Jan. 11, 1944. H. NAGIN 2,339,098

PORTABLE BRIDGE STRUCTURE

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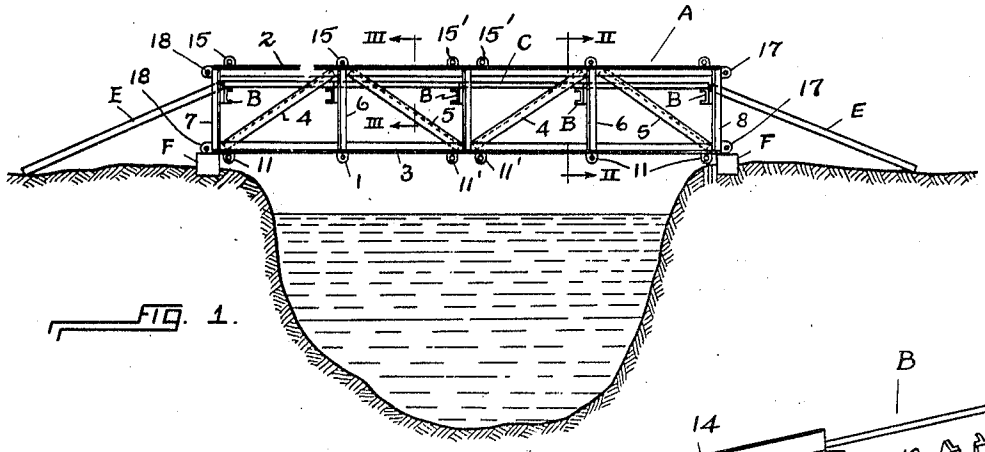


FIG. 1.

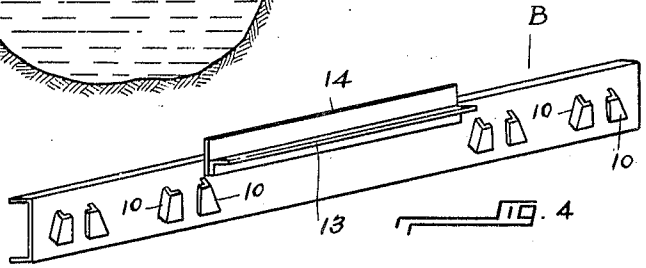


FIG. 4.

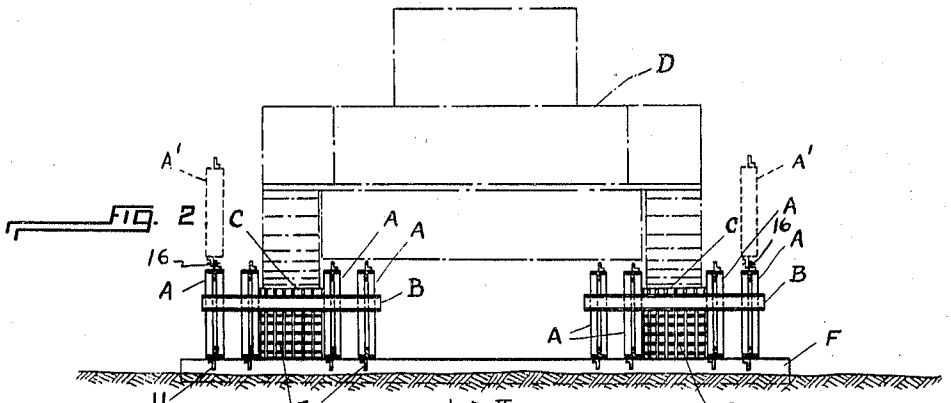


FIG. 2.

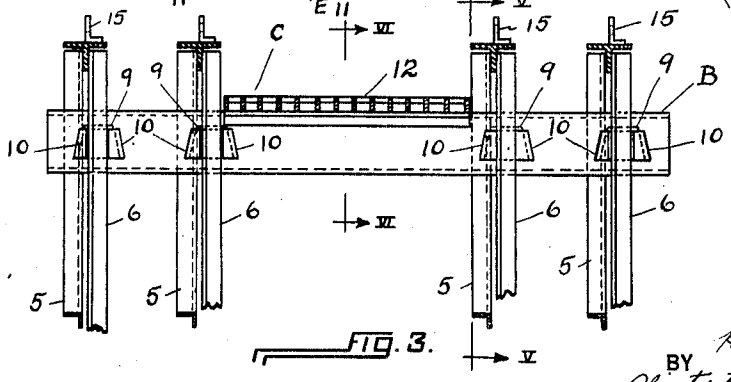


FIG. 3.

