No. 818,511. PATENTED APR. 24, 1906.

R. L. ALLEN.

SKELETON TOWER STRUCTURE.

APPLICATION FILED MAY 15, 1905.

2 SHEETS—SHEET 1.

Fig. 7.

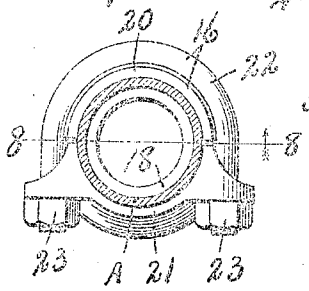


Fig. 1.

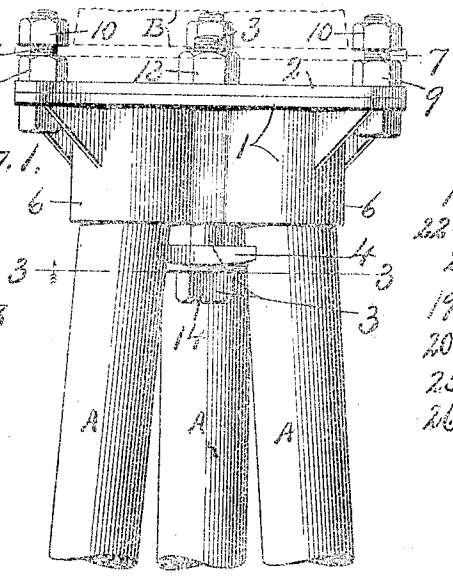
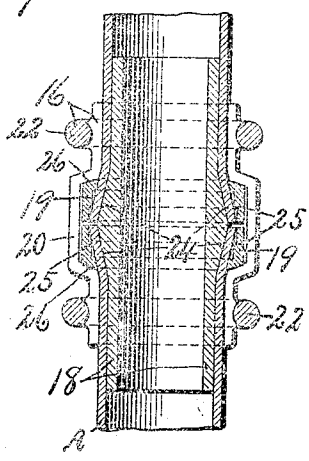
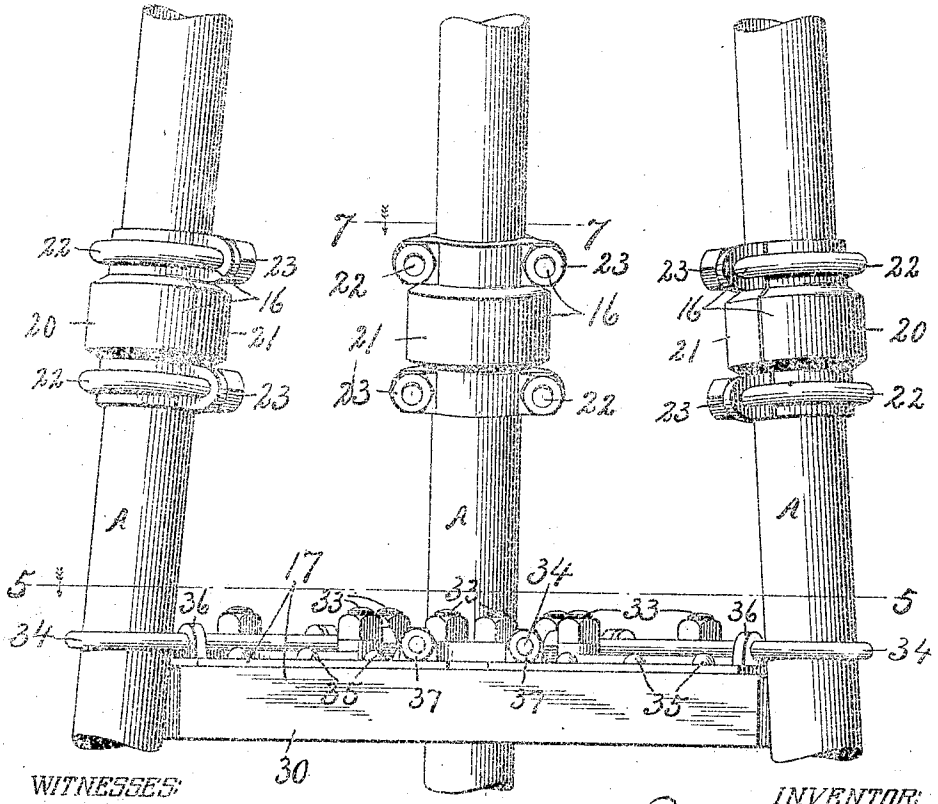


Fig. 8.





