LOAD-BEARING STRUCTURE REVERSIBLY FLEXIBLE AND RIGID

FIG. 1

FIG. 7

FIG. 8

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FIG. 2
FIG. 3
FIG. 4
FIG. 5
FIG. 6

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According to a more specific feature of this invention, each of the body members bearing upon one another in pressure-transmitting relationship is formed with a wall extending substantially perpendicularly to the aforementioned surface, this wall thus lying at least approximately in the plane of flexure, and at least one tension cable is disposed next to this wall in a space affording clearance for the shifting of the cable along the wall surface. Such shifting may be temporarily prevented by removable stops, e.g. pins attached to the wall, though it is also possible to provide a permanent abutment which engages the cable at a single point, remote from the side facing in the direction of bend, while letting the cable flex around that point toward the side proximal to the center of curvature when adjacent members are swung relatively to one another, in the relaxed state of the cable, about axes transverse to the plane of flexure.

The system according to the invention enables the rigid unit so obtained to be used as a more or less horizontal beam which, when loaded, will have a lower tension flange and an upper compression flange, the cable or cables being situated in the region of the tension flange to absorb the negative stresses due to bending moments. A tightening device for the cable or cables may then compress the beam so adapted to be swung from a released position into an operated position along the tension flange, the lever being securely held in the latter position by the stretched cable whose elastic force is supplemented by the loading stresses; if desired, however, a safety catch may be added to prevent any untimely release of the lever even when the load is removed.

The displaceability of the tension cable or cables, besides enabling a shift in the compression zone to suit different types of load, also allows adjacent body members to be artifically interconnected by suitable hinges or the like, for structural continuity, in the region of the compression flange which in operation is remote from the cable position. When the cable is released to collapse the unit, a displacement of the cable toward the hinges will facilitate coiling of the assembly without putting a strain on the linkage between the members. Where a positive coupling of these members to one another is desired only in the rigid condition, the hinges may be replaced by interfitting formations on confronting faces of adjoining members.

An important advantage of this invention is that composite articles, incorporating one or more elongated structural units of the type described, may be folded or rolled up bodily in a preferred direction regardless of the operating position of the tension element or elements within each unit. A foldable stretcher, for example, may include a frame with side bars composed of abutting body sections that are held together by respective pairs of tensionable internal cables extending horizontally near the bottom surface of each bar; such a stretcher could readily be rolled up in a downward direction upon a slackening of the cables, yet it could also be coiled upwardly—should this be preferred—if the cables were vertically shiftable inside the body sections as discussed above.

The foregoing features, partly disclosed in my aforesaid application Ser. No. 72,837, will become more fully apparent from the following detailed description of certain embodiments, reference being made to the accompanying drawings in which:

FIG. 1 is a perspective view of a stretcher frame embodying my invention;
FIG. 2 is a side view of the frame in its rigid state;
FIG. 3 shows the partly collapsed stretcher frame in a top view;
FIG. 4 is an elevational front view of the frame;
FIG. 5 shows the frame of FIGS. 1-4 partially rolled up in a side view;
FIG. 6 shows the stretcher frame completely rolled up for storage, in a side view;

FIG. 7 is a perspective view of an advantageous embodiment of a body section adapted to be used in a frame as shown in the preceding figures;

FIG. 8, in a view similar to that of FIG. 7, shows a modified body section;

FIG. 9 is a longitudinal sectional view of two interconnected body sections of the type shown in FIG. 8, taken on the line IX—IX therefor;

FIG. 10 shows the sections of FIG. 9 in a similar view, but in a relaxed state of an associated pair of tension cables;

FIG. 11 is a view similar to FIG. 9 illustrating still another modification;

FIG. 12 shows the sections of FIG. 11 in a relaxed state in a view similar to FIG. 10;

FIG. 13 illustrates yet another form of body section in a perspective view;

FIG. 14 represents a perspective view of a further modification;

FIG. 15 depicts yet another variant, seen in perspective; and

FIG. 16 is a perspective detail view of a combined handle and tightening device employed in the frame of FIGS. 1—6.

In FIGS. 1—6, I have shown a stretcher frame embodying my invention. Two elongated structural members 10, 10' comprise each a plurality of body sections 11, 11'. These sections are interconnected by tension cables 17 anchored at one end to a pair of tightening devices 12, 12' which have actuating elements 14a, 14b' designed as carrying handles for the stretcher. The other ends of the cables are attached to end stops 16, 16' which, for convenience of manufacture, are of the same basic shape as the devices 12, 12' and which are also associated with carrying handles 14b, 14b'. Artificially cross-linked 13a, 13b are hinged to the terminations 12, 12' and 16, 16' of members 10, 10' and serve to space these members horizontally apart during use of the stretcher; they are horizontally foldable at the center for reducing the separation of members 10, 10' to a minimum when the stretcher is collapsed. Legs 15 depend from end sections 11a, 11'a, 11b, 11'b to support the stretcher. It will be understood, although not specifically shown in the drawing, that a canvas or the like may be fastened by suitable means to the members 10, 10' in order to provide support for a load to be placed on the stretcher.

