No. 782,027. PATENTED FEB. 7, 1905.

W. HILDENBRAND.

SUSPENSION BRIDGE.

APPLICATION FILED FEB. 27, 1900.

Fig. 1

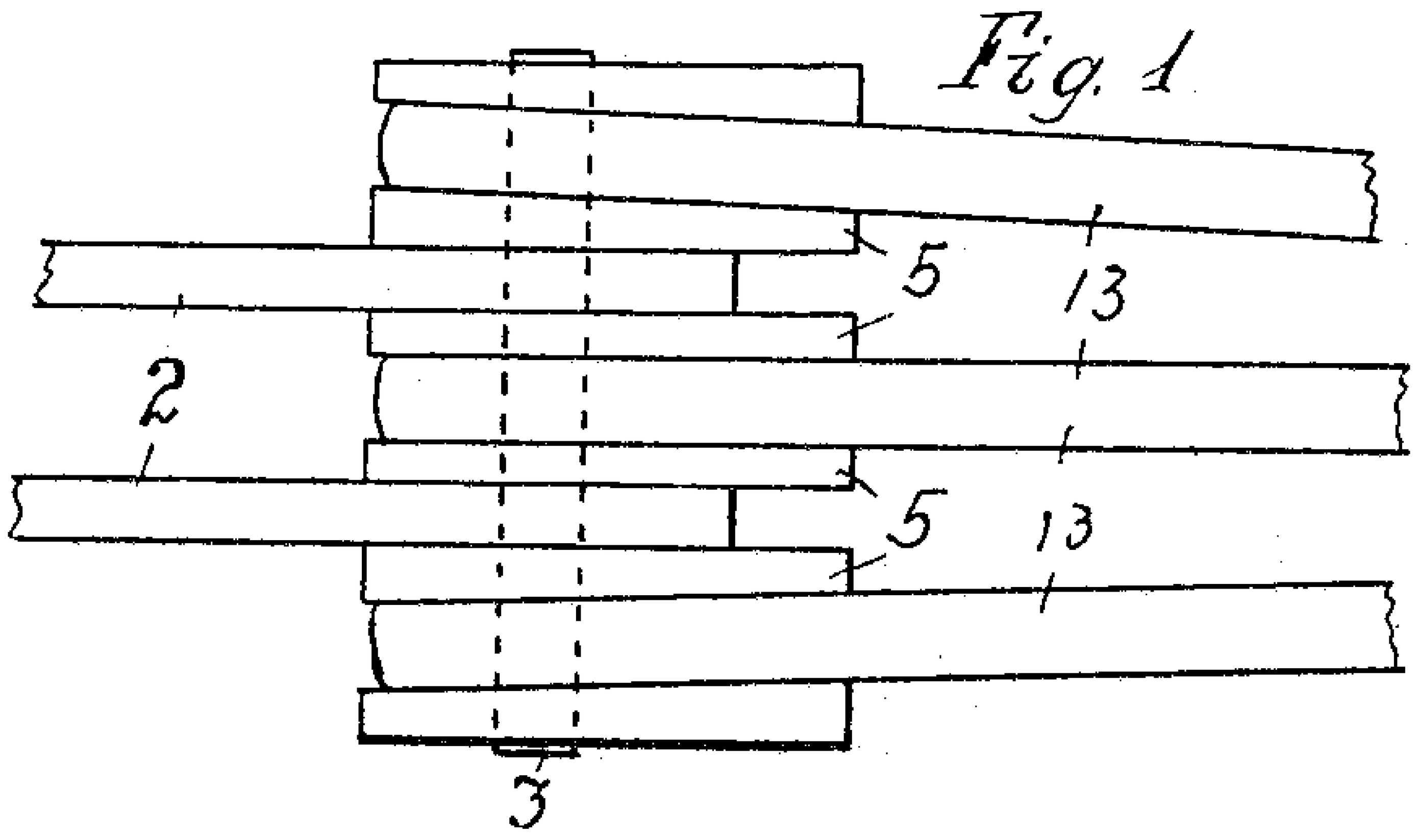


Fig. 1^a

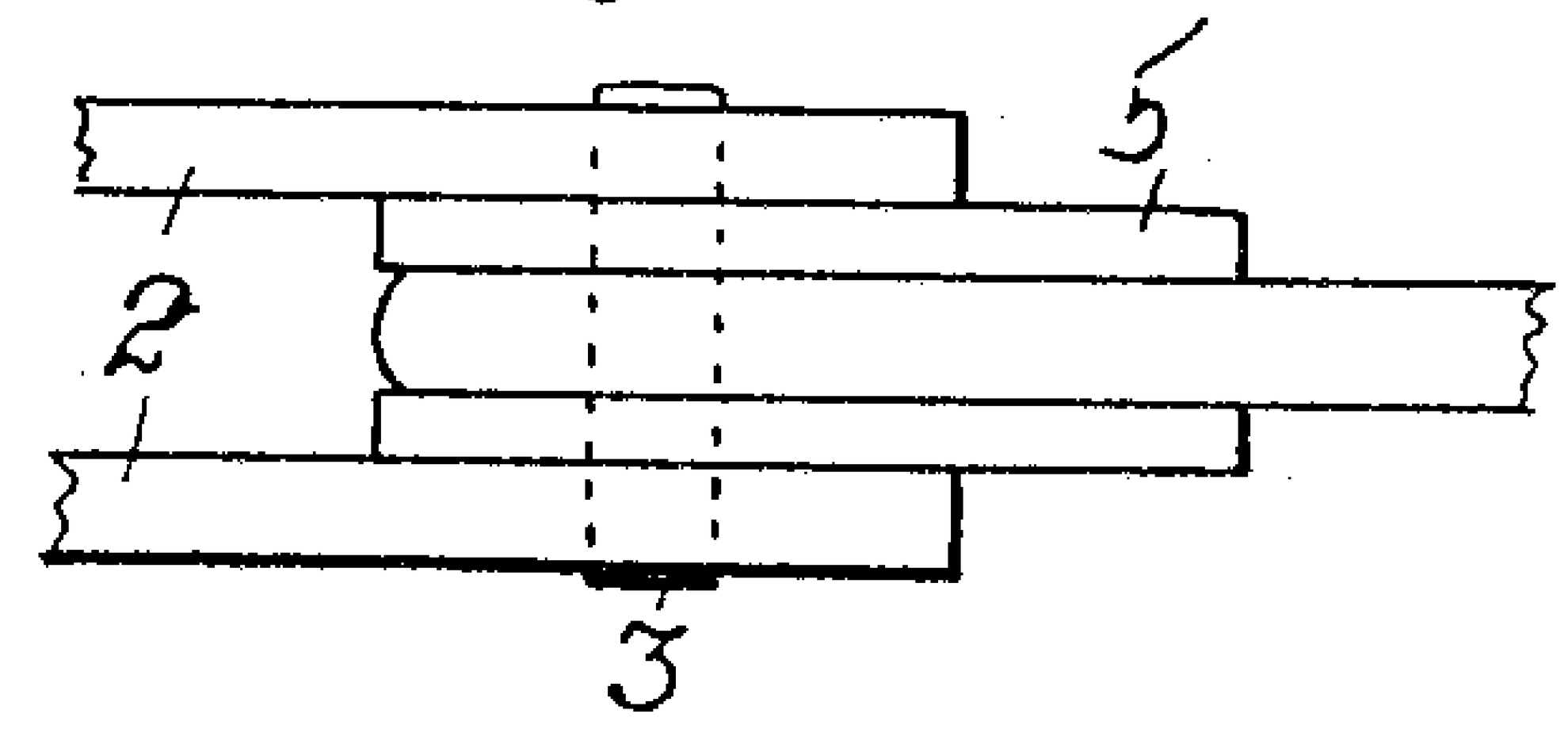


Fig. 2.

