United States Patent [19]

Metailler

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[54] **ASSEMBLAGE OF PIECES OF A METAL FRAME**

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[73] Assignee: **Richier,** Paris, France

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May 16, 1972 France 72.17427

[52] **U.S. Cl.** **52/638;** 52/726

[51] **Int. Cl.** **E04k 12/00**

[58] **Field of Search** ..... 52/637, 638, 726, 758 R, 52/752; 182/178; 403/337

[56] **References Cited**

UNITED STATES PATENTS

712,299	10/1902	Howland et al.	52/301
1,941,952	1/1934	Nickles	52/638 X
2,086,009	7/1937	Walker	52/301 X
2,194,810	3/1940	Reines	52/637 X
2,308,565	1/1943	Mitchell	52/637 X
2,404,276	7/1946	Cohen	52/638
3,245,188	4/1966	Evans	52/638
3,564,802	2/1971	Dreyfus	52/637

Primary Examiner—Frank L. Abbott
Assistant Examiner—Carl D. Friedman
Attorney, Agent, or Firm—Staas & Halsey

[57] **ABSTRACT**

The present invention concerns the assemblage of the elements of a dismountable metal frame, and more particularly a mast, such as a crane tower which has to be raised by successive superimposed elements or, on the contrary, dismounted.

The assemblage devices must be designed in such a manner as to permit the transmission of the components of the stresses in several directions, that is to say in a mast the longitudinal stresses exerted on the uprights placed in prolongation of one another, and the transverse stresses, transmitted more particularly by the cross-braces and resulting from shearing stresses and torques.

The assemblage device according to the invention comprises the combination of parts generally provided with connecting bolts, which receive the longitudinal stresses, and other parts, distinct from the preceding parts, intended for transmitting the transverse stresses, and preferably also for connecting the cross-braces to the uprights, these means projecting with respect to the surface of the joint on each of the pieces to be assembled, externally but tangentially to the perimeter of the said surface.

