No. 629,935. Patented Aug. 1, 1899.

N. H. STURGIS.

SUSPENSION BRIDGE.

(Application filed July 11, 1898.)

(No Model.) 3 Sheets—Sheet 1.

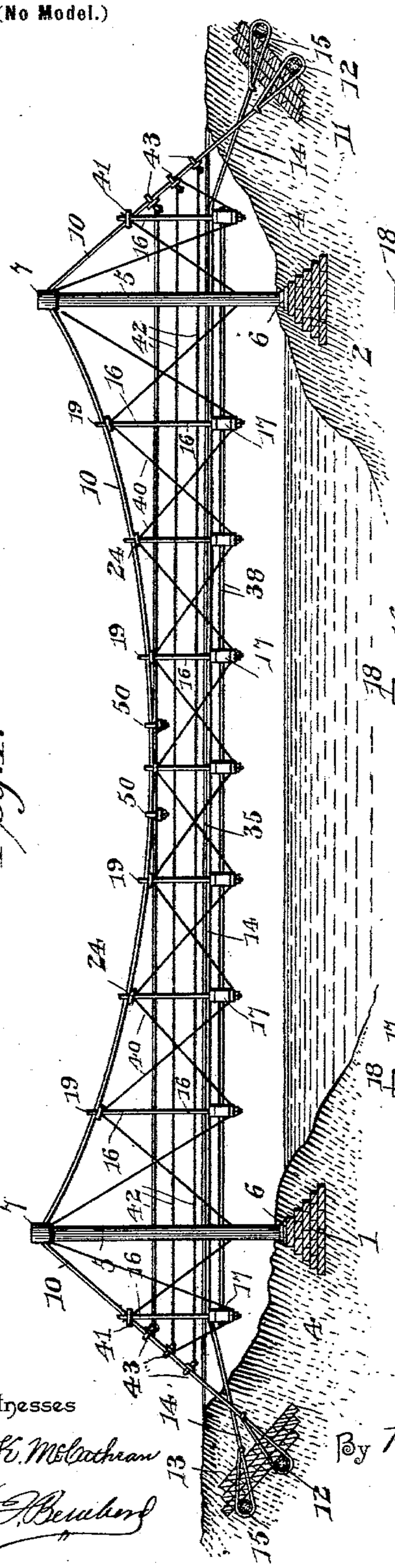

Fig. 1.

