(No Model.) 2 Sheets—Sheet 1.

P. H. JACKSON.

BUILDING OR BRIDGE CONSTRUCTION.

No. 366,839. Patented July 19, 1887.

Fig. 1.

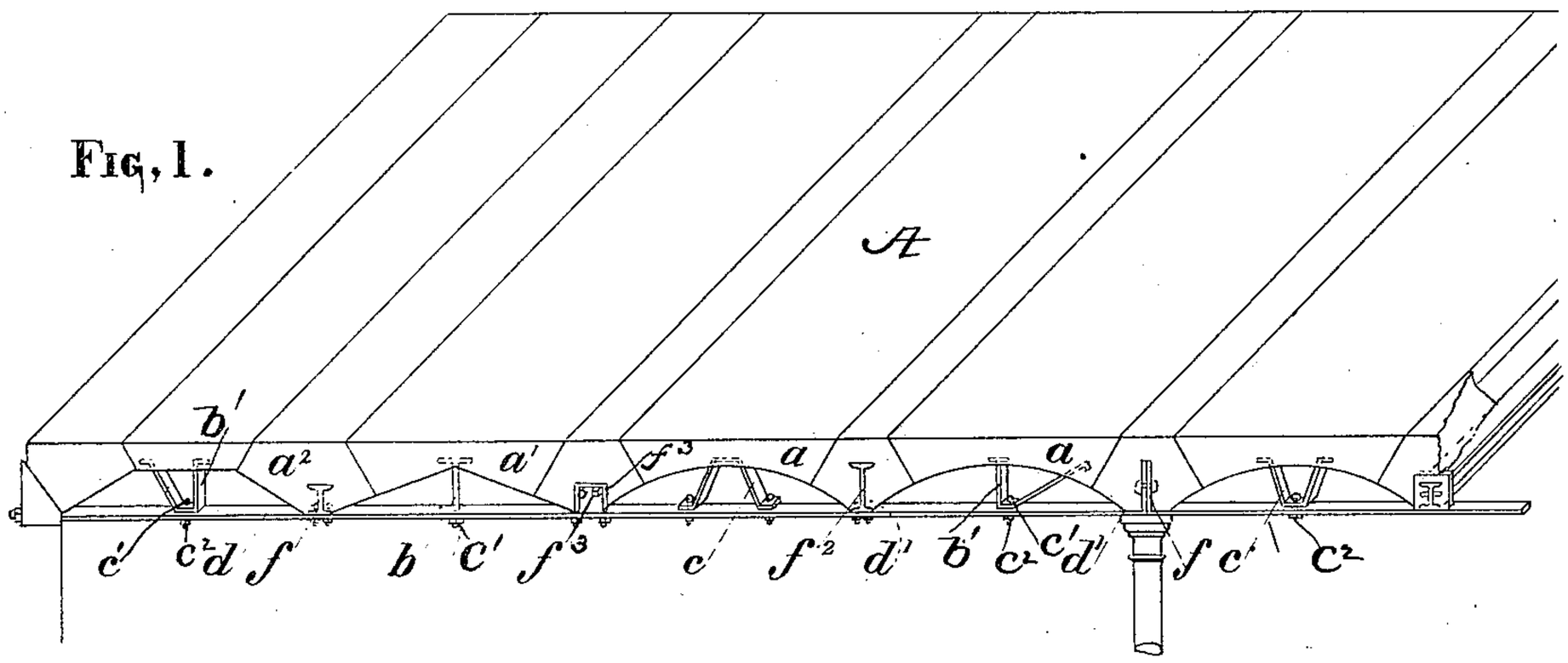


Fig. 2.