9 Claims, 16 Drawing Figures

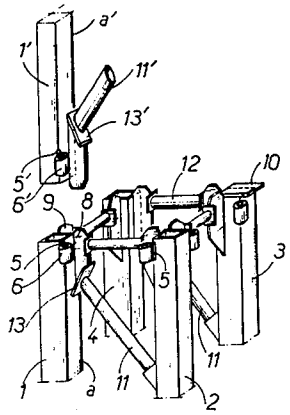


FIG.: 1

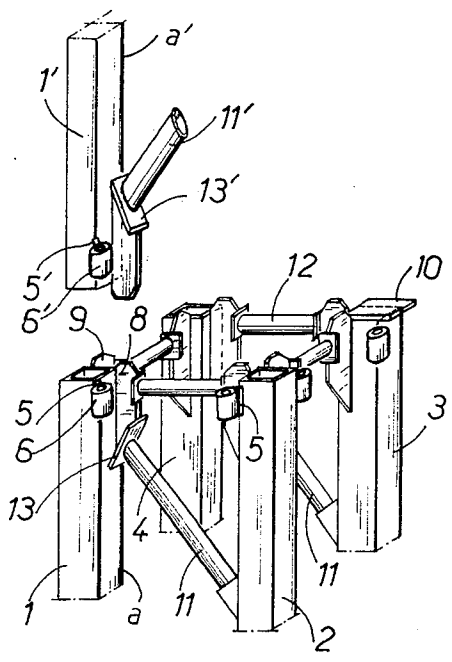


FIG.: 2

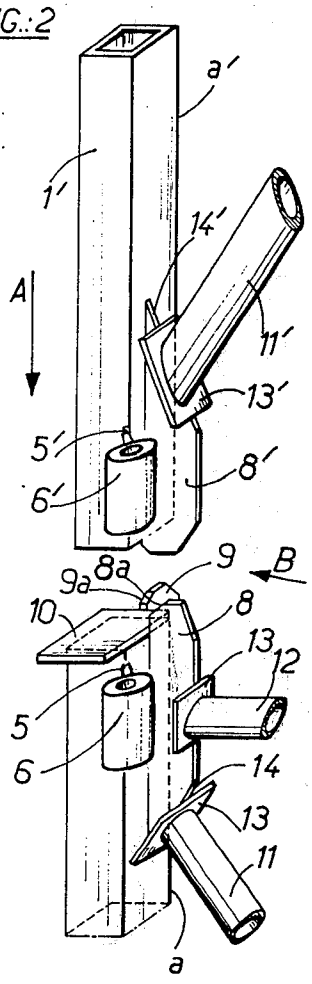


FIG.: 6

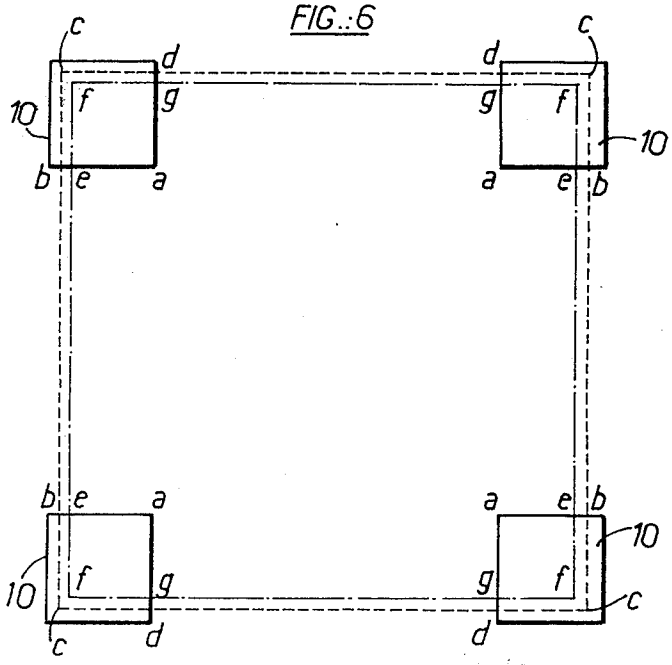


