

March 24, 1931.

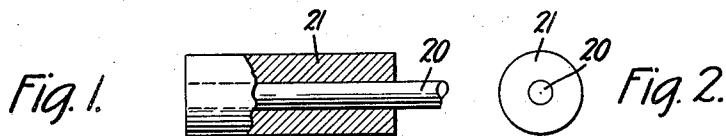
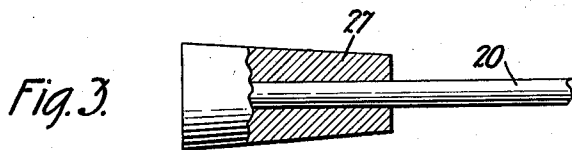
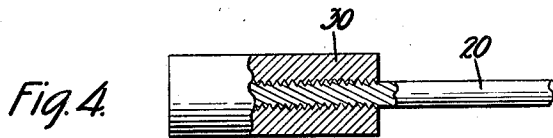
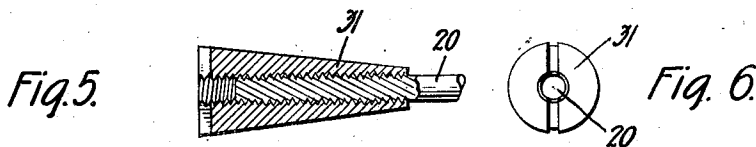
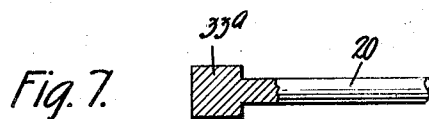
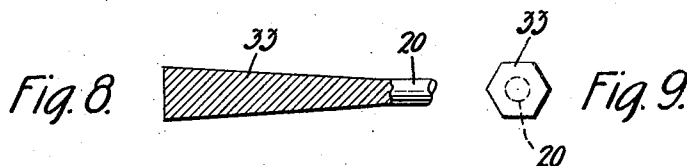
A. V. DE FOREST

1,797,759

WIRE STRAND UNIT

Filed Jan. 28, 1928

2 Sheets-Sheet 1



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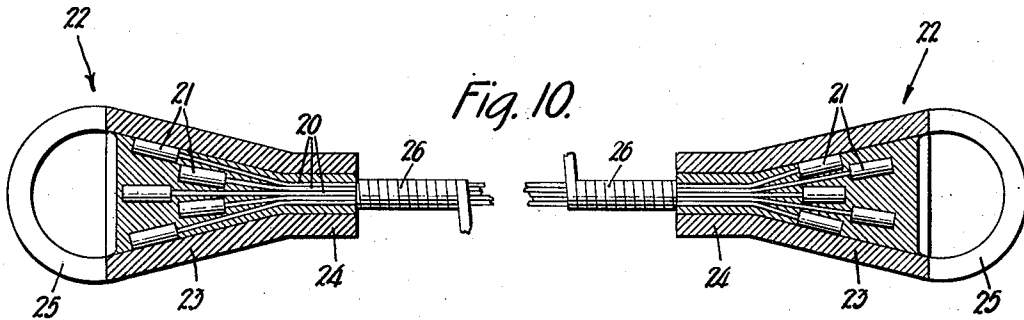
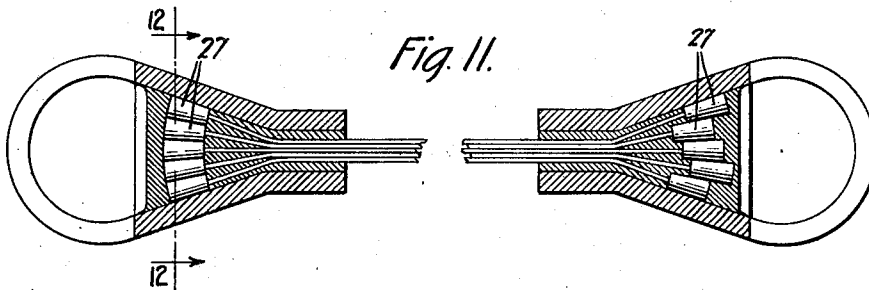
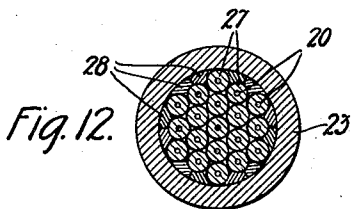
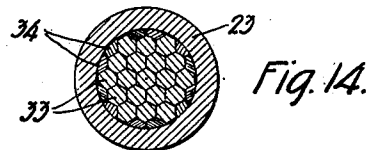
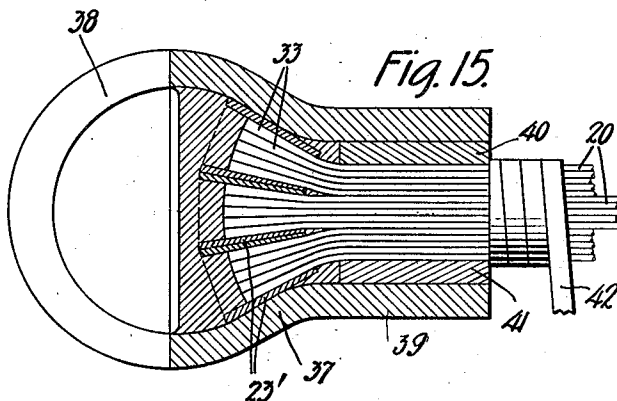
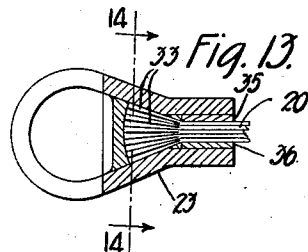
A. V. DE FOREST

