(No Model.) 3 Sheets—Sheet 1.

E. E. RUNYON.

SUSPENSION BRIDGE.

No. 394,940. Patented Dec. 18, 1888.

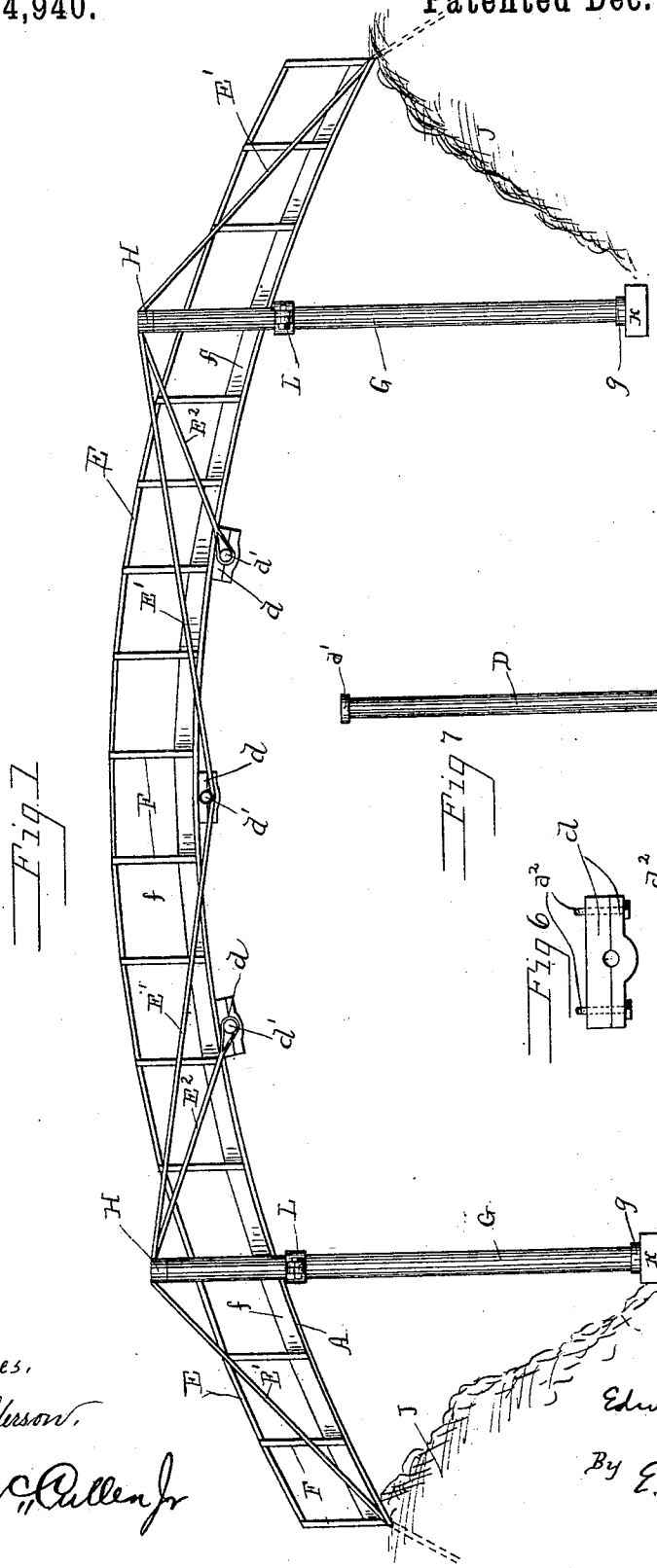


Fig 1

Fig 7

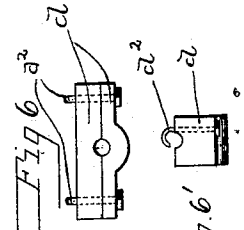


Fig 6

Fig 6'

Witnesses.
R. A. Balderson.
B. McAllen Jr

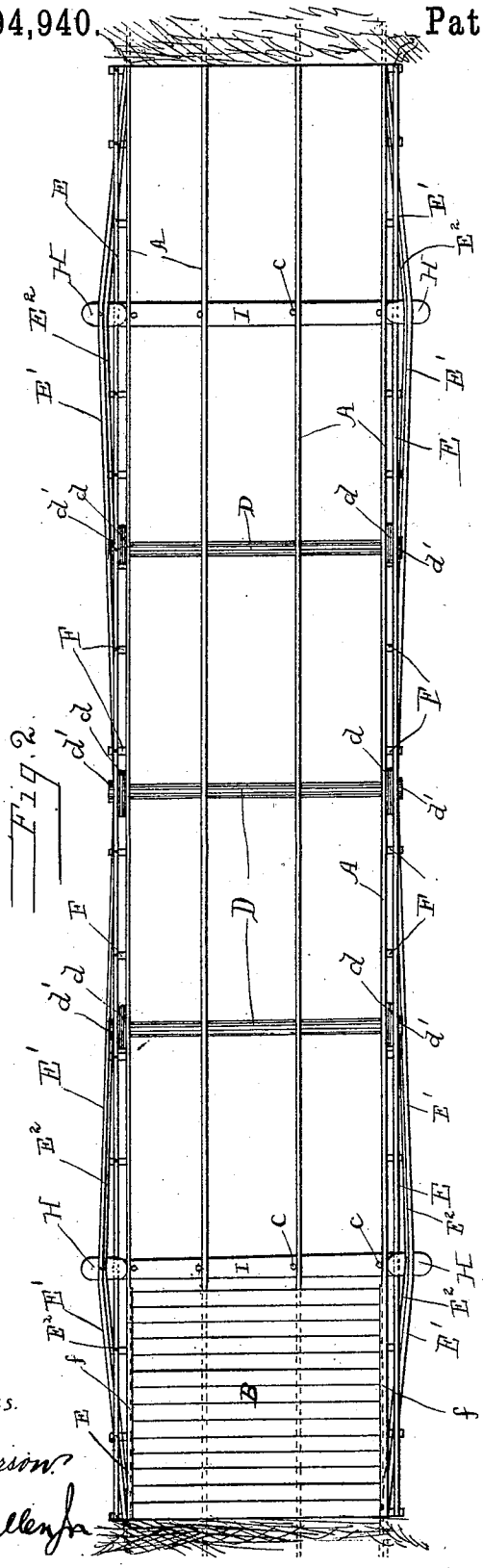
Inventor.
Edwin E. Runyon
By E. H. Gelston
His Attorney.

(No Model.) 3 Sheets—Sheet 2.

E. E. RUNYON.

SUSPENSION BRIDGE.

No. 394,940. Patented Dec. 18, 1888.



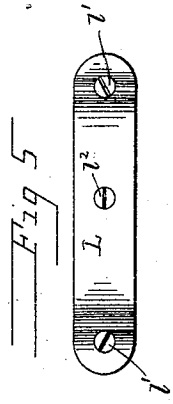


Fig. 5.

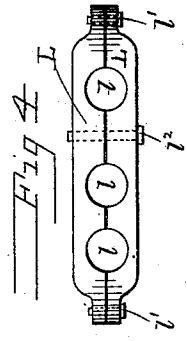


Fig. 4.

Witnesses.
R. A. Baldeson
B. McAllen Jr.

Inventor.
Edwin E. Runyon
By E. H. Gelston
His Attorney.

(No Model.) 3 Sheets—Sheet 3.

E. E. RUNYON.

SUSPENSION BRIDGE.

No. 394,940. Patented Dec. 18, 1888.