FIG.:5

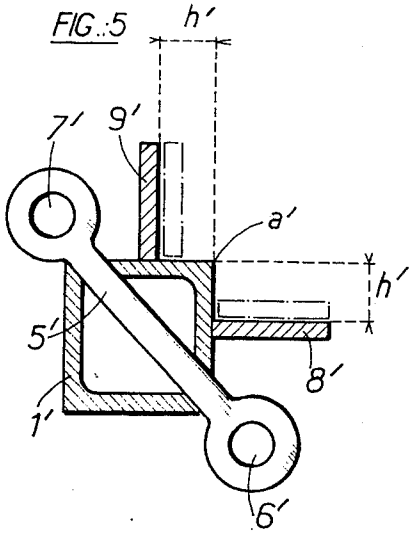


FIG.:4

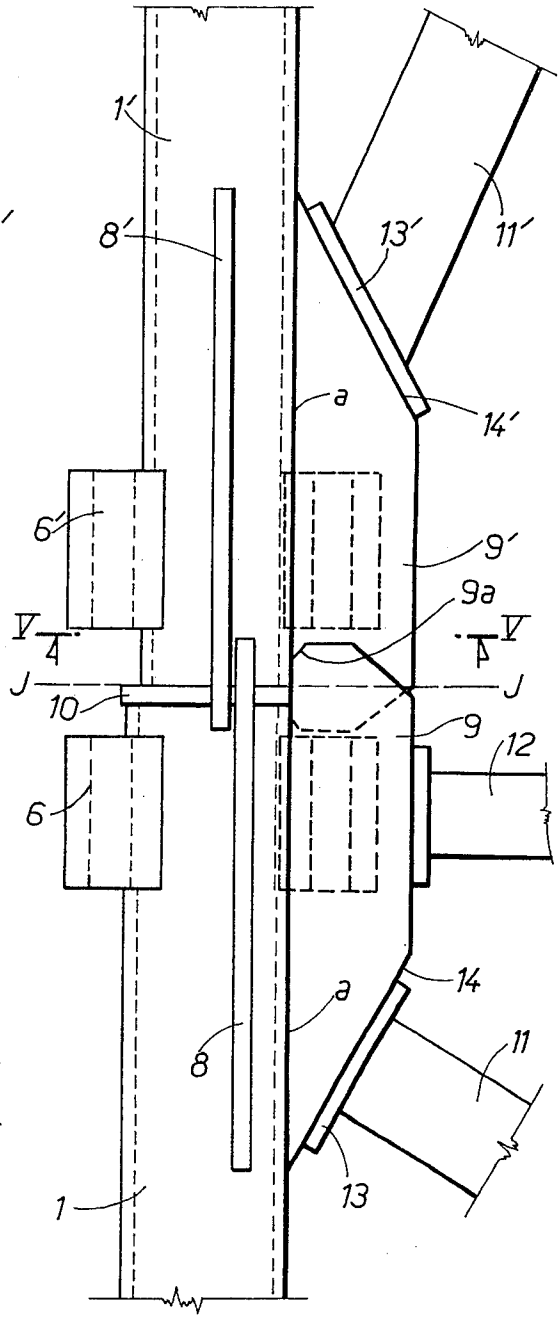


FIG.:3

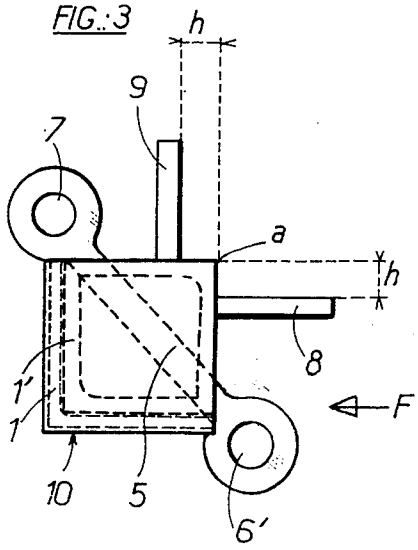


FIG.: 9

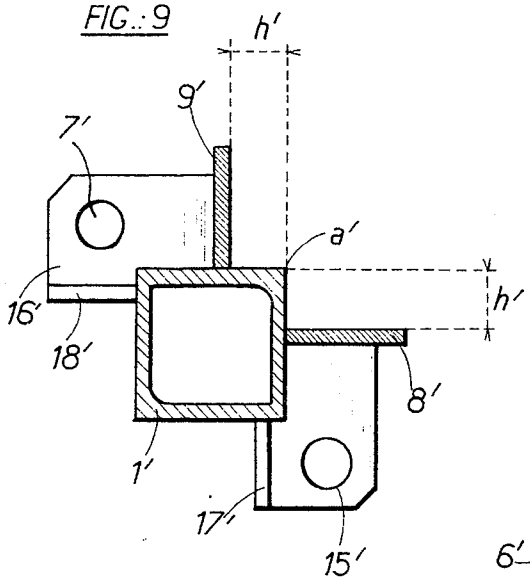


