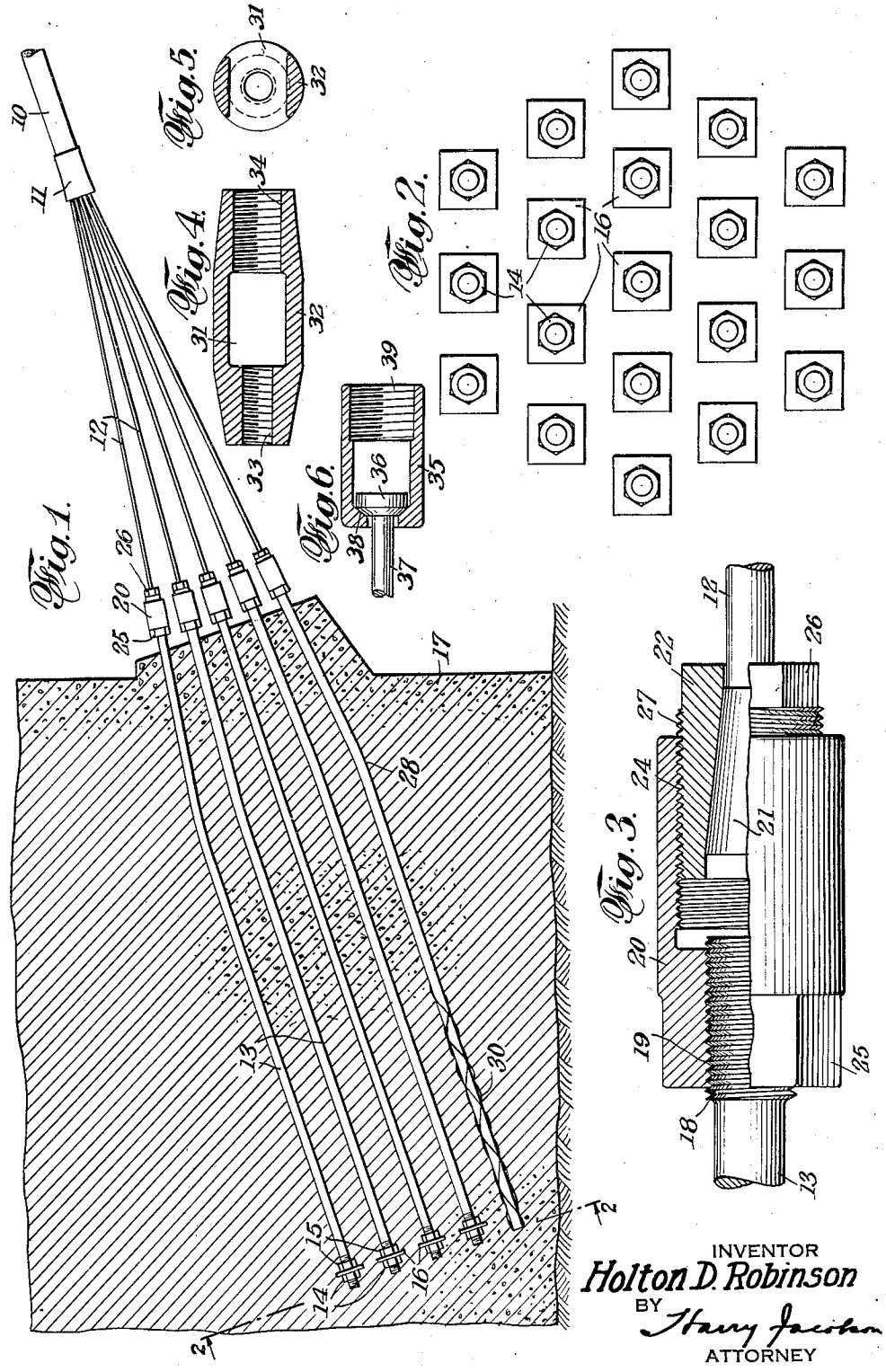
Aug. 16, 1938. H. D. ROBINSON 2,127,235

ANCHORAGE FOR SUSPENSION BRIDGE CABLES

Filed Oct. 24, 1936



INVENTOR
Holton D. Robinson
BY
Harry Jacobs
ATTORNEY

Patented Aug. 16, 1938

2,127,235

UNITED STATES PATENT OFFICE

2,127,235

ANCHORAGE FOR SUSPENSION BRIDGE CABLES

Holton D. Robinson, New York, N. Y.

Application October 24, 1936, Serial No. 107,406

9 Claims. (Cl. 14—21)

This invention relates to anchorages for suspension bridge cables and relates particularly to the means for anchoring the ends of the separate strands divided from the cable.