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APPLICATION FILED MAY 15, 1905.

2 SHEETS—SHEET 2.

Fig. 2.

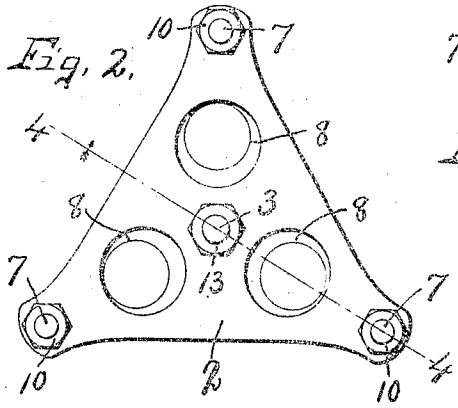


Fig. 3.

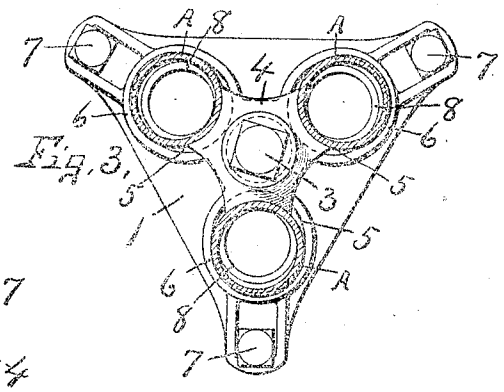


Fig. 4.

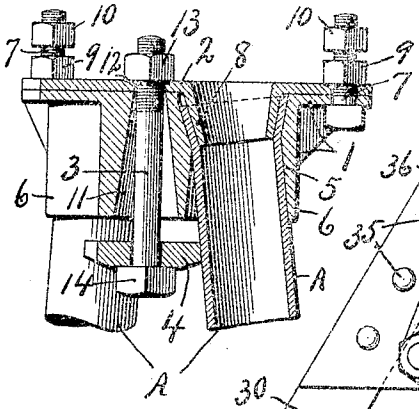


Fig. 5.

Fig. 6

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SKELETON-TOWER STRUCTURE.

No. 818,611. Specification of Letters Patent. Patented April 24, 1906.

Application filed May 15, 1905. Serial No. 260,526.

To all whom it may concern:

Be it known that I, ROBERT L. ALLEN, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Skeleton-Tower Structures, of which the following, taken, in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to improvements in skeleton-tower structure, and refers more particularly to the tripod type, similar to that set forth in my Patent No. 791,975, June 6, 1905, in which the primary object is to produce a comparatively light yet strong and durable structure, possessing a maximum resistance to tensile, torsional, and crushing strains and capable of being manufactured and set up at a minimum cost. This is also the main object of my present invention, although I have sought to improve upon the former structure, first, by clamping the upwardly-converging extremities of the legs of the tower within a one-piece casting in substantially the same relative triangular positions as the base of the tower and at the same time providing means to expand and frictionally hold said converging extremities in fixed relation to each other; second, by utilizing a portion of the clamping means for the reception of superstructures, such as insulator-pins and similar devices, without loosening or disengaging the clamping-head from the upper ends of the tower-legs; third, by clamping the expanded meeting ends of the leg-sections together in such manner as to relieve the tubular legs from buckling strains and at the same time to reinforce the clamping-sections by the use of U-shaped bolts for drawing said sections together upon opposite faces of the expanded ends of the tubular legs, whereby the tightening of the bolts operates to draw said meeting ends together; fourth, to secure the transverse braces or decks to each tubular leg by means of a clamping-plate and U-shaped bolt, which engage opposite faces of the leg in substantially the same plane, so as to avoid short leverage strains upon the leg and parts of the clamping device.

Other objects relating to the specific construction of the parts hereinbefore mentioned will be brought out in the following description.

