No. 891,417.

PATENTED JUNE 23, 1908.

H. FRIEND.

BRIDGE CONSTRUCTION.

APPLICATION FILED AUG. 29, 1907.

3 SHEETS—SHEET 1.

Fig. 1.

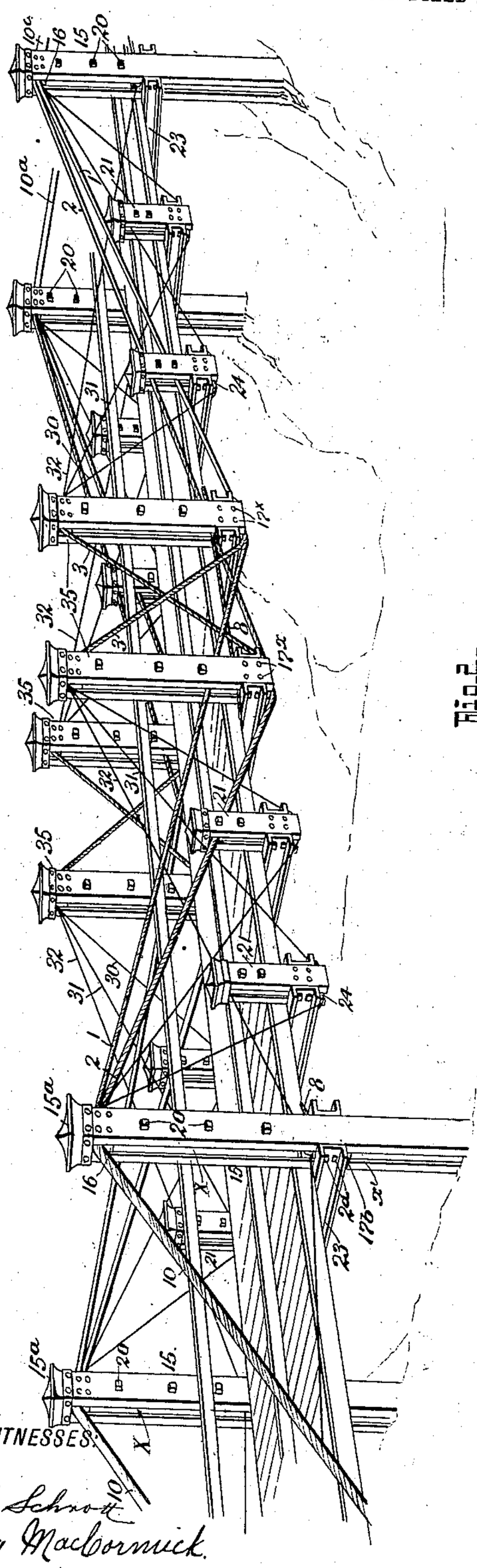
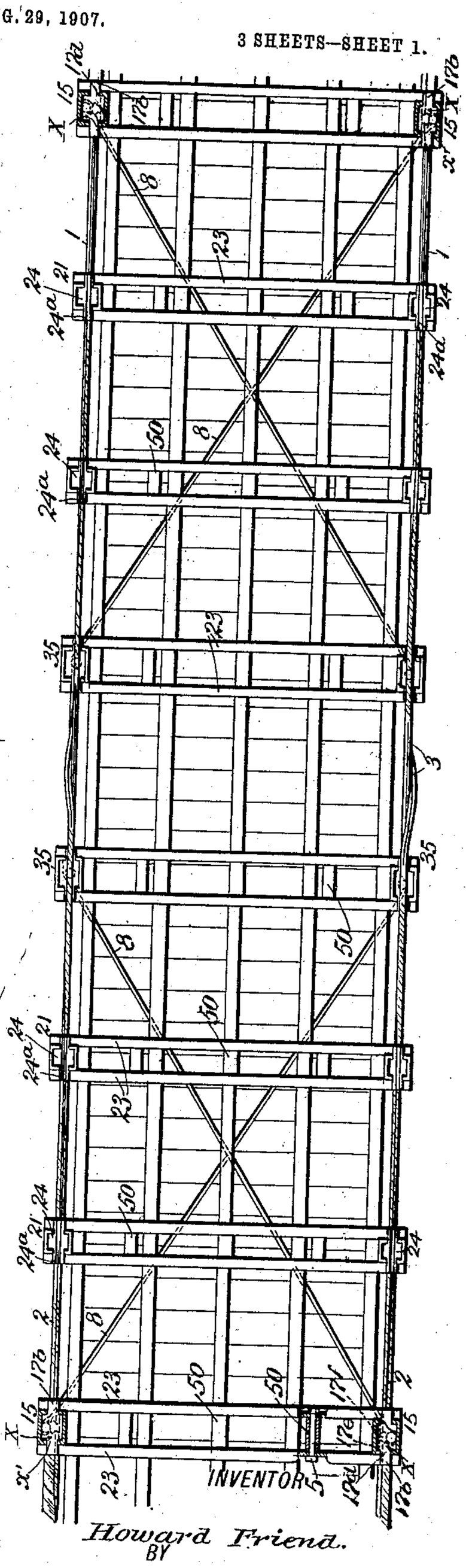