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PORTABLE BRIDGE STRUCTURE

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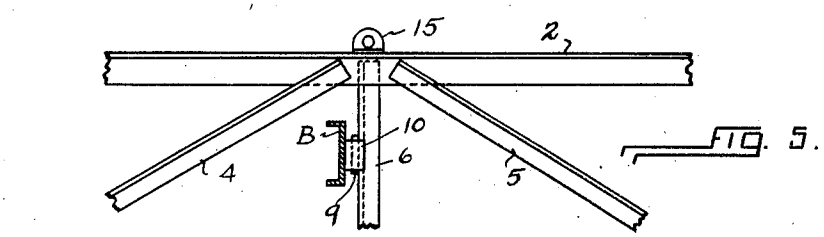


FIG. 5.

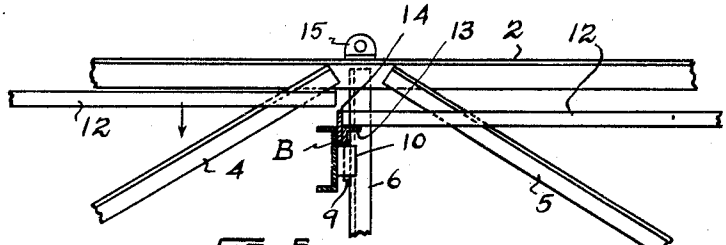


FIG. 6.

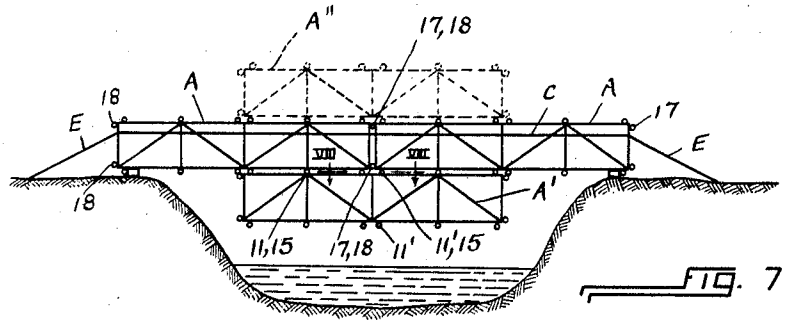


FIG. 7.

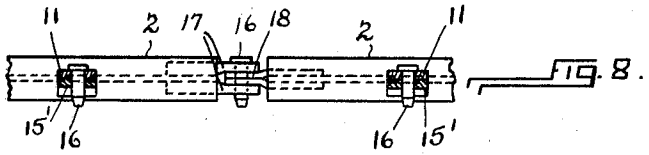


FIG. 8.

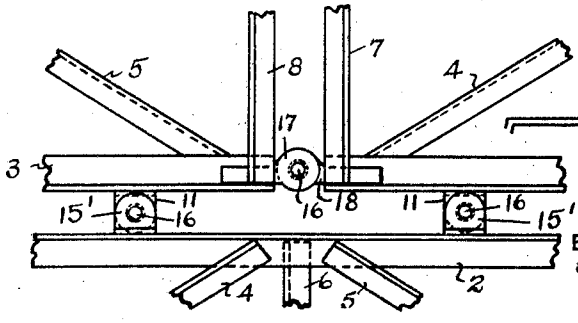


FIG. 9.

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PORTABLE BRIDGE STRUCTURE

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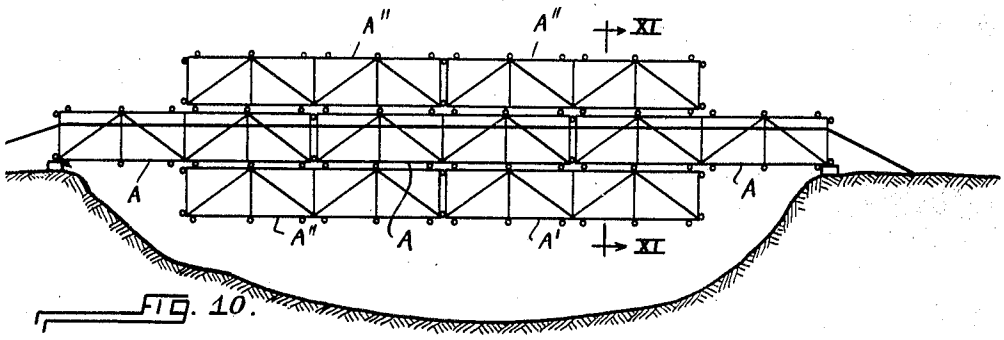


FIG. 10.