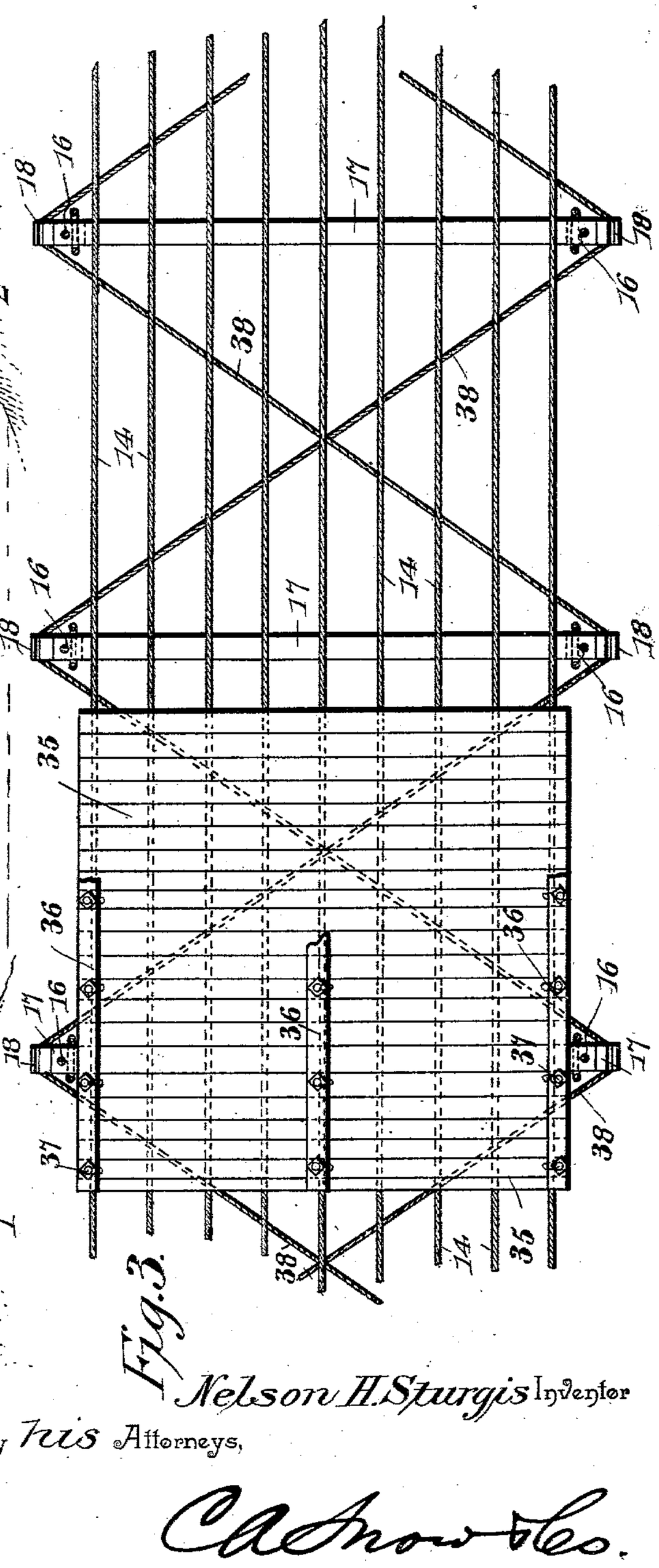

Fig. 3.

Witnesses
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SUSPENSION BRIDGE.

(Application filed July 11, 1898.)

(No Model.) 3 Sheets—Sheet 2.

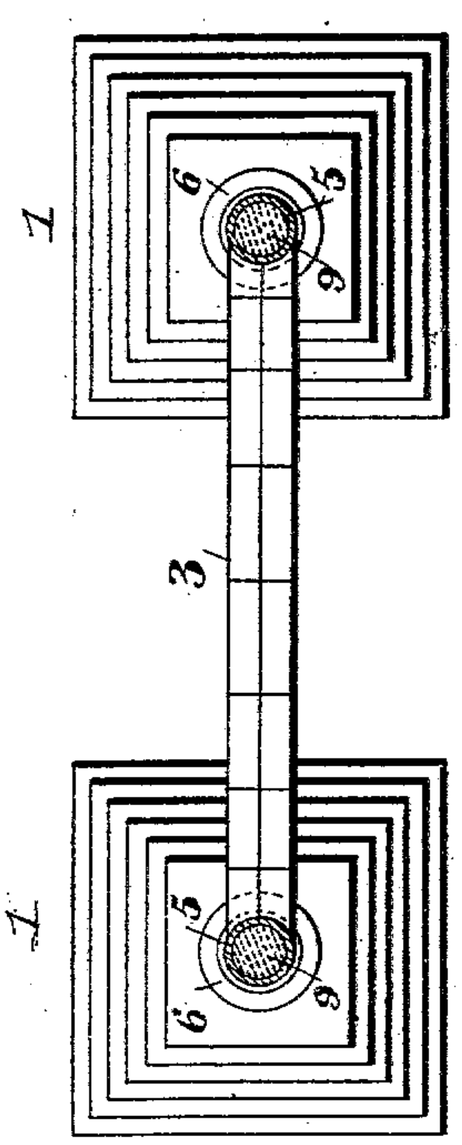

Fig. 4.