FIG.: 7

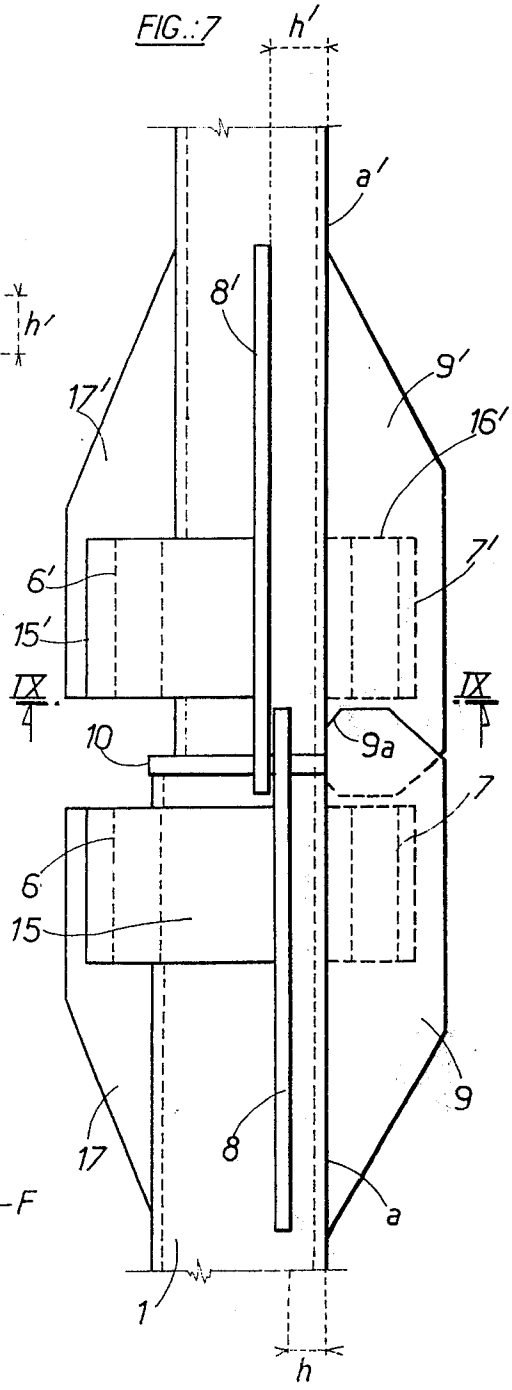
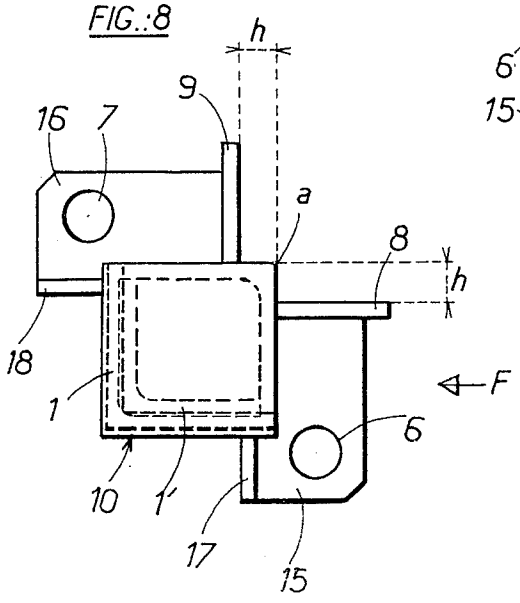


FIG.: 8



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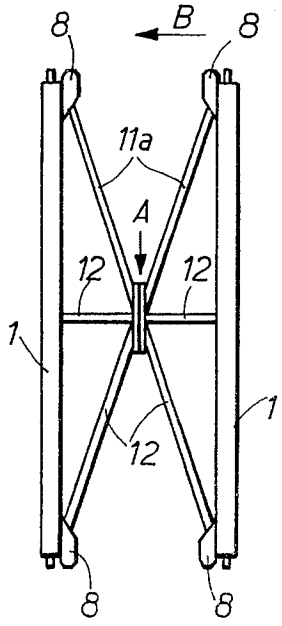


