No. 625,902.

Patented May 30, 1899.

A. RIEPPEL.

SUSPENSION BRIDGE.

(Application filed Nov. 8, 1898.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1

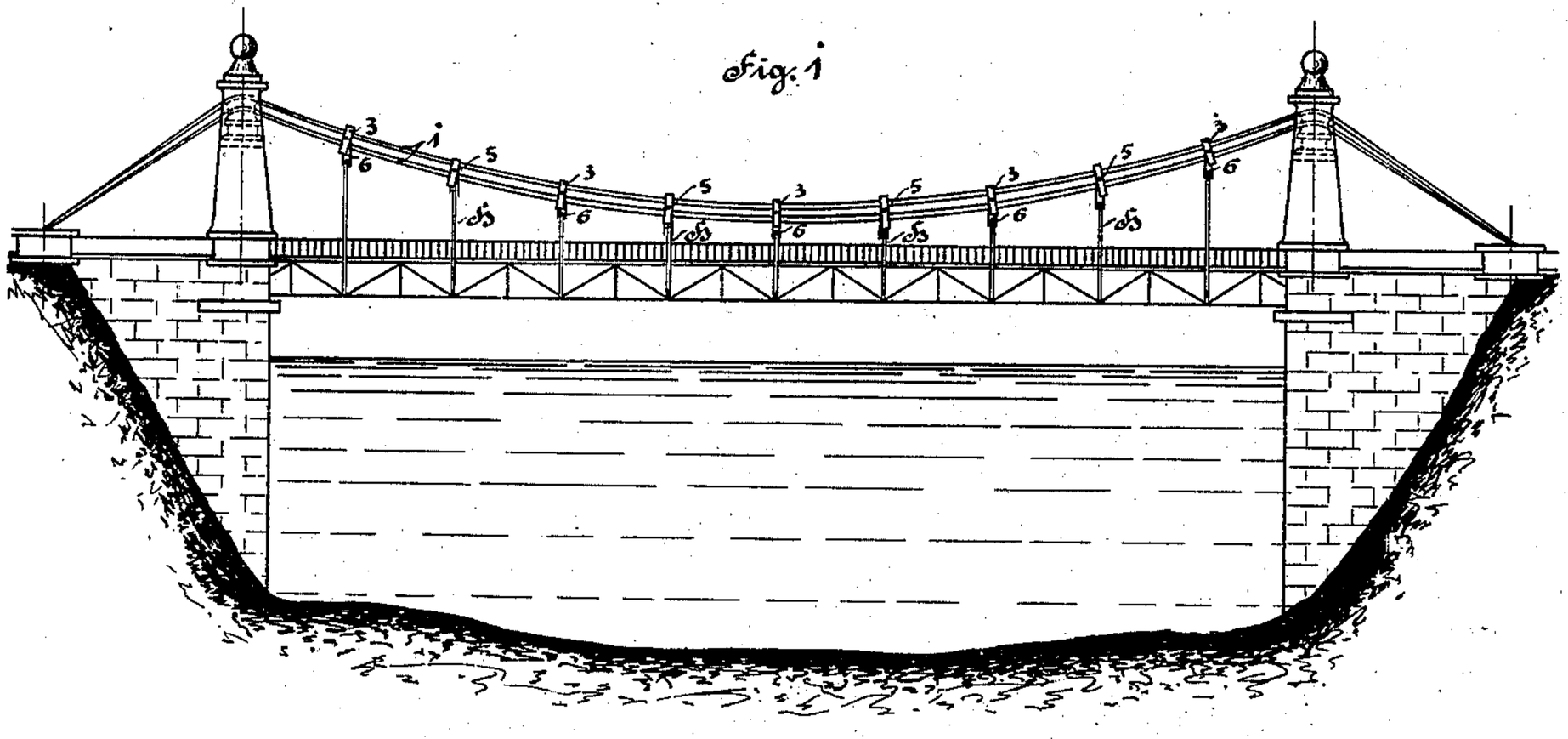


