May 2, 1961 R. E. FISHER 2,982,379

FOLDING TOWER

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FIG_1

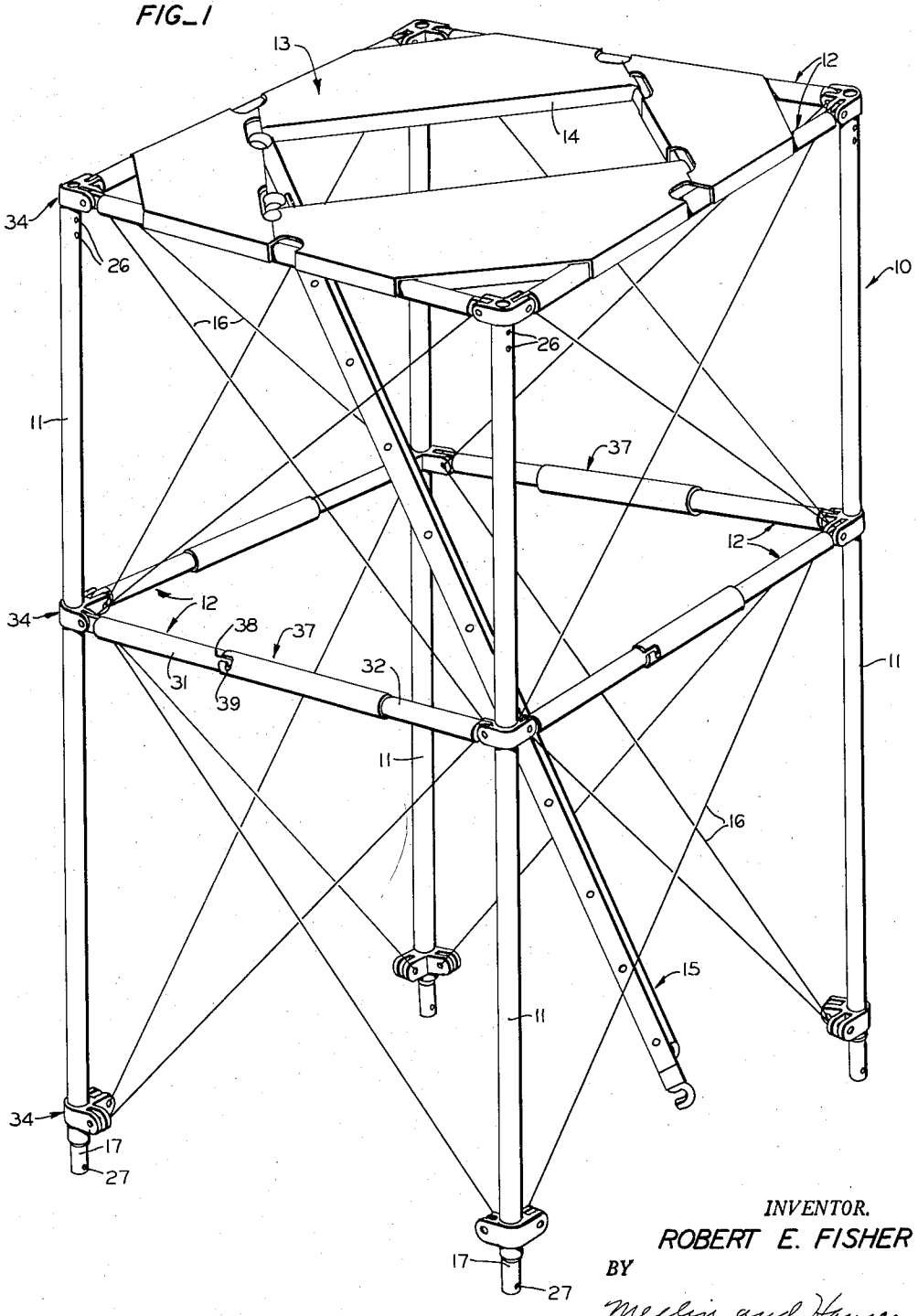

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FIG_2

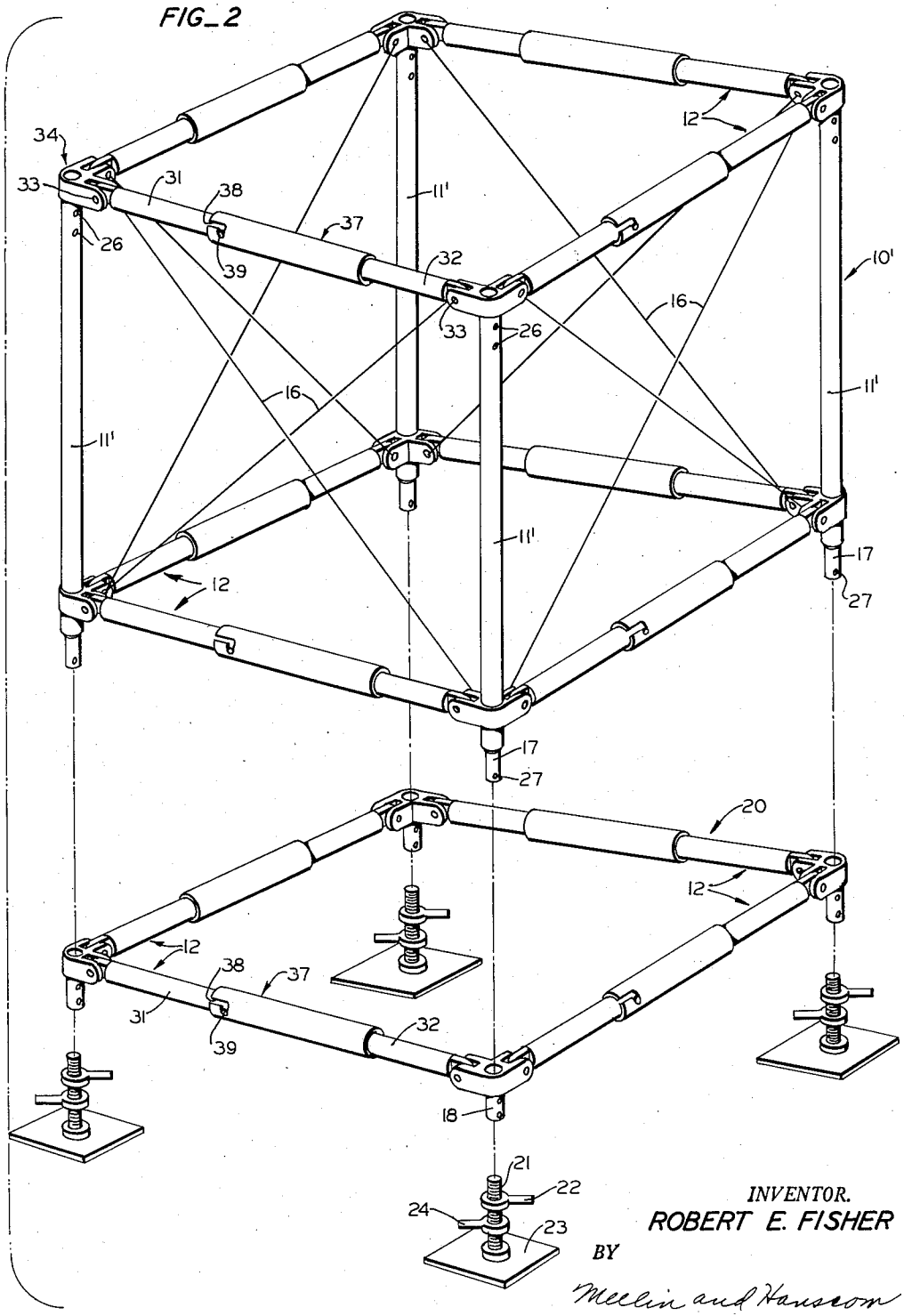

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FIG_3

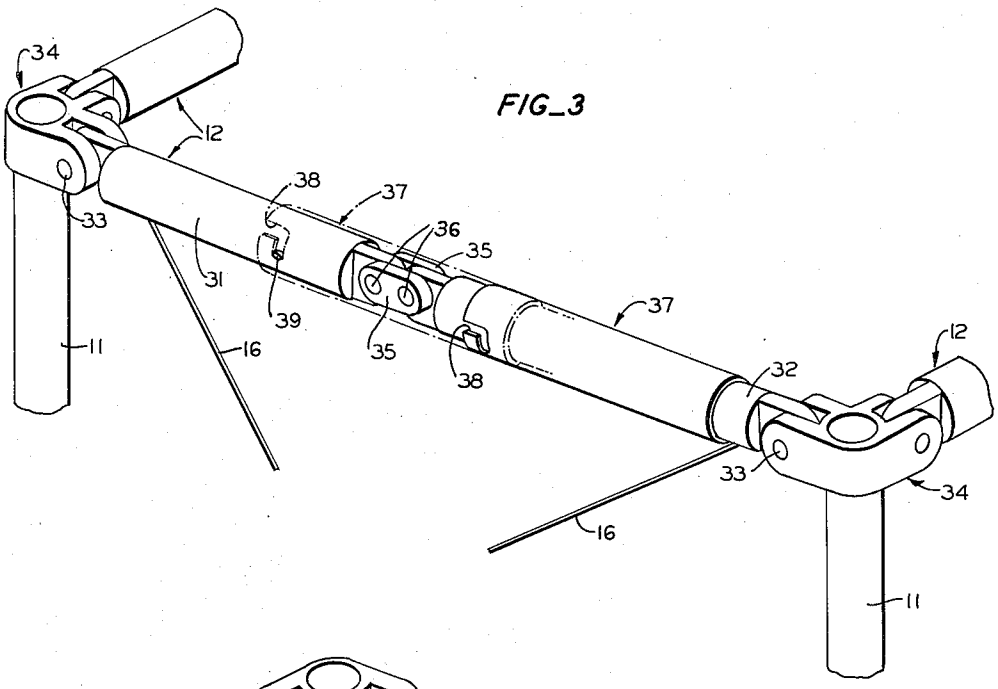

FIG_4

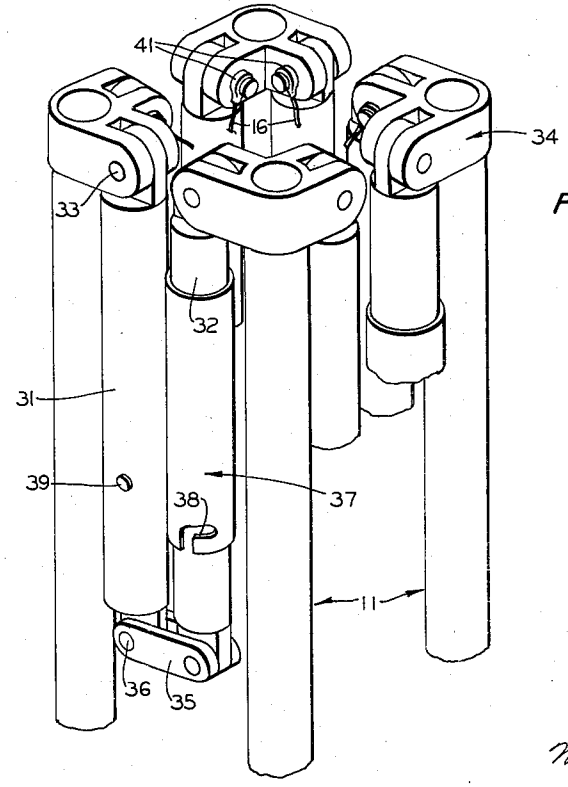

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FIG_5

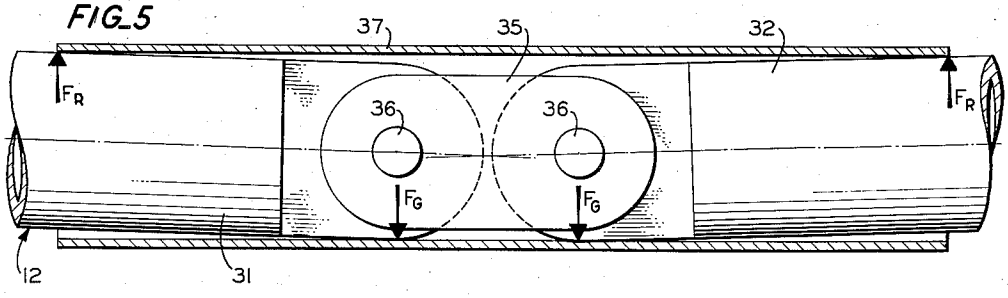


FIG_6

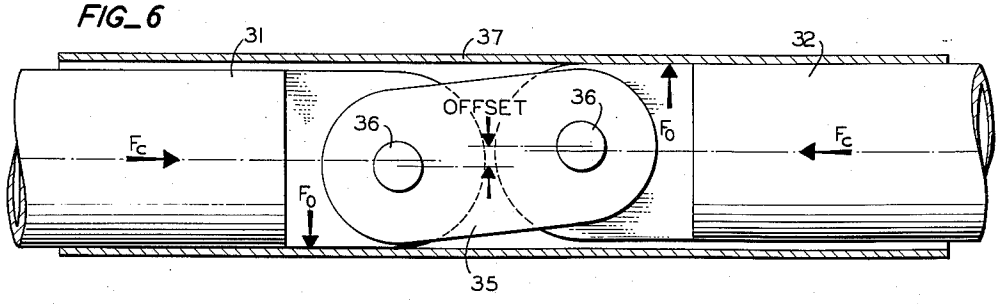