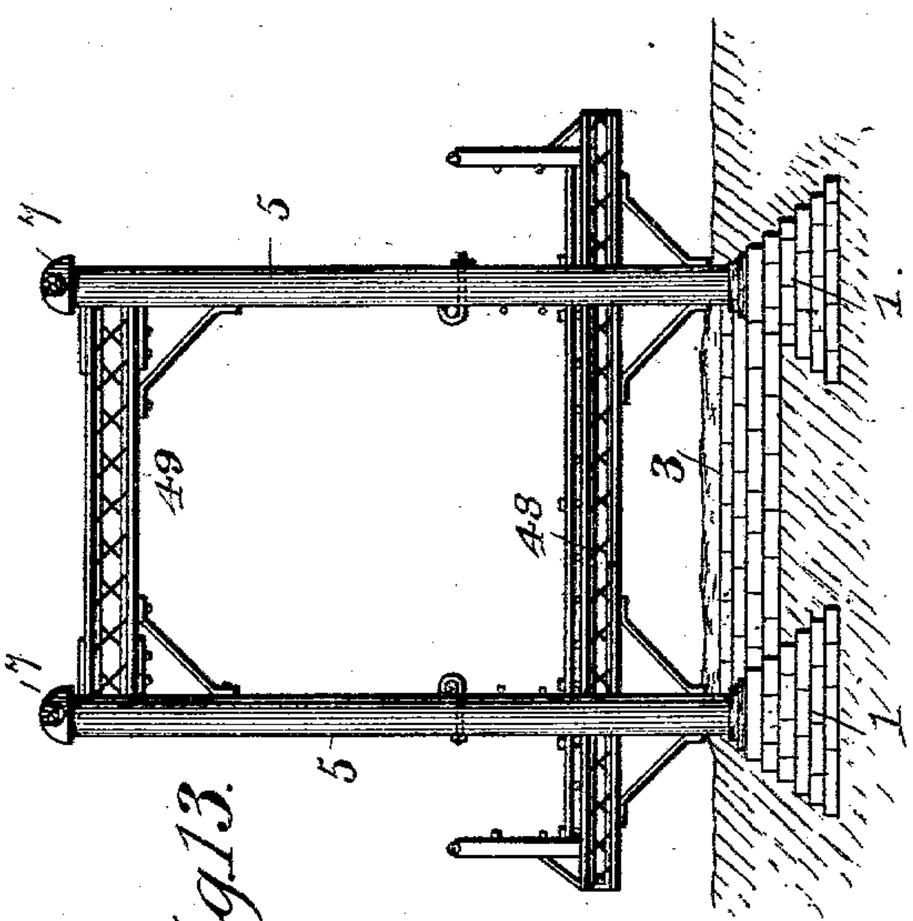

Fig. 13.

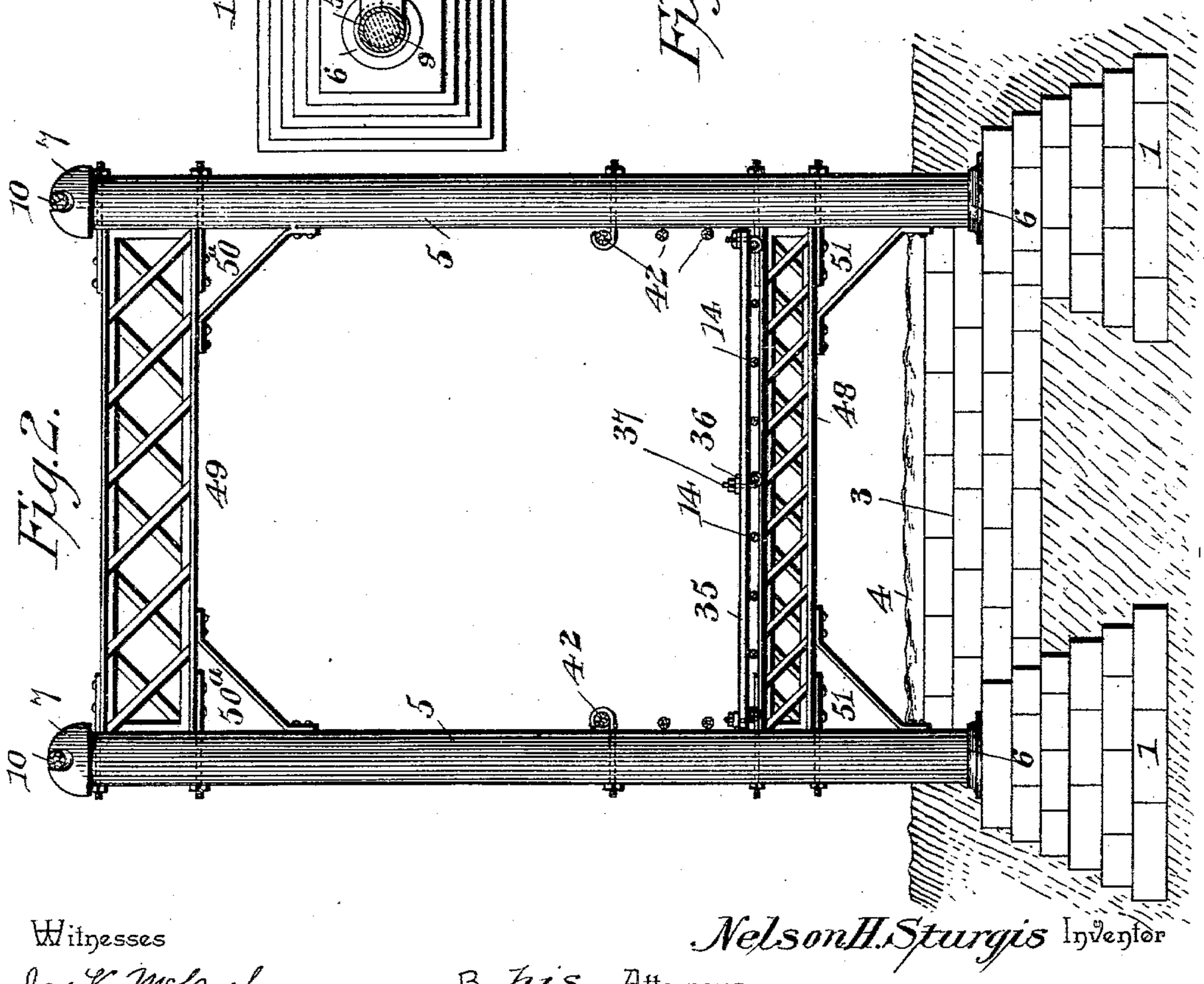

Fig. 2.