In the drawings, Figure 1 is a side elevation, partly broken away, of a portion of a tower, showing a portion of my improved tower structure, and particularly the clamping-head for the upper extremities of the tubular legs, and also one of the clamps for the meeting ends of the leg-sections and one of the horizontal skeleton decks or transverse brace-frames by which the legs are tied together at suitable intervals throughout the height of the tower. Figs. 2 and 3 are respectively top and inverted plan of the clamping head or cap for the upper converging ends of the tower-legs, the latter being shown in section in Fig. 3. Figs. 4, 5, 6, 7, and 8 are sectional views taken, respectively, on lines 4 4, Fig. 2, and 5 5, Fig. 1, 6 6, Fig. 5, 7 7, Fig. 1, and 8 8, Fig. 7.

Towers of this character are adapted to be built to a considerable height from the ground for supporting electric wires, lights, or other electric fixtures, as well as wind-motors, and, in fact, any device for which such a tower would be adapted, and preferably consists of a tripod structure composed in this instance of three tubular legs A, which are preferably arranged at the vertices of an equiangular triangle of considerably greater area at the base than at the top, according to the height of the tower, so that the tubular legs converge upwardly from the ground in which they are anchored and are brought close together at the top, but in the same triangular arrangement instead of in a straight line, as set forth in my application previously referred to. These upper converging extremities of the tubular legs are preferably expanded, as best seen in Fig. 4, and are held in fixed relation to each other by means of a one-piece metal casting or plate 1, a second plate 2, and a clamping-bolt 3, carrying at its lower end a spacing washer or separator 4.

The clamping-plate 1 is provided with a series of—in this instance three—apertures 5, one for each of the tubular legs A, which have their expanded ends inserted into their respective apertures 5, and the upper end of each aperture is made flaring to fit the flaring or expanded end of its tube, while the lower portion of each aperture is elongated radially to permit the tubes A to be moved endwise upwardly in their respective openings and folding radially toward each other before the tower structure is assembled to permit the leg-sections A, with the cap-section 1 thereon, to be stored or transported to their destination in a knockdown position to occupy a minimum space, thereby facilitating the handling, storage, and transportation of the

parts of the tower and also enabling the tower to be more quickly assembled while being erected. Although in the erection of the tower the upper ends of these legs A are brought close together, yet they are separated or spaced apart in the form of an equilateral triangle, and the apertures 5 of the plate 1 are similarly spaced apart to receive and retain the upper ends of the legs in the same relation without friction one with the other, thereby leaving a portion of the casting intervening between the openings 5 and upper ends of the legs A for the reception of a clamping-bolt 3 and washer 4, which will be presently described. It is now clear that the axes of the openings 5 in the plate 1 are disposed at an angle to each other and coincident with the axes of their respective tubular legs A and the portions of the plate 1 immediately surrounding the tubes A are extended downwardly a considerable distance below the upper face of the plate for forming reinforcing-hubs 6, which tend to reduce the shearing strains at the junction of the plate 1 with their respective tubes. The plate 2 also consists of a one-piece metal casting, which is mounted upon and secured to the top face of the plate 1 by clamping-bolts 7 and is provided with a series of—in this instance three—hollow conical hubs 8, which enter the upper ends of the openings 5 and snugly fit within the expanded upper ends of the legs A, so that when the plate 2 is drawn downwardly by the clamping-bolts 7 the conical hubs or bosses 8 wedge into the flaring expanded ends of the tubular legs A, thereby tending to further expand said flaring ends against the flaring sides of the upper end of the openings 5, and it is therefore apparent that when this plate 2 is rigidly clamped in place the expanded ends of the legs A are impinged between the conical bosses 8 and walls of the openings 5, thereby firmly locking the plates 1 and 2 to the expanded ends of the legs A. One of the important features of this manner of securing the upper ends of the tubular legs together is that it avoids any buckling or eccentric strains upon the legs, which may therefore be made of comparatively thin light metal.

The clamping-bolts 7 for fastening the plates 1 and 2 together are passed through apertures in radially-projecting flanges at the vertices of the plates at the outside of the hubs 6, and one of the important advantages of the use of these bolts is that the heads engage the lower faces of the plate 1 and extend upwardly through said plates some distance above the upper face of the plate 2, which is preferably flat horizontally, the upper ends of said bolts being threaded and receive lock-nuts 9, which engage the top face of the plate 2. The upper ends of these bolts, which project some distance above the lock-nuts 9, constitute studs for receiving various kinds of superstructures, such as an insulator B, (shown by dotted lines in Fig. 1,) such superstructure being held in position by additional clamping-nuts 10, which are engaged with the upper ends of the bolts 7. I do not wish, however, to limit myself to the use of insulators, as many other devices not herein necessary to mention may be applied to the upper ends of the bolts 7 and secured by the nuts 10 without loosening the nuts 9 or any of the parts by which the upper ends of the tubular legs are clamped together.