Fig 3

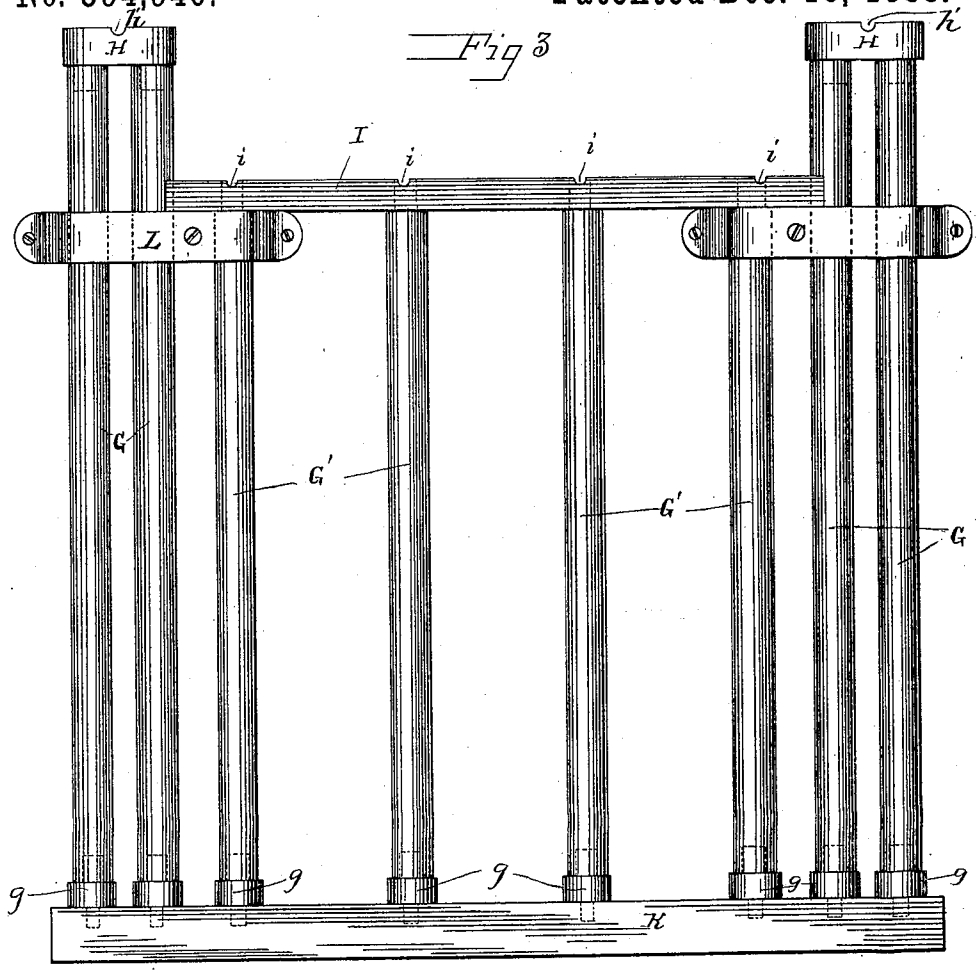


Fig. 9.

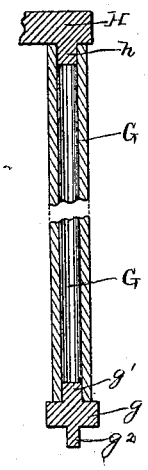


Fig 8

Witnesses.
R. A. Balderson
F. C. Campbell

Inventor.
Edwin E. Runyon
By E. N. Eelsen
His Attorney.

(No Model.)

E. E. RUNYON.

NEEDLE BEAM FOR BRIDGES.

No. 400,874. Patented Apr. 2, 1889.

Fig. 1.

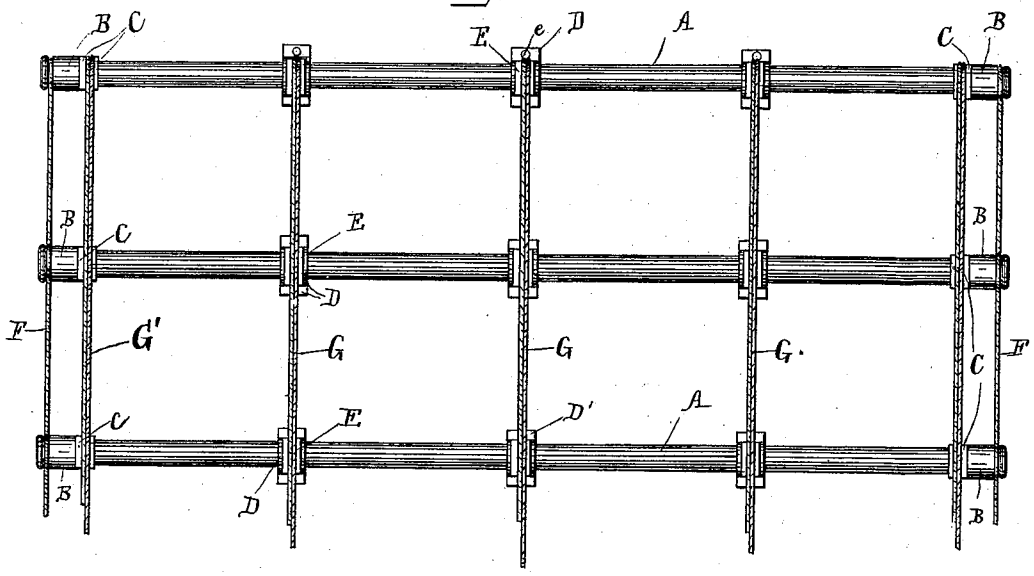


Fig. 2.

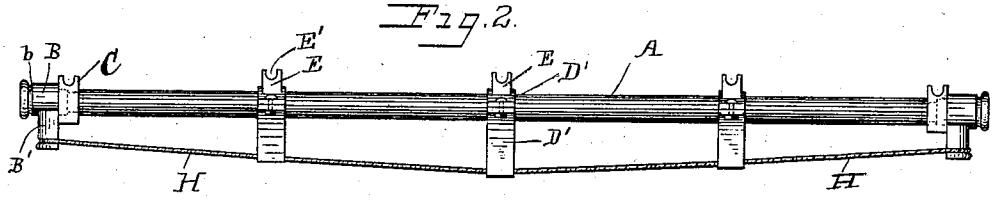


Fig. 3.

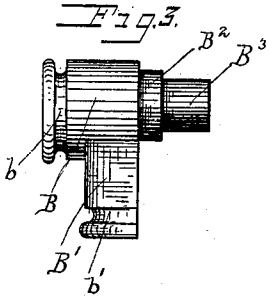


Fig. 4

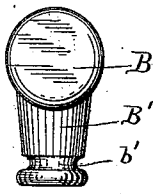


Fig. 5

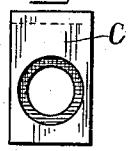


Fig. 6.

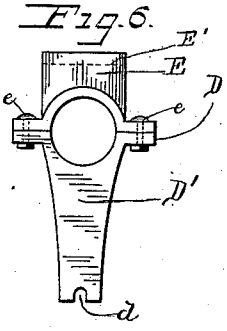
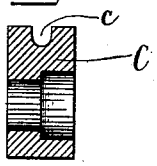


Fig. 7.



WITNESSES.
R. A. Balderson.
Wm. Geleton.

INVENTOR.
Edwin E. Runyon
By
E. N. Geleton
his
ATTORNEY

UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF MOUNTAIN SPRING, TEXAS.

NEEDLE-BEAM FOR BRIDGES.

SPECIFICATION forming part of Letters Patent No. 400,874, dated April 2, 1889.

Application filed November 22, 1888. Serial No. 291,525. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Mountain Spring, in the county of Cooke and State of Texas, have invented certain new and useful Improvements in Needle-Beams for Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to needle-beams for bridges; and its objects are, first, to provide them with appliances whereby to maintain wire cables in proper position and conduct them between the termini of the bridge; second, to provide for interweaving the strands of the cable during the progress of the construction; third, to adapt the parts to coact so that they will maintain the cables permanently in their pristine condition; fourth, to provide such correlation of the parts that they shall uniformly conduce to invariable results, and, fifth, to attain these ends with structural simplicity and economy. I accomplish these aims by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents a plan view of a section of bridge constructed according to the principles of my invention. Fig. 2 is a side elevation of one of the needle-beams. Fig. 3 shows one of the terminal caps that keep the cable-supports in an inflexible position. Fig. 4 is an end view of the same. Fig. 5 is an elevation of a perforated annular casting that encircles the needle-beam near the terminal cap. Fig. 6 is an elevation of one of the cable-supports, and Fig. 7 is a central vertical section of the annular casting shown in Fig. 5.

