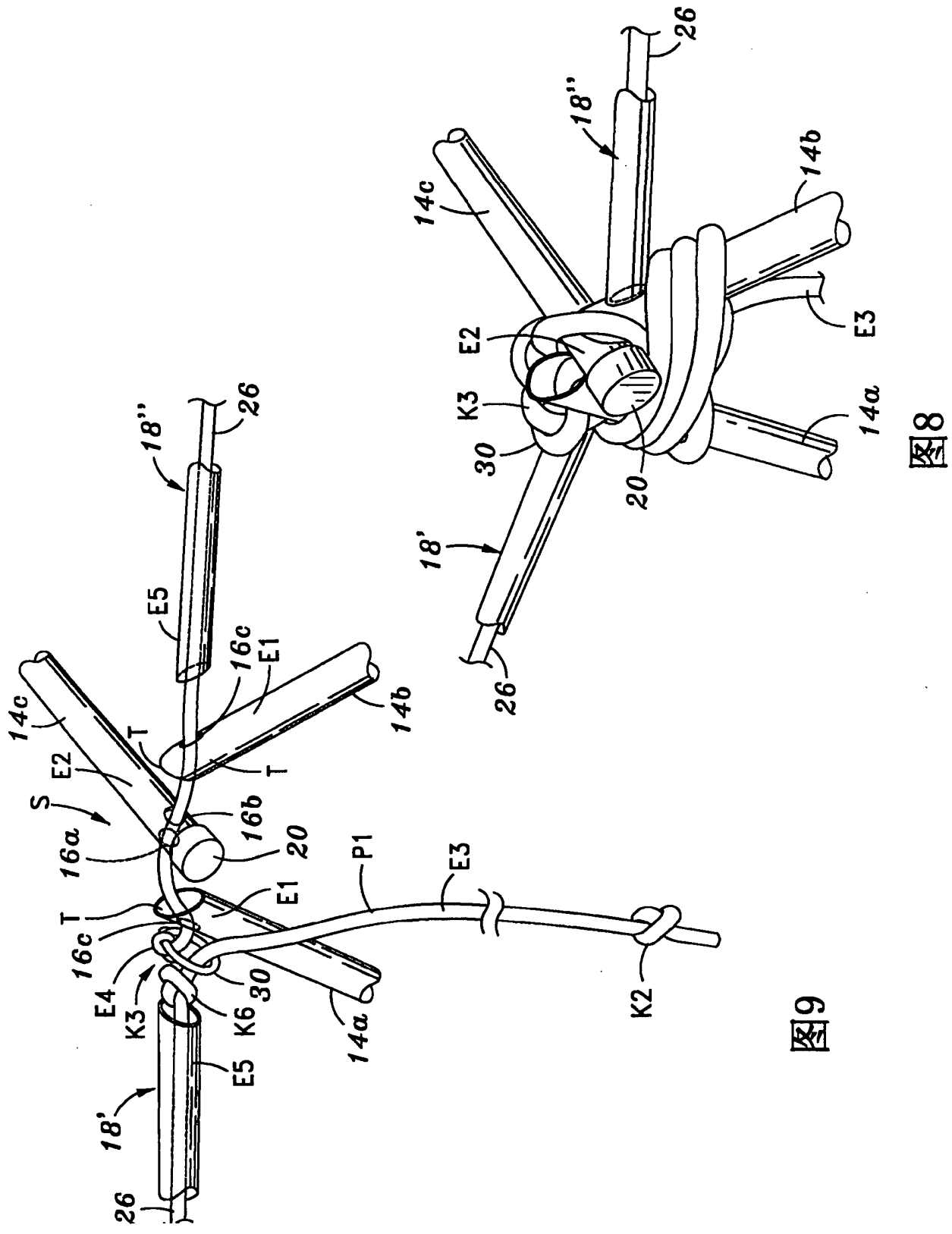

26
18''
14c
14b
E2
E3
K3
14a
30
20
18'
26
E5
16c
E1
T
S
16b
16a
P1
K2