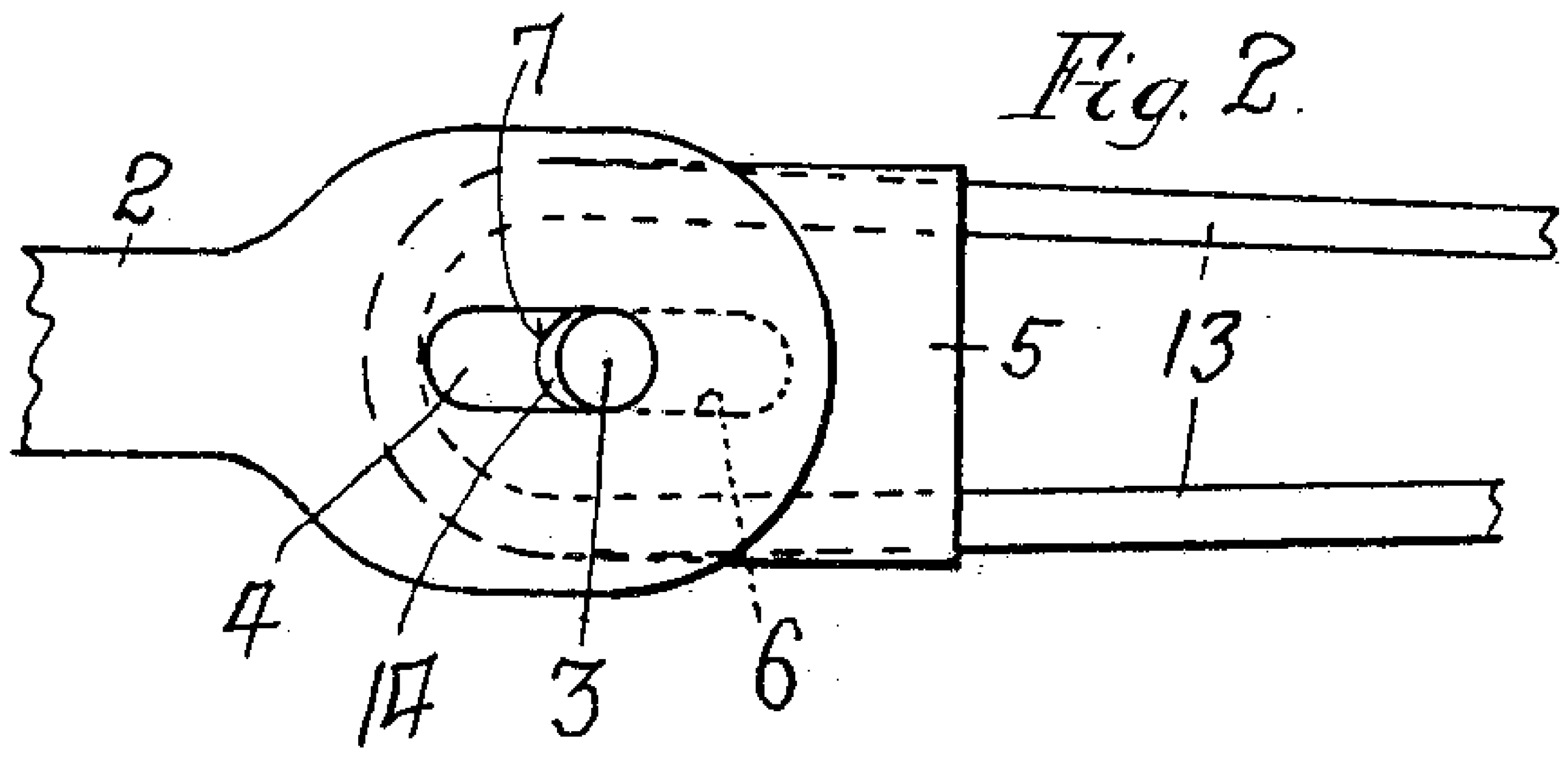


Fig. 2^a