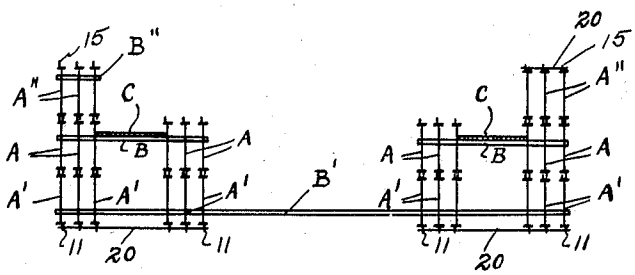


FIG. 11.

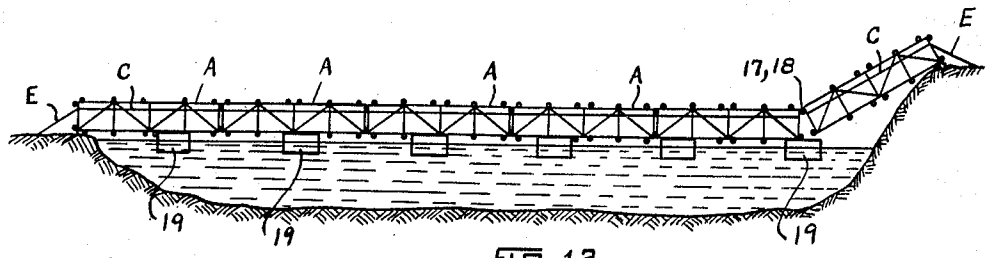


FIG. 12.

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UNITED STATES PATENT OFFICE

2,339,098

PORTABLE BRIDGE STRUCTURE

Harold Nagin, Pittsburgh, Pa., assignor to Reliance Steel Products Company, McKeesport, Pa., a corporation of Pennsylvania

Application June 17, 1942, Serial No. 447,328

4 Claims. (Cl. 14—13)

This invention relates to bridges, especially to temporary bridges of the sort used by military forces to effect passage of tanks and other motorized equipment across waterways and the like. The invention consists generally in refinements in bridge construction, and more particularly in an improved truss unit which may be used interchangeably with like units in constructing bridges of any desired length and load-sustaining capacity.

The bridge of the invention is of extremely simple design, requiring in its construction only four essential parts, that is, multiples of four essential parts; namely, a truss, a floor beam, a floor panel, and a self-locking pin. All of these parts are easy to handle in the field, and they may be packed in minimum space for storage and transportation. The truss, the largest and heaviest of the parts, is still so light in weight that it may be readily lifted and carried into position by a field crew, say a crew of army engineers, and no special skill is required quickly to erect or take down a bridge. The structure lends itself to the erection of either pontoon bridges or self-sustaining spans, whichever is desired in the field. Thus it is that the invention will prove of particular advantage to the military.

In the accompanying drawings an exemplary embodiment of the invention is illustrated:

Figure 1 is a view in side elevation of a self-sustaining bridge across a waterway. The span of the bridge is short, equal in length to the identical trusses used in its construction;

Figure 2 is a view of the bridge in cross section, on the plane II—II of Figure 1. A tank is shown in broken lines upon the bridge;

Figure 3 is a fragmentary sectional view showing a portion of the bridge to larger scale, on the plane III—III of Figure 1;

Figure 4 is a view in perspective and on equal scale with Figure 3 of one of the floor or cross beams used in the bridge structure;

Figure 5 is a fragmentary sectional view on the plane V—V of Figure 3;

Figure 6 is a similar view on the plane VI—VI of Figure 3;

Figure 7 is a diagrammatic view similar to Figure 1, showing a bridge of greater span, and illustrating how the load-sustaining capacity of a bridge may be increased by superposing and uniting certain of the trusses of the span;