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No. 629,935. Patented Aug. 1, 1899.

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SUSPENSION BRIDGE.

(Application filed July 11, 1898.)

(No Model.) 3 Sheets—Sheet 3.

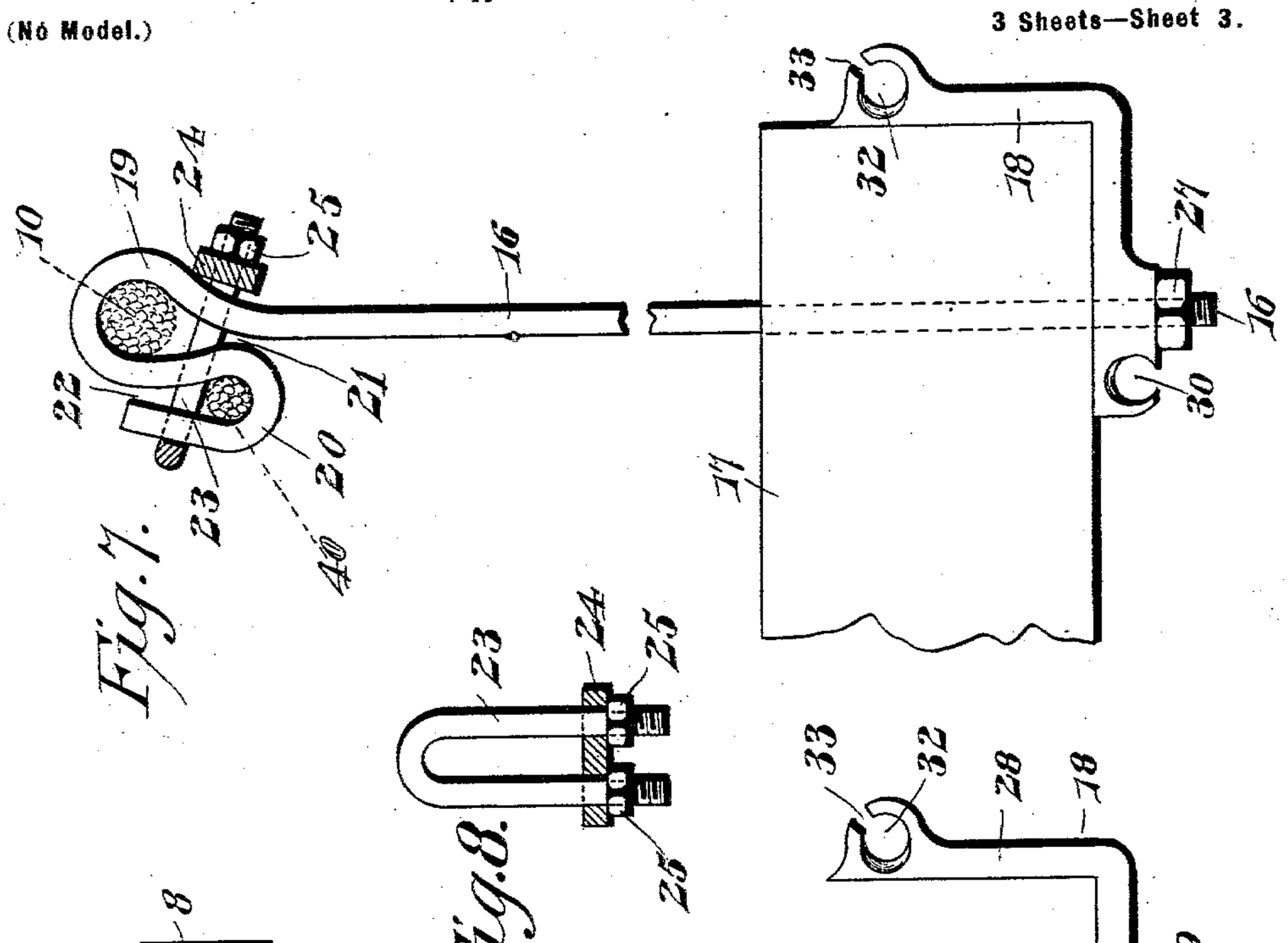

Fig. 1.

Fig. 8.

Fig. 9.

Fig. 5.

Fig. 6.