K6
E4
14a

图8

图9

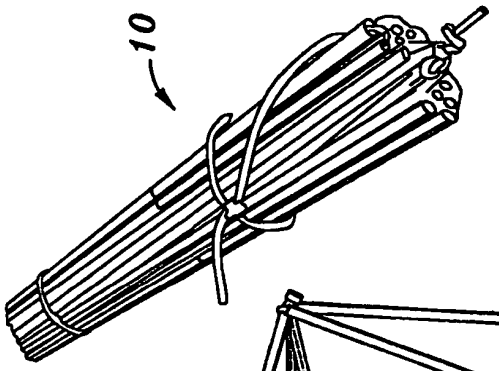


图11

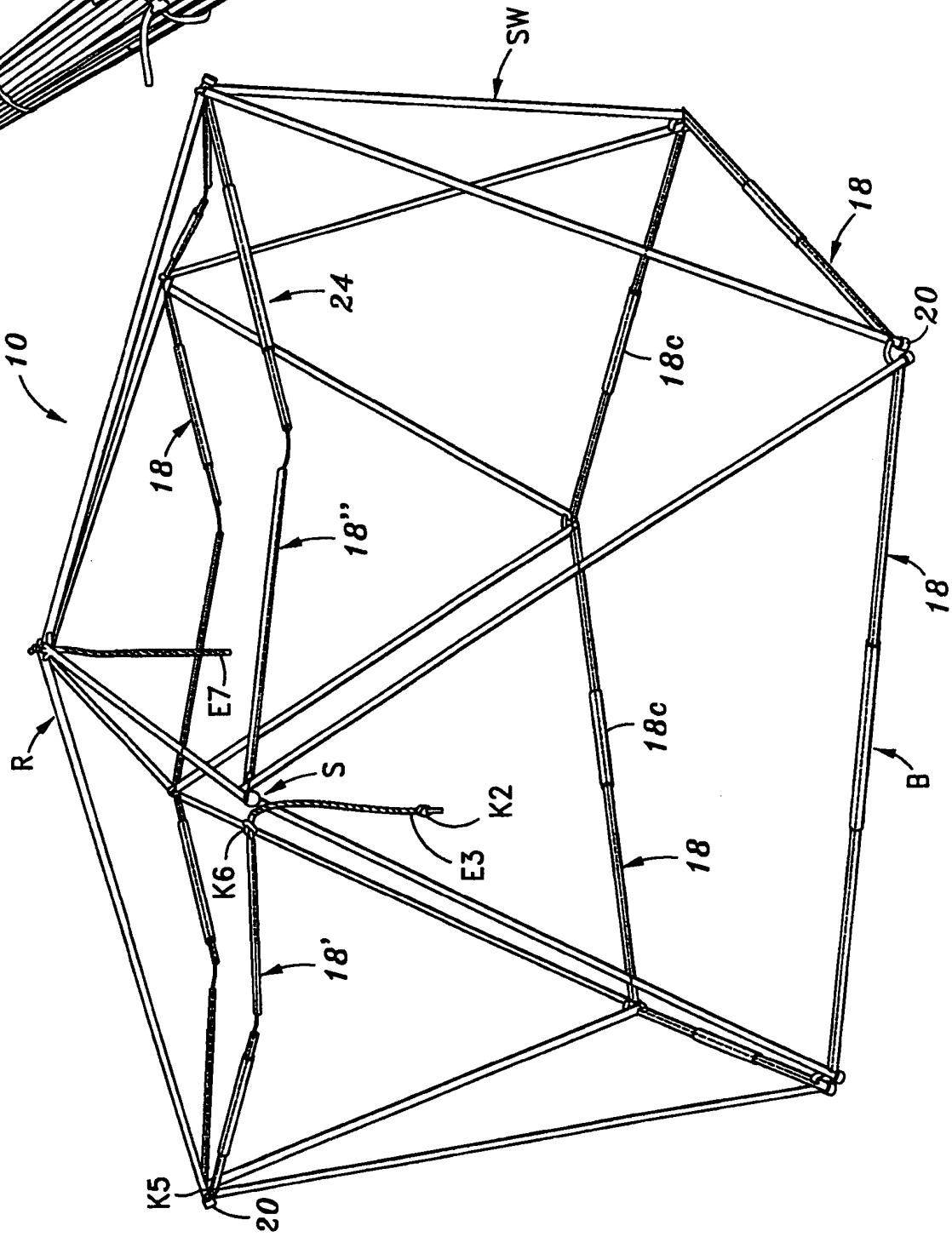


图10