Figure 8 is a fragmentary sectional view, showing to larger scale and in structural detail the medial joint of the truss assembly in the bridge of Figure 7, the plane of section of Figure 8 being indicated at VIII—VIII in Figure 7;

Figure 9 is a view in side elevation of the medial joint shown in Figure 8;

Figure 10 is a diagrammatic view comparable with Figure 7, showing a bridge of still greater span and employing more elaborate truss reinforcement;

Figure 11 is a diagrammatic view in cross section of the bridge of Figure 10, as seen on the plane XI—XI; and

Figure 12 is a diagrammatic view, illustrating the use of the structure of the invention in a pontoon bridge.

Referring to the drawings the truss of the invention is indicated at A. The truss includes upper and lower chords **2** and **3** formed of lengths of metal bar. In this case the bar is of T-shape in cross section, but it is to be understood that bars of other cross sections, or metal tubing, may be used. The web of the truss is formed of lengths of angle iron welded to the central or vertical flanges of the T-shaped chords **2** and **3**. Preferably, but not essentially, the truss is of the Warren type, a truss whose web comprises diagonals **4** and **5**, vertical struts **6**, and end posts **7** and **8**.

The bridge shown in Figure 1 is a single-span structure, that is, a bridge whose length equals the length of the trusses employed in its construction. Indeed, the bridge here shown consists in effect in two parallel bridges, each constructed of four trusses A, five cross-beams B, and a floor C. As illustrated in Figure 2, the two parallel bridge units are laterally spaced to provide ways for the treads of the vehicles (here a caterpillar tank D is shown) which use the bridge, and at opposite ends of the bridge prows or ramps E extend from the floors C to the ground. The trusses A are supported at their ends upon sills F placed upon the banks of the waterway to be spanned.

The parallel trusses A in each bridge unit are united to and integrated by the cross-beams B, which cross-beams in this case are formed of channel. The union of the cross-beams B with the trusses is a detachable union, such that the bridge may not only be quickly erected but may be readily taken apart. The means for effecting the rigid but detachable integration of the cross-beams with the trusses comprise tapered keys or wedge-plates **9** welded or riveted to the struts **6** of the trusses, and tapered sockets formed by paired members **10** (Figure 4) welded upon the backs of the channel-shaped beams B. The

erection of the structure is manifestly simple, it being merely necessary to place the four trusses with proper lateral spacing upon the sills F; then to project the cross-beams transversely through the webs of the trusses; and then to adjust the cross-beams in such position that the paired socket members 10 severally engage the wedge-plates 9. The wedged union of the parts is exceedingly rigid and secure. While in Figure 2 the cross-beams are shown of such length as to extend through and engage only the four trusses of each of the two bridge units, it is to be understood that the beams may be equal in length to the width of the two bridge units, whereby the individual beams are caused to engage all eight trusses of the structure.

If desired, transverse tie-rods (not shown) may be threaded through and secured to eye-lugs 11 that extend downwardly from the nether edges of the lower chords 3 of the trusses. More will later be said of these eye-lugs.

The floors or treads C and brows E of the bridge structure are formed of panels 12 of metal grating. The panels that form the floors are supported at their ends upon the upper edges of the beams B, and in order to insure maximum bearing engagement of the ends of the panels upon the beams, without requiring the use of beams of unduly heavy section, an angle iron 13 is welded to the back of each beam as shown in Figure 4. The horizontal flange of this angle iron is flush with the surface of the upper flange of the beam B, and the flange of the beam provides the seat for an end of one floor panel, while the horizontal flange of the angle iron provides the seat for the adjacent end of the next-succeeding floor panel. In refinement a plate 14 is welded between the back of the beam B and the angle iron 13. This plate, extending upward from the seat-forming faces of the beam and the angle iron, lies between the otherwise abutting ends of the floor panels (see Figure 6), and serves to prevent creeping of the floor panels under the traction stresses produced by vehicles moving upon the bridge.

It will be perceived that in the assembled structure the cross-beams B are positioned adjacent to the upper ends of the struts 6, whereby the floors or treads C of the structure lie only a few inches below the upper chords 2 of the trusses. By virtue of this organization, the upper chords of the four trusses arranged between the two floors or treads C do not interfere with the under-structure of the vehicles traveling upon the bridge.