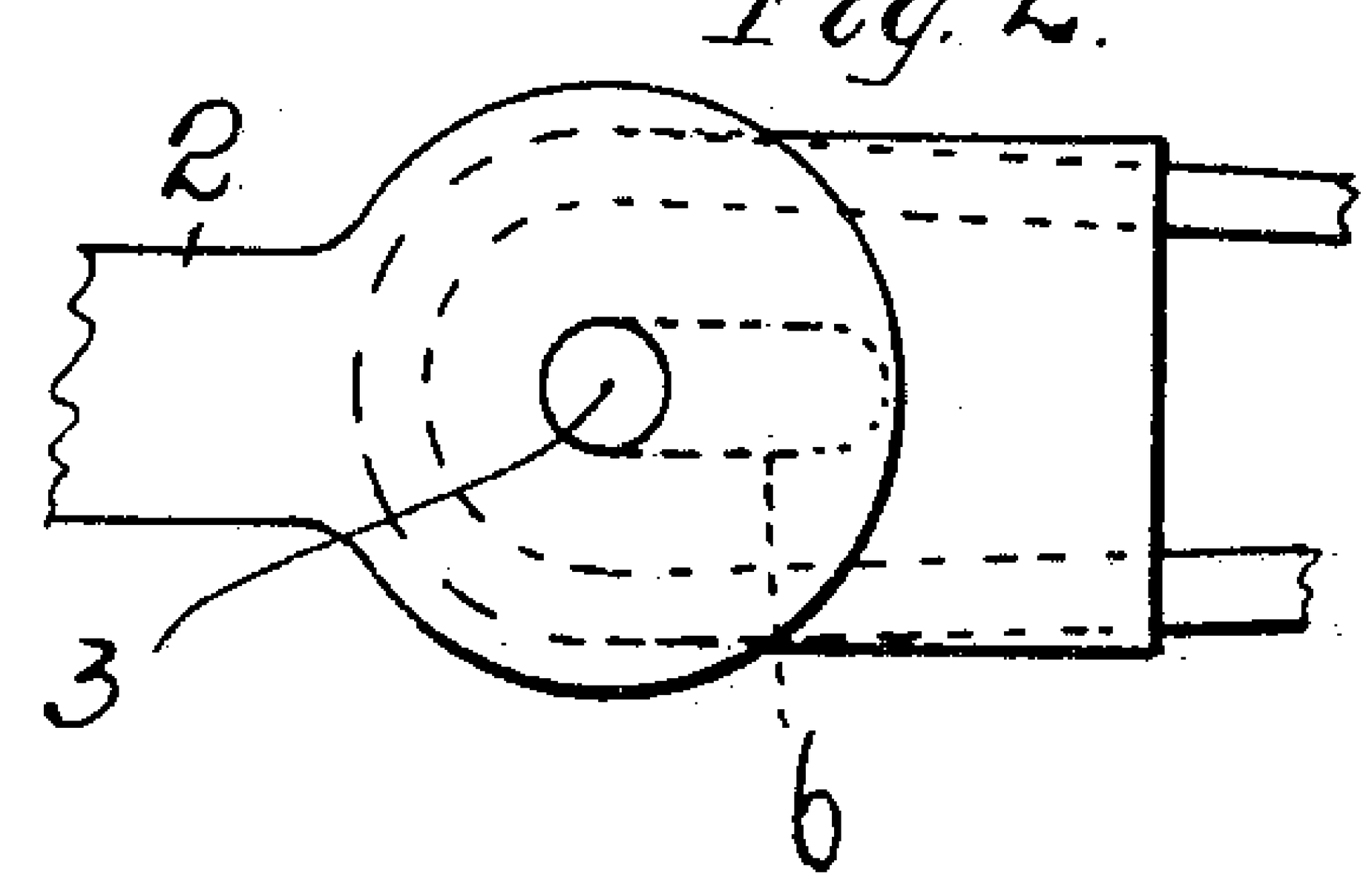
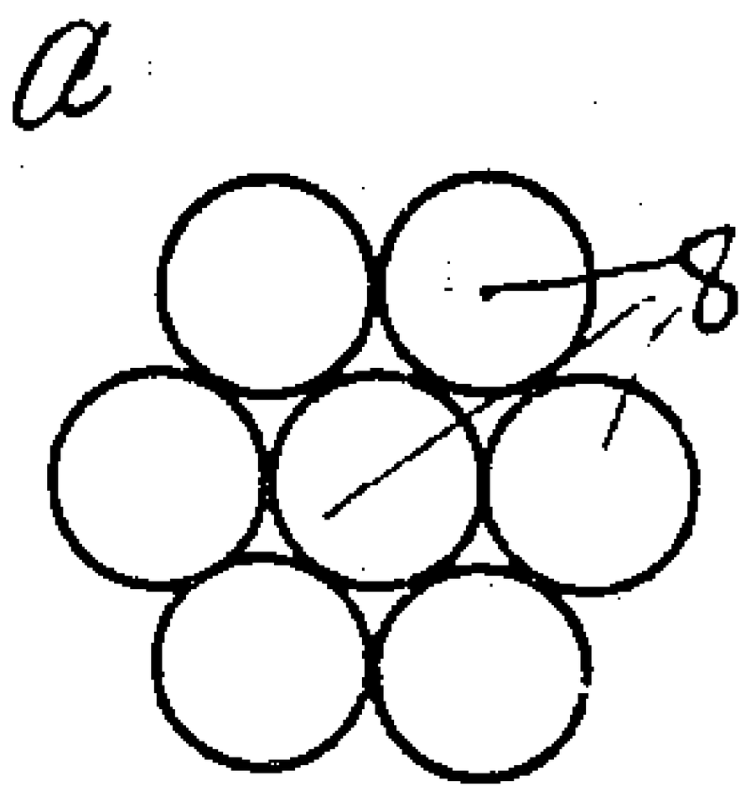


