March 22, 1955 L. P. FRIEDER ET AL 2,704,522

READILY DEMOUNTABLE TRUSS

Filed Feb. 28, 1951 3 Sheets-Sheet 1

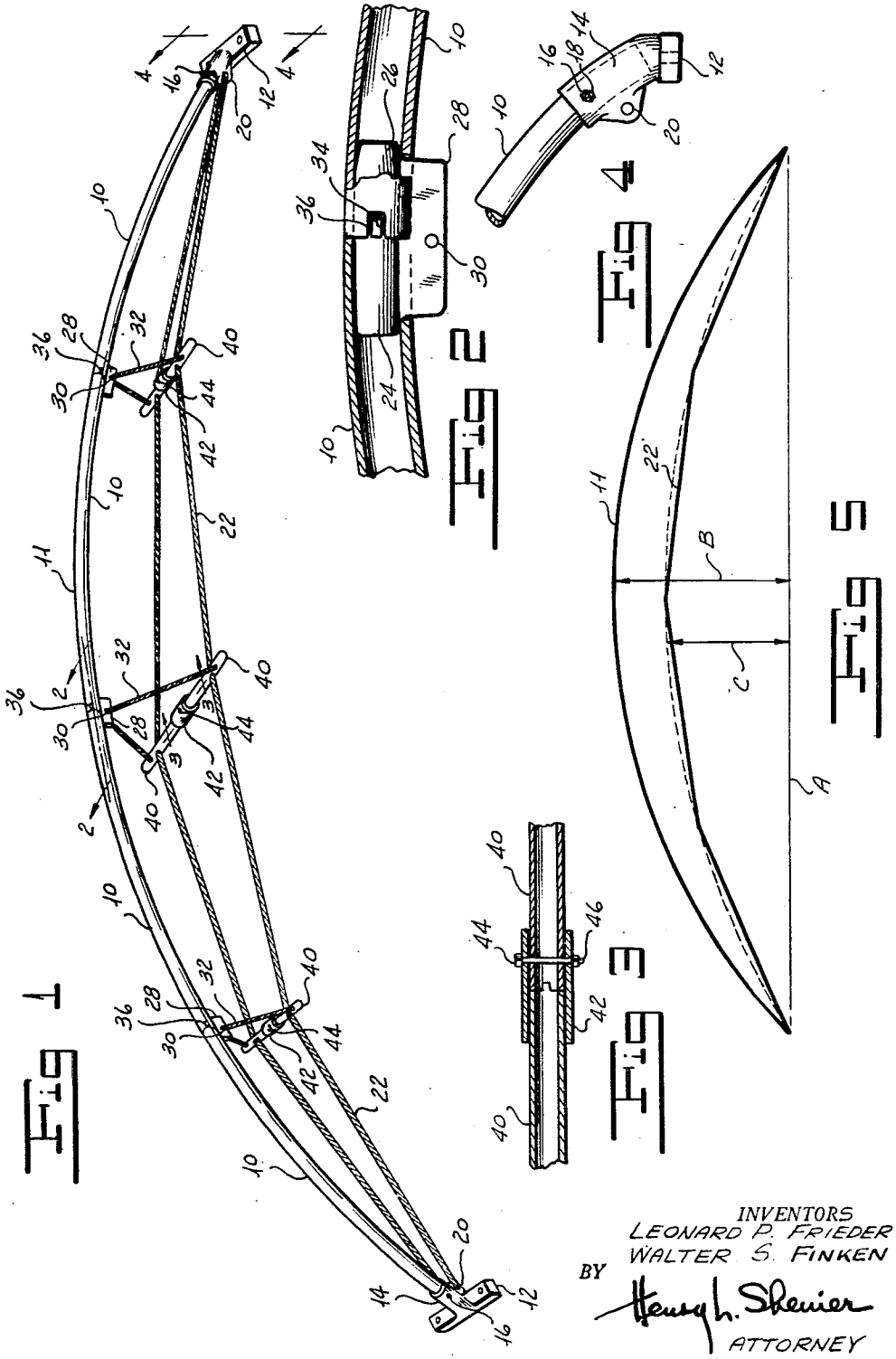


Fig 1

Fig 2

Fig 4

Fig 5

Fig 3

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READILY DEMOUNTABLE TRUSS

Filed Feb. 28, 1951 3 Sheets-Sheet 2

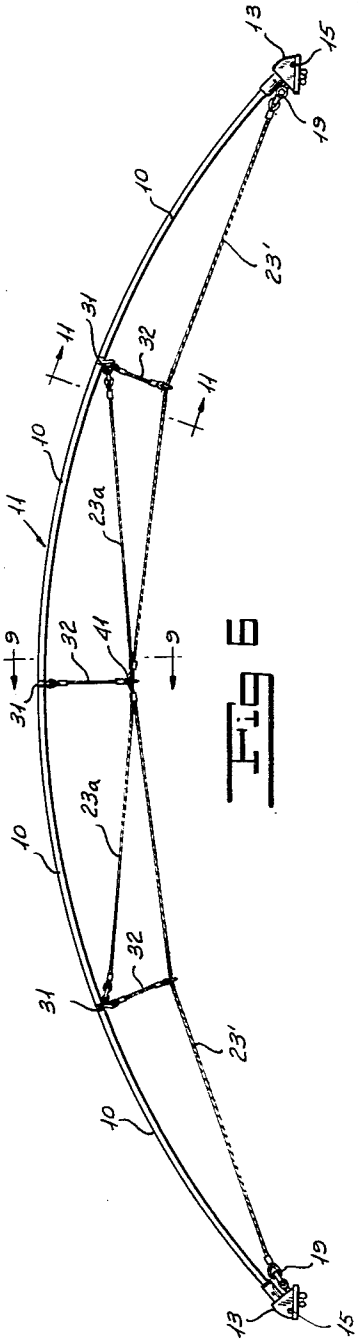


Fig 6

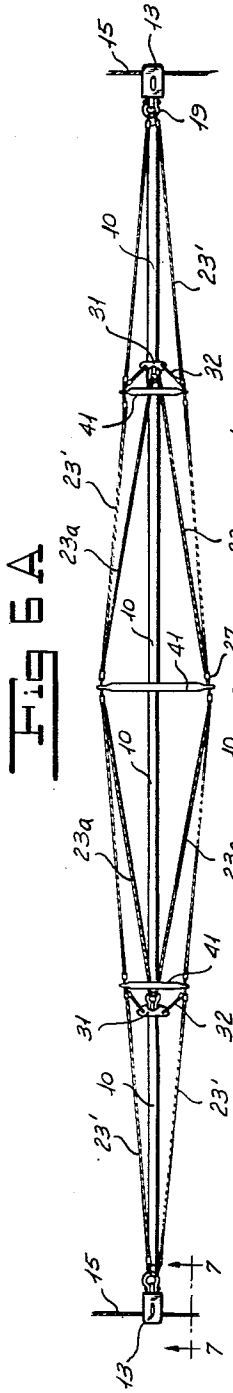


Fig 6A

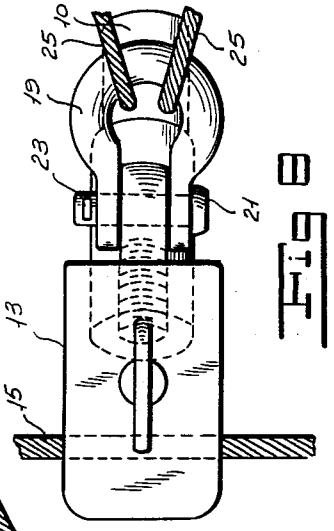


Fig 8

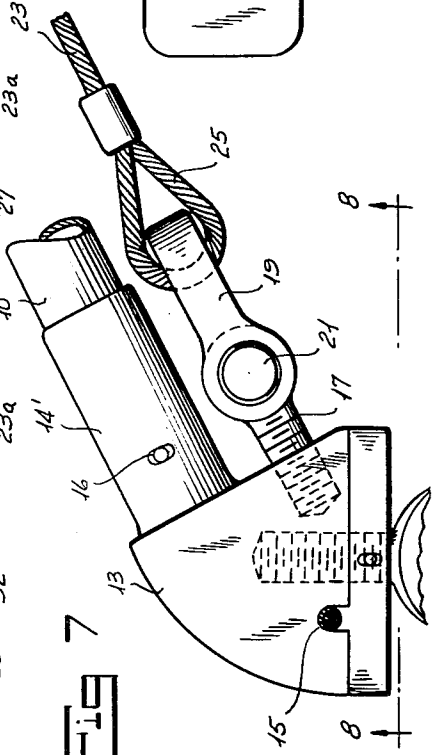


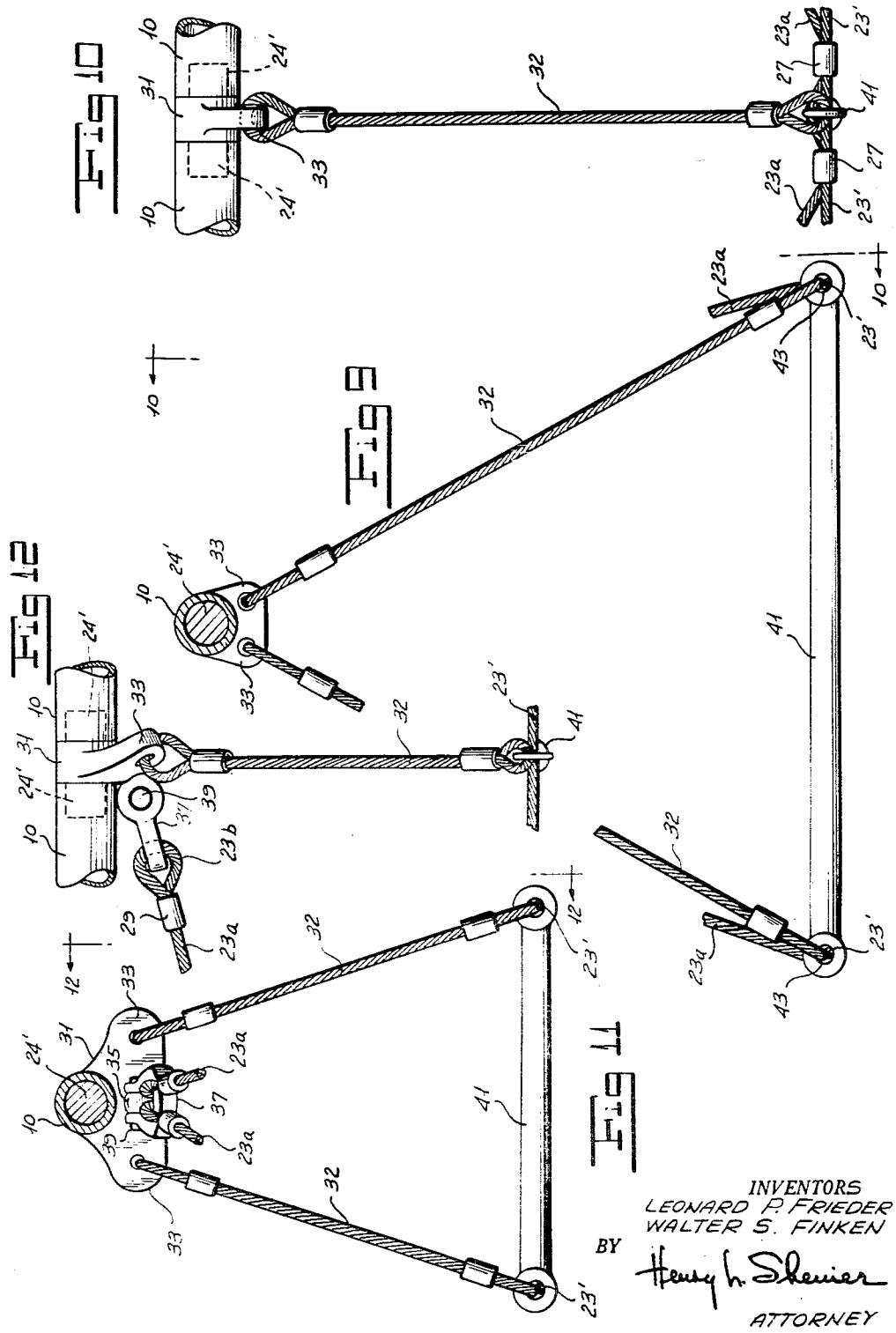
Fig 7

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READILY DEMOUNTABLE TRUSS

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READILY DEMOUNTABLE TRUSS

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Application February 28, 1951, Serial No. 213,246

17 Claims. (Cl. 108—23)

Our invention relates to an improvement in a readily demountable truss and more particularly to a sectional crescent arch truss.