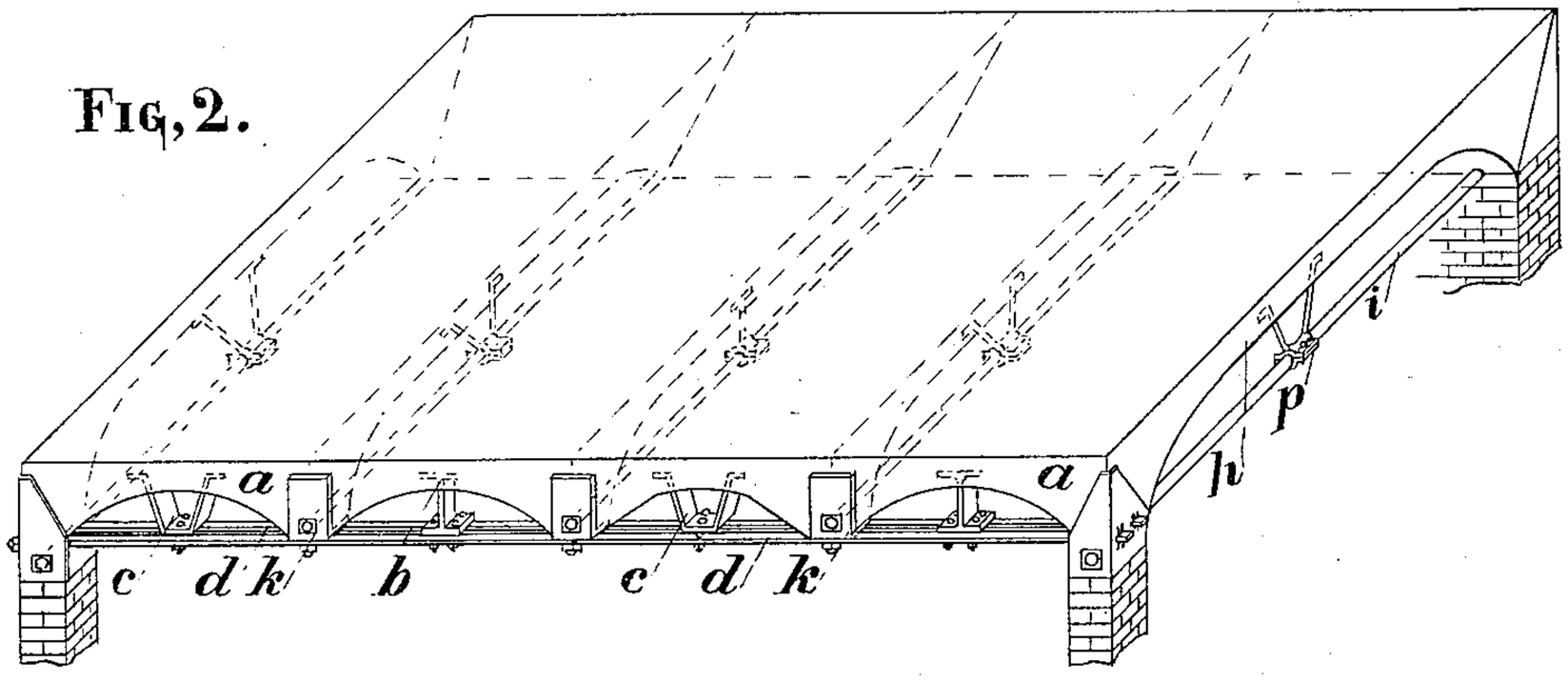
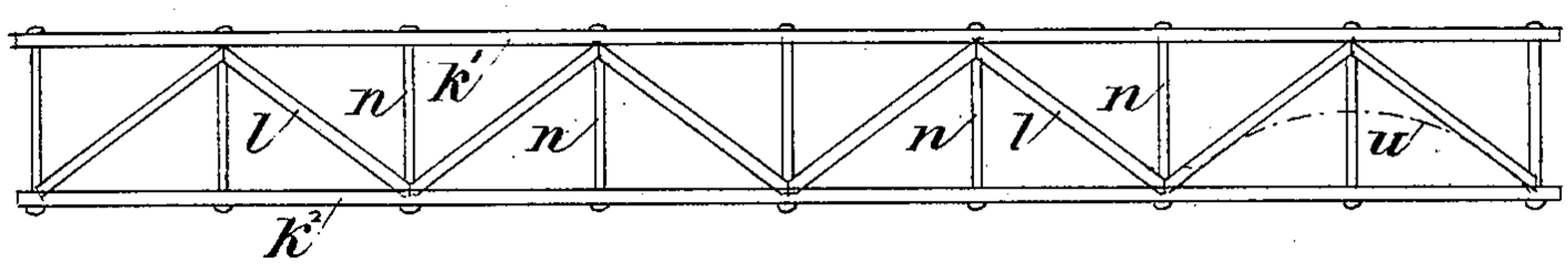