Fig. 2

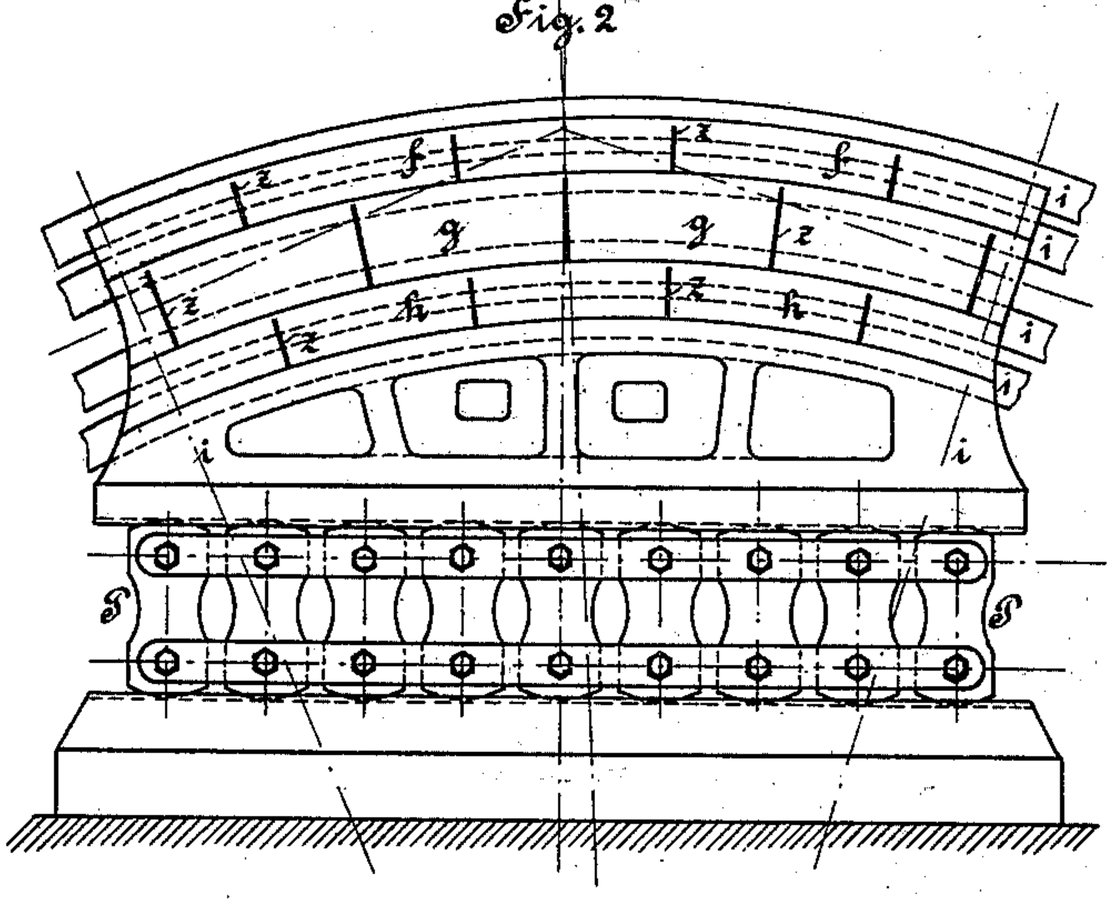
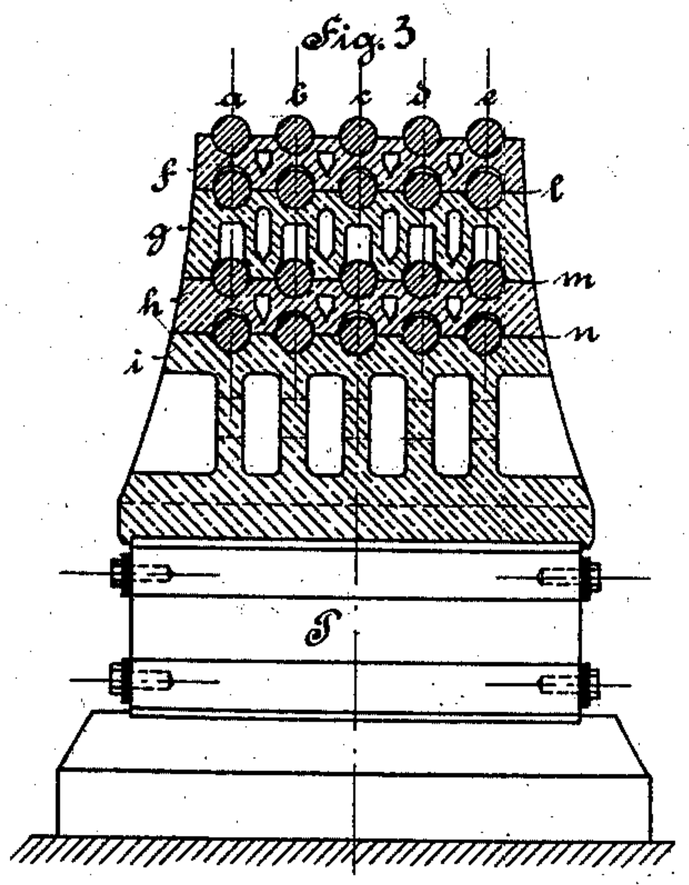


Fig. 3



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(No Model.) 2 Sheets—Sheet 2.