It has been customary in the past, to separate the individual strands which go to make up a suspension bridge cable and to anchor the strands in suitable masonry or concrete anchorage piers by means of various systems of bearing blocks, pins, plates, eye bars, and similar structural members. Such anchorages have customarily been used in connection with strands composed of wires twisted together in various ways so that the strand may be manipulated as a unit. At the ends of the strands there are usually provided strand sockets, each firmly secured to the strand end and provided with a suitable bearing surface. The socket is also provided with means, often in the form of a hook, whereby the socket may be engaged by a suitable jack or pulling device and tension put upon the strand to adjust the position of the ends thereof.

Means have also been provided for transferring the tension in the strands to the anchorage pier. Such means has taken various forms, but in most cases, involves the use of numerous pins, plates, and/or shims, and/or bearing blocks finally connected to tension members embedded in the pier, and thereby indirectly connecting the strand sockets to the embedded tension members.

Such anchorage structures are comparatively complicated and cumbersome and expensive both in materials and in labor, necessitating the use of a great number of parts and connections and the careful and accurate assembly thereof, including the pulling of the strand by a jack and often the insertion of shims in place.

My invention therefore contemplates the provision of a simple, economical but efficient anchorage means utilizing comparatively few parts, and adapted to be quickly and easily assembled and adjusted to put the required amount of tension upon each individual strand, independently of the tension on the other strands, by a simple and rapid operation.

My invention further contemplates the provision of an anchorage structure wherein the connecting means between the strands and the anchorage pier are adapted for exposure if desired in the open for easy access for the purposes of inspection, painting or repair, and which provides no inaccessible spaces for the accumulation of foreign matter, whether the connecting means are arranged in the open or in a chamber in the interior of the anchorage pier.

My invention further contemplates the provision of a direct adjustable threaded connection between each individual strand and the aligned member provided for transferring the stress from the strand directly to the anchorage pier, whereby the tension on each strand may be individually adjusted to the proper amount, the connection having a sufficient range of adjustment to compensate for errors in the length of the socketed strand.

The various objects of the invention will be clear from the description which follows and from the drawing, in which,

Fig. 1 is a side elevation of my new anchorage, partly in section.

Fig. 2 is an inclined section taken on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section of my new adjustable connection between the cable strands and the anchorage rods.

Fig. 4 is a similar section of a modified form of the connecting member.

Fig. 5 is a cross-section of the same.

Fig. 6 is a longitudinal section of another modified form of the connecting member.

In the practical embodiment of my invention which I have shown by way of example, the cable 10 is composed of a number of strands, the wires of which may be arranged in parallel relation or which may be twisted together in any of the usual ways. The finished cable 10 may be compacted and if desired wrapped with wire as is usual. The usual play casting or sleeve 11 is also provided in the finished structure to hold the strands 12 together in advance of their points of divergence. Beyond said casting, the individual strands 12 are separated and diverge from each other to the required extent to permit their connection to the tension transfer members. Said members may take any of the usual forms, but for purposes of illustration are here shown in the form of anchorage rods 13. The cable may have as many strands therein as may be required, but for the purposes of illustration, I have shown a cable with 19 strands, whereby 19 anchorage rods are provided, one for each strand.

As shown in Fig. 2, the anchorage rods 13 may be arranged in any convenient manner, the form shown being that of a hexagon, though it will be understood that any other form such as that of a circle, rectangle, square or other polyg-

onal figure may be used, if found convenient or desirable, and as will be obvious and therefore requires no illustration. Each of the rods 13 is embedded in the anchorage pier 17, which may be of masonry, concrete, or other suitable heavy material customarily used for that purpose. Any suitable means may be employed for bonding the rods 13 to the anchorage pier 17, to transfer the stresses in the rods to the pier. As a typical form of bonding or anchoring means for the embedded tension members, I have shown at the outer end of each of the rods, a pair of nuts 14, 15, between which the bearing plate 16 is fastened, the rod being suitably threaded so that the nuts 14, 15 may be tightened against the plate.

It being understood that substantially the entire rod 13, except the innermost end portion thereof, is embedded in the anchorage pier, it will be seen that tension transmitted from the strand 12 to its anchorage rod 13, is put upon the bearing plate 16 and thence transferred directly to the pier.

Instead of using a number of individual plates 16, one for each rod 13, it is obvious that a single plate provided with suitable perforations for the passage of all of the rods may be used, if a greater bearing surface is found advisable. It will also be understood that the bearing plates 16 and holding nuts 14 and 15 may be omitted and that the tension members as 30 may be roughened or provided with suitable projections or deformations for approximately one-third of the lengths thereof in much the same manner in which reinforcing rods for concrete are made, to provide an adequate bond between the tension members and the material of the anchorage pier 17, the precise form of the connection between the embedded tension members and the anchorage pier being immaterial to the present invention.

