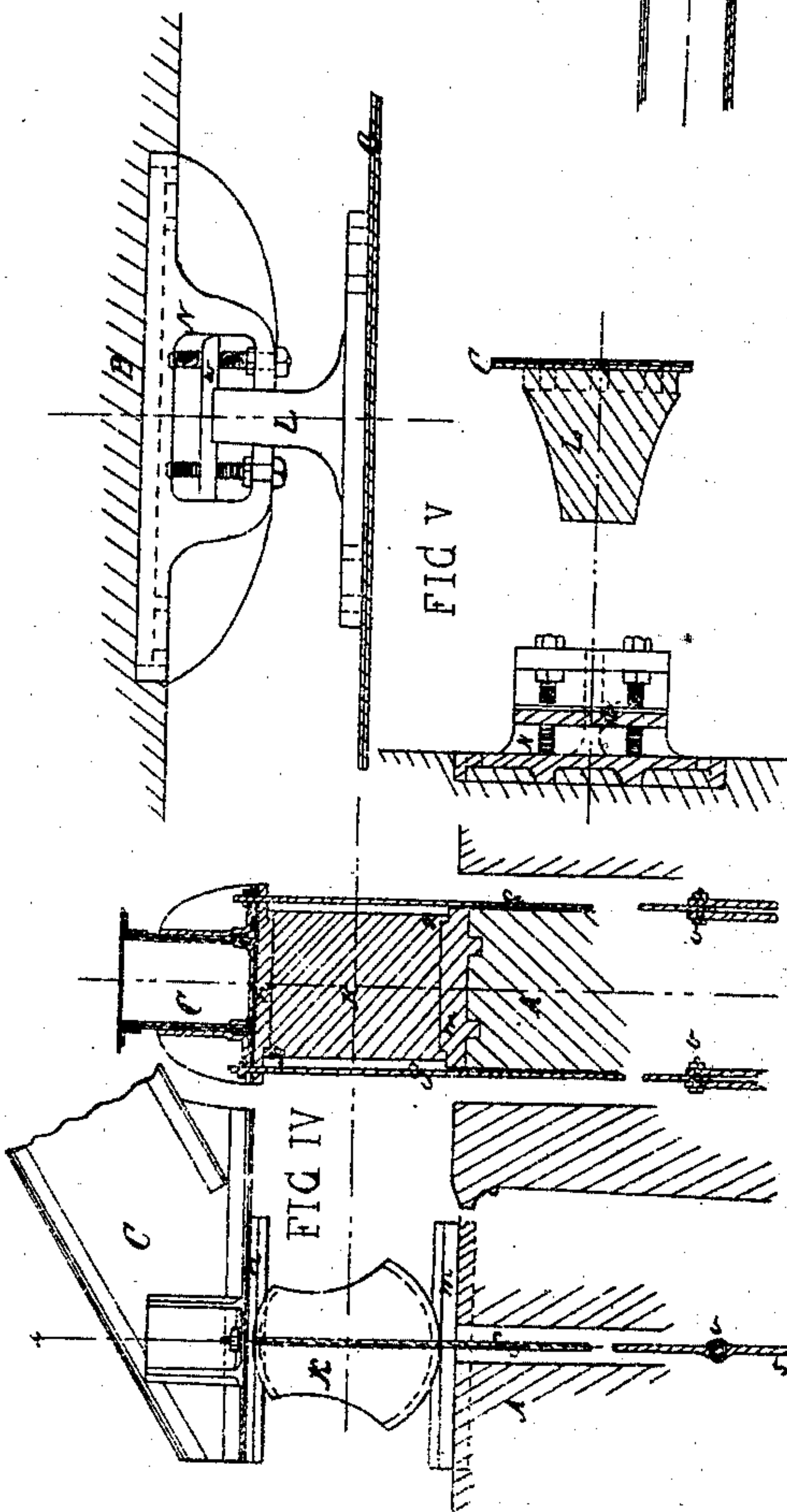
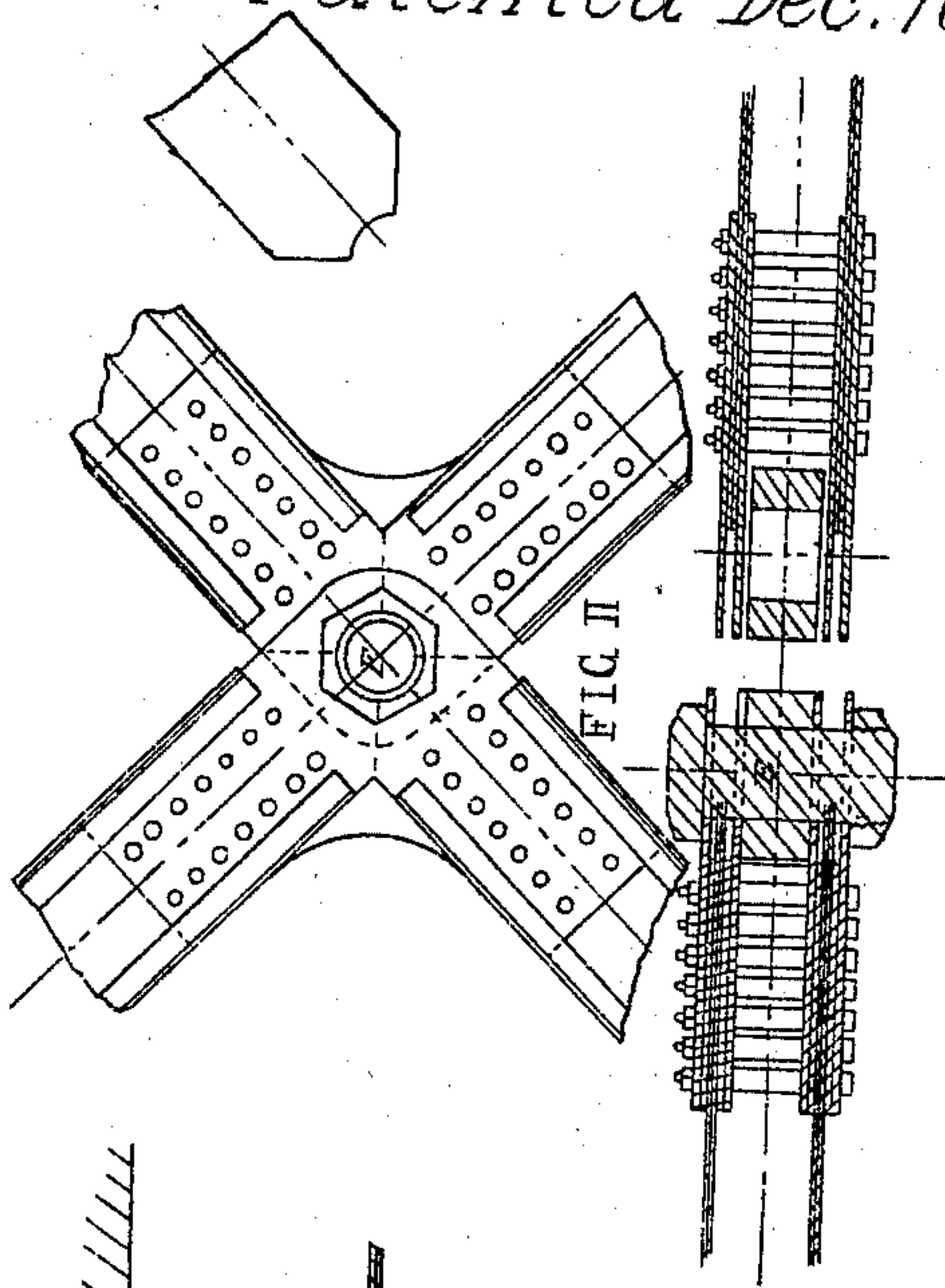