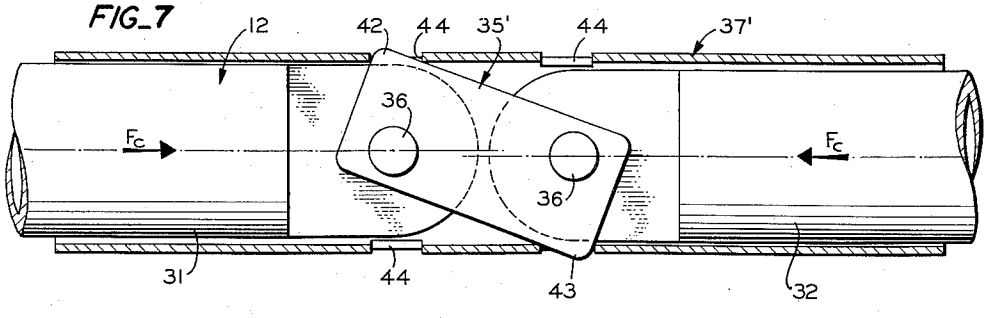


FIG_7



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2,982,379

FOLDING TOWER

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3 Claims. (Cl. 189—19)

This invention relates to folding towers and, more particularly, to folding tower sections which may be unfolded and erected to form a tower of a desired height.

It is a principal object of the invention to provide a tower section having no loose parts, which may be easily erected by hand into a rigid tower section for assemblage into a tower structure, and which may be easily disassembled and folded into a compact storage unit.

Another object is to provide a folding tower structure with improved locking devices for locking the tower section in its erected position to prevent accidental collapse of the tower.

A further object of the invention is to provide a folding tower section which is light in weight, rigid when erected, easy to repair and service, with minimum wind resistance, and economical in manufacture.

A more specific object of the invention is to provide a folding tower section comprising a pair of generally vertical parallel legs, a generally horizontal cross beam connected between said legs, said cross beam comprising first and second members each pivotally connected at one end thereof to one of said legs, a link pivotally connected at each end thereof to the other ends of said members, and a locking sleeve surrounding said cross beam for longitudinal sliding movement thereon, said locking sleeve having a length greater than the distance between the pivotal connections of said link.