1,797,759

WIRE STRAND UNIT

Filed Jan. 28, 1928

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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WIRE-STRAND UNIT

Application filed January 28, 1928. Serial No. 250,315.

The present invention relates to improvements in wire strand units and relates more particularly to tension units adapted for use in making the cables of suspension bridges.

5 Heretofore in building suspension bridges, it has been the practice to make the cable out of a number of strands, each strand being formed by spinning a wire back and forth between the anchorages, subjecting each
10 wire length to a predetermined tension as it is spun, so that all the wire lengths shall lie mutually parallel, and thereafter wrapping the strands with a suitable seizing to form a single cable. This process is time-consuming and difficult because of the unfavorable
15 conditions under which the work must be done, and it represents a very material part of the entire cost of constructing the bridge.

20 An object of the present invention is to reduce the cost of construction by providing wire strands of correct length for any given bridge, the strands being preformed instead of being assembled on the bridge.

25 Another object of the invention is to provide strands made of high tensile heat-treated wires, each strand consisting of a bundle of individual wires of length equal to that of the strand. It has not been considered practicable, before this, to use high tensile
30 heat-treated steel wire in bridge cables without special precautions, because of the stresses produced by bending the wire at the anchorages where the wire is looped over the anchor shoes. The present invention,
35 however, avoids the use of loops, and the strands are made up of substantially straight lengths of wire.

40 Another object of the invention is to provide improved anchorage means for securing the wires at their ends to suitable eyes, shackles or other attaching devices.

45 With these and other objects in view which will appear hereinafter, several embodiments of the present invention will now be described and thereafter the novelty and scope of the invention will be defined in the claims.

50 Fig. 1 is a view, partly in section, of one end of a wire on which a cylindrical sleeve has been applied to form a head;

Fig. 2 is an end view, as seen from the left-hand side of Fig. 1;

Fig. 3 is a view similar to Fig. 1, but in which a frusto-conical sleeve has been applied to the wire to form a head;

Fig. 4 shows another construction, viz., a wire with threads swaged thereon and a cylindrical sleeve screwed on the threaded wire end;

Fig. 5 is a view of a similar construction in which a frusto-conical head is screwed upon the end of the wire;

Fig. 6 is an end view as seen from the left-hand side of Fig. 5;

Fig. 7 shows still another construction, viz., a wire having a cylindrical head formed integrally thereon;

Fig. 8 is a similar view showing a tapered head formed on the end of a wire;

Fig. 9 is an end view as seen from the left-hand side of Fig. 8;

Fig. 10 is a view in longitudinal section of the opposite ends of a completed strand, in which the wires are formed with cylindrical heads;

Fig. 11 is a similar view in which the wires are formed with frusto-conical heads;

Fig. 12 is a view in cross-section taken on the line 12—12 of Fig. 11;

Fig. 13 is a view in section of one end of a completed strand in which the wires are formed with hexagonal tapered heads of the type shown in Figs. 8 and 9;

Fig. 14 is a view in section taken on the line 14—14 of Fig. 13; and

Fig. 15 is a view in section of one end of a cable formed of a number of strands of the type shown in Figs. 13 and 14.

