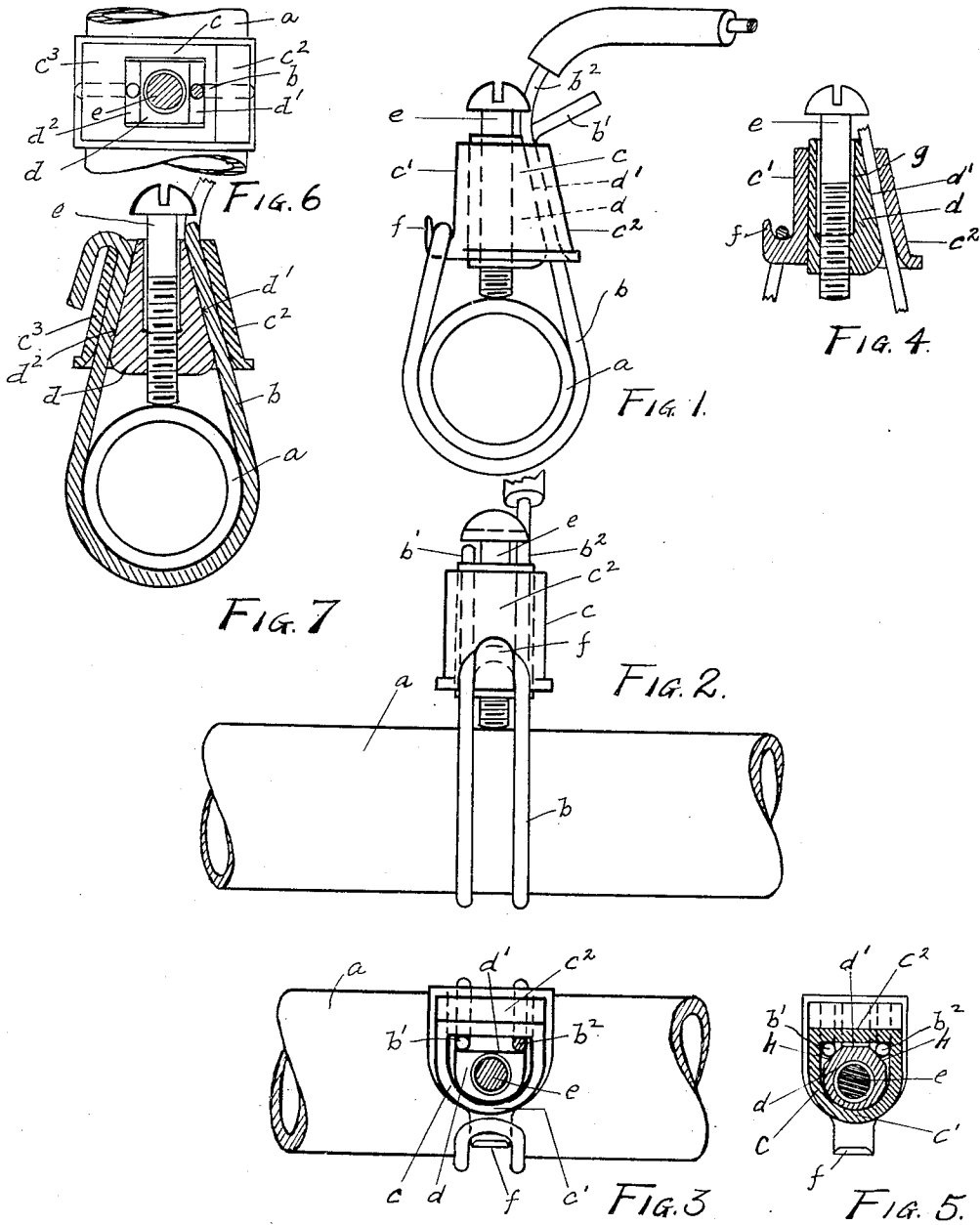


C. J. BARROW.
GROUND WIRE CONNECTION.
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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHARLES J. BARROW, a citizen of the United States, residing at Hull, in the county of Plymouth and State of Massachusetts, have invented new and useful Improvements in Ground-Wire Connections, of which the following is a specification.