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 1.

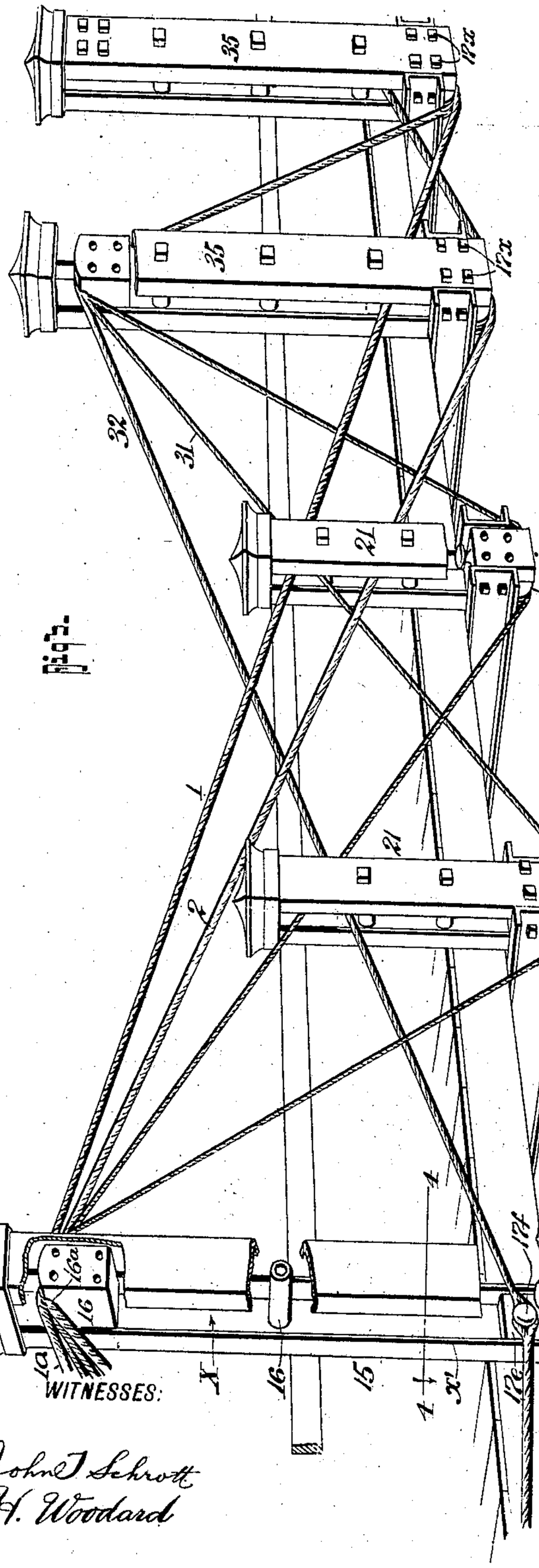


Fig. 7.

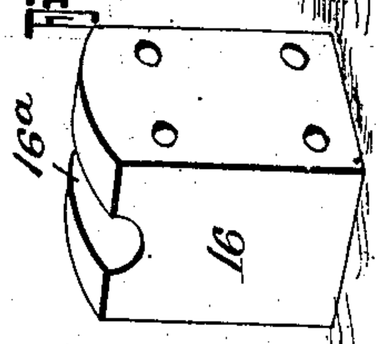


Fig. 6.

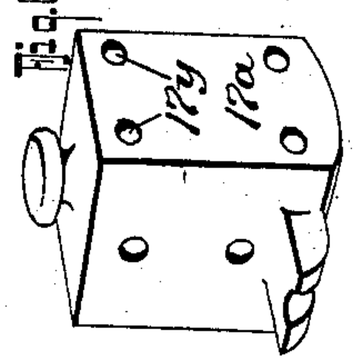


Fig. 8.