The same designations indicate corresponding parts in the several views.

In cable bridges it is desirable to prevent shifting of the cables under stress of wind or because of contraction and expansion. It is important also to construct the needle-beams of as light a structure as is consistent with the strain to which they are subjected. To effect both ends economically is the aim of my invention.

The needle-beams A, when about to be located in proper position, are provided with three central supports for the cables G, consisting of the two pieces D′ E. The former has a groove, *d*, is hollowed semi-circumferentially, and has flanges D. The latter has a groove, E′, at right angles to the groove *d*, and is similarly hollowed and flanged to encircle the beam, the whole being secured by bolts *e*. The cable H is passed through the grooves *d* and secured at each end by the caps B in the groove *b*′, that is made in the projection B′. The cap B also confines in place the annular casting C, through whose groove *c* the cable G′ passes. This casting is so constructed that the end B^2 of the cap B rests in the recess of larger diameter, and the end B^3 thereof rests in the recess of smaller diameter, thus making the casting and cap flush. The cable F passes in the groove *b* of the cap B. As the wires constituting the cables F G G′ are placed in position they are twisted to form cables, sufficient tension being secured from the termini to prevent uneven interweaving. The needle-beams are usually made of gas-piping, whose tubular structure combines lightness with durability.

Having thus fully described my invention, what I claim is—

1. The combination, with the needle-beams A, of the castings C, the caps B, the supports E and D′, and the cables, substantially as described.

2. The combination, with the needle-beams A, of the supports E and D′, the caps B, and the cables G and H, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:

JOHN HATCHER,

E. A. VINCENT.

UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF MOUNTAIN SPRING, TEXAS.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 394,940, dated December 18, 1888.

Application filed June 29, 1888. Serial No. 278,596. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Mountain Spring, in the county of Cooke and State of Texas, have invented certain new and useful Improvements in Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to bridges; and its objects are, first, to transmit a given pressure equally in either direction therefrom to the piers or abutments; second, to balance a given pressure irrespective of its location; third, to provide an elastic yielding road-bed or flooring which will transmit the pressure of an incumbent weight or strain; fourth, to increase the length or span over existing conditions; fifth, to dispense with piers, except on the shore margins; sixth, to facilitate the construction and increase the life of bridges, and, seventh, to accomplish these aims with structural simplicity and economy. I accomplish these ends by the devices illustrated on the accompanying drawings, in which—

Figure 1 represents a side elevation of a bridge operatively embodying the essential elements of my invention. Fig. 2 is a plan view of the same, showing the flooring partly laid. Fig. 3 is an enlarged detail view of the bridge-supports. Fig. 4 is a plan view of the adjustable clamp by which the altitude of the bridge is regulated. Fig. 5 is a side view of the same. Fig. 6 is a detail view of one bearing in which the tubular metallic braces are held. Fig. 6′ is an end view thereof. Fig. 7 is a detail of the brace that supports the flooring. Fig. 8 represents a detail view of the spool whose projecting pins from either face of different diameter fit, respectively, into the supporting-column and the mud-sill, thus connecting them; and Fig. 9 represents a central vertical section of a column, showing the relative position of the spool.

The same designations indicate corresponding parts in the several views.

It is greatly desirable to make a single span from shore to shore, or at most to have but one pier embedded in the river, because of the difficulty in sinking coffer-dams and finding strata of sufficient density to form stable anchors for the piers. It is moreover desirable in constructing a bridge that as few nails be used in securing the flooring as consistently possible, because of the tendency to impair the wood by their oxidation. It is furthermore a desideratum that the flooring should have an elastic basis which will transmit the pressure of the incumbent weight and thus diminish the strain of the piers and the connecting-cables. To practicalize all these aims in a simply-constructed bridge is therefore the purpose to which my invention is addressed.

Suitable cables, A, formed of continuous twisted wires are stretched between the shore-lines J J, and are secured therein by embedded anchors. They pass over and rest upon the clamp L, supported on the pier-columns G, and the tubular intermediate braces, D, and constitute the basis for the flooring B, which is preferably grooved or rabbeted, so that adjoining faces will interlock. The columns G, held in the anchoring mud-sills K by the spool g, (shown in Fig. 8,) so that the greater pin, g', will be held in the base of the column by frictional contact merely, and the smaller pin, g^2, will be similarly retained in the mud-sill K, are encircled near the top by the adjustable clamp L, having perforations l, terminal bolts l', and binding-screw l^2. Resting upon the clamp is the grooved cross-bar I, having grooves i, for the passage of the cables A, and in which the short columns G′ are terminally embedded, being stayed by nails C. The outer columns, G, are higher than the intermediate ones, G′, and pass through the clamp L, and are capped by a cross-piece, H, having pin h, and groove h', over which the supporting-cables E′ E² pass, that relieve and transmit the strain on the tubular braces D, to which they are fixedly secured by reason of insertion between the head d' of the brace D and the clamp d, in which the brace is terminally held by bolts d^2. Short cables E², holding the side supports, D, pass over the cross-piece H, adjacently to the cables E′ in the same groove. These supports need be stayed from one side only, because

the clamps d are made fast to the bridge by reason of the bolts d^2 clinching therein when driven.

F represents the posts having grooves in which a railing, E, is carried, and a base-board, f, is secured thereto.

It will be understood that the twisted wire cables A, anchored at either end, pass over the cross-bar I and the tubular braces D. The braces D transmit received pressure to the columns G′ through the cables E′ E², which are also anchored at the same place. The flooring B is then laid so that adjacent surfaces shall interlock by reason of dovetailing or otherwise. The highest point of the bridge will be in the center, and it will decline gradually in either direction therefrom. By reason of the elasticity of the cables the longevity of the bridge will be greatly promoted, because the strain is thus transmitted.

Having thus fully described my improvements, what I claim is—

1. The tubular columns G, in combination with the grooved cross-piece H, having pin h, the spool g, having pins g' g^2 of unequal diameter projecting from opposite faces, and the mud-sill K.

2. The tubular columns G G′ and the mud-sill K, suitably connected, as shown, in combination with the grooved cross-bar I, over which the cables A pass, and the adjustable clamp L, on which the bar I rests.

3. The cables A, in combination with the braces D, having terminal heads d' and held in clamps d, and the supporting-cables E′ E², secured between said heads and clamps.

4. The cables A, in combination with the braces D, having terminal heads d' and held in clamps d, the cables E′ E², the columns G G′, supporting grooved cross-bar I, and the adjustable clamp L, on which the bar I rests.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:
W. R. MADDUX,
S. B. HODGE.

(No Model.)

E. E. RUNYON.

DEVICE FOR TWISTING WIRE CABLES OF SUSPENSION BRIDGES.

No. 404,934. Patented June 11, 1889.

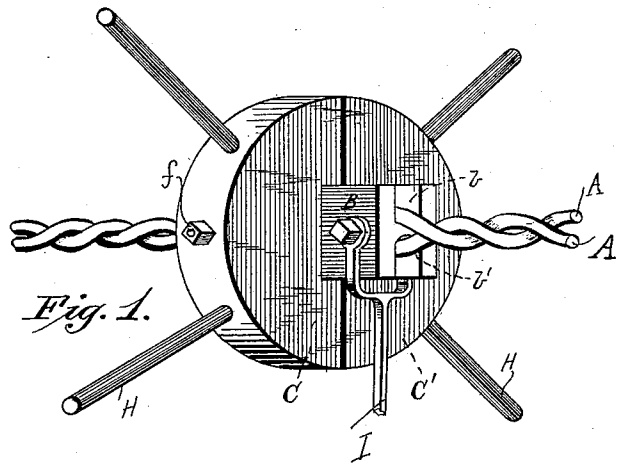


Fig. 1.

Fig. 2.