Fig. 12.

Fig. 9.

Fig. 10.

Fig. 11.

Witnesses
Jas. K. McCathran
H. J. Bemberd

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UNITED STATES PATENT OFFICE.

NELSON H. STURGIS, OF GUTHRIE, OKLAHOMA TERRITORY.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 629,935, dated August 1, 1899.

Application filed July 11, 1898. Serial No. 685,608. (No model.)

To all whom it may concern:

Be it known that I, NELSON H. STURGIS, a citizen of the United States, residing at Guthrie, in the county of Logan and Territory of Oklahoma, have invented a new and useful Suspension-Bridge, of which the following is a specification.

My invention relates to improvements in suspension-bridges; and the object that I have in view is to improve the construction of parts to enable the threading or running of the wires which form the cables with ease and facility and without passing the reels or spools around the elements of the bridge structure.

A further object of the invention is to join the railing and joist-cables together by devices which produce a camber or arch in said cables and cause them to pull or strain against each other, so as to render the structure exceedingly stiff and rigid and reduce vertical vibration thereof to a minimum.

A further object of the invention is to provide novel means for suspending the needle-beams from the main bowed cables and to enable the main and lateral truss-cables to be joined firmly together by the needle-beam-supporting devices, the latter serving to firmly hold the main and lateral truss-cables in proper relation to each other, so as to dispense with the use of individual devices for uniting the hanger-rods, the truss-cables, and the main cables together.

With these ends in view the invention consists in the novel combination of elements and in the construction and arrangement of parts, which will be hereinafter fully described and claimed.

To enable others to understand the invention, I have illustrated the preferred embodiment thereof in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a side elevation of a suspension-bridge constructed in accordance with the principles of this invention. Fig. 2 is a vertical cross-sectional elevation adjacent to the vertical columns at one shore end of the structure. Fig. 3 is a plan view illustrating a fragment of the bridge with the flooring partly broken away. Fig. 4 is plan view of the foundation on which the columns are erected. Figs. 5 and 6 are enlarged detail views of the upper part of one column and the cap therefor which constitutes a saddle for one of the main suspension-cables. Fig. 7 is an enlarged detail view of one of the hanger-rods which receive the main cable and lateral truss-cables. Fig. 8 is a detail view of the clamp for use in connection with the hanger-rod shown by Fig. 7. Fig. 9 is an enlarged detail view of one of the angular brackets adapted to be fitted to one of the needle-beams. Figs. 10, 11, and 12 are detail views of various forms of clamps for uniting different parts of the bridge structure together, as will hereinafter appear. Fig. 13 represents a cross-sectional elevation of a modified construction of the bridge, showing footwalks on opposite sides of a main driveway.

Like numerals of reference denote like and corresponding parts in each of the several figures of the drawings.

The numerals 1 and 2 designate the foundations which are provided at the shore ends of a suspension-bridge constructed in accordance with my invention. As is usual in bridge-building, the foundations are laid in excavations on opposite sides of a stream or chasm in order to secure stability to the structure, and the space between the transversely-separated foundations is closed by a filling-wall 3, which joins with the foundations and prevents the dirt filling 4 from displacement in the direction toward the bank of the stream which is spanned by the bridge. On the foundations 1 2 are erected the vertical posts or columns 5, arranged in pairs on opposite banks, and these posts or columns are spaced apart equal to the width of the bridge. To add strength to the structure, I employ the metallic foot-plates 6, which are firmly secured to the foundation and receive the columns, and the upper ends of these columns are surmounted by the metallic cap-pieces 7, which are secured firmly to said columns in any suitable way. Each cap-piece is cast, preferably, in a single piece of metal with a curved slot which extends transversely across the cap-piece and forms a saddle 8, adapted to receive one of the main suspension-cables. I may employ wood or metal in the construction of the columns at the option of the builder; but where great strength is required

I prefer to employ tubular or hollow columns made of metal and containing a filling 9 of concrete or other suitable substance. It will be understood, however, that I do not limit myself to the employment of metallic concrete-filled columns.

10 designates the main suspension-cables, which are arranged in pairs and extend between the bridge columns or posts 5 on opposite sides of the bridge. These cables are fitted and held in the curved saddles 8 of the column cap-pieces, and at their ends they are anchored by devices which will be presently described, while the portion of the cables between the posts is allowed to bow or sag in a downward direction, as is usual in the art. In the approaches to the bridge on opposite sides of the two pairs of columns 5 are erected the anchor-abutments 11, and through each abutment are led or carried the main cables 10 and the joist-cables, presently referred to, which cables are attached individually to "dead-men." The main cables 10 are fastened to the dead-men, which lie in rear of the anchor-abutments and are concealed by the filling 13, that covers the anchor-abutments.