Wires which are to be placed under heavy tension, as, for instance, in bridge cables, should preferably be kept straight with no material bends therein to produce dangerous stresses. In order to anchor such lengths of wire, the present invention provides for the forming of a head at each end of each wire length. One form of head is shown in Figs. 1 and 2. The wire is indicated at 20 and secured thereon is a cylindrical sleeve 21. The sleeve may be pressed on by hydraulic pressure so as to adhere tightly thereto, and the

whole wire is then galvanized or coated with some suitable protective material to guard against rust.

The length of the sleeve should be such as to offer sufficient frictional engagement to prevent the sleeve from slipping under the tension to which the wire is to be subjected. The manner in which the wires are assembled to form a strand and anchored at each end in suitable sockets, is illustrated in Fig. 10. The socket 22 at each end of the strand consists of a frusto-conical hollow body portion 23 which terminates at its small end in a hollow neck portion 24 and may be provided at the opposite end with suitable attaching means such as a shackle or eye 25. In this socket the headed ends of the wires are introduced. The inner diameter of the neck portion 24 is such as to provide just sufficient clearance for the head of one of the wires to be inserted therethrough after all the rest of the wires have been inserted in the socket. In other words, if the strand is to consist of seven wires, the inner diameter of the neck 24 must be equal to the sum of the diameters of two wires plus the diameter of one of the heads; if, as shown in the drawings, the strand consists of nineteen wires, the inner diameter of the neck should be equal to the sum of the diameters of four wires plus the diameter of one of the heads, etc. The wires may therefore be introduced singly through the neck of the socket and after all the wires but one have been introduced, there will be space enough to pass the head of the last wire through the neck. In assembling the strand, it is preferable to arrange the wires somewhat after the fashion shown in Fig. 10.

It will be understood that all the wires are as nearly as possible of the same length and, in order to reduce the diameter of the body portion 23 as much as possible, it is preferable to stagger the heads, as shown in Fig. 10. Thus, the wire whose head extends farthest in the socket at one end of the strand, will not extend as far into the socket at the other end of the strand. After the wires have been introduced, the neck of each socket is closed and molten zinc or other suitable metal is poured into the socket, firmly embedding the wires therein. This done, the wires between the sockets are seized with a winding of wire or tape 26, thus completing the strand. Under some conditions the embedding of the wire heads in metal at one end of the strand may be deferred until after the seizing has been completed.

Strands so made in the shop may then be coiled on large reels and carried to the site of the bridge where they may be set up in place as a single strand, instead of following the usual laborious method of building up the strand in situ.

The wire end shown in Fig. 3 differs from that in Fig. 1 only in the fact that a tapered

or a frusto-conical head 27 is applied to the wire 20. This permits of assembling the wires after the manner shown in Fig. 11. The taper of the head 27 is such that, when the heads are all assembled in the socket eye, they will fit snugly one against the other throughout their entire length and certain of the outer heads will also contact throughout their entire length with the side wall of the sleeve portion 23 of the socket. While this may be true of one end of the strand, as shown at the left in Fig. 11, it may not necessarily be true of the opposite end of the strand, owing to slight variations in the length of the wires, and the heads may assume the position shown at the right-hand end of Fig. 11. In any case, however, a much closer fit will be obtained by this construction than is shown in Fig. 10.

As shown in Fig. 12, the heads of the wires, when nested together, contact with the socket 23 at six points, and a hexagonal envelope or socket would be required to contact with all the outer wire heads. As it is preferable to use a socket of circular cross-section, wedges 28 are driven between the wire heads and the socket member to fill up the gaps between the hexagonal group of wire heads and the circular envelope of the socket. These wedges may be tapered plugs of circular cross-section or they may be shaped as illustrated to conform on one side to the socket and on the other side to the wire heads.

The construction shown in Fig. 4 differs from that in Fig. 1, only in the fact that a cylindrical head 30 is threaded on the wire 20. This is done by swaging a thread on the end of the wire 20 and thereafter screwing the head 30 on the threaded wire end. By this means the head may be securely attached to the wire.

Fig. 5 shows a similar construction in which a frusto-conical head 31 is substituted for the cylindrical head 30. In the latter case, preferably, the head 31 is formed with a slot at its outer end to permit of applying a screw driver thereto. With this construction the wires may readily be nested together at each end of the strand in the manner shown at the left-hand end of Fig. 11. In other words, if there are slight variations in length of the wires, these variations may be taken up by screwing the heads further on or off the wire, as the case may be, so that they will all bear snugly against each other and against the side wall of the socket body or the wedges driven therein.