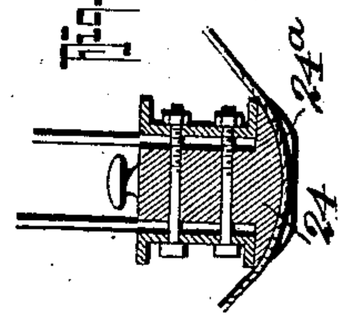


Fig. 5.

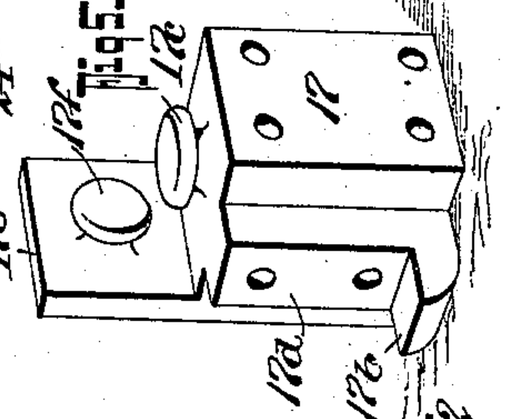
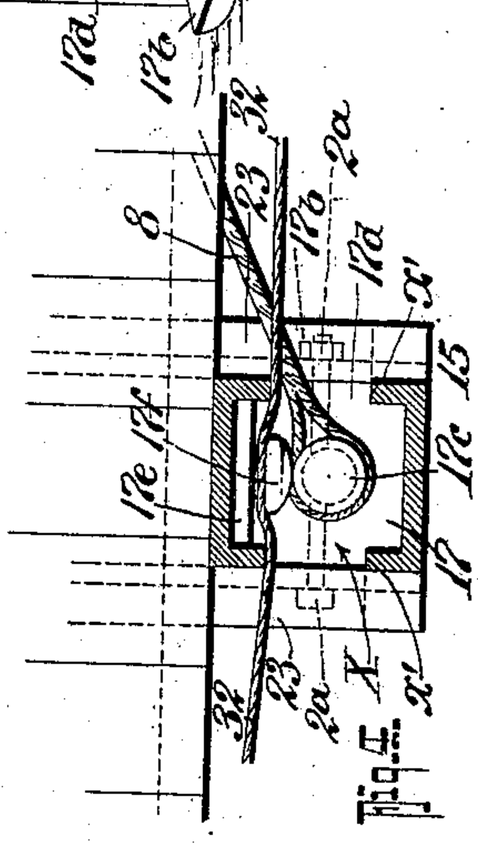


Fig. 4.



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No. 891,417. PATENTED JUNE 23, 1908.

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BRIDGE CONSTRUCTION.

APPLICATION FILED AUG. 29, 1907.

3 SHEETS—SHEET 3.

Fig. 9.