Roof trusses and arches are well known to the art. When these are used for supporting roofs of portable buildings or for portable bridges and the like they require the use of tools and considerable time and labor in their assembly and disassembly. Furthermore, the designs of the prior art have been bulky and heavy.

One object of our invention is to provide a crescent arch truss which can be readily demounted, which is light, strong and portable.

Another object of our invention is to provide a readily demountable crescent arch truss which can be assembled and dismounted without the use of tools in a simple, convenient and expeditious manner.

Other and further objects of our invention will appear from the following description.

In general, our invention contemplates a truss having a rigid top member formed of a plurality of sections. The rigid top member lies generally along the locus of the curve of an arc of a predetermined radius. The bottom members of the truss comprise a pair of flexible members such as wire cables or the like secured to the ends of the rigid member. A plurality of struts or spreader members are carried by the flexible members at spaced points therealong. The ends of each strut are attached to the rigid member by a pair of flexible tie members formed of wire cable or the like. The tie members and the strut form a triangle, with the tie members lying along the radius of the upper rigid member. Each strut is sectional and adapted to complete a rigid structure when in assembled position. When the struts are disassembled the lower cables become slack. This permits the upper sectional rigid member to be disassembled.

In the accompanying drawings, which form part of the instant specification and which are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a perspective view of a readily demountable crescent arch truss showing one embodiment of our invention.

Figure 2 is a sectional view drawn on an enlarged scale taken along the line 2—2 of Figure 1.

Figure 3 is a sectional view drawn on an enlarged scale taken along the line 3—3 of Figure 1.

Figure 4 is a fragmentary view drawn on an enlarged scale viewed along the line 4—4 of Figure 1.

Figure 5 is a diagrammatic view showing the relation of the rise of the upper rigid member and the rise of the lower flexible members with respect to the span of the truss.

Figure 6 is a side elevation of a readily demountable crescent arch truss showing another embodiment of our invention.

Figure 6A is a bottom plan view of the truss shown in Figure 6.

Figure 7 is a side elevation drawn on an enlarged scale viewed along the line 7—7 of Figure 6A.

Figure 8 is a bottom plan view taken along the line 8—8 of Figure 7.

Figure 9 is a sectional view drawn on an enlarged scale taken along the line 9—9 of Figure 6.

Figure 10 is a side view taken along the line 10—10 of Figure 9.

Figure 11 is a sectional view drawn on an enlarged scale taken along the line 11—11 of Figure 6.

Figure 12 is a side view taken along the line 12—12 of Figure 11.