The construction shown in Figs. 7 and 8 differs from that shown in Figs. 4 and 5 in the fact that the heads 33a and 33 are formed integrally on the wires. This is done in the case of high tensile heat-treated wire by upsetting the wire at the proper points thereon before it is heat-treated. An advantage of this system is that heads of smaller diameter may be employed. The head 33a is cylin-

dricul and because it is an integral part of the wire, it need not be as long as the cylindrical heads 21 and 30 which must have sufficient length to provide the requisite grip on the wire.

The head shown in Fig. 8 is preferably hexagonal in cross-section so that, when the wires are assembled, they will fit snugly against each other after the manner shown in Figs. 13 and 14. As in the construction shown in Fig. 12, the wire heads in the socket form a hexagonal group, leaving gaps between the group and the inner wall of the socket. These gaps are closed by plugs 34 suitably shaped to snugly fit therein.

The construction shown in Fig. 13 differs from that shown in Fig. 11 also in the fact that a bushing is provided to fit around the wires after they have been assembled in the socket. This bushing fills the space between the wires and the neck portion 24 of the socket. Preferably, the bushing is made of two semi-cylindrical portions 35 and 36 which are driven into the neck 24 after the wires have been assembled. Owing to the hexagonal form of the heads, it is not absolutely necessary to fill the socket with zinc, but this may be done if so desired, and is so indicated in Fig. 13. Owing to the fact that upsetting of the wire is done before the wire has been hardened by the heat-treating process, heads of ample size may readily be formed on the wire. The heads need not be as bulky as those shown in the previous constructions and, consequently, the diameter of the socket may be materially reduced.

While the socket members 23 are shown as formed with a shackle or eye 25, any other means may be provided for attaching the socket members to an anchorage or the socket itself may be socketed in an anchorage member.

In Fig. 15 is shown a cable or heavy tension unit made up of a number of strands, each strand being made up of a number of headed wires anchored in a socket member 23'. The socket members 23' have no shackle or eye 25, but serve, like the heads of the individual wires, to provide tapered or frusto-conical heads for the strands. These socket heads 23' are nested in a large socket member 37, also of frusto-conical form, with a shackle or eye 38 at the larger end thereof and a neck portion 39 at the smaller end of the socket. After the strands have been assembled in the socket member 37, the space between the strands and the inner wall of the neck portion is closed by means of a bushing which may consist of a pair of semi-cylindrical sleeves 40 and 41. As in the construction previously described in connection with the forming of the strands, the socket members 37 may be filled with molten zinc or other suitable metal in which the socket members 23' of the strands are embedded. After the

cable has thus been assembled, the strands may be bound together by a seizing of wire or tape 42.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. As an article of manufacture a tension unit comprising a plurality of substantially straight wires, a head on each end of each wire, and a socket member at each end of the unit, each socket member having a reduced neck portion through which the headed ends of the wires may be passed individually but not as a body.

2. As an article of manufacture a strand formed of a plurality of substantially straight wires, each wire having a head thereon, a socket member having a reduced neck portion through which the headed wires may be inserted individually but not as a body, and a plug of metal in the socket member in which the wires and heads are embedded.

3. As an article of manufacture a strand formed of a plurality of substantially straight wires, each having a head at one end thereof, and a socket member in which the wire heads are anchored, the socket member being of hollow tapered form with an opening at the smaller end thereof large enough to permit of passing the headed ends of the wires therethrough individually, but too small to permit of withdrawing the headed portions therefrom in a body.

4. As an article of manufacture a strand formed of a plurality of substantially straight wires each having a head at one end thereof, a socket member having a frusto-conical sleeve portion, the smaller end of the sleeve portion having an internal diameter substantially such that there will be just room enough to pass the head of one of the wires therethrough after all the rest of the wires of the strand have been inserted in the socket member, and a metal filling introduced in molten condition in the socket about the headed wire ends to form, when cooled, a solid plug adhering to the socket and in which the headed ends are embedded.

5. As an article of manufacture a strand formed of a plurality of substantially straight wires each having a head at one end thereof, a socket member in which the headed ends of the wires are anchored, the socket member having a frusto-conical sleeve portion and a neck portion at the smaller end of the sleeve of a diameter too small to permit the headed ends of the wire to pass therethrough as a body but large enough to provide clearance for the head of one wire after all the rest of the wires of the strand have been passed therethrough, and a bushing inserted in the said neck portion to take up the clearance between the neck portion and the wires.