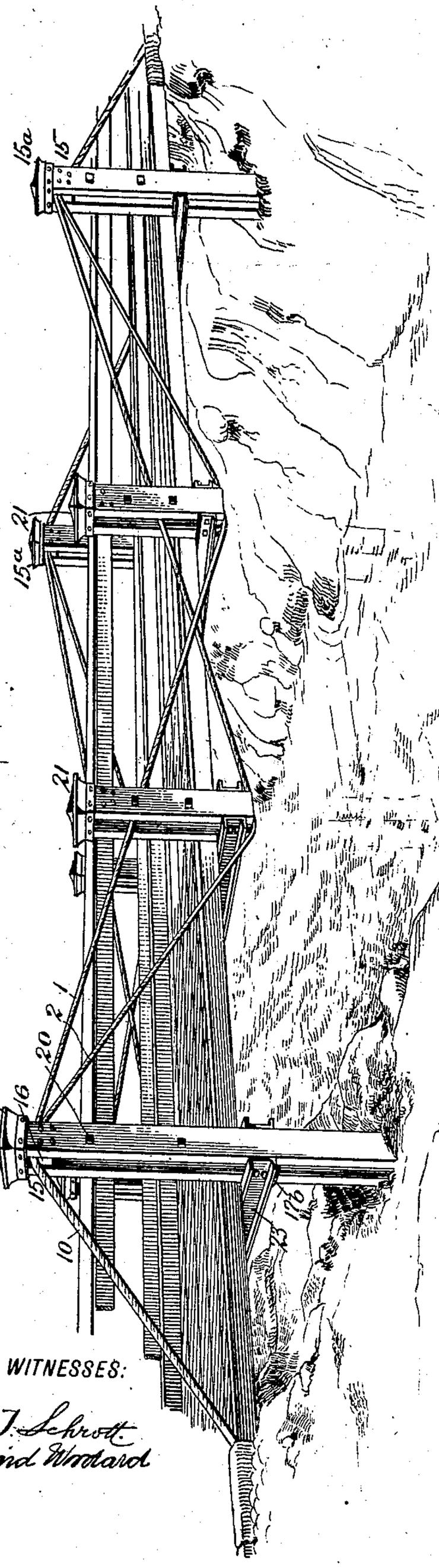
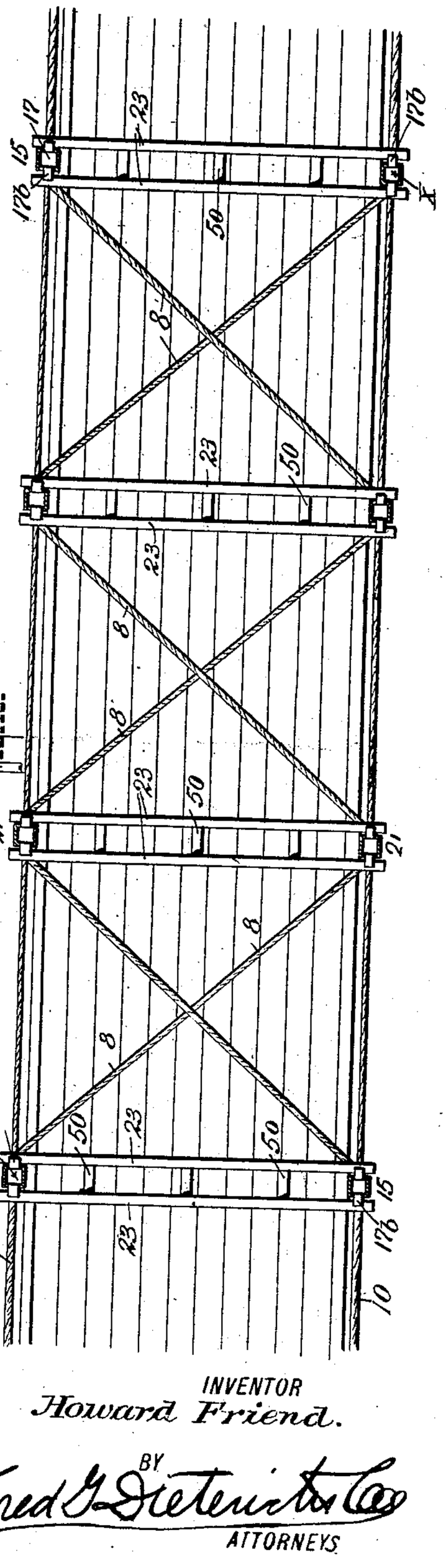


Fig. 10.



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BRIDGE CONSTRUCTION.

No. 891,417. Specification of Letters Patent. Patented June 23, 1908.

Application filed August 29, 1907. Serial No. 390,665.

To all whom it may concern:

Be it known that I, HOWARD FRIEND, residing at Lexington, in the county of Cleveland and State of Oklahoma, have invented certain new and useful Improvements in Bridge Construction, of which the following is a specification.

My invention, which relates generally to improvements in bridge construction, primarily has for its object to provide an improved type of truss bridge composed of wire cables and main and intermediate tower supports that have each correlative arrangement and capable of being anchored whereby the cost of building the same in proportion to the weight and class of material used is reduced to the minimum.

Another object of my invention is to provide a plan of bridge construction in which a sustaining means is so designed that a perfectly rigid truss is provided, and having a greater carrying capacity in proportion to the cost and weight of the materials used than is attainable in the ordinary types of truss bridges now in general use.

Furthermore, my invention has for its object to provide an improved combination and arrangement of parts having such connection that a uniform and even division of strain is effected, another and essential feature of my invention lying in a new and improved means of connecting the truss or suspension cables with the main tower posts and the anchorage in such manner that a uniform bridge floor level is maintained under the contraction and expansion of the cables.