The stretcher frame, shown in its rigid state in FIGS. 1 and 2 partially collapsed in FIGS. 3 and 4, is seen in FIG. 5 in the forwardly disposed tension cables 217a, 217b, 217c as formerly shown in FIG. 9, attached, is shown swung downwardly in the direction of those body surfaces along which the tension element 17 is disposed, hence this arrangement requires but a small bending radius.

FIG. 6 shows the stretcher fully rolled up, the tension element 17 released and the handles (only those designated 14a', 14b' being visible) disposed inwardly of the relaxed elements 10, 10'.

FIG. 16 is a detail view of the tightening device 12 with its carrying handle 14a. A channelled bracket 30 comprises its rear end two flanges 31', 31' through which the tension element 17 extends. At its other end a lever 32, having a hook formation 33, is fulcrumed at a point 34. This lever is integral with the carrying handle 14a. A latch 36 is horizontally slidable in a slot 35 extending transversely through the bracket 30. Latch 36 is urged in the direction of the flanges 31', 31' by a spring (not shown). In operation, the looped end of the slack tension element 17 is slipped around hook 33 and lever 32 is pivoted counterclockwise into nesting position within the bracket 30, thereby causing the latch 36 to be cammed forwardly by a lug 37 on that lever before being biased back into its original position to engage in the recess 38, thus locking the lever in position. It should be noted that, in its tensioned state, the looped end of cable 17 lies somewhat below fulcrum 34 so as to tend to maintain the seen 32 in tightening position.

FIG. 16 also shows a pair of lugs 39, rigid with lever 32, in which the handle 14a is axially slideable, the other handles 14a', 14b, 14b' being similarly mounted. It will be understood that the tightening device 12 may also be used without the lugs 39 and the handle 14a (or 14a') and this device is to serve only for the tightening of a cable without any carrying function.

In FIGS. 7—15 I have illustrated a variety of body sections which may be used as or in lieu of the members 11, 11' in FIGS. 1—6.

The body section shown in FIG. 7 is of prismatic configuration and provided in three of its walls with longitudinal slots 112a, 112b and 112c, the slot 112a accommodating a tension cable 117a whereas the two slots 112b and 112c, together constituting a channel of L-shaped profile, receive a cable 117b. It will be understood that the two cables 117a, 117b may be part of a single looped tensioning element as shown at 17 in FIG. 16. Each of the slotted walls of member 111 is provided with a set of through-going holes 113a, 113b, 113c permitting the insertion of pegs, such as those shown at 114a and 114b, for holding the cables 117a, 117b against transverse motion in selection within their respective channels 112a, 112b, 112c. With the aid of these pegs, the plane of the parallel tension elements 117a, 117b may thus be shifted up or down or even tilted into a nearly diagonal position, depending on the direction of the load to be sustained by the structure. With downward directed load pressures as indicated by the arrow P, for example, the illustrated bottom position of the cables 117a, 117b will be most effective; if the load direction is subject to reversals, a positioning of the cables in or near a horizontal median plane will be more suitable.

Approximately diagonal positioning, of course, will be preferred where the load acts in a direction other than vertical.

FIG. 7 also illustrates a pair of corner bosses 115a, 115b, integral with the body of member 111, which fit into complementary recesses 116a, 116b of an adjoining member when several such members are interconnected to form an elongated structure as described in connection with FIGS. 1—6. It will be noted that the projections 115a, 115b and the recesses 116a, 116b are provided near the top of the member, thus in the portion thereof which forms a compression flange in the presence of a load as symbolized by arrow P. This load, which includes the dead weight of the elongated structure itself, prevents separation of the mating formations 115a, 115b and 116a, 116b in the tightened condition of the cables 117a, 117b.

In FIGS. 8—10 I have shown another type of body section 211 which is of U-shaped profile and provided with longitudinal channels 212a, 212b within the arms of the U, these channels accommodating a pair of tension cables 217a, 217b as in the preceding embodiment. At their lower ends, i.e. in the region of the height of the U, the channels 212a, 212b are countersunk to form recesses 216a, 216b accommodating channel-form elements 215a, 215b which slideably ride on the cables 217a, 217b to form interfiting abutments between adjoining body sections, upon a tightening of the cables, as functional equivalents of the bosses 115a, 115b of FIG. 7 (see particularly FIG. 9).