In my bridge structure I aim to minimize the use of wood as much as possible and to substitute therefor metal in the form of wire cables, and to this end a series of joist-cables 14 are stretched between the shore ends of the bridge and attached to the dead-men 15, which are held in place by the anchor-abutments 11. These joist-cables are arranged in substantially the same horizontal plane and extend longitudinally of the bridge, and said cables pass between the columns at a suitable height above the foundations. The ends of the joist-cables at each end of the bridge are fastened to a dead-man 15, which is common to the series of cables, and the two dead-men for the joist-cables bear against the anchor-abutments 11 above the dead-men 12 for the main suspension-cable, all the parts of the anchorages being covered by the filling 13. Each dead-man may consist of a metallic tube filled with concrete or its equivalent; but the particular construction of this element may be varied at the option of the skilled constructor.

With each main suspension-cable I employ a series of vertical hanger-rods 16, and the hanger-rods for the two cables 10 are attached coincidently thereto, so as to lie in the same vertical plane on opposite sides of the bridge. The hanger-rods carry the needle-beams 17, which lie in horizontal positions to sustain the flooring of the structure, and these hanger-rods serve to attach the angle-brackets 18 to the needle-beams. The pair of hanger-rods on opposite sides of the bridge sustain a needle-beam 17 and a pair of angular brackets, and said rods and brackets are peculiarly constructed to provide for the threading or passage of the wires which form the cables without the necessity for carrying the reels or spools around the ends of the needle-beams, thereby promoting the erection of the bridge and contributing to the strength and stability thereof.

Each hanger-rod is made from a single length of metal of the proper length to extend between the main cable and the needle-beam, and the upper end of this hanger-rod is peculiarly fastened or constructed for the reception of the main cable and the lateral truss-cable. Said hanger-rod has its upper end bent or doubled upon itself to form a loop 19 and is then bent or doubled in the opposite direction to produce an auxiliary loop 20. In bending said hanger-rod the loop 19 is carried adjacent to one face of the straight length of the rod; but it does not come in contact therewith, thus leaving a contracted throat or opening 21, forming a passage to the eye of the loop 19. In a similar manner the free extremity of the hanger-rod which forms the auxiliary loop 20 is bent inwardly toward the loop 19 to leave an opening or throat 22, which communicates with the eye of the loop 20, and the described method of bending the hanger-rod to form the two loops thereon produces the throats or openings 21 22 at opposite ends of the respective eyes formed by said loops 19 20, the throat 21 to the eye-formed loop 19 opening in a downward direction, while the throat 22 to the eye-formed loop 20 opens in an upward direction. This construction of the duplex eye-formed upper extremity of the hanger-rod provides for the ready passage of the wires which form the cables, and to confine the main and lateral truss-cables in the loops of each hanger-rod I employ a single clamping-clip 23. This clip is of substantially U shape, as shown by Fig. 8 of the drawings, and it is adjusted or applied externally to the looped end of the hanger-rod, so as to lie across the throats 21 22 to the eyes of said rod. The clip lies in a slightly-inclined position across the loops of the hanger-rod for its doubled or closed end to bear against the end of the rod which forms the loop 20, while to the threaded extremities of this clip is fitted an apertured plate 24, that bears against the loop 19 and receives the nuts 25, which are screwed on the threaded extremities of the clip. The lower end of the straight length of said hanger-rod is externally threaded at 26 to receive a clamping-nut 27, and said end of the rod is adapted to pass through the needle-beam and one of the angular brackets fitted thereto.

Each angular bracket 18 is cast in a single piece of metal of right-angular form, thus producing a vertical member 28 and a horizontal member 29. In the production of the bracket a transverse jaw 30 is produced on the lower side of the horizontal bracket member 29, and this jaw is formed with a slot or opening 31, which forms a curved bearing-face against which the wires constituting the lateral truss-cable are adapted to bear when said cable is confined within said jaw 30. A similar jaw 32 is formed on the outer face of the vertical bracket member 28 for the re-

ception of the wires adapted to form the horizontal truss-cable which extends beneath the bridge-floor, and this jaw 32 has an opening or slot 33, that permits of the ready introduction of the wires in the formation of the horizontal truss-cables. Coincident openings 34 are produced vertically in the needle-beam and the horizontal member of the angular bracket for the reception of the threaded lower extremity 26 on the hanger-rod, and the nut 27 is screwed on said extremity of the hanger-rod to bear against the lower side of the angular bracket. This bracket thus serves a twofold purpose in that it answers as a washer for the nut of the hanger-rod and as a retainer for the lateral and horizontal truss-cables provided on the side and beneath the floor of the bridge, and said bracket, with the openings or slots in the jaws thereof, enables the wires forming said cables to be readily fitted in the jaws without passing the spools or reels around the ends of the needle-beam.