Fig. 3.



Witnesses.
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(No Model.) 2 Sheets—Sheet 2.

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FIG. 4.

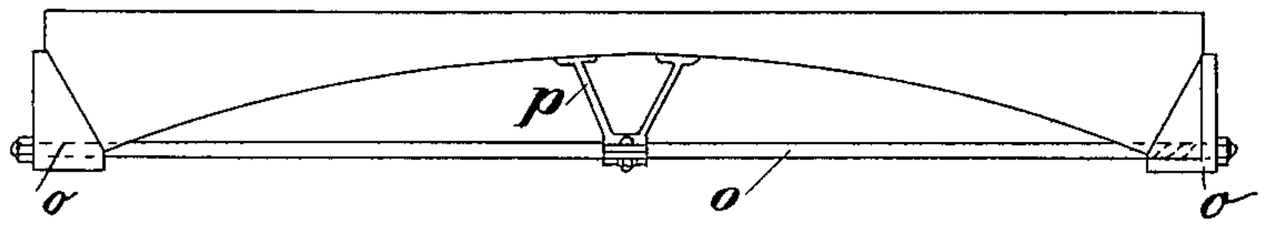


FIG. 5.

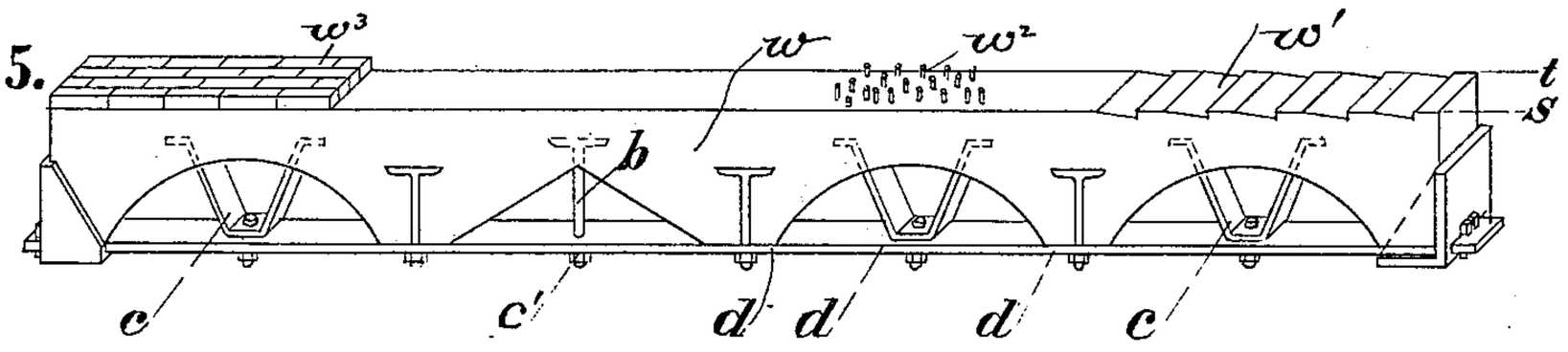
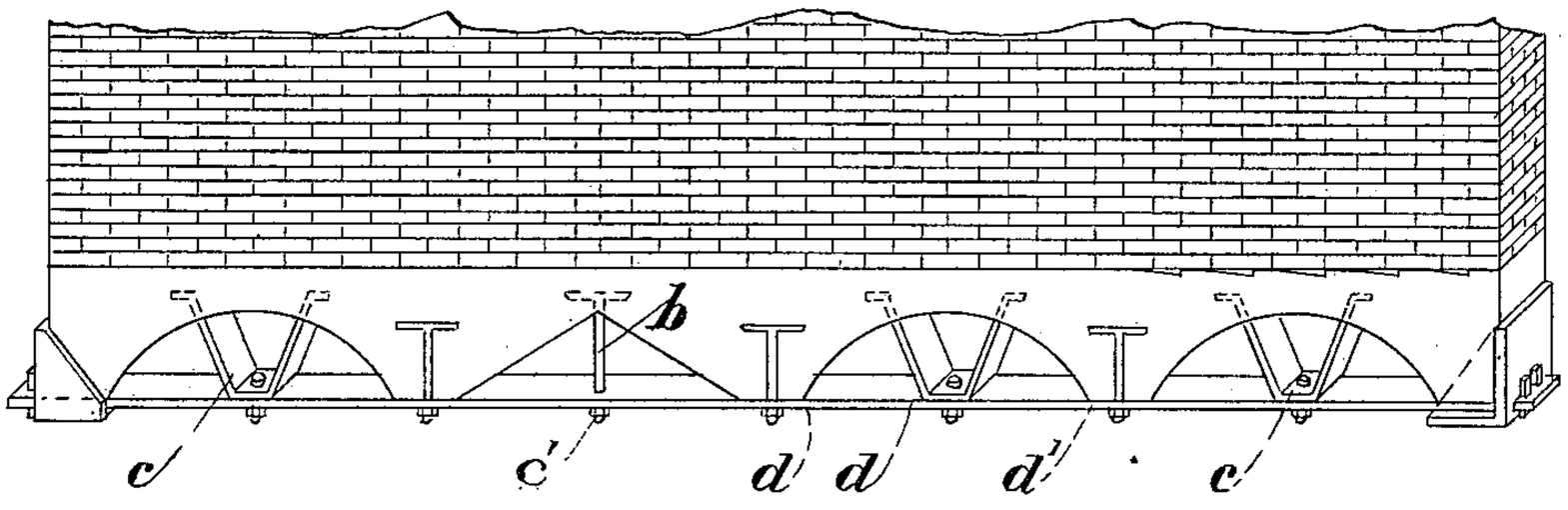


FIG. 6.



Witnesses.
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James B. Lane.

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UNITED STATES PATENT OFFICE.

PETER H. JACKSON, OF SAN FRANCISCO, CALIFORNIA.

BUILDING OR BRIDGE CONSTRUCTION.

SPECIFICATION forming part of Letters Patent No. 366,839, dated July 19, 1887.

Original application filed January 7, 1886, Serial No. 187,930. Divided and this application filed August 24, 1886. Serial No. 211,772. (No model.)

To all whom it may concern:

Be it known that I, PETER H. JACKSON, of San Francisco, State of California, have invented an Improvement in Building or Bridge Construction; and I declare the following to be a full, clear, and exact description thereof, sufficient to enable any person skilled in the art to which my invention belongs to make and use the same, reference being had to the accompanying drawings, forming part of the specification.

This invention relates to girders, bridges, sidewalks having vaults or chambers beneath them, floors, and similar structures. The object is to strengthen such structures in a superior manner and at less cost than is now possible when the said structures are constructed with arches and formed with cement, concrete, artificial stone, or similar material.

With this object in view my invention consists, broadly, in supporting the footings of the arches of a structure, in which footings are preferably embedded metallic-flanged beams or rods having resistance-plates on a non-embedded metallic tie or ties extending beneath and in contact with the footings of the several arches of the body or structure and in a direction transverse to said arches, the said footings being bolted or otherwise securely fastened to the tie or ties, the ties thus preventing the arches from spreading when a load or weight rests upon them, uniting them as a whole and resisting tensile strain, while the upper part of the arches above the neutral line of the body or structure resists the compressive force, whether the structure is constructed integral or in sections or divisions.