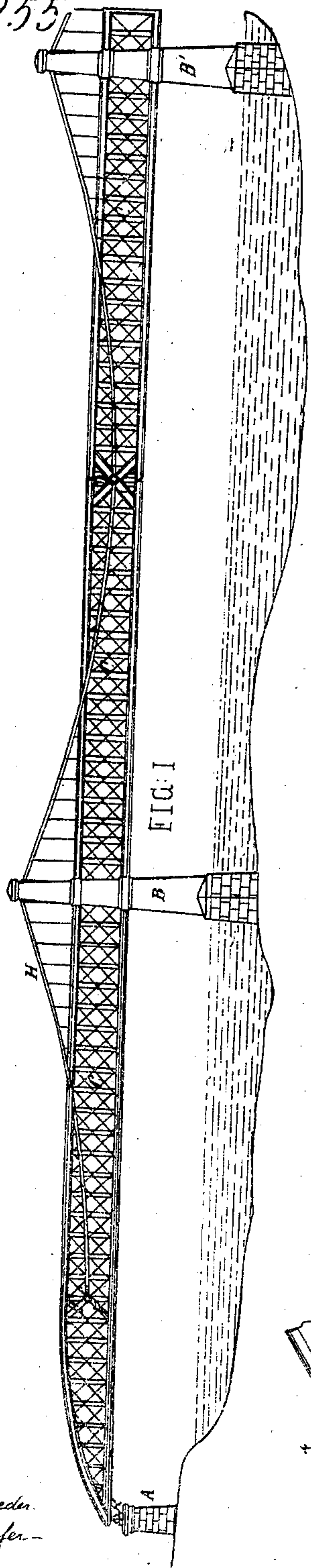