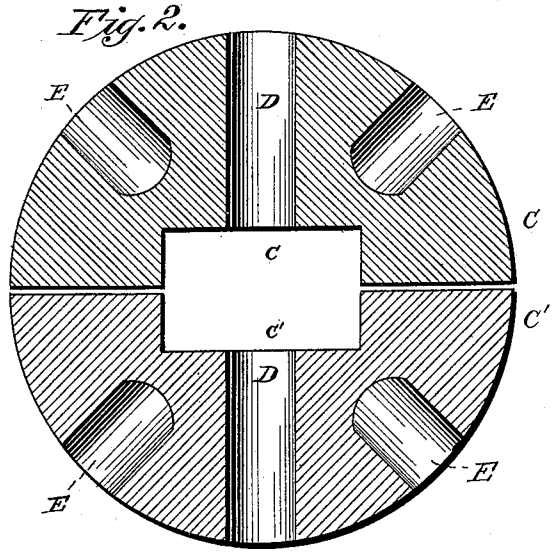
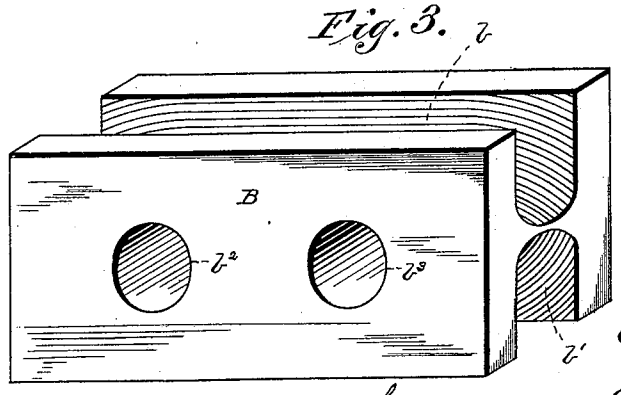


Fig. 3.



Witnesses
M. B. Harris
Wm Gelston.

Inventor
Edwin E. Runyon
By his Attorney E. N. Gelston

UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF MOUNTAIN SPRING, TEXAS.

DEVICE FOR TWISTING WIRE CABLES OF SUSPENSION-BRIDGES.

SPECIFICATION forming part of Letters Patent No. 404,934, dated June 11, 1889.

Application filed April 1, 1889. Serial No. 305,588. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Mountain Spring, in the county of Cooke and State of Texas, have invented certain new and useful Improvements in Devices for Twisting Wire Cables for Suspension-Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the acccompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to an improved device for twisting the wire cables of suspension-bridges similar to the bridge shown in my patent, No. 394,940, whereby the required tension of the same is secured in an easy and rapid manner; and it consists in the construction and arrangement of the parts hereinafter described, and definitely pointed out in the claims.

In the accompanying drawings, forming part of this specification, like letters of reference indicate corresponding parts in the several views.

Figure 1 is a perspective view of my device, showing the casting or wire-separator in place. Fig. 2 is a longitudinal vertical section of the twisting device with the casting removed. Fig. 3 is a detail view in perspective of the casting or separator.

In the drawings, A represents the several wires forming a cable of a suspension-bridge. As these wires are first placed, they are more or less slack and need tightening. To tighten these wires and thus give the required tension to the several cables, so that they will receive the strain of the weight equally, I place between the strands a metallic casting, as B, constructed rectangular in shape, and having grooves b b' formed in its upper and lower edges, in which the wire rests. The ends of these grooves are gradually deepened until they are brought nearly together, as shown, their sides being rounded to form a smooth rest for the wires. Two openings b^2 b^3 are made in the casting B at points respectively midway, its longitudinal center extending entirely through the same.

C and C′ represent two semicircular disks of hard metal, having rectangular grooves c c' formed laterally in their straight faces at the center thereof. Openings D are formed in the disks, which extend from their peripheries into the grooves D and in alignment with each other when the disks are placed together. On each side of the openings D in the respective disks are formed pockets or holes E, which extend into the metal for a short distance. When the disks are placed together to form a complete circle or wheel, the space formed by the grooves is occupied by the casting B, which exactly fits therein, one of the openings b^2 being in direct alignment with the openings D. When the parts are in this position, a binding-bolt F is passed through the openings D and b^2 and a nut f fitted on its end, thereby securing the parts firmly together.

H represents radial arms or levers secured in the pockets E and extending out from the disks to serve as means for twisting the device.

I is a metallic tie-rod, which is secured in the opening b^3 of the casting and extends down to and is adapted to be connected with the tower-cables or needle-beams of the bridge.

The operation is as follows: When the casting B is placed between the wires, the disks are placed over it at a point to cover the opening b^2. The bolt is then passed through the several parts and secured. The levers H are then grasped and the device with the cables is turned until the cables have been twisted sufficient to give them the required tension. The tie-rod I is then inserted through the outer hole in the casting and secured therein and extended down and made fast to the bridge or cable below, thus preventing the cable from untwisting. The disks can then be removed and used on other cables.

Having thus described my invention, what I claim is—

1. The cable-twister consisting of the casting B, the two disks C C′, the bolt F, and the arms H, substantially as described.

2. The combination, with the casting B, having grooves $b\ b'$ and openings $b^2\ b^3$ therein, of the semicircular disks C and C′, having grooves $c\ c'$ therein and openings D, extending through the same, the bolt F, for binding the several parts together, and the arms H, extending out from the disks, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:
W. H. RAYZOS,
W. R. MADDUX.

(No Model.) 2 Sheets—Sheet 1.

E. E. RUNYON.

BENT FOR SUSPENSION BRIDGES.

No. 410,201. Patented Sept. 3. 1889.

Fig. 1.

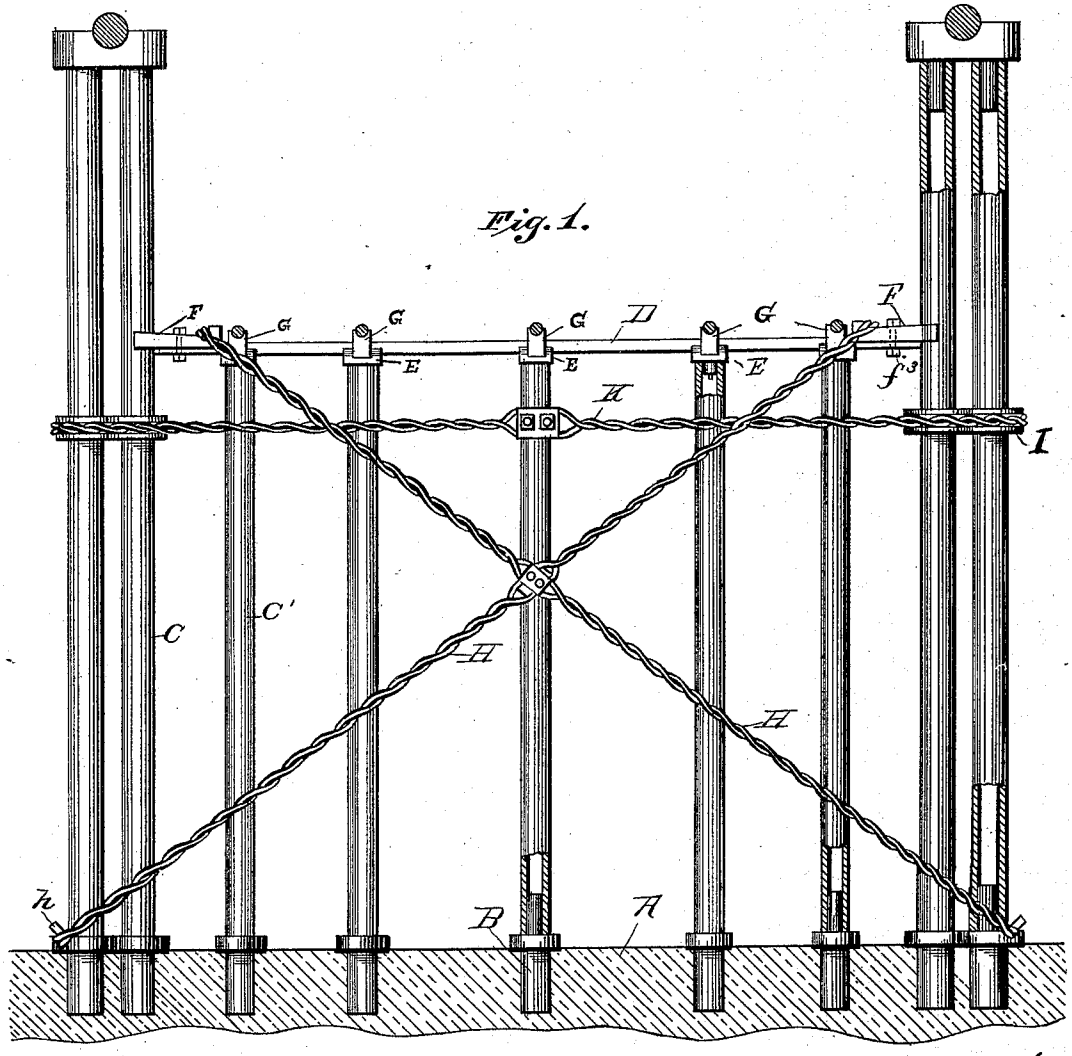


Fig. 2.