Furthermore, the invention consists in vertical or diagonal metallic ties having their upper ends embedded or built in the upper part of the arches, the lower ends of one form of the vertical ties passing through the horizontal tie or ties, and having screw-nuts or keys on their threaded ends below the longitudinal tie or ties, while the lower ends of the diagonal or inclined ties, and also of the other form of vertical tie, extend down to within a short distance of the longitudinal tie or ties, and have screw-bolts provided with nuts (keys or other suitable retaining means) extending through the longitudinal tie or ties, so that by screwing up the nuts or keys of either the vertical or inclined ties the crowns of the arches are drawn down toward the longitudinal tie or ties, and the latter is drawn up, tightening the longitudinal tie or ties between each arch and producing tensile strain, and producing compression on the arches, both forces being exerted before the structure is loaded.

This is a division of the application for patent filed January 7, 1886, Serial No. 187,930.

In the accompanying drawings, in which like letters of reference indicate corresponding parts, Figure 1 is a perspective view, partly in section, of a bridge or similar structure made in arches of cement, concrete, artificial stone, or like material, showing a longitudinal tie extending beneath and supporting the footings of the arches, (in which flanged metallic beams and bars having resistance-plates are embedded,) and to which the said footings are fastened, showing the different forms of arches, and also showing the vertical and diagonal ties and their adjustable attachments. Fig. 2 is a perspective view of a floor or sidewalk with a vault beneath it, bridge, or like structure, of concrete, cement, artificial stone, or similar material, showing its lower surface arched both transversely and longitudinally, showing the longitudinal tie or ties supporting the footings of the several transverse arches, and the vertical and diagonal ties connecting the crowns of the said arches with the said longitudinal ties, and showing also the longitudinal arches and the means for bracing and strengthening the same. Fig. 3 is a side view of a form of truss in common use, introduced for the purpose of showing that the forces exerted on its various parts are similar, and are resisted in the same manner as in short or transverse arches shown in Figs. 1 and 2. Fig. 4 is a side view of an arch and its braces similar to the longitudinal arches shown in Fig. 2, showing more clearly the construction and arrangement of parts thereof. Fig. 5 is a perspective view showing a girder in which my invention is embodied, and Fig. 6 is a perspective view

showing a wall constructed and cemented on a girder of my improved construction.

Bridges, &c., constructed with arches and formed of cement, concrete, artificial stone, or similar material are strong in resisting compression, but comparatively very weak in resisting tensile strain, and I strengthen the structure A against tensile strain by bolting or otherwise securely fastening the footings of the arches *a a' a²*, (in which are embedded and cemented longitudinally either small flanged metallic beams, as *f*, large flanged metallic beams *f²*, or rods *f'*, having end resistance-plates, *f³*,) to a longitudinal metallic tie or ties, *d*, and by embedding in the crowns or upper parts of the transverse arches the heads or upper parts of vertical ties *b b'*, or diagonal ties *c*, the lower ends of the vertical ties *b* extending through the tie *d*, as shown in Figs. 1, 5, and 6, and having nuts or keys on their threaded lower ends below tie *d*, while the form of vertical tie shown at *b'*, and the diagonal ties are of such length that their lower ends extend down to within a short distance of the longitudinal tie or ties *d*, and have screw-bolts *c'*, provided with nuts *c²*, (keys or other suitable retaining means,) extending through the longitudinal tie or ties *d*, so that by screwing up the nuts or keys of either the vertical or diagonal ties the longitudinal tie or ties are tightened between each arch, preventing the bottom parts of the arches along the intrados (the part below the neutral axis) from being tensilely exerted, which would not be the case if the tie were not tightened before the structure was subjected to deflection under a weight. As the longitudinal tie or ties are thus tightened, the crowns of the arches are at the same time drawn down, compressing and strengthening the arches. The bottom or intrados of the arches may be arched in the usual form, as shown at *a*, pedimental, as at *a'*, or of the form shown at *a²*, or any other similar shape.