The joist-cables are stretched above the needle-beams, which lie across the length of the bridge, and upon these joist-cables is laid the flooring 35. I dispense with the employment of nails and screws in uniting the parts of the flooring together by the employment of the stringers or rails 36, which are laid upon the planks forming the flooring 35. Two of these stringers are disposed at the respective ends of the floor-planks, and a central stringer is employed between the side stringers. The stringers and floor-planks are united firmly together and to the joist-cables at proper intervals by the hook-bolts 37, which pass through the stringers and certain of the planks and have their hooks engaged with the joist-cables at the sides of the bridge as well as at the middle thereof. It is not necessary to pass the hook-bolts through each floor-plank because the longitudinal stringers and the joist-cables bind the floor-planks firmly together, and hence I am able to employ the fastening-bolts 37 at intervals of from three to four feet.

38 designates the horizontal truss-cables, which are arranged beneath the floor of the bridge and extend from opposite sides thereof diagonally across the sections between the needle-timbers and the pairs of hanger-rods. These truss-cables are formed by wires which are drawn from reels or spools and are led through the jaws 32 on the rear sides of the angular brackets, thus firmly seating the truss-cables in position against displacement, and the truss-cables cross each other, as shown by Fig. 3, the ends of said cables being suitably secured in place. The truss-cables at opposite sides of the bridge are carried or led through the jaws 30 at the ends of the angular brackets and through the auxiliary loops 20 at the upper ends of the hanger-rods. These lateral truss-cables 40 are formed by wires which are drawn from reels or spools and fitted in the jaws 30 and the loops 20 without passing the reels around the needle-timbers and the hanger-rods, and said lateral truss-cables are arranged diagonally to cross in the center of the section between an adjacent pair of hanger-rods lengthwise of the bridge. The ends of the truss-cables 40 are fastened to the main cables or to the hanger-rods by the end clamps 41, each of which consists of a clip that embraces the main cable and a clip-plate which is held in place by nuts that are screwed on the threaded legs of the clip.

The sides of the bridge are formed without the use of timbers, nails, screws, or bolts. In lieu of these devices I employ a series of railing-cables 42, each series of which cables lie in the same vertical plane on one side of the bridge and extend the full length thereof from the inclined sections of the main suspension-cables, as shown by Fig. 1. The railing-cables 42 are each formed of a plurality of wires which are attached to the inclined lengths of the main cables 10 by clamps 43. Each clamp consists of a strap which is bent to embrace the main cable and has one arm thereof extended at 44, the free extremity of the arm being bent to produce a guide eye or loop 45. The clamp 43 is held in place on the main cable and the strands of the railing-cable by a clip-plate 46, against which bears a nut or nuts 47, and the extended hook or eye 45 of this clamp serves as a guide to the wire when it is drawn from the reel or spool in the process of forming the cable 42. The series of cables 42 are not designed to be attached to the hanger-rods; but to strengthen the structure I prefer to attach the upper railing-cable to the central portion of the bowed main cable 10 by a clamp 50, which unites the top railing-cable to the hanger-rods and the main suspension-cable at the lowermost portion of its bowed section between the pillars or columns.

The space between each pair of columns or posts 5 is braced by the employment of trussed frames 48 49, arranged horizontally between the posts and each bolted solidly thereto, as at 50^a 51, whereby the posts or columns are maintained in parallel relation to each other and the parts are prevented from sagging or displacement under the strain and vibration of the structure.

As is usual in the art, camber is given to the lateral truss-cables 40 and the series of horizontal joist-cables 14. The employment of the hanger-rods having a threaded connection with the needle-beams and the angular brackets on which the floor-cables are supported makes the truss and joist-cables pull or strain against each other, and thereby gives to the bridge structure additional stiffness and rigidity, whereby the vertical vibration on the bridge is reduced to a minimum.

The wires forming the cables may be twisted together, if desired, or they may be arranged according to the option of the builder.

It is evident that the flooring of the bridge may be extended beyond the vertical plane

of the main cables, so that the bridge will be equipped with footwalks at each side of the main driveway, as shown by Fig. 13 of the drawings. The foundations for the piers may be of masonry or of wood piling.

The bridge may of course be of any desired length, and it may consist of two or more spans, according to the width of the stream or the chasm.

The railing-cables may be and preferably are confined on the upright posts or columns by hook bolts or clamps, as shown by Figs. 2 and 3, said bolts being of the form shown by Fig. 12.