The channels 212a, 212b are internally provided with curved ramps 218a, 218b which descend from the top of the respective channel and approach the bottom of the channel, substantially midway along its length, with just enough clearance for the associated tension cable. The presence of these ramps is essential, as cables 217a, 217b in their bottom positions upon the tensioning of the cables by the associated tightening device (FIG.
when the cables are relaxed, they can curve about the ramp surfaces so as to facilitate the swinging of adjoining members 211 about a small radius as illustrated in FIG. 10. It thus becomes possible to interconnect these members by means of mating hinge elements 219', 219'' so as to form a continuous articulated structure, such hinges being, of course, also usable in the embodiment of FIG. 7 (in lieu of the formations 115a, 115b, and 116a, 116b) where the channels 112a, 112b allow the cables 117a, 117b to be slid towards these hinges preparatory to the collapsing of the structure.

FIGS. 11 and 12 show a part of a similarly articulated strut comprising L-shaped sections 210 which are hinged together at 319, the principal difference being that sections 310 and 210 being that the ramps 210a, 210b have been replaced by a transverse pin 318 near the bottom of each cable-receiving channel 312. The channel 312 is in each arm of the U is upwardly open (in contradistinction to the channels 210a, 210b of FIG. 8) to permit a sliding of the relaxed cable 317 past the hinges 319, 319' in the collapsed position illustrated in FIG. 12. FIG. 13 shows a body section 410 of L-shaped profile with a single channel 412 for a cable 417a and a longitudinal bore holding the other cable 417b in a transversely fixed position, this bore terminating in a recess 416 and in a complementary boss 415 slidingly received in the recess by the cable. The channel wall of section 410 has again a series of throughgoing holes 413 adapted to receive suitable fastening means for temporarily immobilizing the cable 417a, such as a cable-straddling stirrup 414 or the pegs 414a, 414b of FIG. 7.

FIG. 14 shows a similar L-shaped section 510 with a longitudinal channel 512 for a cable 517 and a slanted throughgoing slot 520 intersecting that channel, the slot 520 being traversed by a stud 521 which has a cross-bore 522 through which the cable passes; a clamping screw 523 is threaded into an end stud 521 to immobilize the latter with reference to cable 517a whereby the latter may be selectively held at any level of the inclined slot 520 and channel 512. The other cable 517b is again fixedly lodged, except for longitudinal slidable, within the other leg of the L.

The L-shaped member 610 shown in FIG. 15 is similar to section 510 of FIG. 14, except that the longitudinal channel 512 is omitted from the leg of the L formed with the inclined slot 620; the two cables 617a and 617b, flanking this leg of the L, are adjustably received in a single stud 621 (in the manner described for cable 517a in FIG. 14) which has two clamping screws 623, 625b, on opposite ends, for immobilizing the cables with reference to the stud at a selected common level. Bosses 615a, 615b are provided on the other leg for cooperation with complementary recesses in the manner and for the purpose described in connection with FIG. 7.

It will be apparent that the various types of body sections shown in FIGS. 7–15 have many interchangeable features which can be used in various combinations. Thus, for example, these sections can be hinged inter-connected, as in FIGS. 8, 12, and/or provided with inter-fitting formations including recesses (116a etc.) and projections (e.g. 115c, 215a, 415, 615a) which may be located either at corners remote from the operative cable positions (FIGS. 7 and 15) or at points traversed by the cables (FIGS. 8, 9 and 13). In the latter case, again, the projections may be supported only by the cables or may be integral with one or two adjoining sections between which they are located. Other modifications and adaptations of the disclosed arrangements, readily apparent to persons skilled in the art, are also possible and are intended to be embraced in the spirit and scope of my invention as defined in the appended claims.

Claims:

1. A load-bearing structure comprising an elongated body subject to flexural stress in a given plane by the load, said body including a plurality of juxtaposed sections of substantially identical configuration each having a wall surface disposed substantially parallel to said plane, said sections having aligned passages defining at least one throughgoing channel; elongated, flexible and substantially inextensible means for solidifying said body by aligning said sections in pressure-transmitting relationship and thickening solid body by releasing said sections for limited relative displacement, said sections being provided with clearances enabling at least partial displacement of said tensioning means along said wall surface between a region subject to negative stresses under load and a location remote from said region; and actuating means anchored to said tensioning means for alternately tightening and relaxing same.

2. A structure as defined in claim 1 wherein said sections are hingedly interconnected in the vicinity of said remote location.

3. A load-bearing structure comprising an elongated body subject to flexural stress in a given plane by the load, said body including a plurality of juxtaposed sections of substantially identical configuration each having a wall surface disposed substantially parallel to said plane, said sections having aligned passages defining at least one throughgoing channel; elongated, flexible and substantially inextensible and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and thickening said body by releasing said sections for limited relative displacement, said sections being provided with clearances enabling at least partial displacement of said tensioning means along said wall surface between a region subject to negative stresses under load and a location remote from said region; and actuating means anchored to said tensioning means for alternately tightening and relaxing same.