Fig. 3^a



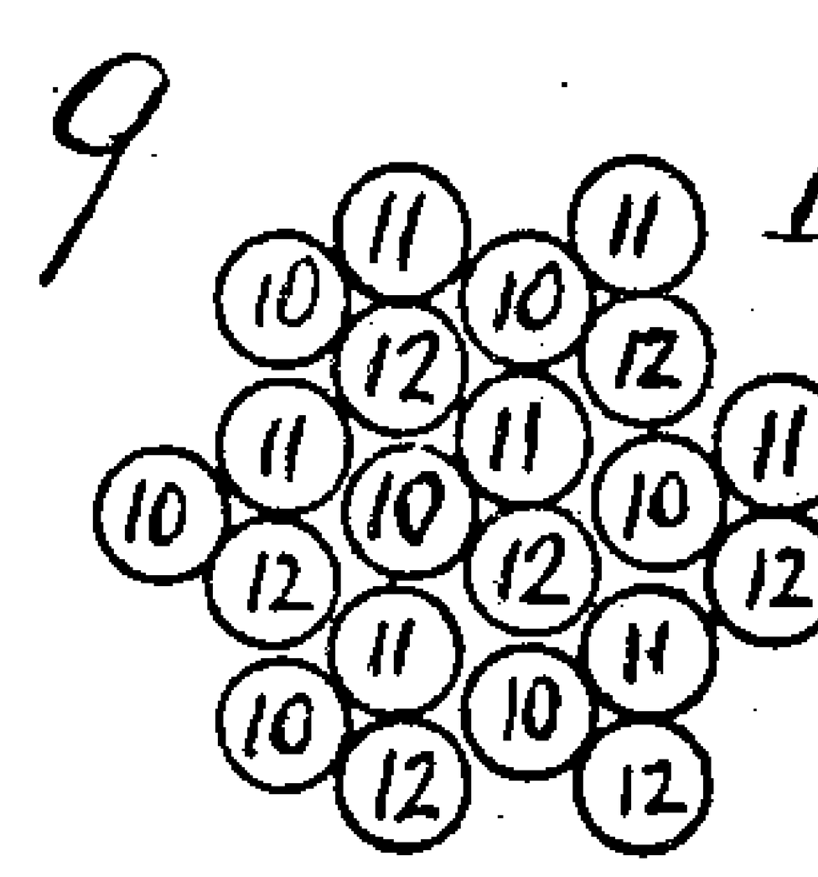


Fig. 3.