By the improved construction shown in the accompanying drawings expensive iron supporting-girders are dispensed with, which are commonly used in supporting the ends of several arches; also, the room that the depth of the girder usually employed would occupy is gained in head room or height of room in the apartment beneath. The lower side of the structure may also be arched both transversely and longitudinally, as shown in Fig. 2, the transverse arches *a* being braced and strengthened as shown and described in Fig. 1; but instead of the arches being straight in the direction of their length and supported by flanged metal beams, as shown in Fig. 1, they are arched over their length forming the longitudinal arches *h*, each of which is strengthened and braced, as more clearly shown in Fig. 4, by a longitudinal tension-rod, O, having the end resistance-plates, *o o*, and resisting the tensile strain, while a strut, *p*, rests on the top of the said rod and supports the crown of the arch from settling under a load.

It will be seen that the short transverse arches *a*, braced against tension and compression, as described, resist tensile and compressive force in the same manner as the expensive truss usually employed, which is constructed entirely of metal, and shown in Fig. 3, the tops of the series of arches resisting compression like the top chord, *k'*, of the said truss, and the tie *d* resisting tensile strain like the bottom chord, *k²*, of the truss, while the sides of the arches are compressed and operate in the same manner as the diagonal braces *l l* of the truss, the diagonal braces *l l* and the sides of the arches both resisting the same force—viz., compression. The vertical ties *n* of the truss connect and tighten the top and bottom chords thereof, and the vertical ties *b b'* of my construction operate in precisely the same manner, my general construction, however, having the advantage of resisting lateral strain in a superior manner.

In Fig. 5, I show a girder, *w*, constructed of cement or like material in arches having the footings of the arches connected and bolted to a longitudinal non-embedded tie, *d*, and having diagonal and vertical ties *c b b'*, similar to those previously described, and shown in Figs. 1 and 2. The top of this girder is formed with transverse serrations or notches *w'*, and metallic projections *w²*, and with part of a layer of brick, *w³*, built upon it, either of which devices may be employed when constructing and cementing a wall on the girder, as shown in Fig. 6, whereby the girder becomes integral with the wall and resists compression, while the girder resists tensile strain. This feature of my invention, the roughened top on which the wall is built, forms a part of a separate application, Serial No. 232,455.

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

1. The combination, with a bridge or like structure, of cement, artificial stone, or like material, constructed with a series of arches, of a longitudinal tie or ties on which the footings of the said arches are supported and to which they are fastened.

2. The combination, with a bridge or like structure, of cement, artificial stone, or like material, constructed with a series of arches, of a longitudinal tie or ties on which the footings of the said arches are supported and to which they are fastened, and the vertical and diagonal ties embedded at their upper ends in the upper part of the arches and having the screw-bolts, nuts, keys, or other retaining devices.

3. The combination, with a bridge or like structure, of cement, artificial stone, or like material, constructed with a longitudinal arch or arches, of the longitudinal tension rod or rods having end resistance-plates, and the strut having obliquely-extending arms the ends of which are embedded in the crown of the arch and assist in supporting the same.

4. The combination, with a bridge or like structure, of cement, artificial stone, or simi-

lar material, constructed with transverse and longitudinal series of arches, of a longitudinal tie or ties on which the footings of the said arches are supported and to which they are fastened, the vertical and diagonal ties embedded at their upper ends in the upper part of the arches, and having the screw-bolts, nuts, keys, or other retaining devices, and the longitudinal tension-rods having the end resistance-plates, and the struts mounted on the said rods and supporting the crowns of the longitudinal arches.

5. The combination of a girder or like body, of concrete, cement, artificial stone, or similar material formed with transverse arches, of a longitudinal tie having end resistance-plates, and on which the footings of the said arches are supported and to which they are fastened, and the vertical and diagonal ties embedded at their upper ends in the upper part of the arches, and having the screw-bolts, nuts, keys, or similar devices.

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Witnesses:
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