In that form of my invention shown in Figs. 1 and 2, the inner or forward end of each of the anchorage rods extends beyond the anchorage pier 17, but whether it so extends or whether it is arranged in a hollow chamber in the pier, it is provided with a suitable preferably enlarged threaded portion 19 of substantial length and engaging the internal threads 19 of the sleeve 20.

The extreme end 21 of each of the strands 12 is of generally conical shape, the wires thereof being wedged apart, and maintained in said shape in any well-known manner. The strand end 21 is firmly secured in the correspondingly shaped opening of the externally threaded socket 22. Said socket is of substantial length and the threads 27 thereof are in engagement with the internal threads 24 of the sleeve 20.

At its outer end, said sleeve may be provided with a hexagonal portion 25 adapted for engagement by a wrench to rotate it relatively to the rod 13 and the socket 22. A similar hexagonal portion 26 is provided at the inner end of the socket 22 for the application of a wrench thereto to prevent it from turning when the sleeve is rotated.

It being understood that the threads 18 at the end of the rod 13 are right-hand threads and that the threads 24 of the sleeve and the corresponding threads 27 of the socket are left-hand threads, or vice versa, rotation of the sleeve will move the rod 13 and the socket 22 in opposite directions, either toward each other or away from each other. Said sleeve when rotated in the proper direction, pulls the strand to its proper stressed position. The sleeve and the threads thereof, are made of substantial length.

After the rods 13 and the strands 12 have been arranged in place, and the strand ends secured to their sockets 22, the ends of the threads 24 in the sleeve may be engaged with the threads of the socket, before or after said sleeve has been partly threaded on to the corresponding rod 13. Rotation of the sleeve in the proper direction causes said sleeve, as viewed in Fig. 3, to advance toward the left carrying with it the socket 22 and the strand 12. At the same time, the threads 24 advance on the threads 27, drawing the socket 22 into the sleeve and taking up the slack in the cable strand. The relative rotation of the sleeve and socket may be continued until the cable strand has been tensioned to the exact amount required. The operation may be repeated on each of the strands, each strand being separately adjustable and separately put under tension independently of the tension on the other remaining strands.

While the member 20 has been shown in the form of a sleeve, it will be understood that it may be made in any of the well-known forms in which turnbuckles are made, such as is for example shown by the turnbuckle 32 of Figs. 4 and 5. The turnbuckle 32 is provided with the transverse opening 31 and with the right and left-hand internal threads 33 and 34 adapted respectively to engage the threaded end of the tension member and the threaded strand socket. A bar or the like may be inserted into the opening 31 to rotate the turnbuckle.

As shown in Fig. 6, the connecting means for directly connecting the socket 22 to the tension member may take the form of the union member 35, which engages the enlarged head 36 at the end of the tension member 37. The head 36 engages the preferably beveled bearing surface 38 of the member 35, which is threaded as at 39 to engage the threads 27 of the socket 22. It will be understood that the member 35 is arranged at its proper place on the tension member 37 before said tension member is embedded in the anchorage pier. It will also be seen that rotation of the member 35 in the proper direction will advance the threads 39 thereof on the socket threads and put the desired tension on the strand.

Since the anchorage pier 17 may be constructed at the same time that or before the tower and cable work on the bridge is being done, the completion of the anchoraging operation on the cable strands becomes a comparatively simple one. After the rods 13 have been properly set in the anchorage pier, with the inner or forward parts of the respective rods in alignment with the final taut positions of the diverging corresponding strands, all that is required is the connection of the strand socket directly to its corresponding pre-set rod by means of the sleeve 20 or turnbuckle 32, or union 35, whereby the strand becomes substantially aligned with its rod. The adjustment of the turnbuckle, sleeve or union may then proceed.

If it becomes desirable to lessen the space in the anchorage pier to be occupied by the rods, or to lessen the spread of said rods, each of the rods 13 may be provided with a suitable slight bend 28 to arrange the rear or outer parts of the rods in substantial parallelism or at least to decrease their angle of divergence. Since great stresses are involved in suspension bridges, the distribution of such stresses to the piers presents a difficult and complicated problem. It will be

seen that the problem of distribution of the stresses has been adequately solved by the simple threaded connection of the present invention. It will further be understood that while I have described the tension members 13 as rods, any suitable structural members such as bars, or other common forms of tension members may be used instead, if desired, it being advisable only that one of the ends or a member attached to said ends be enlarged and/or properly threaded for engagement with the connecting member.

It will further be seen that I have provided a structure, which while simple in construction and assembly and comparatively inexpensive, efficiently solves the problems involved and meets the severe requirements of practical use.