C. Bender.
Suspension Bridge.

N^o 719,551

Patented Dec. 10, 1867.



Witnesses
Henry E. Roeder.
William Defer-

Inventor
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United States Patent Office.

CHARLES BENDER, OF NEW YORK, N. Y.

Letters Patent No. 71,955, dated December 10, 1867.

IMPROVED SUSPENSION-BRIDGE.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, CHARLES BENDER, of New York, in the county and State of New York, have invented a new and useful Improvement in "Suspension-Bridges;" and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention refers particularly to the different species of stiffened suspension-bridges, and its nature consists, first, in dividing or separating the beams or trusses at one or more points, and connecting them by yielding joints; further, in the attachment of the chains or cables to the beams or trusses of the bridge itself, instead of fastening the same to abutments; further, in the manner of securing the ends of the bridge to the end piers vertically, and in such a manner as to allow for the expansion and contraction of the bridge; and, lastly, in attaching the beams or trusses to the central piers sidewise, and fastening them, at the same time, at one pier in such a manner as to prevent any horizontal movement in the direction of the longitudinal axis of the bridge.

Figure I represents a longitudinal elevation of my improved bridge.

The remaining figures represent details, showing the separate parts on an enlarged scale, and will be more particularly referred to in the description.

In the accompanying drawings, A represents the end or shore pier, and B B' the central piers. C are longitudinal trusses, constructed in the usual manner, subject to many variations, to correspond with the style and nature of the bridge. D, in Fig. I, represents the yielding joints, at the point where the beams or trusses are separated. One of the many possible plans of strengthening and stiffening this part of the beams or trusses, and of joining the same together by means of a strong bolt, E, is represented in Figure II.

The object of providing one or more joints in the whole length of the beams or trusses is to prevent thereby any danger from the unequal expansion resulting from the different materials used in the construction of said beams or trusses, as well as of the cables or chains, further to facilitate thereby the bending of the bridge by changes of temperature, to equalize any irregularity at the points of support of the structure on the piers, and likewise to facilitate and rectify thereby considerably the analytical calculation of the whole structure. The manner of constructing this joint, as well as the manner of strengthening the adjoining ends of the beams or trusses, is subject to many variations, and has to correspond with the style and nature of the bridge. In Fig. I this joint is represented exactly in the centre, between the central piers B and B', but the same may be placed in different positions, and may even be arranged at two or more places, according to the nature and to the number of the spans of the bridge, and may be used for all descriptions of stiffened suspension-bridges.

Between the shore pier A and the first central pier B, strong diagonal trusses F F, shown at an enlarged scale in Figure III, sheet 2, are arranged in the truss-work of the beams, having at their point of junction, near the middle of the height of the longitudinal beams or trusses, a strong bolt, G, around which the cables or chains H are fastened. These trusses F transfer equally the horizontal forces of the cables or chains to the chords of the trusses, while strong uprights, J, resist the vertical pressure acting in the system of the trusses F.