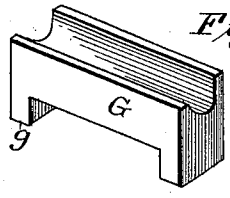


Fig. 3.

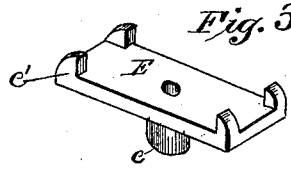


Fig. 4.

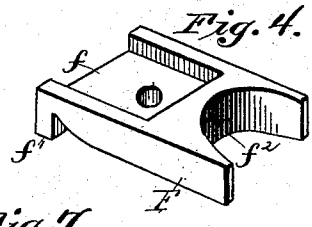


Fig. 6.

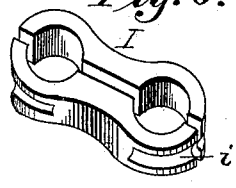
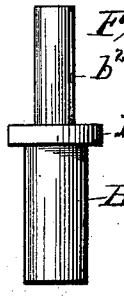


Fig. 7.



Witnesses
M. B. Harris
Wm Gelston

Inventor
Edwin E. Runyon
by
E. N. Gelston
his Attorney

(No Model.) 2 Sheets—Sheet 2.

E. E. RUNYON.

BENT FOR SUSPENSION BRIDGES.

No. 410,201. Patented Sept. 3, 1889.

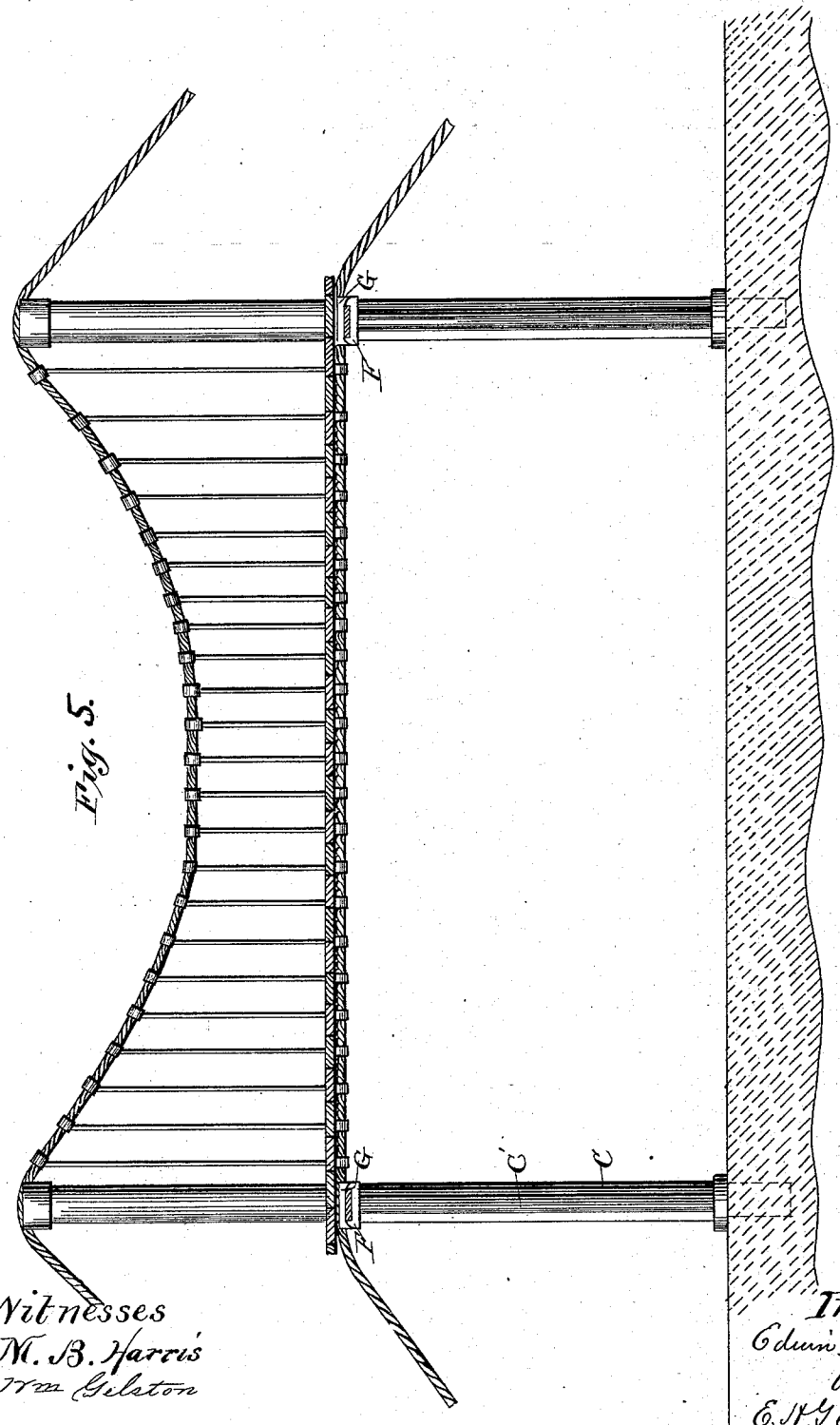


Fig. 5.

Witnesses
M. B. Harris
Wm Gelston

Inventor
Edwin E. Runyon
by
E. N. Gelston
his Attorney

UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF MOUNTAIN SPRING, TEXAS.

BENT FOR SUSPENSION-BRIDGES.

SPECIFICATION forming part of Letters Patent No. 410,201, dated September 3, 1889.

Application filed April 1, 1889. Serial No. 305,589. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Mountain Spring, in the county of Cooke and State of Texas, have invented certain new and useful Improvements in Bents for Suspension-Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to an improvement in bents for suspension-bridges, especially that class of bridge shown in my patent, No. 394,940; and it consists in the construction and arrangement of parts more fully hereinafter described, and definitely pointed out in the claims.

The object of my invention is to provide a strong, durable, cheaply-manufactured, and easily-erected bent for suspension-bridges. I attain this object by the construction illustrated in the accompanying drawings, wherein like letters of reference indicate corresponding parts in the several views, and in which—

Figure 1 is an elevation of my improved bent, portions of which are shown as being broken away. Fig. 2 is a detail view of a saddle. Fig. 3 is a detail of a bar and saddle-holder. Fig. 4 is a detail of one of the yokes. Fig. 5 is a longitudinal section of a bridge. Fig. 6 is a detail of a clamp, and Fig. 7 is a detail of an anchor-pin.

In the drawings, A represents the masonry foundation, in which are embedded the anchor-pins B, provided with collars *b* and projecting ends *b'*, which fit in the hollow ends of the columns C and C', the former being arranged in pairs at the ends of the bent and supporting the main cables on their upper ends.