More particularly, referring now to the drawings, the upper member comprises a plurality of sections 10 formed of steel tubing or the like of any suitable wall thickness or any desired diameter. The dimensions of the tubular sections 10 will depend upon the load for which the truss is to be designed and the span through which the truss is to extend. The ends of the truss are formed by step blocks 12. Each step block is formed with a socket portion 14 in which the end sections 10 of the rigid member are adapted to be stepped. The interior of the socket portion 14 is tapered for ease in stepping the end sections. The end of each end section 10 is held in stepped position by means of a pin 16. The end of the pin 16 may be threaded for the reception of a nut 18 if desired. Each step block 12 is formed with a ring 20 through which the ends of the flexible members such as cables 22 are secured in any suitable manner. One end of each sectional member 10 has secured thereto a plug 24 the end 26 of which is adapted to extend into and seat within the adjacent end of another tubular section. The plug 24 carries a depending block 28 formed with an opening 30 through which the flexible tie members 32 are secured to the upper rigid member of the truss formed by the assembled sections 10. The plug 24 is formed with a key 34 adapted to fit into a slot 36 formed in the adjacent section 10 to maintain adjacent sections in predetermined interfitting relation. As shown in the drawings, the upper rigid member indicated generally by the reference numeral 11 lies along the radius of a circle. It is to be understood that if desired each of the sections may be straight, in which case the sections will form chords of the circle, that is to say, the upper rigid member 11 lies either along the segment of a circle or along a segment of a regular polygon.

Each strut or spreader 40 is provided with means adjacent its ends for the passage of the flexible member 22 therethrough. The arrangement is such that the strut ends position the flexible members keeping them separated a predetermined distance. The tie members 32 are likewise secured to the strut ends in any suitable manner. The tie members are designed to lie along a radius of the circle of the rigid member 11. Each strut is sectional. The free ends of the strut adjacent its center are adapted to interfit within a sleeve 42. The sleeve is held in position by means of a bolt 44 which carries a nut 46. When the bolts are removed the sleeve may be slid clear of the junction of the strut sections permitting them to be separated. This removes the tension on the tie members 32 and upon the lower strut cables 22. The slack resulting from the disassembly of the strut members permits a ready disassembly of the rigid member 11 into its component sections 10.

Referring now to Figure 5, it will be seen that the upper member 11 lies along the radius of a circle. The strongest arch truss would be a semicircle since this would give minimum stress per unit cross-sectional area. The arch of a semicircle, however, is too high and would require too much material to accomplish the results we desire. We have found empirically that an efficient truss can be achieved by making the rise B of the rigid member 11 lie between 15% and 25% of span A while making the rise C of the flexible member 22 lie between 10% and 20% of the span A. For a long span, say in the vicinity of forty feet, for a roof truss of a hangar tent which is designed to withstand snow loads and high wind velocities, we would make the rise B of the rigid member 25% of the span and the rise C of the lower cable 20% of the span. For a smaller tent where the span would be in the vicinity of twenty feet or less, we would make the rise of the rigid member 15% of the span while the rise of the lower flexible member would be 10% of the span.

It is to be understood that these dimensions are illustrative and will vary within the limits outlined, depending on the particular load conditions to be encountered by the truss in the service designed. In general, the rise of the upper rigid member will lie between 15% and 25% of the span, while the rise of the lower flexible

member will lie between 10% and 20% of the span. These ratios will give us a truss of maximum strength and minimum weight.

It will be clear to those skilled in the art that when a load is applied to the truss the upper rigid member and the strut members are in compression while the flexible tie members and the lower flexible members are in tension.

We have shown a crescent arch truss having four sections of the rigid member **11** and three struts. It is to be understood that any suitable number of sections may be employed. The triangles formed by the struts and the tie members **32** are generally equilateral. In use, the flexible members are folded upon themselves so that the completed truss forms a package substantially equal to the length of one of the rigid member sections **10**. This bundle can be easily transported in very little packing space. When it is desired to assemble the truss, the end sections **10** are stepped in the sockets **14** and the remaining sections assembled by fitting the plugs **24** into the sockets of adjacent sections. The slack of the lower flexible member **22** is sufficient to permit this to be done with ease. The center strut **40** is then assembled and its sleeve **42** pinned in position. Since this is the biggest stretch this one is assembled first. The assembly of the center strut removes a good deal of slack from the flexible members **22**. One end strut **40** is then assembled in a similar fashion. This can be done with comparative ease since all of the slack is not removed by the assembly of the center section. After this the last end strut **40** is assembled. Due to the fact that a comparatively small force is needed to spread the flexible members, the last strut can be assembled without difficulty. Upon the assembly of the last strut a unitary rigid truss will be formed which can be then placed in any desired position in which it is to be used with ease.