The plates 1 and 2 are formed with central apertures 11 and 12, which are alined with each other vertically and receive the bolt 3. This bolt 3 is therefore located substantially midway between the upper ends of the tubular legs A, and its upper end is usually threaded and provided with an adjusting-nut 13, while its lower end is provided with a head 14, upon which the washer 4 rests, said washer being therefore located between the head 14 and under side of the plate 1, leaving clearance for the vertical adjustment of the washer. This washer, as best seen in Figs. 3 and 4, is substantially triangular in form and is provided with curved bearing-faces which have sliding engagement with the inner adjacent faces of the tubular legs A, so that by screwing the nut 13 in one direction this washer is wedged upwardly between and against the adjacent faces of the legs A, thereby tending to spread them laterally and firmly impinging them within their respective sockets or openings 5, thus establishing a means for taking up any imperfect fit or lost motion of the legs in the sockets 5 and at the same time further wedging the conical hubs 8 into the expanded ends of said legs.

It will be observed that the plates 1 and 2 are not only clamped together upon the expanded ends of the legs A at each vertex of the triangle, but are further clamped at the center by the bolt 3 and washer 4. On account of the height of these towers it is necessary to make the legs in sections, which sections are clamped together end to end by suitable clamps or fastening means 16, as best seen in Figs. 1, 7, and 8 and are braced at suitable intervals throughout their height by transverse or horizontal frames 17. (Best seen in Figs. 5 and 6.)

The tower is preferably built in the factory in sections of suitable length to reduce the cost of manufacture and facilitate and expedite the work of setting it up on the ground, and therefore the joints or meeting ends of the tubular legs are brought in substantially the same horizontal plane when the tower is completed.

The meeting ends of the leg-sections are expanded and brought close together, and the means for fastening them in this relation preferably consists of an inner bushing 18,

outer collars 19, one for each expanded end of the leg-sections and outer clamping-sections 20 and 21, which engage opposite faces of the leg-sections and inclose the collars 19 and are drawn together by a U-shape bolt 22 and nuts 23. The inner bushing 18 is hollow and of greater length than the outer clamping-sections 20 and 21, so as to avoid buckling or compression upon the tubular leg-sections, which would be more liable to occur if the corresponding ends of the inner bushing 18 and outer sleeve-sections 20 and 21 terminated in the same horizontal planes. This inner bushing 18 is provided with double cone-surfaces 24, which closely fit against the inner faces of the expanded ends of the leg-sections, and thus serve to reinforce said leg-sections against compression, it being understood that the bushing 18 fits closely within the adjacent ends of the leg-sections throughout its entire length, thereby distributing the twisting or buckling strains and preventing in a measure crystallization of said leg-sections at their junction with the clamps. The collars 19 fit upon the expanded ends of the leg-sections A and are preferably provided with gripping-teeth or vertical serrations 25 to better resist separation or endwise strains upon the tubular legs. The upper and lower edges of these collars 19 are beveled and the lower sections 20 and 21 are provided with similarly-beveled shoulders 26, which engage the beveled surfaces of the collars 19, so that when the sections 20 and 21 are drawn together the beveled shoulders 26 wedge upon the beveled faces of the collars 19, thereby drawing the collars endwise toward each other and by reason of the gripping-teeth 25 operate to draw the meeting ends of the tubes A toward each other and along the conical surfaces 24 of the bushing 18. It is now seen that the clamping members 20 and 21 not only serve to hold the meeting ends of the leg-sections in perfect alinement, but also operate through the medium of the collars 19 to draw said meeting ends toward each other, forming a more rigid and permanent connection.

The clamping-sections 20 and 21 are substantially semicylindrical, except that the section 21 is provided with upper and lower pairs of ears having suitable apertures for receiving the threaded ends of the U-shape bolt 22, so that the circular part of the U-shape bolt 22 fits upon and engages the periphery of the section 20, while the ends of the bolt are passed through the apertures in the section 21 and are engaged by the nuts 23, which bear against the section 21, thereby drawing said sections firmly against opposite sides of the tubular sections 8 and collars 19.