Fig. 4

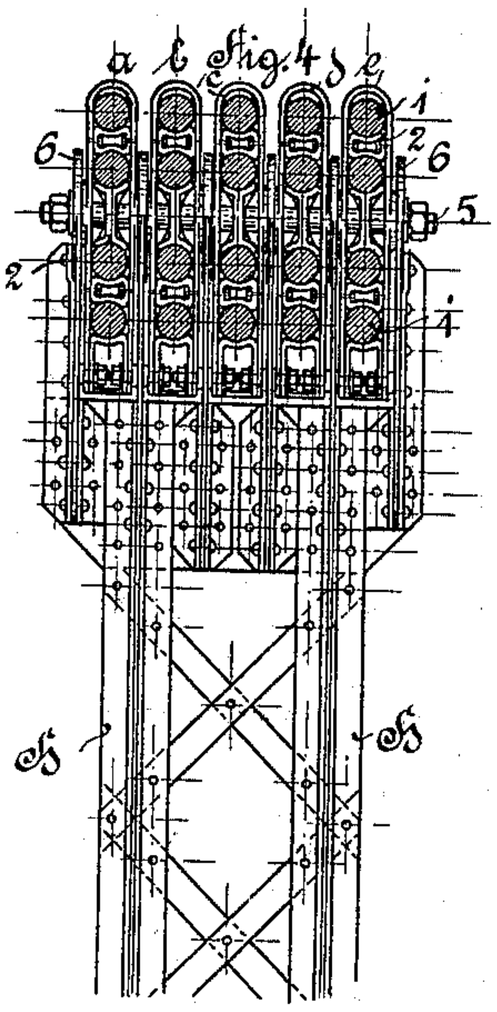


Fig. 5

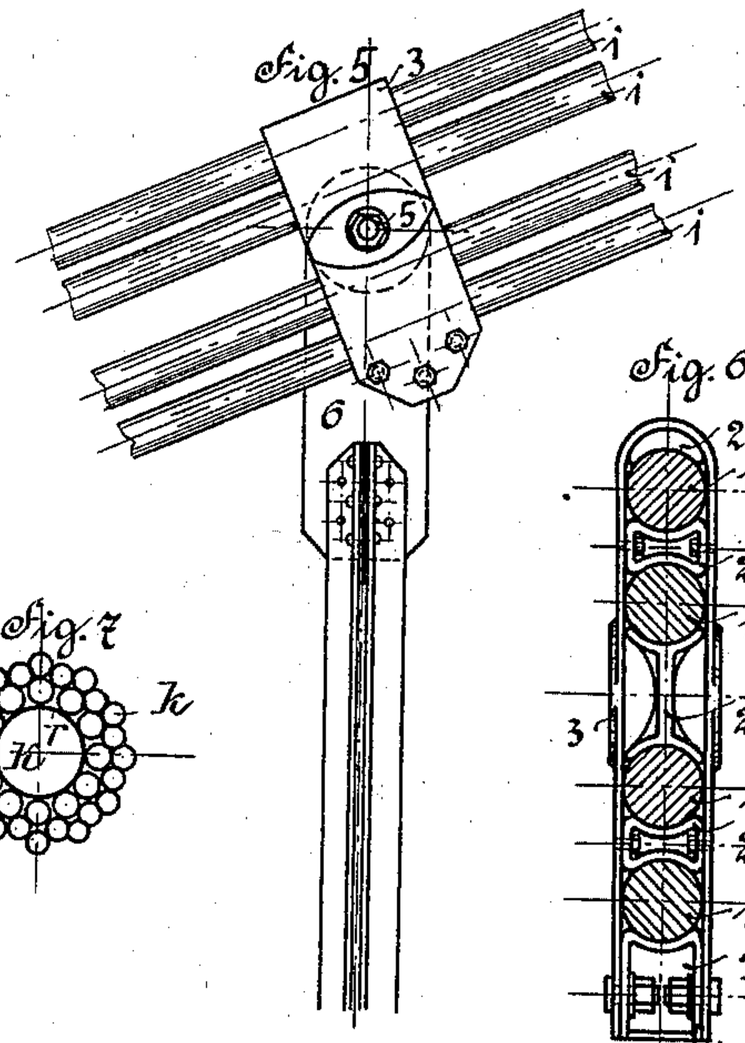