Fig. 4

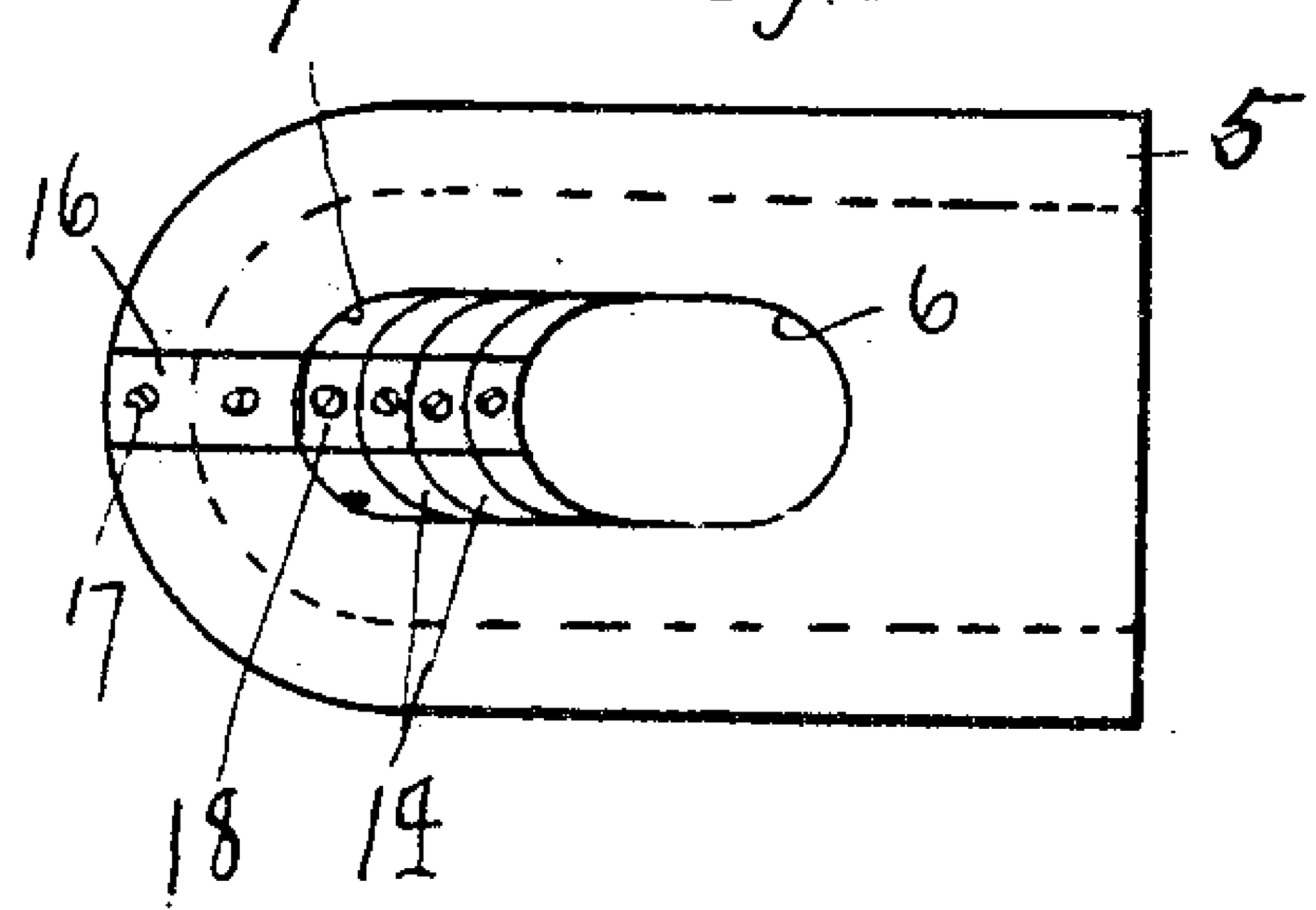
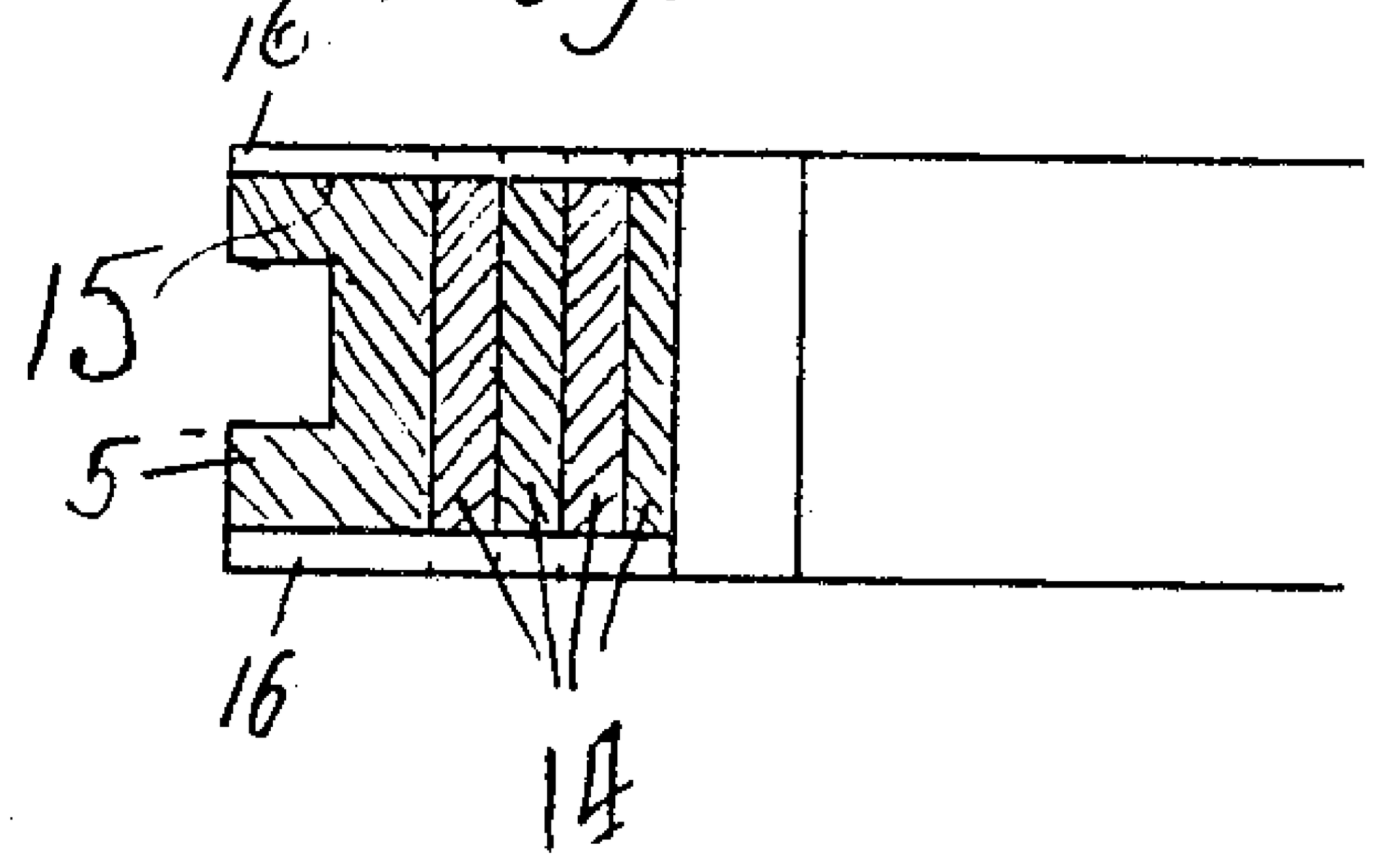