It is not essential by what arrangement of details the strains of the cables or chains are transferred to the chords of the trusses or to the beams. The only task to be fulfilled is the equal distribution of said strains, and the annihilation of the different secondary forces; and this may be effected by various arrangements of the different parts in a suitable manner.

The exact position of the attachment of the chains or cables to the beams or trusses depends likewise on circumstances, and may be either nearer to or farther away from the shore pier A, and, in some cases, it may even be advisable to extend the beams or trusses beyond the said shore pier A, and place the point of attachment of the chains or cables beyond said shore pier. Mathematical and analytical examination in each single case will determine the most profitable position of these points.

By this arrangement of attaching the cables or chains to the beams or trusses, a great saving is in most cases obtained, as I dispense thereby with a great part of the expensive masonry at present necessary, at each end of the bridge, to secure the ends of the cables or chains.

The cables or chains H are carried on the top of the central piers B and B', and the beams or trusses C are suspended from the same in the usual manner. Below the ends of the bridge, rollers K are placed, provided with side flanges x x , fitting over the surfaces of the plates n and m , to prevent any side motion of the bridge at

the ends. The plate *n* is securely fastened to the under side of the beams or trusses, and the plate *m* is attached to the top of the shore pier A. The ends of the bridge are at the same time fastened down by heavy bolts S, arranged on each side of the roller K. The lower ends of these bolts S are securely fastened in the foundation of the piers, and are provided with suitable joints, *v*, to allow for the horizontal motion of the beams or trusses, resulting from expansion or contraction, in consequence of the change of temperature.

This vertical anchorage of the ends of the beams or trusses of stiffened suspension-bridges to the end or shore piers, or near the ends of the bridge, prevents any upward movement of the truss-ends, in case of any overloading in certain contingencies.

This arrangement of fastening down the ends of the bridge is represented at an enlarged scale in Figure IV, in front view and cross-section.

To prevent the undulatory motion caused by the wind, as well as for other reasons hereafter mentioned, I attach the outer beams or the cords of the trusses of the bridge to the central piers opposite the middle of the same. Projections L are securely attached to the outside of the beams or trusses C, at the desired position, which enter into suitable guide-frames N, fastened to the piers (see Figure V) in such a manner as to brace thereby the bridge against the piers, sufficient play being allowed in one or more of the same to allow for the expansion or contraction of the beams lengthwise. In the frames N fastened to the piers, suitable plates *w* are arranged, against which the projections L, attached to the beams C, are made to bear, said plates *w* being capable of being regulated, by means of set-screws *a a*. On that pier which is either in the middle of the bridge, or on that next to its centre, I attach these beams in such a manner as not to allow for any longitudinal motion, whereby the differences of the length of the bridge, caused by changes of temperature, are regulated, and brought to a certainty, on either side of this point of attachment. By this attachment of the beams or trusses, sidewise to the piers, the pressure caused by the wind is partly annihilated, the side motion of the same caused by the wind is considerably reduced, and the piers themselves are strengthened, as the pressure resulting from those causes, and which in other cases is all on the top of said piers, where the cables or chains are supported, is brought thereby lower down, or nearer to its base.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The construction and arrangement of one or more yielding joints, connecting the beams or trusses of stiffened suspension-bridges, substantially as herein described.
2. I claim the attachment of the ends of the cables or chains, at or near the first or shore piers, to the longitudinal beams or trusses of stiffened suspension-bridges, substantially as set forth.
3. I claim the means and method by which the ends of the beams or trusses of stiffened suspension-bridges are secured to the shore piers by vertical anchorage, and the arrangement of suitable joints *v* in said anchors, substantially for the purpose described.
4. I claim the means and method employed to reduce the side motion, by attaching the longitudinal beams or trusses of stiffened suspension-bridges to the central piers sidewise, said attachment being on one pier perfectly immovable in any horizontal direction, while at the other piers allowance is made for the variations of the length of the beams, substantially as set forth and described.

CHARLES BENDER.

Witnesses:

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WILLIAM DERFER.