Fig. 6

Fig. 7

Fig. 8

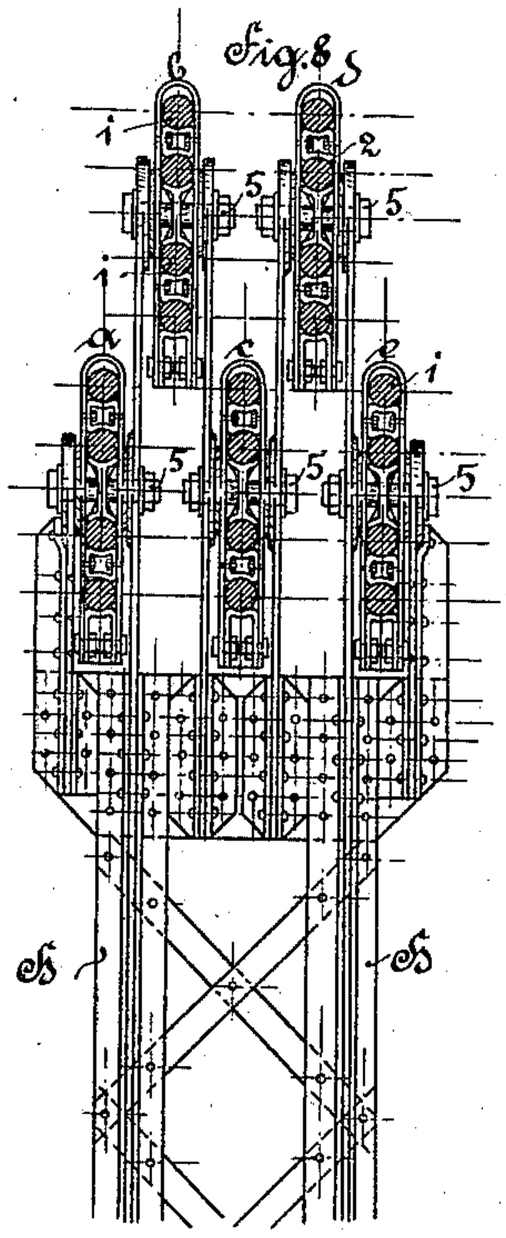
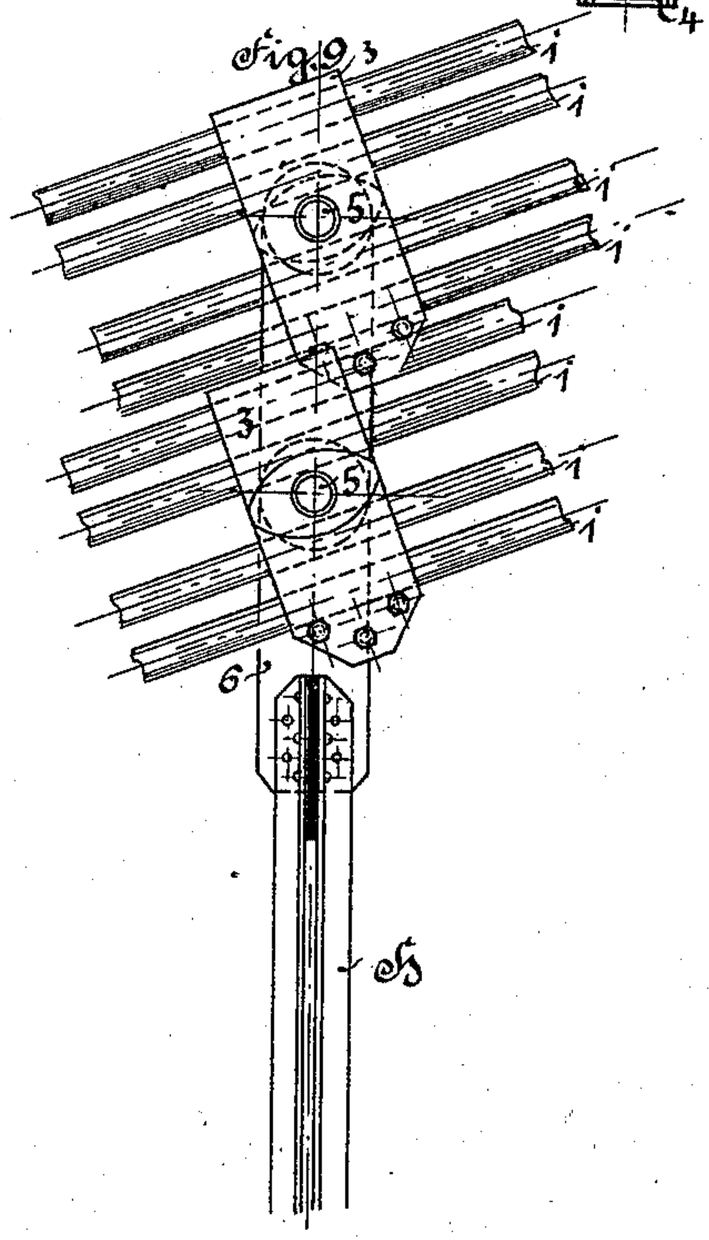