With other minor objects in view which will hereinafter appear, this invention consists in certain details of construction and combination of parts, all of which will be hereinafter fully explained, specifically pointed out in the appended claims, and illustrated in the accompanying drawings.

Referring to the drawings: Figure 1 is a perspective view that illustrates a single span bridge in accordance with my invention. Fig. 2 is an inverted plan view thereof, the end or main tower posts being in horizontal section and particularly illustrating the horizontally-disposed transverse brace rods hereinafter referred to. Fig. 3 is a perspective view of a portion of the end or main tower posts, one of the intermediate tower posts and the parts coöperatively connected therewith, parts of the tower posts being broken away to better illustrate their construction. Fig. 4 is a detail horizontal section taken on line 4—4, of Fig. 3, and looking in the direction of the arrow. Fig. 5 is a perspective view of one of the main tower blocks hereinafter referred to. Fig. 6 is a similar view of one of the saddle-blocks used in the lower ends of the intermediate towers and side posts hereinafter referred to. Fig. 7 is a detail view of one of the saddle-blocks that are used in the top of the main and intermediate towers. Fig. 8 is a detail cross section of one of the stationary tower blocks hereinafter referred to. Fig. 9 is a perspective view, and, Fig. 10 is an inverted bottom plan of a modified form of my invention, hereinafter referred to.

By referring now more particularly to Fig. 1, which shows the single span bridge construction in accordance with my invention, 15—15 designate what I term the main tower posts, which posts are arranged in pairs at opposite sides of the stream to be bridged, and each of the said posts 15 comprises two like sections of channel iron with their channel faces opposing each other, so as to form an intermediate space x as best shown in Fig. 3, from which it will be noted that said channel sections are closed at the upper ends by caps 15^a—15^a and are secured by transverse bolts 20 and braced and held separated by the tubular members 16 that are mounted on the said bolts 20 as shown.

In the lower ends of each of the main tower posts is mounted a cast-iron block 17, shown in detail in Fig. 5. Each of the blocks 17 has oppositely-disposed flanges or ribs 17^d that fit in the vertical slots x' formed between the opposing edges of the post sections, and the lower ends of said blocks have integral and laterally-projected flanges 17^b that form the supports for the channel-iron cross-beams 23 that carry the bridge floor beams, said beams 23 being firmly secured to the block 17 by the bolts 2^a as clearly shown in Fig. 3, from which it will also be noticed that the said beams 23 are arranged in pairs with their ends straddling the posts 15, such connection of the beams with the blocks 17 and the mounting of the blocks 17 within the posts 15 being provided to permit vertical movement of said cross-beam sustaining blocks upon the posts 15 for reasons hereinafter explained.

Each of the blocks 17 has a button-shaped head 17^c on its upper side and it also has a vertical extension 17^e provided with an inwardly-projecting button head 17^f, the purpose of which will be hereinafter apparent.

Fixedly mounted in the upper ends of the main tower posts and preferably just below the caps 15^a are saddle-blocks 16 having longitudinal grooves 16^a in their upper faces, as shown in detail in Fig. 7. By reason of forming the main tower posts as shown and described, a strong and rigid main and supporting post is provided at a minimum cost which can be firmly set to form the main supports for the suspension cables.

In the construction shown in Fig. 1, supplemental or intermediate tower posts 35—35 are provided and these posts are constructed similar to the main or end tower posts, except that their cross-beam sustaining blocks 17^a are fixedly secured to the channel sections that constitute the said posts 35 by bolts 17^x—17^x that pass through the channel sections and through the transversely disposed apertures 17^y—17^y in the block 17^a. In addition to intermediate or center tower posts 35—35 a number (depending on the length of the bridge required to complete the span) of short side posts 21 are included which are constructed like the central tower posts 35, except that they have no saddle-blocks in their upper end, and the saddle-blocks 24 mounted in the lower ends thereof have grooves 24^a on the under side as clearly shown in Fig. 8. The several intermediate tower and side posts are sustained by the suspension cables that pass from and are supported by the end or main tower posts 15—15, and in constructing the bridge the posts 35 and 21 are placed in position after the suspension cables have been anchored and suspended from the main tower posts 15—15.

1 and 2 designate the two main supporting cables. These cables are separate and independent of each other until they reach the saddle-block 16 in the tops of the end towers 15 where they unite to form single cable portions 10—10^a that run to anchorage, this being the manner of joining the two main cables 1 and 2 when a single span bridge is to be built. When the bridge is of two or more spans, the two cables, after passing over the main tower posts 15—15, again separate and perform the same functions as in the first span. The cables 1 and 2 are the only ones that run independent from one end of the span to the other end, since all of the other cables hereinafter referred to are united on top of the intermediate tower posts, as will presently more fully appear.