The brows E serve in manifest way to break the rise between the floors C and the surface of the ground or roadway at the two ends of the bridge. The brows will, of course, be tied or otherwise anchored at their upper ends to the cross-beams B that are borne upon the end posts or struts 7 and 8.

The number of trusses employed in the bridge may be varied to meet the load requirements. Here four trusses are shown for each floor or tread C. In the case of vehicles of light weight two trusses might be used instead of four; on the other hand if the vehicles are relatively heavy more than four trusses may be used on each side of the structure. In adapting the bridge for maximum loads, while maintaining the weight of the individual trusses at minimum value, the trusses which stand on the outside of the two floors C may be reinforced by superposed trusses A', as indicated in dotted lines in Figure 2. The trusses A' are identical with the trusses A, the structure of all of the trusses being standard, and the trusses being universally interchangeable in any of the various bridge structures that may be built. It has already been mentioned that eye-lugs 11 are provided on the lower chord 3 of each truss. Similarly, eye-lugs 15 are provided on the upper chords of the trusses. These lugs, welded rigidly to the chords 2 and 3 in the outstanding position illustrated, are complementary in shape and arrangement, with the consequence that two (or more) trusses may be positioned one upon the other in common vertical plane, and the lugs 11 on the upper truss caused to register with the lugs 15 on the lower truss. Pins 16 are inserted and secured in the eyes of the so-registered lugs, such pins 16 being diagrammatically indicated in Figure 2. While the particular form of the pins used is not of the essence of the present invention, the self-locking pin or bolt illustrated and described in my copending application, Serial No. 444,681, filed May 27, 1942, is particularly effective for the purpose.

In some cases it may be desired that the floor C shall extend substantially the full width of the bridge. In such event the inner trusses (the trusses between the floors C, Figure 2) will be eliminated, and the cross-beams will extend the entire width of the structure, to sustain floor panels that cover the entire area between the outer trusses.

The truss of the invention may be employed in the construction of multiple-span bridges; that is, bridges whose trusses each comprise multiples of two or more of the truss units A, arranged end to end and interconnected. The means for interconnecting the truss units A consist in perforate lugs 17 and 18, secured to the opposite ends of the upper and lower chords 2 and 3. Figure 7 illustrates a bridge having a span equal in length to two trusses A. The interconnection of the lugs at the meeting ends of the trusses is illustrated in Figure 8; the lugs 17 and 18 are each formed of two straps of metal welded to the ends of the chords 2 and 3, respectively; the straps that form each lug 17 are spread apart at their ends, forming a bifurcation within which the end of lug 18 is positioned; thus it will be understood that the lugs 17 and 18 are complementary in shape and are so arranged at the ends of the trusses that when two trusses are arranged end to end the lugs 17 and 18 fit together, with their perforations in registry to receive truss-uniting pins 16, as shown in Figures 8 and 9.

The bridge structure of Figure 7 is constructed of a plurality of paired and united trusses A, A. The paired or aligned truss units A, A are arranged upon sills, and united by cross-beams B (not shown in Figure 7) in the same way that the single trusses of Figure 1 are arranged and united, and floors C and brows E are secured in place in the so-assembled framework.

Usually, but not always, a reinforcing truss A' will, by means of the lugs 11, 15 and pins 16, be secured beneath and across the joint of each pair of trusses A, A, and if further reinforcement be desired additional trusses A'' may be similarly embodied in the structure above the joints of the paired trusses. It will be noted that the lugs 11 and 15 are secured to the chords 2 and 3 at the panel points of the truss, all save the lugs at the medial panel point. Instead of one lug on each chord at said medial panel point, two lugs 11' and 15', respectively, are provided.

These two central lugs on each chord of the truss are spaced apart a sufficient interval to compensate for the space taken up by the united lugs 17 and 18 between the paired trusses A, A. Thus it is that the lugs 11 and 15 adjacent the united ends of the paired trusses will register with the lugs 15' and 11' of the reinforcing trusses A' and A''. In any of the possible truss assemblies the lugs 11 or 11' on the lower chord 3 of one truss will register with lugs 15 or 15' on the upper chord 2 of a truss positioned below it. This holds true whether the truss assembly be such as indicated in Figure 2 or that indicated in Figure 7.