It will be observed that the distance between the high point of the rigid member **11** when assembled and the high point of the flexible members **22** lies between 20% and 25% of the rise of the rigid member. That is to say, the ratio

$$\frac{B-C}{B}$$

lies between ¼ and ⅕, it being understood that the rise of the rigid member is always more than the rise of the flexible member, and that the closest approach of the flexible member to the rigid member is 20% of the rise of the rigid member. Expressed in another fashion, the rise of the flexible members is between 80% and 75% of the rise of the rigid member.

Referring now to Figure 6, the upper rigid member indicated generally by the reference numeral **11** is formed of a plurality of sections of arcuate tubing **10** interfitted as in Figure 1. The ends of the truss, however, are formed by step blocks **13** having a different form than that shown in Figure 1. The truss shown in Figure 6 is adapted to form, say, the roof truss of a catenary tent. The step blocks **13** are supported by catenary cables **15** which pass through the blocks **13**. Each of the blocks is fitted with a socket portion **14'** for the reception of the end tubular member **10** which is adapted to be secured in the socket portion **14'** by a pin **16**. An eye bolt **17** is adapted to be secured to the block **13** by means of a threaded end portion. A shackle **19** is pivotally secured to the eye bolt **17** by means of a pin **21**. The pin is readily removable and is normally held against dislodgment by means of a stay pin **23**. The shackle **19** is adapted to secure the ends of the flexible members **23'** to the step block **13**. Each flexible member **23'** is formed with an eye **25** adapted to be slipped over the end of the shackle **19** when it is uncoupled from the eye bolt **17**. The spreader members **41** in the form of the invention shown in Figures 6 and 6A are unitary struts and are not separable as are the struts in the form of the invention shown in Figure 1. It will also be observed that the flexible members **23'** on the left-hand side of the truss extend from the shackle **19** to the center spreader **41** and that the right-hand flexible members **23'** extend from the right-hand shackle **19** to the center strut **41**. The center strut **41** is shown on an enlarged scale in Figures 9 and 10. The left-hand flexible members **23'** pass through openings **43** formed in the ends of the strut **41**. They then double back upon themselves. The doubled back portion **23*a*** is secured to the standing part **23'** by means of a clip **27** forming an eye securing the end of the flexible member **23'** to the end of the strut **41**. The portion **23*a*** of the flexible member extends upwardly diagonally toward the truss ends and terminates in an eye **23*b*** formed by means of a splice or clip **29**. The tubular sections **10** are joined by a fitting **31** having ends **24'** adapted to lodge in the adjacent tubular sections **10**. The fitting **31** is formed with a pair of ears **33** to which the flexible tie members **32** are secured. The fitting **31** also carries an eye member **35** to which a shackle **37** is secured by means of a pin **39**. The eye ends **23*b*** of each flexible member **23*a*** pass around the shackle **37**, as can readily be seen by reference to Figures 11 and 12. In this manner the portions **23*a*** of the flexible members form diagonal bracing extending from the center strut **41** to the fittings **31**, as can readily be seen by reference to Figures 6 and 6A.

When it is desired to disassemble the truss of the form shown in Figure 6, the end blocks **13** are pressed toward each other distorting the curvature of the upper rigid member **11**, thus creating a slight slack in the flexible members. Advantage is taken of this slack to remove one of the pins **21**. This immediately permits the opposite pin **21** to be removed, it being understood, of course, that the stay pin **23** is first removed in each case. After this occurs the pins **39** may be removed unshackling the upper ends of the diagonal flexible bracing portions **23*a***. The tubular sectional members **10** are then pulled away from the coupling fittings **31** and the truss may be stowed in a small space for ease in transportation.