The horizontal bracing frames or decks 17 are triangular in outline and fit with their vertices against the inner faces of the tubular legs A and preferably consist of a series of—in this instance three—angle-bars 30, tie-plates 31 for securing the converging ends of the bars 30 to each other, corner-plates 32, which are secured by bolts 33 to the plates 31, and U-shape clamping-bolts 34, which are fitted upon the outer faces of the tubular legs A and secured to the plates 32.

It will be seen upon reference to Fig. 6 that the circular portion of the bolt 34 and outer end of the plate 32 engage opposite faces of the tubular leg A in nearly the same horizontal plane, or, rather, in the same diametrical plane of the leg A, thereby avoiding short leverages, which are more or less liable to cause abrasion or buckling of the legs by the vibration of the tower.

The plates 31 are comparatively broad horizontally and are permanently secured to the flat top faces of the angle-bars 30 by rivets or bolts 35 and serve as a means for receiving and supporting the plates 32, which in this instance are secured to the top faces of the plates 31 and are each provided with apertured ears 36 for receiving the ends of the bolt 34, said bolt being provided with nuts 37, engaging the inner ears or lugs 3, and thereby drawing the curved or circular portion of the bolt against the outer face of the leg A and at the same time forcing the outer concave end of the plate 32 against the opposite or inner face of the leg forming the rigid connection, whereby the bracing frame or deck is held in its adjusted position.

I have now described the three important features of my invention—viz., a cap or means for securing the upper expanded ends of the legs and holding them in separated fixed relation, the means for clamping the expanded meeting ends of the leg-sections together, and, third, the means for bracing the tower-legs horizontally—and it will be observed that when all of the parts are assembled in the manner described the upper ends of the tubular legs are open and are subsequently filled with concrete, which is admitted in a liquid or semiliquid state by pouring it into the upper ends of the tubes, thereby further reinforcing and stiffening the entire structure.

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

1. In a skeleton-tower structure of the class described, the combination of a plurality of legs converging upwardly from the base toward the top, a one-piece metal casting or plate having a series of apertures therethrough one for each leg in which said legs are inserted, a wedging member movable lengthwise of and engaging the inner faces of said legs, and means for drawing said member upwardly, thereby tending to spread the upper ends of the legs and causing them to frictionally engage the walls of their respective apertures in the first-named plate.

2. In a skeleton tower of the character described, a series of upright tubular legs converging toward the top and having their upper ends expanded, a plate having flaring openings one for each leg receiving said expanded ends, conical hubs fitting in said expanded ends, and means to secure said hubs in operative position.

3. In a skeleton tower of the character described, a series of tubular legs converging upwardly from the bottom, and having their upper ends expanded, a plate having flaring openings receiving and fitting upon said expanded ends, a second plate having conical hubs fitting within said expanded ends, and means for clamping said plates together.

4. In a skeleton tower of the character described, in combination, a series of upright tubular legs converging from the bottom upward and having their upper ends expanded, a plate having a series of openings receiving the upper ends of the tubular legs, the upper ends of said openings flaring upwardly and fitting upon said expanded ends, the lower end of said openings being elongated radially to permit the lower ends of the tubular legs to be brought into parallel position to each other, and means for securing the expanded ends in their respective openings.

5. In a tower of the class described, the combination with a series of upwardly-converging tubular legs having their upper ends expanded, a plate having a series of upwardly-flaring openings receiving and fitting upon the expanded ends of the legs, a second plate having hollow conical hubs fitting within said expanded ends of the legs and means for clamping said plates together, thereby wedging the conical hubs into said expanded ends.

6. In a tower of the class described, the combination with a series of upwardly-converging tubular legs having their upper ends expanded, a plate having a series of openings receiving and fitting upon the expanded ends of the tubular legs, a second plate having conical hubs fitting within the expanded ends of said legs, means for clamping the plates to each other to wedge said hubs into the expanded ends of the legs, a third plate beneath the first-named plate and wedging between and against the inner faces of the legs, and means for moving said third plate endwise of the legs for the purpose described.

7. In a tower of the character described, the combination of a series of upwardly converging legs, a plate having conical hubs wedging within the upper ends of the legs, and means to clamp said plate in operative position.