To brace and rigidly hold the columns C' in place, I extend an iron bar, as D, across their tops, which rests in a casting E, having a cylindrical projection *e* on its under side, which fits in the top of the columns, and upwardly-extending lugs *e'* on its respective corners, between which the bar is placed, thus preventing its lateral movement. To firmly brace the bar D against the outer columns, I secure on its ends yokes, as F, having a rectangular groove *f* on their under surfaces, a notch *f'* in their upper faces, and a curved recess f^2 in their ends, which fit partly around the column, the end of the bar fitting in the groove *f* and being bolted to the yoke by a bolt f^3. To still more effectively hold the bar D in place, pins may be inserted through the same into holes in the castings E.

G represents the saddle, which has a grooved upper face in which the cable rests, and downwardly-projecting flanges, as *g*, on its ends, which pass by the sides of the bar D and rest on the casting E between the lugs *e'*. By this arrangement all side-play and longitudinal movement are prevented.

To give rigidity to the entire structure and more securely unite the several parts, I extend wire cables H and H from the yokes F down obliquely on both sides of the bent, around pins *h*, secured in the collars of the anchor-pins. The upper ends of these cables rest in the grooves *f'* of the yokes. To prevent the outer columns from spreading, clasps I, formed of two pieces, with semicircular grooves on their inner faces near their ends and edge grooves *i* on their outer ends, are placed around the columns and secured together by a suitable bolt passing through their centers between the columns, and a wire cable K is stretched around the bent and rests in the grooves *i* of the clasps. These brace-cables H and K are formed of separate strands of wire placed separately in position and then twisted to give them the right tension. After they have been sufficiently twisted they are prevented from untwisting by having suitable tie-bolts inserted between the strands and made fast to the bent.

I am aware that many minor changes in the construction and arrangement of the parts of my invention can be made and substituted for those shown and described without in the least departing from the nature and principle of my invention.

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

1. In a bridge-bent, the combination, with vertically-arranged columns, of a cross-bar

uniting the inner columns, and obliquely-arranged cable-braces for giving rigidity to the bent, substantially as described.

2. The combination, with the outer columns, of the inner columns, the castings E on the latter, the cross-bar D on the castings, the saddles G, resting on the castings and bar, the yokes F on the ends of the bar, the clasps I on the outer columns, and the twisted-wire brace-cables H and K, substantially as described.

3. The combination, with the columns, of the castings E, having extension *e* and lugs *e'*, the bar D, resting on the castings, the saddles G, having flanges *g* on their under sides, which fit over the bar and between the lugs on the casting, and the yokes F, substantially as described.

4. The bridge-bent composed of a series of hollow columns united by wire braces and a cross-bar on the top of the central columns, substantially as described.

In testimony whereof I affix mysignature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:

W. H. RAYZOS,

W. R. MADDOX.

(No Model.) 2 Sheets—Sheet 1.

E. E. RUNYON.

SUSPENSION BRIDGE.

No. 446,209. Patented Feb. 10, 1891.

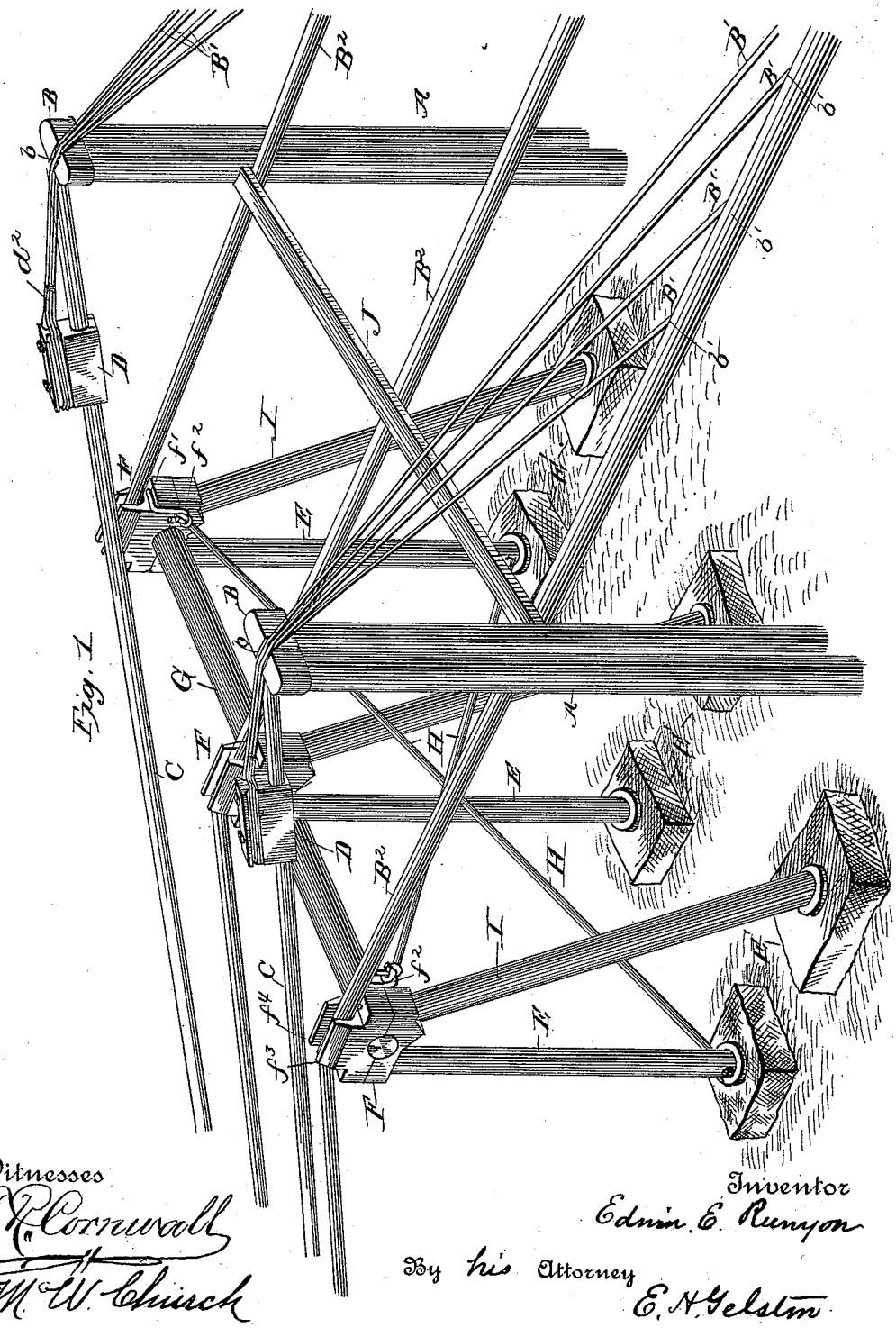


Fig. 1.

Witnesses
F. H. Cornwall
M. W. Church

Inventor
Edwin E. Runyon
By his Attorney
E. N. Gelston

(No Model.) 2 Sheets—Sheet 2.

E. E. RUNYON.

SUSPENSION BRIDGE.

No. 446,209. Patented Feb. 10, 1891.

Fig. 2.

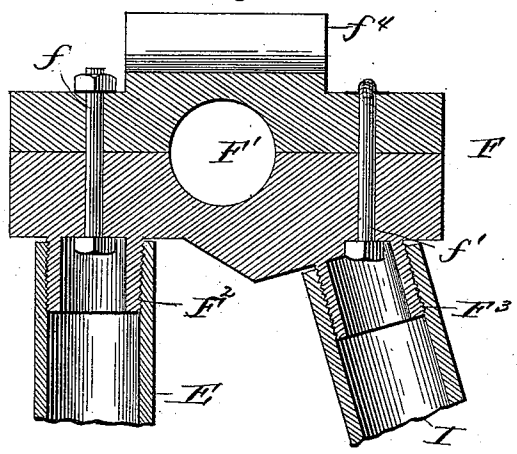


Fig. 3.