FIG.:12

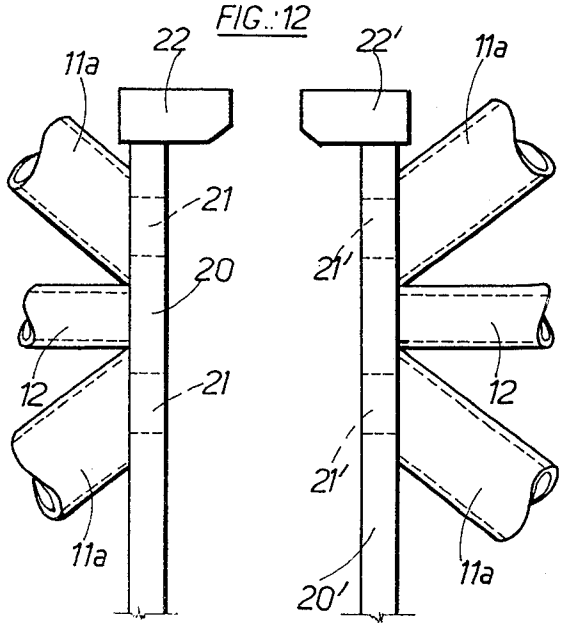


FIG.:11

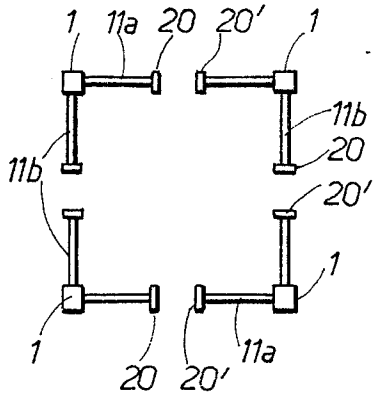
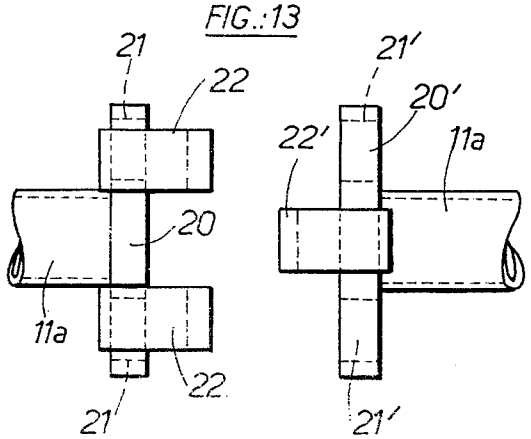


FIG.:13



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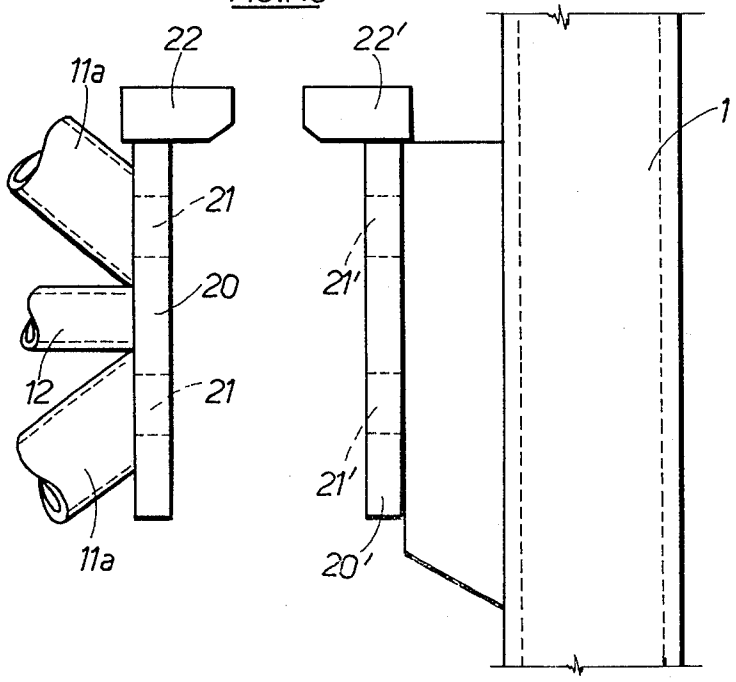


FIG.: 14

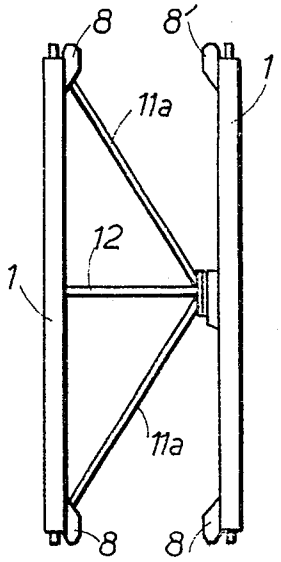
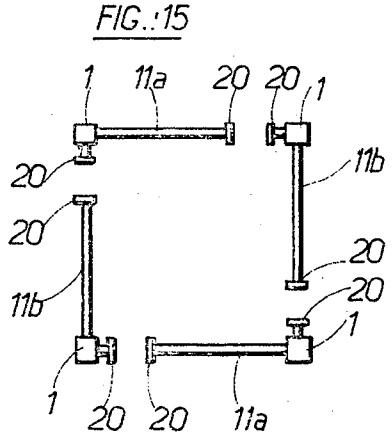


FIG.: 15



ASSEMBLAGE OF PIECES OF A METAL FRAME

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention concerns the assemblage of the elements of a dismountable metal frame, and more particularly a mast, such as a crane tower which has to be raised by successive superimposed elements or, on the contrary, dismounted.

The assemblage devices must be designed in such a manner as to permit the transmission of the components of the stresses in several directions, that is to say in a mast the longitudinal stresses exerted on the principal members or the uprights placed in prolongation of one another, and the transverse stresses, transmitted more particularly by the cross-braces and resulting from shearing stresses and torques.