Fig. 5



Witnesses
[illegible]
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No. 782,027. Patented February 7, 1905.

UNITED STATES PATENT OFFICE.

WILHELM HILDENBRAND, OF NEW YORK, N. Y.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 782,027, dated February 7, 1905.

Application filed February 27, 1900. Serial No. 6,731.

To all whom it may concern:

Be it known that I, WILHELM HILDENBRAND, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, have invented a certain new and useful Improvement in Suspension-Bridges, of which the following is a specification.

The present invention relates to improvements in suspension-bridges, one object being to render the construction thereof less hazardous than heretofore.

Another object is to reduce the strains upon the "letting-off" apparatus.

Another object is to be able to lengthen strands as well as to shorten them.

Another object of the invention is to be able to vary the length of strands without removing the pins by which they are secured to the upper ends of the anchor-bars and other objects, as will hereinafter appear.

To these ends the invention consists of features of construction and combinations of devices hereinafter described, and more particularly pointed out in the appended claims.

In constructing cables for suspension-bridges of large span the strands are not built in their final positions; but the shoes for the ends of each strand are fastened to temporary bars and pins placed somewhat back from the final positions of the shoes, and after the strand is completed a suitable apparatus takes hold of each shoe, releases it from its temporary seat, and moves it—that is, "lets off the strand"—to its final position between two anchor-bars, where it is pinned.

In a prior method of attaching wire cables to anchor-bars there have been employed two such bars for each end of each of the strands making up the cable, the eyes of the strands being formed about metal shoes which are held between the anchor-bars by round pins, which fit round holes in the bars and abut against a semicylindrical end surface of oblong or elongated perforation or through-slots in the shoes or against segments or liners, which rest against said end surfaces. If when said end surfaces of the shoes rest against the pins the strand is not long enough, there is no way of lengthening it so that it can be used without changing the design of the entire bridge, though a strand which is too long may be shortened by pulling back the shoe and strand, drawing out the pin, lifting the shoe out, and placing one or more steel segments of suitable thickness against said end surface of the slot in the shoe, and then replacing the strand and shoe between the anchor-bars and replacing the pin. It is obvious that the pin must be removed from the slot in the shoe before the shoe can be taken out for the insertion of the liner segment or segments. This removal of the pin, the shoe, and the strand end is troublesome, laborious, and dangerous, since the strand must be held meanwhile against very great tension, sometimes as much as seventy (70) tons, and the operation becomes more troublesome, laborious, and dangerous when, as in another prior construction, one pin serves to retain several strands. In the latter case there are more eye or anchor bars by one than there are strands, so that each strand lies between two such eye-bars and the pin passes through all the bars and strand-shoes. In the last-named case it may be requisite that two or more of the strands shall be held temporarily while the pin is drawn or driven out and the required strand-shoe lifted out and the segments or segment inserted and also while these parts are being replaced.