4. A structure as defined in claim 3 wherein said cable-engaging means comprises peg means adjustably disposed on said wall surface.

5. A structure as defined in claim 4 wherein said wall surface is provided with a slot extending at an angle to said cable means, said peg means being displaceably received in said slot and selectively immobilizable therein in different positions.

6. A load-bearing structure comprising an elongated body subject to flexural stress in a given plane by the load, said body including a plurality of juxtaposed sections of substantially identical configuration with at least two mutually perpendicular longitudinal walls, one of said walls forming a surface disposed substantially parallel to said plane; elongated, flexible and substantially inextensible cable means alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and thickening said body by releasing said sections for limited relative displacement, said sections being provided with clearances enabling at least partial displacement of said tensioning means along said wall surface between a region subject to negative stresses under load and a location remote from said region; and actuating means anchored to said cable means for alternately tightening and relaxing same.

7. A load-bearing structure comprising an elongated body subject to flexural stress in a given plane by the load, said body including a plurality of juxtaposed sections of substantially identical configuration with at least two mutually perpendicular longitudinal walls, one of said walls forming a surface disposed substantially parallel to said plane; elongated, flexible and substantially inextensible cable means alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and thickening said body by releasing said sections for limited relative displacement, said sections being provided with clearances enabling at least partial displacement of said tensioning means along said wall surface between a region subject to negative stresses under load and a location remote from said region; and actuating means anchored to said cable means for alternately tightening and relaxing same.
in pressure-transmitting relationship and slackening said body by releasing said sections for limited relative displacement, said sections being formed with internal clearances enabling at least partial displacement of said cable means along said surface between a region subject to negative stresses under load and a location remote from said region; cable-engaging means on said wall surface for maintaining said cable means in said region in the tightened condition thereof; and actuating means provided with clearances enabling at least partial displacement of said cable means for alternately tightening and relaxing same, said one of said walls being provided with an internal longitudinal channel accommodating said cable means, the channels of all said sections being co-planar and forming the clearances for the displacement of said cable means.

8. A structure as defined in claim 7 wherein said cable-engaging means comprises an abutment fixedly disposed in said channel, said abutment contacting only a limited length of said cable means substantially midway within the channel in the tightened condition of said cable means.

9. A load-bearing structure comprising an elongated body subject to flexural stress in a given plane by the load, said body including a plurality of juxtaposed sections of substantially identical configuration each having a wall surface disposed substantially parallel to said plane; a pair of elongated, flexible and substantially inextensible parallel cables alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and slackening said body by releasing said sections for limited relative displacement, said sections being provided with clearances enabling at least partial displacement of said cables along said wall surface between a region subject to negative stresses under load and a location remote from said region; cable-engaging means on said wall surface for maintaining said cables in said region in the tightening condition thereof; and actuating means anchored to said cables for alternately tightening and relaxing same.

10. A load-bearing structure comprising an elongated body subject to flexural stress by the load, said body including a plurality of juxtaposed sections of substantially identical rectangular profile, said sections having aligned passages defining at least one through-going channel; elongated, flexible and substantially inextensible tensioning means in said channel alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and slackening said body by releasing said sections for limited relative displacement, said tensioning means being confined at least in the tightened condition thereof to a region subject to negative stresses under load; actuating means anchored to said tensioning means for alternately tightening and relaxing same; and coupling means disposed between confronting faces of adjoining sections for positively interlinking same against relative lateral displacement in the aligned position of said sections, said coupling means including a general frustoconical bead slideable on said tensioning means, said bead being located at a corner of the rectangular profile at least in the tightened condition of said tensioning means, said sections being formed with internal clearances enabling at least partial displacement of said tensioning means in a plane parallel to two of the sides of said rectangular profile.

11. A structure comprising a collapsible frame which includes a pair of parallel bars each composed of: a plurality of juxtaposed sections of substantially identical configuration, said sections having aligned passages defining at least one through-going channel; elongated, flexible and substantially inextensible tensioning means in said channel alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and slackening said body by releasing said sections for limited relative displacement, said sections having aligned passages defining a pair of through-going channels, a pair of elongated, flexible and substantially inextensible parallel tension elements in said channels alternately tightenable and releasable for solidifying said body by aligning said sections in pressure-transmitting relationship and slackening said body by releasing said sections for limited relative displacement, said tension elements being confined at least in their tightened condition to two adjoining corners of the rectangle in a region subject to negative stresses under load; and actuating means anchored to said tension elements for alternately tightening and relaxing same, said sections being provided with clearances enabling a shifting of at least one of said tension elements towards a third corner of the rectangle.

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