While I have shown and described certain specific embodiments of my invention, I do not wish to be understood as limiting myself thereto, but intend to claim my invention as broadly as may be permitted by the state of the prior art and the scope of the appended claims.

I claim:

1. In an anchorage for a suspension bridge cable having the individual strands thereof separated and diverging at the end part of the cable, an anchorage pier, inaccessible elongated tension members embedded in and in surface contact with the interior material of said pier, each of said tension members being aligned with one of the separated strands and having an exposed externally threaded end portion thereon, an externally threaded socket secured to the extreme end of each of the strands, and a threaded turnbuckle engaging the threaded end of the tension member and the threaded socket.

2. Strand adjusting and tensioning means for anchoring the diverging ends of suspension bridge cable strands to an anchorage pier comprising a threaded socket secured to the end of each of the strands, a tension member for each strand aligned at least in part with the strand and immovably embedded in the pier and having a threaded end, and an adjustable threaded member directly engaging and connecting said socket and said threaded end.

3. The combination with the individual strands of a multiple strand suspension bridge cable of means for adjustably anchoring each of said individual strands and for individually tensioning said strands comprising means for holding parts of said strands inwardly of the end portions thereof in contacting relation, said end portions of the strands being free of any connection with each other and arranged in diverging relation, a threaded member secured to the end of each strand, a tension member substantially aligned at least in part with the diverging end part of each strand, a pier in which the tension member is anchored independently of its strand and with the inner ends thereof projecting from the pier, and a socket in threaded engagement with the threaded member of each strand and engaging the inner end of the tension member projecting from the pier.

4. Strand adjusting and tensioning means for anchoring the diverging ends of the strands of a multiple strand suspension bridge cable to an anchorage pier comprising a threaded socket secured to the end of each of the strands, a tension member for each strand aligned at least in part with the strand and embedded in the pier with an end part thereof projecting from the pier, and an adjustable threaded member directly engaging and connecting the socket and said projecting end part.

5. In an anchorage structure for the cable strands of a suspension bridge, a cable comprising a plurality of strands, the end portions of said strands being exposed and accessible and being arranged in independent diverging relation free of any connection with each other, an anchorage pier, a series of inaccessible tension members embedded in and immovably bonded at the surfaces thereof to the material in the interior of said pier and in spaced relation to each other, and each having an accessible externally threaded end portion, an externally threaded socket at the end of each of the strands of the cable, and an internally threaded turnbuckle in the form of a sleeve directly engaging the threads of each of said tension members and also engaging the threads of a corresponding socket, the threads of said tension member and said socket being of opposite hand, and said turnbuckle closing the space therebetween against the accumulation of foreign matter.

6. An individual anchorage for each of the individual strands of a multiple strand suspension bridge cable, each of the strands being provided with an independently movable and accessible end portion free of any connection with the end portions of the remaining strands of the cable and diverging therefrom, a socket for the end of each end portion, a relatively fixed and immovable tension member for each of said end portions, means for fixing the tension member against movement irrespective of the movement of the strand, and means concentric with and rotatable about the axis of each strand end portion for connecting each strand socket to its tension member independently of the remaining strands and tension members, said means being adjustable on the rotation thereof to put a predetermined tensile stress upon the strand and being adapted to draw together said socket and tension member on the rotation thereof in one direction.

7. In an anchorage for individually anchoring each of the independent diverging end portions of the strands of a multiple strand suspension bridge cable, said end portions being exposed and accessible for painting and repair, a threaded socket for each strand end, a fixed anchored tension member in the form of an elongated rod for each strand, a turnbuckle directly connecting the socket to the tension member, and means arranged inwardly of the diverging end portions of the strands for holding said strands together and in contact with each other.

8. In an anchorage for a multiple strand cable of a suspension bridge, a plurality of strands in the cable, a member embracing and holding said strands together, diverging end portions on the strands beyond said member, and an anchorage device for each of the individual strands comprising an anchorage pier, a socket for each of the ends of the strands, a tension member for each of the strands, each of the members being partly embedded in the interior of and held immovable by the surrounding material of the pier, and a screw threaded member in direct engagement with and adjustably connecting each of the sockets and a corresponding tension member.

9. Strand adjusting and tensioning means for anchoring the outer ends of the strands of a multiple strand suspension bridge cable to an anchorage pier comprising means for holding

the strands together with the end portion of each strand freely movable in all directions and means for maintaining said end portions in diverging relation comprising a threaded socket secured to the end of each strand, a tension member having a part thereof aligned with the strand and immovably embedded in the pier, and a turnbuckle adjustably and directly connecting said part of the tension member and the socket.

HOLTON D. ROBINSON.