According to the present invention each main strand is divided, by preference, into three substrands, and one end of each of these substrands is placed on a shoe between two eye-bars, and the ends of each of the other two substrands are placed on shoes which are mounted on extensions of the (single) pins by which each of the first-named shoes is secured to the eye-bars. The substrands are "regulated" separately in any suitable or known manner, the middle substrand—that between the eye-bars—being regulated first and the other two being regulated afterward without removal of the pin from its position, said substrands being put in place by slipping their shoes over the projecting ends or extensions of the pins by which the shoes for the middle substrand are held in place. In any given

bridge the number and size of the eye or anchor bars and the diameters of the pins do not in the new construction of the strands vary from what they would be were prior methods used; but the pins are longer in order to provide supports for the outside shoes. With the new construction and arrangement the letting-off apparatus need be only about one-third as strong as it must be in the case where the larger strand is to be let off, thus making its construction simpler, rendering it capable of being operated by hand, and reducing the dangers, especially since the loads are reduced about two-thirds. After being regulated the substrands are wrapped or clamped together to form a main strand, and the various main strands are subsequently formed into a circular or circularly-shaped cable in any suitable or known manner.

One part of my invention makes provision for the regulation of a strand after it is in place between two eye or anchor bars without the necessity of removing or disturbing the pin by which the shoe is fastened to the eyes. One or both of the eye-bars for each main strand is provided with an oblong or elongated perforation or through-slot having a round or semicylindrical end to form a seat for the said pin, said perforation or slot being of a size such that the segments or liners aforesaid may be inserted and removed therethrough, so that the segment or liner may be put in place between the shoe and the pin and also be removed therethrough without the pin being moved or displaced from its working position--that is, the regulating can be done in perfect safety without disengaging the shoe and the pin from each other, since should the letting-off apparatus fail the shoe can only move relatively to the pin by the distance separating said rounded end of the shoe-slot from the pin.

For the purpose of lengthening as well as shortening a strand—main or sub, as the case may be—I provide the usual slot in the shoes with a number of liners or segments, which are detachably secured in place in the slot. These segments are to be in place in the shoe when the strand is built and "let off." These segments may be held in place in the slot in any convenient manner, as by magnetizing one or more of them sufficiently to prevent them from falling out before the shoe bears against the pin, or rather before the inner segment bears against the pin, or the segments may be held in place by mechanical means.

In order to secure uniformity of size in a suspension-bridge cable and to render the wire forming the same equally flexible at all points, the ends of the separate wires making up the strand are united by brazing or soldering or by welding. The brazed or welded joint or union is practically of the same diameter as the wires and is equally flexible. In this way the inflexibility of prior unions or splices of the wires in suspension-bridge work is altogether avoided and a construction by which the union may pass around the small sheaves and other sharp curves without danger of breaking the union is provided. When the prior splices, as right and left threads on the abutting or adjacent ends of two wires and a right and left threaded sleeve-nut, a telegraph-wire splice, and tapered or scarfed joints and wire-wrapping thereon, come at such sharply-curved places, the splices must be cut and remade in order to transfer the splice to a straight portion of the strand; but the new unions may come at the bights or eyes of the strands and may pass around sheaves without danger of being broken. One advantage of the new union is that the cables and strands are of uniform size throughout, the humps and inequalities due to the prior splices being wholly eliminated. Also each wire is of uniform section and of equal flexibility throughout.

The invention is illustrated in the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view of an embodiment of my new method of forming strands and attaching them to anchor-bars. Fig. 1[a] is a like view of a prior method of making and attaching strands to anchor-bars. Fig. 2 is a side elevation of the construction shown in Fig. 1. Fig. 2[a] is a like view of the construction shown in Fig. 1[a]. Fig. 3 is a cross-section of a cable wherein the main strands are each composed of three substrands. Fig. 3[a] is a cross-sectional view of an ordinary cable having a number of strands equal in number to the main strands shown in Fig. 3. Fig. 4 is a side elevation, and Fig. 5 is a horizontal section, of a shoe and segments detachably connected thereto.

The same reference character will be employed to designate the same part in the different figures of the drawings.

2 indicates the upper ends of anchor-bars, to which the cable-strands are connected.

3 is a round pin or bar which fits in round holes in the bars 2 in the old construction, Figs. 1[a] and 2[a], and against the semicylindrical end of the through-slots 4 in the new construction of the anchor-bars.