The assemblage device according to the invention comprises the combination of parts generally provided with connecting bolts, which receive the longitudinal stresses, and other parts, distinct from the preceding parts, intended for transmitting the transverse stresses, and preferably also for connecting the cross-braces to the uprights, these means projecting with respect to the surface of the joint on each of the pieces to be assembled, externally but tangentially to the perimeter of the said surface.

In this way, various advantages are secured such as, for example, that of ensuring automatic guiding for the assemblage of the lower and upper members, and that of being able to vary, without expensive arrangements, the sections of the assembled elements by simply providing at one of the ends of the pieces to be assembled a supporting plate for the juxtaposed piece.

The invention covers metal frameworks, in particular masts or towers comprising elements assembled by the device concerned.

Other features of the invention will appear from the following description with reference to the accompanying drawings, given by way of non-restrictive examples.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings relate to the construction of a mast, such as that of a tower crane, to which construction the invention is very advantageously applied.

FIG. **1** is a diagrammatic perspective view showing the upper end of a mast element and the lower end of one of the members of the element above.

FIG. **2** shows in perspective on a larger scale the upper end of a member of an element and the lower end of the corresponding member of the element above.

FIG. **3** is a view in horizontal projection of the upper end of a member of an element.

FIG. **4** is a view in elevation corresponding to FIG. **3** regarded in the direction of the arrow F, and shows the junction of the members of the two superimposed elements.

FIG. **5** is a section view along V—V of the member of the upper element.

FIG. **6** is a view in horizontal projection of the joint plane of two elements and illustrates the possible variation of the sections of the said elements.

FIGS. **7, 8** and **9** are views corresponding respectively to FIGS. **3, 4** and **5** and illustrate an embodiment modification.

FIGS. **10** and **11** show, in elevation and plan, an assemblage device for the panels of a mast element in application of the invention.

FIGS. **12** and **13** show on a larger scale, in elevation and in horizontal projection, the detail of the assemblage device before connection of its two portions.

FIGS. **14, 15** and **16** correspond respectively to FIGS. **10, 11** and **12** and concern a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows in perspective the upper end of the four vertical uprights or members of a metal mast element of square section, and the lower end of one only of the four uprights of the element above, which is to be superimposed and assembled with the first element, while FIG. **2** shows on a slightly larger scale the uprights on the left of FIG. **1.**

FIGS. **3, 4** and **5,** recapitulating the means shown in FIG. **2,** show them this time in vertical and horizontal projection.

The reference numbers indicated in the following will denote the same parts on two successive elements, but will be provided with the "prime" index for those of the upper elements.

Each of the box uprights of square section, such as **1,** 2, 3, 4 (or **1'**, **2'**, **3'**, **4'**, the upright **1'** only being shown), is provided at each of its ends with a bridle **5** (or **5'**, see above) provided with two bores **6, 7** for the passage of assemblage bolts, the said bridles being set back with respect to the joint plane. These bridles with their bolts, which may or may not be prestressed, serve for transmitting their longitudinal stresses to the uprights, that is to say, the stresses parallel to the arrow A of FIG. **2;** as will be seen in FIGS. **3** and **5,** the bridles are placed obliquely with respect to the sides of the section of the upright and pass through this section. This arrangement may be modified by providing two long ribs **8, 9** parallel to the axis of the upright and welded respectively to the two faces of the upright which are turned towards the interior of the section of the element formed by the four uprights. On each of the uprights, these ribs project with respect to the joint plane (plane J — J in FIG. **4**) and are provided with a slight chamfer to facilitate fitting (see FIG. **4**).

As is shown by FIGS. **3** and **5,** the space h between the ribs **8, 9** of the upper end of an upright and the edge a of the upright which is inside the section of the element is less by the thickness of at least one rib than the corresponding space h' between the ribs **8'** and **9'** of the lower end of an upright and the corresponding edge a'.