Another specific object is to provide a folding tower section comprising a plurality of generally vertical parallel legs, a plurality of generally horizontal cross beams connected between adjacent of said legs, each of said cross beams comprising first and second elongated members each pivotally connected at one end thereof to one of said legs, a link pivotally connected at each end thereof to the other ends of said elongated members, a locking sleeve loosely surrounding each of said cross beams for longitudinal sliding movement thereon, and means for holding said cross beams in compression when said locking sleeve surrounds said links and the other ends of said elongated members, whereby said links will be tilted within said sleeves.

Other objects and advantages will become apparent in the course of the following detailed description.

Referring now to the drawings forming a part of this application, and in which like parts are designated by like reference numerals throughout the same,

Fig. 1 is a perspective view of a tower section constructed in accordance with the invention.

Fig. 2 is an exploded perspective view of the invention, illustrating the manner in which the sections may be telescopically connected and leveled.

Fig. 3 is a perspective detail view of one of the cross beams shown in extended position.

Fig. 4 is a perspective view, illustrating the folded storage position of a tower section.

Fig. 5 is a sectional view of a cross beam and locking sleeve, illustrating the effect of gravity in restraining unlocking movement of the locking sleeve.

Fig. 6 is a view similar to Fig. 5, illustrating the effect of compression on the cross beam in restraining unlocking movement of the locking sleeve.

Fig. 7 is a view similar to Fig. 5, illustrating a modification of the invention.

Referring now to the drawings, and in particular to Fig. 1, a tower section, generally indicated by the reference numeral **10**, comprises a plurality of generally vertical and parallel tubular legs **11**. Tubular cross beams **12** extend generally horizontally between adjacent of the legs **11**. A platform **13** seats upon the upper set of cross beams and is secured thereto by any conventional manner. The platform **13** is provided with a central access opening **14**, and a ladder **15** is hooked thereto to extend downwardly to the platform of the next lower tower section (not shown), as is conventional in towers of this type. Diagonally disposed guy wires **16** extend between adjacent legs **11** for bracing purposes, as will be explained more fully hereinafter.

Fig. 2 illustrates a half length tower section **10'**, in which the legs **11'** are approximately one half the length of the legs **11** shown in Fig. 1, for utilization in instances where the full height of the tower section **10** is not desired. In all other respects, the construction of tower sections **10** and **100'** is identical. The lower ends of the legs **11'** are reduced in diameter at **17** in order to fit telescopically into the tubular corner members **18** of the base frame **20**, which latter members in turn telescope onto the leveling screws **21** to rest upon the upper wing nuts **22**. As is apparent, the wing nuts **22** may be moved upwardly or downwardly relative to the base plates **23**, as desired, and the lower wing nuts **24** may be employed as lock nuts to hold the upper nuts against accidental displacement.

The upper ends of the legs **11'** are open, in order to receive the reduced lower ends **17** of the next highest tower section telescopically thereinto. When so assembled, the sections may be locked together by cotter pins or the like, which may be inserted into the registering holes **26** and **27** formed in the upper and lower ends, respectively, of the legs.

Referring now to Fig. 3, each cross beam **12** comprises two elongated tubular members **31** and **32**, preferably of equal length, each of which is pivotally connected at one end by bolts **33** to an L-shaped bracket **34** mounted on adjacent legs **11**. The brackets **34** are permanently and rigidly connected to the legs by welding, soldering, riveting, or any other conventional manner. Links **35** are pivotally connected at either end thereof by bolts **36** to the other ends of the members **31** and **32**.

An elongated locking sleeve **37** is mounted on tubular member **32** for free longitudinal and rotative movement thereon, and has a relatively loose fit thereon. A bayonet locking slot **38**, formed in one end of the sleeve, cooperates with an outwardly projecting stud **39** on tubular member **31** to lock the sleeve against longitudinal movement when in locking position. As is apparent, the locking sleeve is considerably longer than the distance between the bolts **36** so that, when locked (dotted-line position of Fig. 3), the sleeve **37** will surround the links **35** and portions of both of the tubular members **31** and **32**.