Figures 10 and 11 diagrammatically illustrate a still larger bridge whose framework is constructed of parallel lines of trusses that each include three truss units A. The joints of each line of trusses A are spanned or straddled from below by reinforcing trusses A', while the three lines of trusses arranged outward of the floors or treads C on each side of the bridge structure (see Figure 11) are reinforced from above by means of trusses A''. The tops of the trusses A'' and the bottoms of the trusses A' may be transversely connected by bars 20 passing through the lugs 15 of trusses A'' and lugs 11 of A', respectively. If desired, the tops of trusses A'' may be connected by short cross-beams B'', in a manner similar to that shown in Figure 3. In addition, a long cross-beam B' may be similarly arranged to connect the bottoms of the trusses A'. Such an arrangement of cross-beams may be provided in any of the structures hereinbefore described.

Figure 12 illustrates how the trusses may be used in the construction of pontoon bridges. The trusses A may be united end to end in lines of any desired length, and between the banks of the waterway pontoons 19 may be arranged to afford such medial support as is needed. The lines of trusses are throughout the length of the bridge united by cross-beams B, as in the case of the self-sustaining bridges above described, and floors C and brows E are assembled and secured, to complete the structure. A feature of value is to be noted at this point. If a bank of the stream lies at a substantial interval above the surface of the water, the last two trusses at the end of the bridge will be pin-connected at the ends of their upper chords and the last truss inclined, as shown in the right-hand portion of Figure 12. This feature is especially valuable in the construction of pontoon bridges. Needless to say the trusses will be secured to the pontoons, but the provision of such means does not immediately concern this invention.

The self-locking pins or bolts 16, by means of which the trusses are united, are of slightly smaller diameter than the holes in the registering lugs 11, 15 and 17, 18 that receive them. This loose fit of the pins is of advantage, in that the assembled trusses in an erected bridge can adjust themselves slightly with respect to one another and thus reach a condition in which the load imposed on the bridge is more evenly distributed than would otherwise be the case.

Within the ambit of the invention defined in the appended claims various modifications and refinements in structure are held in contemplation.

I claim as my invention:

1. A portable truss for the erection of temporary bridges, the upper and lower chords of said truss being provided at spaced-apart points in their extent with outstanding perforate lugs, the lugs on the upper chord being complementary in shape and position to the lugs on the lower chord, whereby a plurality of such trusses may be assembled one upon another in vertical plane, with certain of the lugs on the adjacent chords of the superposed trusses positioned in registry to receive truss-uniting pins.

2. A portable truss for the erection of temporary bridges, the upper and lower chords of said truss being provided substantially at the truss panel points with outstanding perforate lugs, the lugs on the upper chord being complementary in shape and position to the lugs on the lower chord, whereby a plurality of such trusses may be assembled one upon another in vertical plane, with certain of the lugs on the adjacent chords of the superposed trusses positioned in registry to receive truss-uniting pins.

3. A bridge constructed of a plurality of lines of trusses, the lines being arranged in laterally spaced-apart and parallel relation, the upper and lower chords of said trusses carrying at their opposite ends means for detachably uniting the trusses end to end in each line, a series of cross-beams extending between the lines of trusses, the struts of said trusses carrying means for detachably engaging and securing said beams to integrate the truss assembly, a floor borne by the cross-beams, trusses arranged in common plane with and in bridging relation relatively to the united ends of the trusses in said lines, perforate lugs arranged at spaced-apart points in the extent of the lower chord of each truss, perforate lugs on the upper chord of each truss complementary in shape and position to the lugs on the lower chord, whereby the lugs on one of the chords of each bridging truss register with certain of the lugs on the adjacent chords of the bridged trusses, and truss-uniting pins secured in the perforations of the registered lugs.

4. A portable truss for the erection of temporary bridges, the upper and lower chords of said truss being provided at their opposite ends with perforate lugs, the lugs at one end of the truss being complementary in shape and position to the lugs at the opposite end of the truss, whereby a plurality of such trusses may be assembled end to end, with the lugs at the meeting ends of the trusses in registry to receive truss-uniting pins, said upper and lower chords of the truss being provided at spaced-apart points in their extent with outstanding perforate lugs, whereby two or more trusses may be assembled one upon another in vertical plane, with certain of the lugs on the adjacent chords of the superposed trusses positioned in registry to receive truss-uniting pins.

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