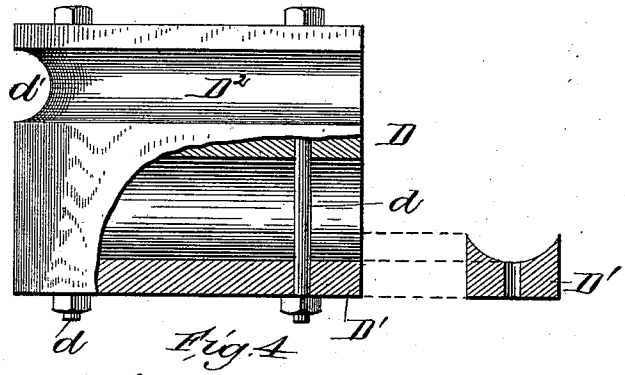
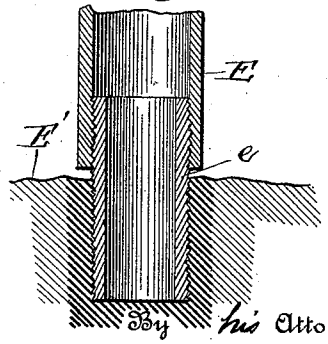


Fig. 4



Witnesses
F. H. Cornwall
M. W. Church

Inventor
Edwin E. Runyon
By his Attorney E. N. Veleton

UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF PILOT POINT, TEXAS.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 446,209, dated February 10, 1891.

Application filed August 23, 1890. Serial No. 362,885. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Pilot Point, in the county of Denton and State of Texas, have invented certain new and useful Improvements in Suspension-Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to a new and useful improvement in suspension-bridges; and it consists in the construction and arrangement of parts, more fully hereinafter described, and afterward definitely pointed out in the claims.

The object of my invention is to provide a suspension-bridge which will be strong, compact, and simple, and one very easily constructed with but little expense; another is to provide a suspension-bridge which will permit the main cable to expand and contract in different temperatures without materially affecting the principal parts and causing them to become displaced by reason of the slack or increased camber. These objects I attain by the construction illustrated in the accompanying drawings, forming a part of this specification, wherein like letters of reference indicate corresponding parts in the several figures, in which—

Figure 1 is a perspective view of my improved bridge, the flooring and joints being removed. Fig. 2 is a vertical longitudinal section through one of the cap-pieces. Fig. 3 is a view, partly in section, of a clamp; and Fig. 4 is a section through the base of one of the pillars and supports or anchors.

In the drawings, A represents the high pillars, having cap-pieces or tie-bands B securing their upper ends. Across the upper surface of these cap-pieces are grooves *b* for the reception of the separated main cables B′, said main cables being secured to the floor-cables B^2, as at *b*′, along half the width of a span. Secured to these cap-pieces B are back-stays C, which are anchored or secured in any suitable manner at their outer ends.

D represents a clamp secured on the stays C by bolts *d* passing through the face of said clamp, through the stays, and through a removable block D′. Near the upper edge of the clamp D are circular grooves D^2, rounded, as at *d*′, for the reception of the main cables B′, said cables being wrapped once or more around the grooves and fastened each to itself, as at d^2.

E represents pillars secured by a connecting-piece *e* to supports or anchors E′. These anchors are preferably hard stone, having openings in which the pieces *e* are placed and then solder placed in the openings, making a firm and secure footing for the pillars, which may be tapped and screwed on, as shown, or they may be placed originally in the anchors and secured.

F represents a cap formed of two pieces connected by bolts *f* and *f*′, and having an opening F′ in its center for the passage and reception of a horizontal beam or support G. The bolt *f*′ is extended over the side and curved to form a hook or loop f^2, on which is secured a wire guy-rope H, which extends to the opposite end post near its bottom and is there secured in any suitable manner. Depending from the lower section of the cap-piece are screw-threaded flanges F^2 and F^3, the former forming a connection for the pillars E and the latter a connection for the brace pillars or posts I, which are placed at an angle to be more effective. Extending upwardly from the upper section are two flanges f^3 and f^4, forming between them a groove in which are slidingly secured the floor-cables B^2.

The operation of my invention may be described as follows: The end pier being erected by setting up and securing the pillars and brace-post in position and the cap-piece being secured, the horizontal or supporting cables are laid in the grooves in the upper face of the cap-piece and extend the length of the bridge directly beneath and supporting the beam J. These supports are preferably anchored at their ends in any suitable manner. The main cables being fastened to the floor-cables half the width of a span, will also support the same should the anchor become displaced. The advantages of a bridge built in accordance with my invention will be obvious. The back-stays being anchored in a different position from the floor-cables affords

a much stronger bridge than if the main and floor cables were attached to the same pier.

I am aware that many minor changes in the construction and arrangement of the parts can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

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

1. A bridge consisting of end piers, pillars of greater height than said end piers, floor-cables supported in castings on said end piers, separated main cables supported on cap-pieces on the tall pillars, back-stays secured to said cap-pieces, and blocks on said back-stays, around the upper end of which are secured the separated main cables, substantially as described.

2. In a suspension-bridge, the combination, with the separated main cables and floor-cables, of metallic pillars rigidly secured to anchors, brace-posts placed at an angle to said pillars, cap-pieces consisting of two sections each, the lower section having depending flanges to afford connection with the pillar and brace-post, the upper section having upwardly-extending flanges to hold the floor-cable, a bolt passing through said sections, extending over the side, and formed into a hook, a guy-rope attached to said hook, and a horizontal beam secured between the upper and lower sections, substantially as described.

3. In a suspension-bridge, the combination, with the pillars, brace-posts, and horizontal beam, all secured by a cap-piece formed in two sections, of pillars extending higher than said horizontal beam, having their ends connected by a cap-piece, a stay secured to said cap-piece, a clamp on said stay having a groove around three sides near its upper edge, a removable block in the lower portion of said clamp, bolts passing through said block, stay, and clamp to rigidly hold said clamp in position, and severed main cables passing through a groove in the cap-piece and around said clamp and each secured to itself, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:
W. S. PRICE,
W. A. EWING.

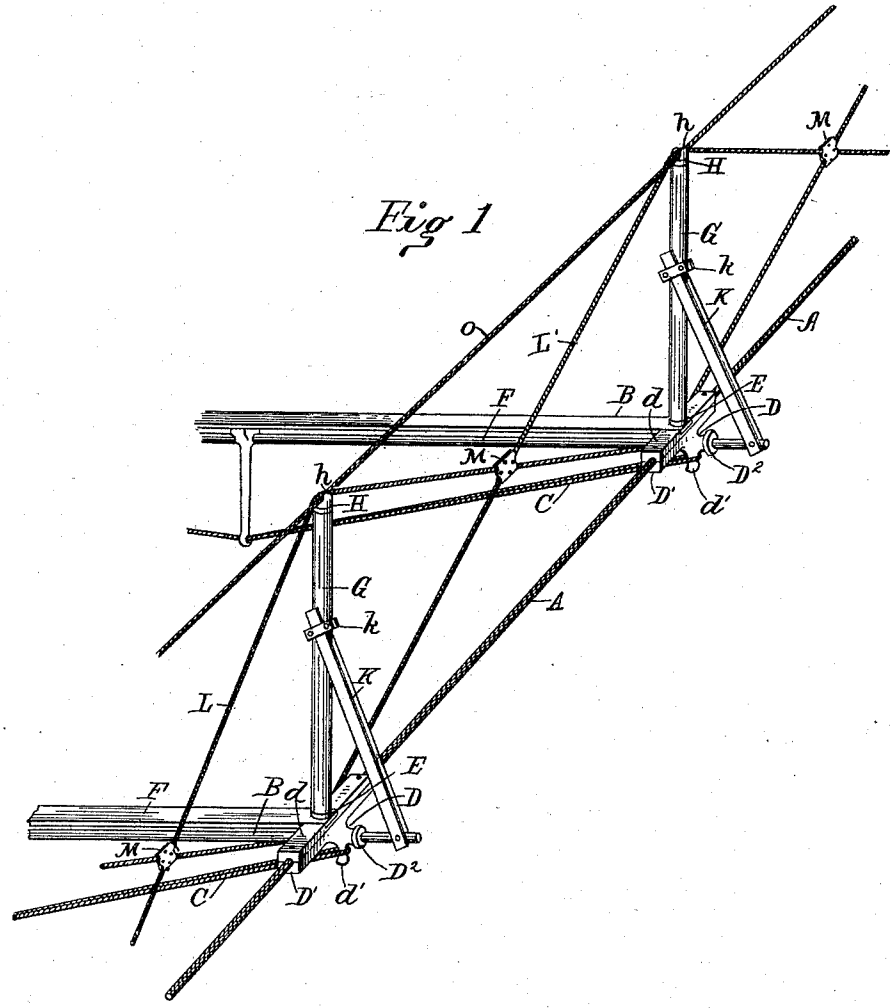
(No Model.) 2 Sheets—Sheet 1.