By referring more particularly to Fig. 1, it will be noted that the cable section 10, which is anchored in any approved manner on the outside or land side of the main tower posts 15, is divided, after passing the block 16 in the top of said post, into a number of smaller cables as follows: The two main supporting cables 1 and 2 supporting the intermediate tower posts 35—35; and the still smaller cables 30 and 31, 32 which support the smaller side posts 21. The main cable 1 extends through the adjacent intermediate tower post 35, and under the saddle-block 17^a in the lower end of the other intermediate tower post 35, from which it passes up to the saddle-block 16 on the other end tower post 15, at which point it merges with the other and smaller cables 2, 30, and 31 32 to form the cable section 10^a at the opposite end of the bridge.

It is to be understood by reference to the drawings, that, while the cable section 10^a is shown in position for anchorage into the bank or ground, said section 10^a may, in case of additional spans, be again divided into smaller cables 30, and 31, 32 the cable 1 passing again under one of a similar pair of intermediate tower posts 35 in the next span. Starting again at the main cable section 10, the cable member 2 formed therefrom passes from the top of the tower post 15 to and under the saddle-block 17^a in the bottom of the adjacent intermediate tower post 35, passing thence through the other post 35, and up to the top of the opposite main tower post 15, at which point it merges with the other cables 1, 30, and 31 32 to form the cable section 10^a aforesaid.

The cross-beams that support the floor are made fast to the saddle-blocks, as before stated, and are braced laterally and held properly spaced apart by bolts 5 and tubular spacing members 50, as shown in Fig. 2. The floor-beams and side-rails of the bridge are mounted on the cross-beams in any approved manner.

To prevent side sway of the bridge I brace the same by two brace wire cables 8—8 which is done by winding one end of each of said cables around the button head 17^c on the blocks 17 in the lower ends of the two opposite tower posts 15 at one end of the bridge and crossing said wires and looping them on the button head of the saddle-blocks in the first set of intermediate posts, and then passing them to and looping them over the button heads of the saddle-blocks in the other set of intermediate posts, from hence they can cross over and join with the button heads of the saddle-blocks in the other end tower posts 15—15, as will be readily understood from the drawings.

3—3 designate a supplemental pair of truss braces, one end of which is secured, by means later described, at the lower end of the intermediate tower posts 35—35. The upper ends of these brace cables 3—3 extend over the blocks 16 in the tops of said intermediate tower posts 35—35, at which point

they are divided into the cables 30, 31, and 32. The cable 30 passes from the top of said post 35 down to and under the saddle-block 24 of the first small post 21, and up to the top of the main tower post 15, where it merges, with other cables, into the main cable section 10. The cable 31 passes from the top of said post 35 down to and under the next small post 21, and up to the top of said main tower post 15 where it also merges with the other cables to form the main cable section 10. The remaining cable 32 passes from the top of the post 35 down to the block 17 that is vertically movable in the lower end of the tower post and to which the floor beam 23 is secured as clearly shown in Figs. 3 and 4 by reference to which, it will be seen that the said cable 32 is looped over the stud 17^f of the said block and from the said stud 17^f it passes forwardly and merges with the main cable section 10 as clearly shown in Fig. 1. If said tower post 15 be a mid-stream post between two spans, said cable 32 passes from said stud 17^f directly to the top of the adjacent intermediate tower post of the next span, and performs the same function as in the first span. The lower ends of the brace cables 3—3 are secured by passing under the blocks 17^a of the intermediate tower posts 35—35, at which point their strands lie with the strands of the cables 1 and 2 and extend therewith over the tops of the main tower posts 15 and to the anchorage.

By reason of providing the supplemental strand 32 and making the saddle-block 17, that carries the cross beams 23 in the lower ends of the tower posts 15 vertically slidable, I provide a simple and effective means for maintaining a floor level during the contraction and expansion of the cables, and by sustaining the intermediate tower and post members as shown and described a uniform and even distribution of the strain is provided.