Since the sections of the elements are such that the edges a and a' come in line with one another in the superposition of the elements, the above-mentioned differences between the spaces h and h' means that the ribs projecting on the joint place come to lie side by side in the superposition of the uprights. This is to be seen in FIG. **4** and the position of the ribs **8** and **9** of the lower upright is shown in FIG. **5.**

The reciprocal fitting of the uprights thus ensured by the ribs absorbs the transverse stresses indicated by the arrow B in FIG. **2.**

Furthermore, the upper end of the uprights is welded to a plate **10** at right-angles to the edges of the uprights and closing the section of the latter. The lower end of the uprights remaining free is supported during assem-

blage on the plate **10** of the uprights below (FIG. **4**). The said plate **10** may project on the faces of the upright, externally of the section of the element as shown in FIGS. **2, 3** and **4,** but it is flush with the two faces of the uprights which are inside the section of the element permitting fitting by the ribs and bringing into alignment the edges *a* and *a'*. The ribs are situated tangentially to the perimeter of the said plate.

Such an arrangement makes it possible, on the one hand, to insert automatic guiding during assemblage of the upper and lower uprights and, on the other hand, to diminish gradually the section of the uprights towards the top of the mast to take into account the reduction in their load, while ensuring the support of the uprights upon one another by means of the plates **10.**

The joint plane of two successive uprights is the plane marked JJ in FIG. **4** or again the plane of FIG. **3.**

FIG. **6,** drawn in a joint plane, shows the four plates **10** terminating at their ends at the uprights of an element. The square *cccc* shown in dashed lines is the section of the element situated below the plane of the drawing whose respective uprights occupy the squares *a b c d,* while the square *ffff,* drawn in chain lines, represents the section of the element situated above the plane of the drawing, whose uprights bear on the plates **10** and have the sections represented by the four squares *a e f g.*

The bridles **5** and **5'** are placed in a manner such that the axes of the bores **6, 7** and **6', 7'** are in coincidence from one upright to the next, which involves a variation in the position of the bridles with respect to the section of the uprights when the said section itself varies. This will be seen by camparison of FIGS. **3** and **5.**

The ribs **8, 9, 8', 9'** are used for fixing the cross-braces **11** and the ties **12** connecting the uprights together. This fixing may be carried out in any appropriate manner. The drawing shows fixing by plates **13** welded to the ends of the cross-braces or the ties and to the ribs, the latter being shaped to offer edges of suitable inclination such as **14, 14'.**

FIG. **7, 8** and **9** show a modified embodiment of the assemblage, differing from the previously described embodiment in that the bores **6, 7** and **6', 7'** for the passage of the assemblage bolts are no longer provided on a bridle crossing the section of the elements, but rather are provided on solid parts **15, 16, 15', 16'** fixed to the external faces of the elements, preferably by welding between the ribs **8, 9** and gussets **17, 18,** welded to the external faces of the uprights. This arrangement is particularly applicable when the longitudinal stresses to be transmitted become considerable.

FIGS. **10** to **12** show a method of applying the invention to the assemblage of panels which are to form a tower.

FIG. **11,** in which the four panels are represented in horizontal projection, positioned opposite one another for assemblage, shows that each panel comprises an upright **1** and two pairs of half cross-braces **11***a*, **11***a*; **11***b*, **11***b*, these pairs being situated in two perpendicular planes passing through the axis of the upright. The half cross-braces are fixed as described in the foregoing to terminal ribs of the uprights and are assembled together to form a triangle, it being possible to provide ties, such as **12,** at the apex of the said triangle.

For assembling the panels thus formed, the apex of each triangle of cross-braces comprises a plate or sole **20** and **20',** respectively, which soles are applied against one another during assemblage. These soles are provided with holes **21, 21',** in which bolts may be introduced for thus supporting the components of stresses exerted perpendicularly to the said soles.

Furthermore, the said soles include at their ends projections **22, 22'** adapted to overlap during assemblage, such that the projections **22** of one sole **20** bearing on the edge of the other sole **20** and vice versa so that the projection **22'** bears on the edge of the plate **20.** This interlocking enables the components of the stresses exerted parallel to the soles to be absorbed and thus enables the shearing stresses on the bolts to be suppressed.

The modification of FIGS. **14** to **16** differs from the preceding embodiment in that on each panel the cross-braces **11***a* extend over almost the entire width of the panel and only in one plane, such that assemblage is effected against one upright.

It is furthermore apparent that the embodiments described are merely examples and that they can be modified by the substitution of technical equivalents, without departing from the scope of the invention.