E. E. RUNYON.

SIDE RAIL FOR SUSPENSION BRIDGES.

No. 493,788. Patented Mar. 21, 1893.

Fig 1



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(No Model.) 2 Sheets—Sheet 2.

E. E. RUNYON.

SIDE RAIL FOR SUSPENSION BRIDGES.

No. 493,788. Patented Mar. 21, 1893.

Fig 2

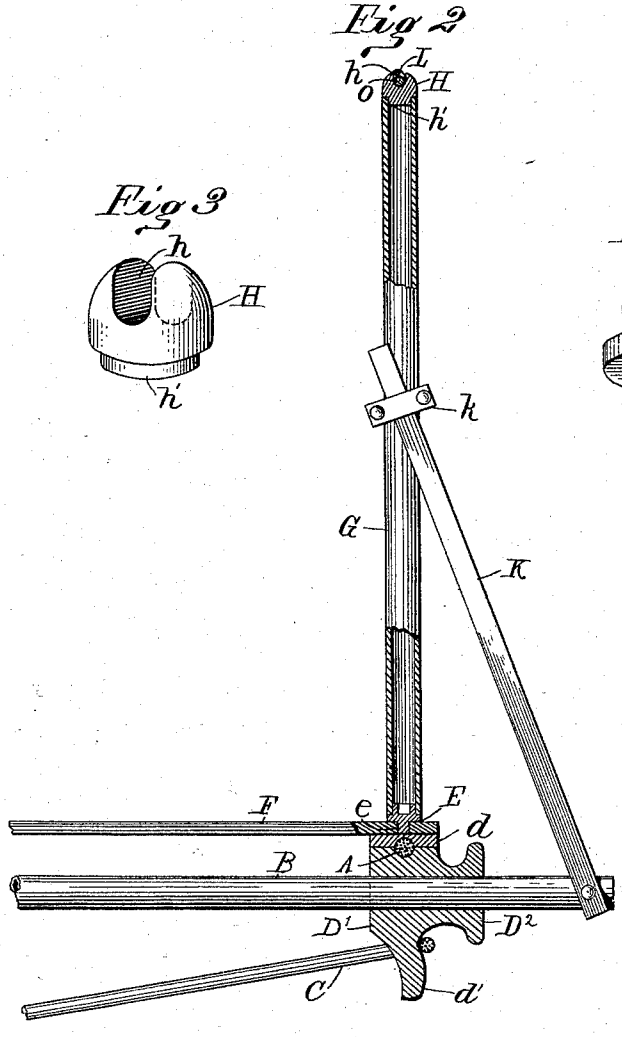
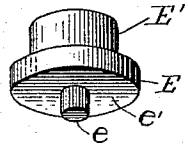


Fig 3

Fig 4



Witnesses
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Wm. Bidwell Brown

Inventor
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C. H. Geleton
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UNITED STATES PATENT OFFICE.

EDWIN ELIJAH RUNYON, OF PILOT POINT, TEXAS.

SIDE RAIL FOR SUSPENSION-BRIDGES.

SPECIFICATION forming part of Letters Patent No. 493,788, dated March 21, 1893.

Application filed November 2, 1892. Serial No. 450,759. (No model.)

To all whom it may concern:

Be it known that I, EDWIN ELIJAH RUNYON, a citizen of the United States, residing at Pilot Point, in the county of Denton and State of Texas, have invented certain new and useful Improvements in Side Rails for Suspension-Bridges; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improvement in side rails for suspension bridges and consists in the construction and arrangement of parts hereinafter described and definitely pointed out in the claims.

The object of the invention is to provide an improved side railing constituting a truss, which will be light, durable, and of structural simplicity. This object is accomplished by the construction illustrated in the accompanying drawings, wherein like letters of reference indicate corresponding parts in the several views and in which—

Figure 1 is a perspective view of a section of a suspension bridge, preferably of that style of bridges shown in Letters Patent granted to me on the 18th of December, 1888, and 3d of September, 1889. Fig. 2 is a detail elevation of one of the columns and its immediate connections. Fig. 3 is a detail perspective view of the saddle, and Fig. 4 is a detail perspective view of a supporting casting for the columns.

In the drawings A represents the floor cable, B, the needle beam and C the truss for the latter. On the ends of the needle beams are castings D, formed with boxings D′, having horizontal seats therein for the floor cable, and a removable top *d*. These castings D have the tongues *d′* around which the trusses C pass and are secured in suitable seats formed thereon. On the outer ends of the castings D are outwardly extending horizontal arms D^2, for purposes hereinafter stated.

F represents flat iron bars arranged directly above the needle beams having their ends counter sunk into and secured to the caps *d* of the boxes D′. In the ends of these bars are formed apertures, in which the pins *e* of the supporting castings E, fit. The castings E, are formed with a flat circular base *e′* having the pins *e* on their underside and sleeves E′ on their upper faces. The bases rest on the upper faces of the bars F.

G are the columns formed of piping, their lower ends fitting around the sleeves E′ and resting in the bases E. In the tops of these columns are fitted the saddles H, formed of castings having the seat or groove *h* in their upper faces and sleeves *h′* on their under faces, which fit in the tops of the columns. To hold the columns in their vertical position inclined braces K, are secured thereto at points near their upper ends by clamps *k*. The lower ends of these braces are made fast to the outer ends of the arms D^2.

L, L′ are the diagonal bracing cables extending alternately up over the columns resting in the seats *h* and below the needle beams. They are joined at their crossings by the twist castings M. Below the cables L, L′ in the saddles H is the hand rail O, made of cable or gas pipe as desired, the cables extending up over and across the same firmly binding and holding it in the saddles.

By the above described construction a very simple and inexpensive trussed side rail is formed, which is much lighter than wooden structures of this nature and more lasting. It may also be very quickly constructed or placed in position.

It will be understood that the cables are secured in suitable anchorages on opposite sides of the stream.

I am aware that many minor changes in the construction and arrangement of the parts of the improvement can be made and substituted for those shown and described without in the least departing from the nature and principle of my invention.

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

1. In a suspension bridge, the combination with the needle beams and floor cables, of a casting on the ends of the beams having horizontal boxings through which the cables pass, arms on the castings, cross bars secured to the castings having apertures in their ends, seats fitted in the apertures, columns on the

seats, saddles on the columns, braces extending from the arms to the columns, a hand rail, and diagonal truss cables extending alternately over the saddles and below the needle beams, substantially as described.

2. In a suspension bridge, the combination with the needle beams and floor cables of castings at the ends of the beams, in which the cables are secured, supporting castings seated on said other castings having upwardly extending projections, columns on the supporting castings surrounding the projections, saddles having extensions on their under sides fitted into the tops of the columns, braces for the columns, a hand rail supported by the saddles, and diagonal cables extending alternately over the saddles and below the beams, substantially as described.

3. In a suspension bridge, the combination with the needle beams, floor cables, and castings uniting the same, of cross bars connected with the castings, supporting castings on the ends of the bars, having sleeves on their upper faces, columns fitted around the sleeves and resting on the supporting castings, saddles on the tops of the columns, braces for the columns, hand rails in the saddles, and truss wires extending alternately over the rail and saddles, and below the beams and united at their crossings, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN ELIJAH RUNYON.

Witnesses:
JOHN H. KING,
I. C. KING.