In the practical construction of bridges under my invention, all of the cables, whose separate strands extend from the anchorage at one end of the bridge to the anchorage at the other end, are formed by laying one strand of wire into place at a time, and then binding the several strands together parallel with each other into the separate cable divisions by wrapping a strand of smaller wire around them. It will be understood that where there are more than one set of intermediate towers in a single span there should be the same number of cross-beams and cables between them as at the end between the intermediate tower and main tower posts, in order to evenly distribute the load and obtain a uniform size in all of the main supporting cables.

From the foregoing, taken in connection with the drawings, the complete construction, combination, and many advantages of my invention will be apparent to those skilled in the art to which it appertains.

In Figs. 9 and 10 I have illustrated a simple form of the invention, especially designed for the construction of smaller bridges of such short spans that intermediate towers are not necessary. In this form the main cable 10 has its separated strands 1 and 2 passed from the opposite tower posts under the short side posts 21—21 and crossed midway between the side posts and thence passed up to the top of the opposite main tower post. In this form the floor bracing is arranged as shown in Fig. 10.

While I have especially described the floor bracing members as consisting of wire cables, it is manifest that when the bridge span is such as to require more than one set of intermediate towers, the said members, to meet the requirement, may be rod irons bolted together at each end between the cross-beams on the said angle that the wire cable would assume if the span were lengthened. Again, where the span requires more than one set of intermediate towers, the main and intermediate towers, to insure the desired rigidity, may be coupled together over the road way in any suitable manner.

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

1. In a suspension bridge of the character described, the combination with the end and the intermediate towers and the cross-beams carried thereon; of suspension cables supported from the end towers, said cables having separated divisions of strands that pass under the cross-beams on the intermediate towers, and yielding connections that join the separate divisions of strands with the main or tower posts, thereby providing for the contraction and expansion of the suspension cables.

2. In a bridge construction of the character described, the combination with the main and intermediate towers and the cross-beams carried thereby; of suspension cables anchored at both ends and supported from the main towers, said cables being divided into separate divisions of strands between said main towers to support the several intermediate towers and their cross-beams, and means for connecting the separated strands with said main tower posts to maintain a floor level during expansion and contraction of the cables.

3. In a bridge construction of the character described, the combination of the main tower posts, intermediate posts and side posts; suspension cables supported on the main tower posts; said cables being divided into separate divisions of strands between the main towers and their cross beams, the common posts and their cross beams, and

means for connecting the separated strands with the said main tower posts to maintain a floor level during expansion and contraction of the cables.

4. In a bridge construction of the character described; the combination with the main and intermediate towers; of suspension cables anchored at both ends and supported from the main towers; said cables passing under the intermediate towers; a separate division of the strands of each said cable passing obliquely from the bottom of each intermediate tower to the top of the other intermediate tower, thence to the bottom of the adjacent main tower.

5. In a bridge construction of the character described; the combination with the main and intermediate towers; of suspension cables anchored at both ends and supported from the main towers; said cables passing under the intermediate towers; the upper ends of the intermediate towers being provided with saddle-blocks; separate divisions of each of the suspension cables passing from the lower ends of said intermediate towers upward obliquely to the tops thereof, and thence to the lower portions of the end towers.

6. In a bridge construction of the character described, the combination with the main and intermediate towers; of suspension cables supported from the main towers, said cables passing under the intermediate towers in separate divisions, saddle blocks mounted in the upper ends of the intermediate towers, separate divisions of each of the suspension cables passing from the lower ends of said intermediate towers upward obliquely to the tops thereof and again forming separate divisions, for supporting the common posts and the floor cross beams, a yielding connection that joins the ends of the last stated separate divisions with the lower portions of the end towers for the purposes specified.

7. In a bridge construction of the character described, the combination with the slotted end and intermediate tower posts, of cross floor beam carrying blocks mounted on the lower ends of said towers, each having an upwardly projecting button head, and the suspension cables that pass from the end towers and support the intermediate towers, crossed truss cables that pass under the cross-beams, said cables having their ends secured to the button heads on the blocks in the said towers, and at points between their ends looped onto the button heads of the intermediate tower blocks, for the purposes specified.

8. In a bridge construction of the character described, the combination with the slotted end and intermediate tower posts, and the common posts; of the cross floor beams bearing blocks thereon mounted in the lower ends of the towers and posts, each of the blocks having an upwardly projecting button head, the suspension cables that pass from the end towers and support the intermediate towers and posts, the trussed cross cables, said cables having their ends secured to the button heads of the blocks in the towers and posts, and at points between their ends looped onto the button heads of the intermediate tower blocks and common post blocks, for the purposes specified.