8. In a tower of the character described, a series of upwardly-converging tubular legs, a plate having openings for receiving the upper ends of said legs, a second plate having conical hubs wedging into the upper ends of said legs, and means for clamping said plates to each other.

9. In a tower of the class described, the combination with a series of upwardly-converging tubular legs, a plate having hollow wedge-shaped projections entering the upper ends of said legs, and means for moving said plate endwise.

10. In a tower of the class described, the combination with a series of upwardly-converging tubular legs, a plate having hollow wedge-shaped projections entering the upper ends of said legs, means for moving said plate endwise, a second plate fitting between and wedging against the inner faces of the legs when moved upwardly and means for clamping said plates together, thereby wedging the second plate between the legs and also wedging said projections of the first-named plate into the open ends of the tubes.

11. A skeleton tower having a series of upright tubular legs composed of sections arranged end to end, the meeting ends of each leg-section being expanded, a bushing fitting within the meeting ends of said sections and provided with double conical surfaces fitting in the expanded ends, clamping-sections embracing said meeting ends and a U-shaped bolt clamping said sections upon opposite faces of the meeting ends of the tubular sections, the inner bushing extending beyond the ends of the outer clamping-section to avoid buckling.

12. In a skeleton tower of the class described, the combination with a series of upright legs, each composed of sections arranged end to end and having their meeting ends expanded, separate collars having a wedging fit upon said expanded ends and movable endwise, and means having a wedging fit upon said collars to draw them endwise toward each other.

13. In a skeleton tower of the class described, the combination with a series of upright legs, each composed of sections arranged end to end and having their meeting ends expanded, a bushing fitted in said expanded ends, separate collars each having a wedging fit upon one of said expanded ends, opposite clamping members having a wedging fit upon said collars, and means to draw said members toward each other.

14. In a skeleton tower of the class described, the combination with a series of upright legs, each composed of sections arranged end to end and having their meeting ends expanded, a bushing fitted in said expanded ends, separate collars each having a wedging fit upon one of said expanded ends, clamping members inclosing said collars and having beveled shoulders engaging their outer ends, and means to draw said members together, whereby the beveled shoulders wedge the collars toward each other and

against the expanded ends of the leg-sections.

15. In a skeleton tower of the class described, the combination of a series of tubular legs converging upwardly from the base and each composed of sections arranged end to end, the meeting ends of the tubular sections being expanded, collars fitted upon the outer surface of the expanded ends each having a biting-tooth engaging said expanded ends, said collars having beveled shoulders and clamping members having beveled shoulders engaging the beveled shoulders of the collars and means for drawing said clamping members together, whereby the engaging beveled shoulders operate to draw the meeting ends of the tubular leg-sections toward each other.

16. In a skeleton tower of the class described, the combination of a plurality of upwardly-converging legs, each composed of sections arranged end to end, collars fitting upon the adjacent ends of the leg-sections and having biting-teeth engaging said leg-sections, said collars having their outer end faces beveled in opposite directions, clamping members engaging said beveled faces of the collars and means for drawing said clamping-sections together around the adjacent ends of the leg-sections, whereby the engagement of the clamping-sections with the beveled end faces of the collars operate to draw said collars and leg-sections toward each other.

17. In a skeleton tower of the class described, the combination of a plurality of upwardly-converging tubular legs each composed of sections arranged end to end and having their meeting ends expanded, hollow double-tapered bushings fitting in the expanded ends of the leg-sections, toothed collars fitting upon the outer faces of said expanded ends and having opposed beveled end faces, clamping-sections inclosing said collars and meeting ends of the leg-sections and provided with beveled faces engaging the beveled faces of the collars and means for drawing said clamping-sections together upon the collars and around the adjacent ends of the leg-sections, the hollow bushing having its ends extended beyond the ends of the clamping-sections.

18. In a tower of the class described, the combination of a plurality of upwardly-converging legs spaced apart, a transverse horizontal brace-frame between the legs and including a clamping-plate and U-bolt for each leg, each clamping-plate and bolt engaging opposite faces of its leg in substantially the same diametrical plane for the purpose of avoiding short leverage strains.

In witness whereof I have hereunto set my hand this 11th day of May, 1905.

ROBERT L. ALLEN.

Witnesses:
H. E. CHASE,
MILDRED M. NOTT.