It will be seen that we have accomplished the objects of our invention. We have provided a readily demountable truss of the crescent arch type which can be assembled and dismounted without the use of tools in a simple, convenient and expeditious manner and which, while light and strong, is readily portable.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is therefore to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. A readily demountable crescent arch truss including in combination a plurality of rigid tubular members, engaging means carried by an end of each of the respective rigid members, complementary interengaging means formed on the other end of each of said rigid members, said engaging means interfitting with said interengaging means to form an elongated curved rigid truss member, a pair of flexible members, means for securing the ends of the flexible members to the ends of the rigid truss member, spreader means for spreading the flexible members from each other intermediate their ends, tie members, means for securing the tie members to the rigid truss member, means for securing the ends of the tie members to the opposite ends of the spreader members whereby the tie members and the spreader members will form triangles, said spreader means being formed with a pair of sections, and means for holding the spreader member sections in assembled condition.

2. A readily demountable truss as in claim 1 in which said elongated curved rigid truss member lies substantially along the locus of a circle.

3. A readily demountable truss as in claim 1 in which the elongated curved rigid truss member lies substantially along the locus of a circle and in which said tie members lie substantially along radii of the circle.

4. A readily demountable crescent arch truss as in claim 1 in which the spreader and tie members are arranged to form the pair of flexible members into a plurality of chords of a circle.

5. A readily demountable truss as in claim 1 in which the rise of said elongated curved rigid truss member lies between 25% and 15% of the span of the truss, and the rise of the flexible members lies between 20% and 10% of the span of the truss.

6. A readily demountable truss as in claim 1 in which the rise of the elongated curved rigid truss member lies between 25% and 15% of the span of the truss, and the rise of the flexible members lies between 80% and 75% of the rise of the rigid truss member.

7. A readily demountable truss as in claim 1 in which the means for securing the flexible members to the ends of the rigid truss member comprise socket members formed with openings, the ends of the truss member being stepped into the socket members and the flexible members passing through said openings.

8. A readily demountable truss as in claim 1 in which said engaging means comprise plugs carried by one tubular member seated in the complementary interengaging means of an adjacent tubular member, and means for preventing relative rotation between adjacent tubular members.

9. A readily demountable crescent arch truss, including in combination a plurality of rigid members, a plurality of coupling members formed with means engaging respective ends of the rigid members for positioning them to form an elongated curved rigid truss member, a pair of flexible members, means for securing the ends of the flexible members to the ends of the rigid truss member, spreader means for spreading the flexible members from each other intermediate the ends of the truss, tie members, means for securing the tie members to the rigid truss member, and means for securing the ends of the tie members to the opposite ends of the spreader means whereby the tie members and the spreader means will form a triangle.

10. A readily demountable truss as in claim 9 in which there is a central spreader member and flexible diagonal bracing members extending upwardly from the ends of the spreader member to the elongated curved rigid truss member, and means for securing the upper ends of the diagonal members to the rigid truss member.

11. A readily demountable truss as in claim 9 in which there is a central spreader member and flexible diagonal bracing members extending upwardly from the ends of the spreader member to the elongated curved rigid truss member, and shackles for securing the upper ends of the diagonal members to the rigid truss member.

12. A readily demountable truss as in claim 9 in which said elongated curved rigid truss member lies substantially along the locus of a circle.

13. A readily demountable truss as in claim 9 in which the elongated curved rigid truss member lies substantially along the locus of a circle and in which said tie members lie substantially along the radii of the circle.

14. A readily demountable truss as in claim 9 in which the flexible members are formed of a plurality of sections extending from the ends of the truss to the spreader member.

15. A readily demountable truss as in claim 9 in which the rise of the elongated curved rigid truss member lies between 25% and 15% of the span of the truss and the rise of the flexible member lies between 80% and 75% of the rise of the rigid truss member.

16. A readily demountable truss as in claim 9 in which said rigid members lie substantially along the locus of a polygon.

17. A readily demountable crescent arch truss including in combination a plurality of rigid members, coupling means positioned between the rigid members and coupling a rigid member to an adjacent rigid member to form an elongated rigid truss member, a pair of flexible members, means for securing the flexible members to the ends of the rigid truss member, spreader means for spreading the flexible members from each other intermediate the ends of the truss, tie members, means for securing the tie members to the rigid truss member, means for securing the ends of the tie members to the opposite ends of the spreader means whereby the tie members and the spreader means will form a triangle.

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