The alignment of the edges *a a'* of the uprights, which are in the interior of the superimposed elements, has the advantage of permitting sliding in the tower, from its base to its summit, an important element for raising the tower, as is the case in some types of telescopic cranes.

The invention is not, however, limited to this type of alignment of the internal edges.

It would also be possible, without departing from the scope of the invention, to construct the elements so that the external edges *c* (FIG. **6**) of the superimposed uprights would be aligned to make it possible to guide along the tower a height-increasing element embracing the tower. In this case, of course, the corresponding edges of the plates **10** should be flush with the faces of the uprights.

It may also be necessary to align both the internal edges and the external edges in the case where the tower of the crane has to be able to slide in a guide sheath (which may be a building in construction) and where it is desired in addition to provide an internal guide in the tower for raising the latter.

I claim:

1. A generally vertical mast structure designed for end-to-end assembly of upright structural units on top of each other in mutual abutting relationship of the adjacent ends of two successive upright units, namely, the upper end of a first upright unit and the lower end of a second upright unit positioned immediately above said first upright unit and extending upwardly, said first and second upright units being fastened endwise to each other by associated bolting means which extend in a longitudinal direction with respect to said mast structure, wherein the improvement comprises the combination of: an end plate fastened with an upright unit end and flanging the same, said end plate having:

i. a bearing face exposed to the adjacent end of the next successive upright unit to be engaged thereby for abutment in said longitudinal direction, and

ii. exposed peripheral sides extending in a transverse direction with respect to said mast structure; and end ribs fastened with an upright unit end and having exposed protruding borders which project longitudinally beyond said end plate at said peripheral sides thereof past the adjacent end of the next ver-

tically successive upright unit, said protruding borders of said end ribs positively engaging sidewise said next successive upright to abut the same against relative displacement in said transverse direction and taking up stresses in such transverse direction whereby said bolting means is relieved from such tranverse stresses.

2. Mast structure as in claim **1,** wherein said end plate comprises at least two adjacent rectilinear peripheral sides which are at an angle to each other and connected at an angular corner point, and said end ribs comprise protruding borders which project beyond said end plate at both said adjacent rectilinear sides thereof.

3. Mast structure as in claim **2,** wherein said upright structural units comprise coextensive upright elemental struts each having at least two adjacent planar outer faces which are at an angle to each other equal to that of said rectilinear sides and which are connected at respective straight edges, said rectilinear peripheral sides of said end plate and said planar outer faces of said elemental struts being flush with each other and coextensive, and said corner point of said end plate and said straight edges of said elemental struts being likewise colinear thereby forming together a smooth continuous dihedral rail which extends from top to bottom.

4. Mast structure as in claim **3,** wherein each upright structural unit comprises a plurality of like upright elemental struts forming corner elements for said unit and provided with end plate and rib systems, and wherein said corner point of the respective end plates and said straight edges of respective elemental struts are directed towards the inside of said upright structural unit whereby said unit comprises inwardly thereof as many smooth continuous dihedral rails as it has upright elemental struts.

5. Mast structure as in claim **4,** wherein each upright structural unit further comprises bracing ties interconnecting said upright elemental struts, said bracing ties bearing against buttress sections of said end ribs spaced from said exposed protruding borders thereof.

6. Mast structure as in claim **2,** wherein said first upright unit comprises at said upper end thereof a pair of end ribs having exposed protruding borders which project upwardly beyond said end plate at said adjacent rectilinear peripheral sides thereof respectively, and said second upright unit comprises likewise at said lower end thereof a further pair of end ribs having exposed protruding borders which project downwardly beyond said end plate at said same rectilinear peripheral sides thereof, respectively, each rib of one pair of said ribs being adjacent to a rib of the other pair of said ribs and associated with the same rectilinear peripheral side of said end plate.

7. Mast structure as in claim **6,** wherein each of said pairs of end ribs forms a dihedral of substantially the same angle as the angle between said two adjacent rectilinear peripheral sides of said end plate.

8. Mast structure as in claim **6,** wherein said end plate is fastened with said upper end of said first upright unit and has an upwardly exposed bearing surface engaged by said lower end of said second upright unit.

9. Mast structure as in claim **8,** wherein said end plate has substantially horizontal rectilinear peripheral sides, and said end ribs have substantially vertical protruding borders associated with said horizontal sides.

* * * * *