The diagonal guy wires **16** have an eye clevis **41** formed on both ends thereof for permanent attachment to the L-shaped bracket bolts **33**.

When in storage and transportation, each tower section is fully collapsed, as shown in Fig. 4, with the legs **11** and cross beam members **31** and **32** all parallel with one another. As is apparent, the distance between the bolts **36** must be slightly greater than the diameter of the

tubular members so that these members will be parallel when collapsed.

To erect a tower section, the legs **11** are pulled apart by hand, causing the cross beam members **31** and **32** to unfold generally to the position shown in Fig. 3. The guy wires **16** are manufactured in proper lengths so that all slack will be taken up when the cross beam members **31** and **32** are both generally horizontal but yet are substantially out of co-axial alignment, such mis-alignment being allowed by the toggle action of the links **35**. The locking sleeves are then forced to the dotted-line position of Fig. 3, with such movement causing the cross beam members **31** and **32** to come into substantial alignment to, in turn, impart a tension in the guy wires. The locking sleeve is then manipulated to lock the bayonet slot **38** onto the stud **39**. In like manner, all of the other cross beams **12** are locked into place, thus forming a rigid tower section unit with tension applied to all of the guy wires and with all cross beams **12** held in compression thereby. The lower ends **17** of the legs **11** are then inserted into the base frame and the tower section is leveled. The next tower section is then erected in the same manner, is inserted into the upper ends of the legs of the previously erected section and is locked thereto by cotter pins or the like extending through the registering leg holes **26** and **27**. The platform sections **13** and ladders **15** are installed in a customary manner as the tower is erected. At desired intervals, guy wires are connected to the tower to extend down to the ground.

The tower is dismantled in the reverse order, and is folded up, as in Fig. 4, for storage or transportation.

Fig. 5 illustrates one manner in which the locking sleeve is restrained from movement from its locking position. The weight of the tubular members **31** and **32** will cause the cross beam **12** to pivot slightly about the L-shaped bracket bolts **34** and sag in the middle. This causes a gravity force, identified as *Fg*, to be imposed upon the central lower inside surface of the locking sleeve **37**, and also produces corresponding reaction forces, identified as *Fr*, to be imposed upon the inside end edges of the locking sleeve. The combination of these forces produces friction forces to restrain the locking sleeve from rotating and moving longitudinally in order to prevent accidental unlocking of the cross beam **12**.

Fig. 6 illustrates another manner in which the locking sleeve is restrained from unlocking movement. As has been described above, when locked, the cross beams **12** will be under compression, as indicated by the compressive forces *Fc*, as a result of the tensions in the guy wires **16**. Since the pivoted link **35** makes the cross beam **12** unstable in compression, the link will be slightly cocked from a horizontal position, and the tubular member **31** will bear downwardly against the inside of the locking sleeve, as indicated at *Fo*, and the tubular member **32** will similarly bear upwardly against the inside of the locking sleeve, also indicated as *Fo*. The friction between the locking sleeve and the tubular members **31** and **32**, as a result of the offset forces *Fo*, will thus restrain rotation and longitudinal movement between the sleeve and cross beam. The amount of the offset forces varies with amount of horizontal offset between the pivot bolts **36**, which is equal to the difference between the outside diameter of the cross beam members **31** or **32** and the inside diameter of the locking sleeve **37**. This amount of offset may be increased by forming the holes in members **31** and **32** for bolts **36** at points offset from the longitudinal axes of the members **31** and **32**, as shown in Fig. 6. Then, the total offset is the initial vertical distance between the pivot bolts **36** plus the differences in diameter between the members **31** or **32** and the locking sleeve, and the offset forces restraining unlocking of the sleeve will be increased.