6. As an article of manufacture a strand

formed of a plurality of substantially straight wires each having a head at one end thereof, a socket member in which the headed ends of the wires are anchored, the socket member having a frusto-conical sleeve portion and a neck portion at the smaller end of the sleeve of a diameter too small to permit the headed ends of the wire to pass therethrough as a body, but large enough to provide clearance for the head of one wire after all the rest of the wires of the strand have been passed therethrough, a bushing inserted in the said neck portion to take up the clearance between the neck portion and the wires, and a metal filling introduced in molten state into the socket member to form, when cooled, a solid plug in which the wires are embedded.

7. As an article of manufacture a strand formed of a plurality of substantially straight wires each having a tapered head at one end thereof, the heads when nested together forming a tapered strand head, and a socket member in which the headed ends of the wires are anchored, the socket member having a frusto-conical sleeve portion of a taper corresponding to that of a strand head and a neck portion at the smaller end of the sleeve of a diameter large enough to permit passing the headed ends of the wires therethrough individually but not in a body.

8. As an article of manufacture, a strand formed of a plurality of substantially straight wires each having a tapered head at one end thereof, the heads when nested together forming a tapered strand head of substantially hexagonal cross-section, a socket member in which the strand head is anchored, said socket member having a hollow frusto-conical sleeve portion of a taper corresponding to that of the strand head, the smaller end of the sleeve portion being large enough to permit of passing the headed ends of the wire therethrough individually but not in a body and wedges fitted between the sleeve portion and the sides of the hexagonal strand head.

9. As an article of manufacture, a strand formed of a plurality of substantially straight wires each having a tapered head of hexagonal cross-section at one end thereof, the heads when nested together forming a tapered strand head of substantially hexagonal cross-section, and a socket member in which the strand head is anchored, said socket member having a frusto-conical sleeve portion of a taper corresponding to that of the strand head and with the internal diameter of the smaller end of the sleeve portion large enough to permit the headed ends of the wires to be passed therethrough individually but not in a body.

10. As an article of manufacture, a strand formed of a plurality of substantially straight wires each having a tapered head of hexagonal cross-section at one end thereof, the

heads when nested together forming a tapered strand head of substantially hexagonal cross-section, a socket member in which the strand head is anchored, said socket member having a frusto-conical sleeve portion of a taper corresponding to that of the strand head and with the internal diameter of the smaller end of the sleeve portion large enough to permit the headed ends of the wires to be passed therethrough individually but not in a body, wedges fitted between the sleeve portion and the sides of the hexagonal strand head, and a metal filling introduced in molten condition in the socket about the headed wire ends to form, when cooled, a solid plug adhering to the socket and in which the headed wire ends are embedded.

11. As an article of manufacture, a tension unit comprising a tapered socket member, and a plurality of strands anchored therein, each strand being formed of a plurality of substantially straight wires with tapered sleeve members in which the wires are anchored.

12. As an article of manufacture, a tension unit comprising a plurality of strands, and a tapered socket member in which the strands are anchored, each strand being formed of a plurality of substantially straight wires formed with headed ends and of a tapered sleeve in which the headed ends of the wires are anchored, said sleeves when nested together forming a tapered unit head, and the socket member being tapered to correspond to and fit the taper of the unit head.

13. As an article of manufacture, a tension unit comprising a plurality of strands, and a tapered socket member in which the strands are anchored, each strand being formed of a plurality of substantially straight wires formed with headed ends and of a tapered sleeve in which the headed ends of the wires are anchored, said sleeves when nested together forming a tapered unit head, the socket member being formed with a tapered hollow body portion of a taper corresponding to that of the unit head and with a neck portion at the smaller end of the body portion, the internal diameter of the neck portion being large enough to permit of passing the strand sleeves therethrough individually but not in a body.

14. As an article of manufacture, a tension unit comprising a plurality of strands, a tapered socket member in which the strands are anchored, each strand being formed of a plurality of substantially straight wires formed with headed ends and of a tapered sleeve in which the headed ends of the wires are anchored, said sleeves when nested together forming a tapered unit head, the socket member being formed with a tapered hollow body portion of a taper corresponding to that of the unit head and with a neck portion at the smaller end of the body portion,

the internal diameter of the neck portion being large enough to permit of passing the strand sleeves therethrough individually but not in a body, and a bushing fitted into the neck portion to take up the clearance between
5 the neck portion and the strand wires.

In testimony whereof, I have signed this specification.

ALFRED V. DE FOREST.

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