Changes may be made in the form of some of the parts while their essential features are retained and the spirit of the invention embodied. Hence I do not desire to be limited to the precise form of all of the parts as shown, reserving the right to vary therefrom.

Having thus described the invention, what I claim is—

1. In a suspension-bridge, the combination with columns, and anchored main cables, of hanger-rods fast with the main cables and carrying the needle-beams, anchored joist-cables laid on the needle-beams, side cables joined to the hanger-rods and fitted below the ends of the needle-beams, horizontal truss-cables fitted around the ends of the needle-beams, and a floor laid on the joist-cables, substantially as described.

2. In a suspension-bridge, the combination with columns and anchored main cables, of the needle-beams, hanger-rods connecting the needle-beams and the main cables, the lateral truss-cables each carried around one end of each needle-beam and said cables arranged to cross each other in the interval between each pair of needle-beams, the side truss-cables united to the hanger-rods and the needle-beams, and floor-carrying joist-cables laid on the needle-beams and anchored beyond the columns, substantially as described.

3. In a suspension-bridge, the combination with columns, and the main cables, of the hanger-rods united to the main cables, needle-beams carried by the hanger-rods, truss-cables connected to the needle-beams, joist-cables independent of the truss-cables and laid on the needle-beams, anchors for said joist-cables, a flooring laid on the joist-cables, and clamping devices to make the flooring and joist-cables fast one to the other, substantially as described.

4. In a suspension-bridge, a hanger-rod provided with independent loops and a single clamp which embraces the hanger-rod and is adapted to prevent the displacement in the loops thereof of main and truss cables, substantially as described.

5. In a suspension-bridge, a hanger-rod having its upper end bent to form independent loops each provided with an opening or throat, and a clip which spans both loops, in combination with a main cable fitted to one loop and a truss-cable fitted in the other loop, said clip arranged to prevent the displacement of either cable from its loop, substantially as described.

6. In a suspension-bridge, a hanger-rod bent at its upper end to form a main loop having a downwardly-opening throat and an auxiliary loop with an upwardly-opening throat, in combination with a main cable, a truss-cable and a clip which embraces both loops of the hanger-rod and spans the throats thereof to prevent displacement of the cables therein, substantially as described.

7. In a suspension-bridge, the combination with main cables, the hanger-rods carrying needle-beams, truss-cables united to the needle-beams and the hanger-rods, and railing-cables independent of the truss-cables and arranged alongside of the latter, substantially as described.

8. In a suspension-bridge, the combination with columns, and the anchored main cables, of hanger-rods carrying needle-beams, truss-cables united to the hanger-rods and the needle-beams, the railing-cables independent of the truss-cables and extending longitudinally of the bridge in substantially parallel relation one to the other and alongside of the truss-cables, and clamping devices to unite the railing-cables to the end portions of the main cables, substantially as described.

9. A suspension-bridge comprising the columns, the anchor-abutments, the main cables fitted to the columns and connected with said anchor-abutments, the joist-cables also connected with the anchor-abutments independently of the main cables, the hanger-rods attached to the main cables, the needle-beams attached to the hanger-rods and supporting the joist-cables, the side and horizontal truss-cables fitted to the needle-beams, and the railing-cables attached to the ends of the main cables, substantially as described.

10. In a suspension-bridge, an angular bracket adapted to be fitted to the needle-beam and provided on its horizontal and vertical members with jaws for the reception of truss-cables, substantially as described.

11. In a suspension-bridge, the combination with a needle-beam, of an angular bracket fitted to said needle-beam to bear against the end face and the bottom thereof and provided with jaws having openings or slots, a hanger-rod attached to the needle-beam and the bracket, and cables fitted to the jaws of said bracket, substantially as described.

12. In a suspension-bridge, the combination with a main cable, of a clamp attached to said main cable and provided with an extended guide and a railing-cable fitted to the clamp and having its individual strands engaging with said guide during the formation of the cable, substantially as described.

13. In a suspension-bridge, the combination with the needle-beams and a series of joist-cables fitted thereto, of a series of floor-planks laid on the joist-cables, the stringers laid upon the floor-planks and the fastening-

bolts attached to the joist-cables and the stringers to bind the floor-planks firmly in place, substantially as described.

14. In a suspension-bridge, the combination with main cables, a series of needle-beams, and a series of hanger-rods, of angular brackets fitted to the needle-beams and provided on their vertical and horizontal faces with jaws having slots or openings, and the two series of truss-cables arranged beneath the floor and at the sides of the bridge structure and each series of cables fitted in the jaws of the hangers, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

NELSON H. STURGIS.

Witnesses:
JAMES N. HUGHES,
N. J. JOHNSON.