Fig. 9



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UNITED STATES PATENT OFFICE.

ANTON RIEPPEL, OF NUREMBERG, GERMANY, ASSIGNOR TO MASCHINENBAU-ACTIEN-GESELLSCHAFT NÜRNBERG, OF SAME PLACE.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 625,902, dated May 30, 1899.

Application filed November 8, 1898. Serial No. 695,820. (No model.)

To all whom it may concern:

Be it known that I, ANTON RIEPPEL, a subject of the King of Bavaria, residing at Nuremberg, Bavaria, German Empire, have invented certain new and useful Improvements in Suspension-Bridges, of which the following is a specification.

In large cable-bridges the suspension-cables were mostly made on the spot of separate wires or strands. Apart from the fact that this work required a very great deal of time the action of the weather had to be taken into consideration during the construction, whereby the exactness of the work is unfavorably affected. Efforts have therefore been made for some time to form the cables for large bridges of separate small cables or pieces of cable each of which is separately portable. Such an arrangement is shown in the accompanying drawings, in which—

Figure 7 is a cross-section of a cable composed of a number of small cables *k*, which, usually parallel to and suitably grouped as closely as possible around a larger cable K, are combined to form a single strong cable and bound together with suitable sockets or straps. Of course in this arrangement vacant spaces *r* remain between the separate cables, which may be filled up by pouring into them a suitable material, but which must always be regarded as a drawback. Another drawback consists in that the attachment sockets or loops which effect the suspension of the bridgeway on the combined cables only come in contact with the cable at single points of its periphery, so that the absolutely necessary resistance against displacement of the loops in consequence of the difference in the tension of the strands before and behind said loops can only be obtained with difficulty by means of friction alone. By the use of cable-loops, as recently proposed, a large amount of dead-weight is caused. In order to avoid the drawbacks arising from the combination of several ropes or cables lying in close proximity parallel with or twisted around one another to form a single strong cable and to avoid the increase of weight which is involved by the use of the said cable-loops, by the present invention a suitable number of the weaker ropes are arranged and anchored independently of one another and only subsequently connected or combined in some suitable manner. My improvement consists in suitably suspending the separate ropes and connecting or combining them by special devices in such a way that they act reliably as a single suspension device. For this purpose each of the ropes is provided at both ends with an anchor-head and fixed by means of anchor-supports independently of the others in such a way that its adjustment up to a clearly-determined tension may be effected. The ropes are supported over the pyramids of the center piers by means of suitably-rounded saddles.

In the accompanying drawings I have shown a form of bridge embodying my invention as a whole and in detail and also an illustration of the construction of cables formerly employed.

In the drawings, Fig. 1 is a side view of a bridge embodying my invention. Fig. 2 is a side view of the preferred form of saddle. Fig. 3 is a transverse upright section through the saddle shown in Fig. 2. Fig. 4 is a vertical section through a system of five series of cables, each series consisting of four superposed cables, and the means for connecting and attaching the cables. Fig. 5 is a side view of the construction shown in Fig. 4. Fig. 6 is a vertical section of four cables combined in a group. Fig. 7, as before stated, shows the old mode of construction. Fig. 8 shows a modified arrangement and grouping of the cables and the device for connecting and attaching the cables, and Fig. 9 is a side view of Fig. 8.