9. In a bridge construction of the character described, the combination with the end towers and common posts, the suspension cables supported from the upper ends of the towers, intermediate pairs of towers, a cross beam mounted on each pair of intermediate towers and common posts, a member on the lower end of each of the intermediate towers and common posts having its lower end shaped to seat on the cable strands, and the crossed truss cables connected at their ends to the end towers passed over the cross beams and secured to the seat portions in the lower ends of the intermediate towers and common posts, for the purposes specified.

10. In a bridge construction of the character described, the combination with the suspension cables, and the end or anchor towers of intermediate towers arranged in pairs, a block mounted on each of the said intermediate towers, each having its lower end fitted to seat upon the suspension cables and having integral lateral projections that form the supports for the floor cross-beams, for the purposes specified.

11. In combination, a pair of end or anchor towers, the suspension cables that hang therefrom, a block fitted into the lower end of each tower and having means for supporting the floor cross-beams, the blocks in the end or anchor towers being movable, and cable strands that pass down from the main tower posts over and under the intermediate tower posts and have their free ends connected to movable blocks, in the end tower posts, for the purposes specified.

12. The combination with the end or anchor posts, and a beam carrying block fixedly mounted in each of the intermediate tower posts; of the suspension cables anchored at the ends and passed over the end towers, said cables having their strands separated at points between the end towers, one set of strands passing in opposite directions under the intermediate tower posts, another set of strands passing under and over the intermediate tower posts and thence to the lower ends of the end tower posts, and beam carrying blocks mounted in the end posts for vertical movement, to which the ends of the last named cable strands are secured, for the purposes described.

13. The combination with the end towers and the suspension cables supported there-

from, said cables having their strands separated; of intermediate towers, each composed of opposing channel irons, means for holding said irons spaced apart, blocks fixedly mounted in the lower ends of the intermediate towers, said blocks having lateral projections for sustaining the floor cross-beams, blocks secured in the lower ends, of the end towers, and having vertical movement therein, one set of cable strands, passing from the opposite end towers under and over the intermediate towers and thence down to and connected with the blocks movably held in the end tower posts, as set forth.

14. In a bridge construction of the character described, in combination with the suspension cables, the strands of the suspension portion of which are separated; of opposing pairs of intermediate towers, each having its outer edges slotted for the passage of the cable strands therebetween, a block mounted in the lower ends of each of the hollow towers, the blocks in the end towers being held for a limited vertical movement, each of the blocks having lateral flanges, the cross-beams mounted thereon, one set of the cable strands passing under and over the intermediate posts and secured at the ends to the movable blocks in the end posts, the other strands passing under the other tower blocks, substantially as shown and described.

15. In combination with the hollow towers having slots in their opposite edges, the cross-beams, the stringers; of blocks mounted in the towers having lateral lugs that sustain the beams, and having vertically projected button heads the blocks in the end towers having limited vertical movement and being provided with lateral button heads, the horizontal truss brace cables secured at the ends to the vertical button heads, on the end tower blocks and passed through the slotted intermediate towers and looped on the button head of the blocks thereon, the suspension cables having their strands separated, some of which pass under the blocks in the intermediate tower posts and some of which pass under and over the intermediate tower posts and have their ends secured to the lateral projections on the blocks in the end towers, as set forth.

16. In a bridge construction of the character described, in combination with the end tower or anchor posts, a pair of intermediate posts, and cross-beams supported on the anchor posts for vertical movement, cross-beams fixedly secured to the intermediate tower posts; of a main cable anchored at the ends and sustained at such ends at the tops of the end posts, the strands of said cables between the end posts being separated, one set of strands crossing and passing under the seats on the intermediate tower posts, another set of strands being passed under and over the intermediate tower posts, connected with the tower posts and joined with the main cable at points beyond the main tower posts, as set forth.

17. In a suspension bridge of the character described, the combination with the end and the intermediate tower posts and opposing pairs of supplemental side posts; of the suspension cables 10—10 sustained from the end posts, the said cables being separated after passing over the end posts to form independent strands 1—2, said strands 1—2 being passed under one set of intermediate tower posts and over the other set of intermediate tower posts and then again separated to form additional strands 31, said strands 31 passing under the supplemental or side posts and thence up to the end tower posts where they again merge with the main cables 10, as set forth.

Witness my hand this 22 day of August, 1907.

HOWARD FRIEND.

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