Fig. 7 illustrates a modification of the invention and illustrates how the locking sleeve **37'** may be positively locked by the compression of the cross beam **12**. In this instance, a generally rectangular link **35'** is provided, which has opposed corners **42** and **43** thereon. When the cross beam **12** is placed under compression as the locking sleeve is moved to locking position, the link **35'** will be tilted, as above described. When the openings **44** in the sleeve are moved adjacent the link corners **42** and **43**, these corners will be forced outwardly through these openings, and will lock the sleeve **37'** against rotation and longitudinal movement. This particular feature may be employed with or without the bayonet connections **38** and **39**, as desired, and the bolts **36** may be in alignment with the axes of the cross beam members **31** and **32**, or out of alignment therewith as desired, it being obvious that the locking force will be considerably increased if the latter condition is present, as discussed above in connection with Fig. 6.

The tower section units are preferably made of aluminum alloys, so as to combine the best properties of strength and lightness, although it is apparent that other materials may be used, if desired.

The above described tower has various advantages that are set forth below. Each tower section folds into a compact storage unit, will all legs and cross beam members parallel, because of the link construction. If only a single hinge were provided in the center of the cross beams, the cross beam members could not fold parallel to one another.

There are no loose parts in each tower section, so that when stored or transported, there is no danger of losing any of the elements. All of the guy wires **16** are permanently attached to the section, and fold up inside the folded up section.

The weight of the tower is kept to a minimum by providing guy wires for bracing and by using tubular members for the legs and cross beams.

The erected tower has a minimum wind resistance, due to the fact that the guy wires **16** have practically no wind resistance, and that the round tubes **11** and **12** have much less wind resistance than other conventional structural shapes such as angles, channels and plates.

The tower is quick and easy to erect and disassemble, and requires no tools for the task.

The tower is easy to repair or to replace parts because all of the legs are identical. All cross beams are identical. All guy wires are identical. All hinge bolts are identical.

Since all faces of the tower are identical, accessories, such as antennae, hoisting davits, outboard platform structures and the like can be attached to any face of any section in like manner.

Although the tower has been illustrated as being square in cross section, it is to be realized that a tower can be similarly constructed with three legs, or more than four legs. Also, a rectangular tower could be so constructed and could serve either as a tower or scaffold.

Thus it is to be realized that the particular forms of the invention herewith shown and described are to be taken as preferred embodiments of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the attached claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A folding tower section comprising a pair of generally vertical parallel legs, a generally horizontal cross beam connected between said legs, said cross beam comprising first and second elongated members each pivotally connected at one end thereof to one of said legs, a link pivotally connected at each end thereof to the other ends of said elongated members, a locking sleeve surrounding said cross beam for longitudinal sliding movement thereon, said locking sleeve having a length greater than the distance between the pivotal connections of said link, and a plurality of flexible guy members connected between said legs, said guy members being under tension

when said cross beam has its elongated members locked by said locking sleeve.

2. A folding tower section comprising a plurality of generally vertical parallel tubular legs, a plurality of generally horizontal cross beams connected between adjacent of said legs, each of said cross beams comprising first and second elongated equal length tubular members each pivotally connected at one end thereof to one of said legs, a link pivotally connected at each end thereof to the other ends of said elongated members, the pivotal connections between said members and said link being offset from the longitudinal axes of said members, a locking sleeve surrounding each of said cross beams for longitudinal sliding movement thereon, said locking sleeves having a length greater than the distance between the pivotal connections of said links, and a plurality of flexible guy members connected between adjacent of said legs, said guy members being under tension when said cross beams have their elongated members locked by their locking sleeves.

3. A folding tower section comprising a plurality of generally vertical parallel tubular legs, a plurality of generally horizontal cross beams connected between adjacent of said legs, each of said cross beams comprising first and second tubular members each pivotally connected at one end thereof to one of said legs, a generally rectangular link pivotally connected at each end thereof to the other ends of said tubular members, the pivotal connections between said tubular members and said link being offset from the longitudinal axes of said tubular members, a locking sleeve loosely surrounding each of said cross beams for longitudinal sliding movement thereon said locking sleeves having a length greater than the distance between the pivotal connections of said links, and a plurality of flexible guy members permanently connected between adjacent of said legs, said guy members being under tension when said cross beams have their tubular members locked by their locking sleeves.

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