In the arrangement shown in Figs. 2, 3, 4, and 5 five vertical rows of cables *a b c d e* are employed, each consisting of four superposed cables *l*, which, with a view to their manifold suspension, are carried over the piers by saddles *f*, *g*, *h*, and *i* and anchored at the ends. These cables, as shown in Figs. 4 and 5, are so interconnected and held at a certain distance apart that the suspension-rods or suspenders H, which carry the bridgeway, distribute the strains which arise evenly over all twenty cables in such a way as to yield an entirely central strain on the cables, but no side ones. In order to attain this, the

four ropes of each vertical row are combined in one group. Their respective distance apart is fixed, as shown in Fig. 6, by means of suitably-shaped iron and steel blocks 2, with a frame or loop 3 of flat iron passed around the whole, leaving at first a gap at *x*. After a closing-piece 4 has been inserted in said gap all four cables *l* are so pressed under high pressure between the upper bend of the loop 3 and the closing-piece 4 that when the closing-piece has been secured by means of screws or in any other suitable manner the blocks 2 and loop 3 cannot slip along the cables *l*. The cables are pressed into the loop 3 by means of hydraulic power or screw-presses, using a lever mechanism of any suitable kind. As shown in Figs. 4 and 5, any suitable number of groups of cables put together in the manner just described or at different heights, as shown in Figs. 8 and 9, (hereinafter described,) may be placed at the suspension place for the bridgeway and in the first-named form of construction, Figs. 6, 4, and 5, connected together by bolts 5, intended for the suspension by means of bands 6. For this object the two arms of each flat iron loop are strengthened or thickened in the center and provided with suitable bolt-holes for the bolts 5. In the form of construction shown in Figs. 8 and 9 instead of a single bolt 5 five are employed, while the number of cables remains the same.

The suspension of the bridgeway obtained in the manner hereinbefore described is an absolutely reliable one, because the clamping in of each separate cable or rope of a group always takes place with equal exactitude and care, so that in the present case, for instance, the frictional resistance to slipping down of the bridge suspension will be twenty-fold the amount of that which is to be expected with a single strong cable of the same weight-carrying capacity and under the most favorable conditions.

The transfer of the strain from the suspension-rods H to the cables or ropes takes place by means of the bands 6 by the intermediary of the bolts 5, so that each separate group of ropes *a b c d e* bears the same load in their central plane. Consequently the strain on each cable or rope is equally great and central.

The construction of the pyramid-supports for the central piers, where the hereinbefore-described grouping of the cables or ropes is employed, is evident from Figs. 2 and 3.

The lowermost horizontal row of cables rests on a curved saddle *i*, which saddle is in turn carried by a sliding mount P. This row of cables is covered by a second saddle *h*, with spaces for play of the cables to allow of their being drawn through when required to be changed, and this second saddle *h* has grooves on its convex side for the second row of cables. Two further saddles *g* and *f* complete the pyramid-support. In order to cause the separate saddles in their total expansion to rest with their curved surfaces in contact at *l*, *m*, and *n*, they are slotted radially at certain places *z* for insuring thereby a certain flexibility.

The construction hereinbefore described has also the advantage that each separate rope or cable may be separately changed without the necessity of staying or supporting the bridge, it being only necessary to remove one vertical row in which the cable to be replaced is included by unfastening the fastening-piece 4. During the period that one vertical row of cables is removed care must be taken to suitably reduce the load on the bridge. The openings in the saddles over the piers for supporting the cables are, as already incidentally mentioned, somewhat larger than the thickness of the cables in order that the cables may be easily drawn through the same when being changed.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. A means for suspending the bridgeway of a suspension-bridge comprising a series of independent anchored cables lying in a vertical plane and means for gripping the said cables and holding them spaced apart in a group and flexible connections of said gripping device with the suspender whereby the strains on the said cables may be equally distributed thereto.

2. A means for suspending the bridgeway of suspension-bridges such as described, comprising a number of cables lying in a vertical plane and means for holding the same together comprising a frame containing spacing devices or intermediate pieces 2, the parts being placed together and retained in position under pressure and one or more bolts for pivotally connecting suspension devices H of the bridgeway to the said cable system.

3. A pyramid-support for suspension-bridges such as described, characterized by the separate rows of cables or ropes lying in proximity to one another being supported by suitable saddles *f g h i* provided with grooves and formed to the curves of the cables, which saddles are arranged one upon the other and brought into mutual inner contact by means of radial slits *z* and as a whole may be mounted rigidly or slidingly, substantially as hereinbefore described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

ANTON RIEPPEL.

Witnesses:
ANDREAS SLIDY,
OSCAR BOCK.