5 represents metal strand-shoes or castings, each having the usual through-slot 6, provided with semicylindrical seats 7 to fit on the pins 3.

8 is the old strand, made up of straight parallel wires having eyes or bights therein to pass around the shoes 5, and 9 is the new main strand, made up of three substrands 10 11 12. The substrands 10 11 12 are formed with bights or eyes 13, which go over the shoes 5.

In Figs. 1 and 2 the pin 3 extends through and beyond both of the bars 2, and three shoes 5 are mounted thereon, one of these shoes being placed on the pin between the eyes of the bars 2 and the other two shoes being mounted on the projecting ends of said pin. The eyes 13 of the substrands 10 and 12 are on the shoes 5, which are outside of the bars 2, while the bight of strand 11 is on the shoe which is between the eyes of bars 2.

14 indicates a liner or segment between the pin 3 and seat 7 of a shoe 5. By removing said segment 14 the strand may be lengthened, thus increasing the sag thereof between its points of suspension. The substrands are clamped or wrapped temporarily or permanently to form a main strand, and all the main strands are brought together to form a cylindrically-shaped cable, which is then suitably covered.

Referring to Figs. 4 and 5, the shoe 5 is shown as provided with grooves 15 therein, parallel with the slot 6, and with bars 16, secured in said grooves by countersunk screws 17. The bars 16 extend partly across the slot 6 and embrace a number of segments or liners 14, which are notched at their ends to receive said bars 16. Small countersunk screws 18 serve to attach segments 14 to the bars 16 and hold the segments in place, abutting against the end face 7 of the slot 6. The described construction provides a means whereby the shoes and segments may be transported together and the strands be built up on the shoes while the segments are in place in the slots 6. The bars 16 may be nicked at each joint between segments, as indicated by the heavy lines, and also at the joint between the end segment and the end of the slot 6 in the shoe 5, so that they may be broken off with a chisel and hammer or the like when desired.

The strand or substrand is built around the shoe 5 in the usual manner and is let off in any usual way and the shoe pinned to its eye-bars 2 in its permanent position, the segments 14 being still in place in the shoe. If now the strand or substrand is too short, the strain is taken off the pin and the requisite number of segments removed. Thus if the strand or substrand is one-half inch too short and each segment 14 is one-quarter of an inch thick the adjustment is made by removing the screws 18 from the two inner segments 14 or those next the pin and breaking the bars 16 at the joint between the fourth and fifth segments, counting from the end face 7 of the slot 6. If the said shoe and segments be between anchor-bars which embody my present inprovement therein, the above-described operation is carried out through the slots 4 without moving the pin 3 in any manner, the segments removed being taken out through the said slots 4 or one of them. On letting off the strand the fourth segment from face 7 now comes against the pin 3, and the strand (or substrand) in the case assumed is lengthened by one-half inch, or the strand may be shortened by inserting one or more segments through a slot or slots 4, all without removing or disturbing pin 3.

While I have described the preferred form of my invention, I do not limit myself to the precise form thereof shown in the drawings and hereinbefore described, inasmuch as the invention may be embodied in many forms without departing from the scope of the claims herein.

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

1. In a suspension-bridge, a main strand consisting of three substrands, combined with two pairs of anchor-bars, and pins in said anchor-bars extending outside said bars on which pins the eyes of the substrands are all secured between and outside said pairs of bars.

2. A strand-shoe for a suspension-bridge provided with a number of segments detachably connected thereto and placed at one end of the slot therethrough.

3. A main strand for suspension-bridge cables consisting of three substrands each formed of a bundle of wires said substrands being united to form the main strand, a pair of anchor-bars at each end of said main strand, a pin for and extending through each pair of anchor-bars, and shoes for each substrand, the shoes for one substrand being between the members of said pairs of bars and the other shoes being outside of said bars, all in combination.

4. In a suspension-bridge, the combination of the two anchor-bars at least one of which is provided with an oblong perforation or through-slot, a strand-shoe, a segment, and a pin connecting said shoe and bars, and passing through said slot, whereby the segment may be inserted through said slot and placed between said pin and shoe and be removed without unpinning said shoe and thereby regulating or varying the length of the strand held by said shoe pin and bars, substantially as described.

5. In a suspension-bridge, the combination of two anchor-bars, a pin extending through and outside of each of said bars, a strand-shoe on said pin between said bars, strand-shoes on the projecting ends of said pin, and strands on said shoes, substantially as described.

6. In a suspension-bridge, the combination of two anchor-bars, a pin extending through and outside of each bar, at least one of said bars being provided with an oblong perforation or through-slot in which said pin rests at one end of the slot, a strand-shoe on said pin

between said bars, strand-shoes on said pin outside of said bars, and strands on said shoes, whereby segments for varying the length of the strand on the middle shoe may be inserted and removed through said slot in said bar without unpinning the said middle shoe, substantially as described.

Signed at New York city, in the county of New York and State of New York, this 26th day of February, A. D. 1900.

WILHELM HILDENBRAND.

Witnesses:

RICHARD W. BARKLEY,

GUS. E. HENNING.