The nature of this invention is in general an improved means for connecting or attaching a flexible element, such as a wire, to a pipe, electrical conduit, rod, bar, cable, or any other article or structure capable of being embraced by a wire, for the purpose of making an electrical or mechanical connection between the wire and such structure or for other purposes; and the specific embodiment thereof herein shown is a means for making the ground wire connection of an electric circuit. The object of the invention is to provide a simple means by which a wire or equivalent electrical conductor, or other flexible element, may be connected to a pipe or other structure, which may be electrically conductive, in a mechanically strong and substantial way, and when the connection is made in an electric circuit, with a substantial electrical contact as well; easily, quickly, without the use of solder, and also in a manner which permits of being readily connected and disconnected without the use of special tools; and to accomplish other results, the nature and manner of accomplishment of which are set forth in detail in the following specification.

The invention consists in the connector and the combination between the connector and the connected parts having the fundamental characteristics and details hereinafter described in the specification and pointed out in the claims, and in the method of making a connection between electrical conductors with the use of such a connection or connecting device.

In the drawings forming a part of this application,—

Figure 1 is a side elevation of a connector or connecting device embodying part of my present invention in association with the things which it is used to connect. Fig. 2 is an elevation as seen from the left of Fig. 1 of the same connecting device in the same association. Fig. 3 is a plan view of the same. Fig. 4 is a longitudinal section of the connection device. Fig. 5 is a cross section

of the connector illustrating a modification in a detail of construction thereof. Figs. 6 and 7 are respectively a plan view and a sectional view of another modification.

The same reference characters indicate the same parts in all the figures.

While I have hereinbefore designated the invention as being adapted specifically for a ground wire connection, and will thus refer to it in the following detailed description, I will state that this designation is not intended to limit the invention in any way or to exclude from the scope of protection which I seek the same or equivalent methods or devices applied to make any sort of electrical or mechanical connection for any purpose.

Referring now to the drawings *a* represents a pipe which may be considered as typifying a water pipe, a metallic conduit for receiving electrical conductors, a pipe hanger, a rod, a bar, a cable, or any other structure which may be required to be connected for any purpose to a wire or other flexible conductor or piece. *b* represents a flexible conductor which is to be coupled to the pipe, and is here shown as a round wire. *c* is the outer clamp and *d* the inner clamp of my connector, and *e* is a take-up member which is here shown as a screw passing through and having a threaded engagement with the inner clamp.

The outer clamp is preferably made as a thimble open at both ends, having a cylindrically curved wall *c'* at one side, an inclined plane wall *c''* at the opposite side, and intermediate connecting walls which may be of any form, but are preferably plane and arranged tangent to the curved wall *c'* and in planes at right angles to the inclined wall *c''*. At one side of the thimble is an outwardly projecting lug or hook *f*. This hook is preferably located at or near the middle of the curved wall *c'* and at or near the larger end for reasons which will presently appear.

The inner clamp is formed as a wedge, shaped similarly to the interior of the walls of the outer clamp or thimble, and having on one side (that opposite to the curved side) an inclined face *d'* which is similar and complementary to the inner surface of the inclined wall *c''* of the outer clamp. Such surfaces are the gripping parts of the connector. In the interior of the wedge is a

continuous passage or bore *g* substantially parallel to the longitudinal elements of the curved side, and consequently at an acute angle to the inclined face, of the wedge.

5 This bore is provided with screw threads through as great a part of its length as may be necessary complementary to the threads of the screw *e*. The wedge is of less width than the interior of the thimble, and the

10 radius of its curved side is somewhat smaller than the radius of the inner surface of the curved wall of the thimble, while the approximate axes of these curved surfaces are parallel, whereby the area of contact between the thimble and wedge at the side

15 opposite to the gripping surfaces, where the reaction of the gripping thrust is sustained, is limited to a relatively narrow tangent contact and lateral rocking motion of the wedge relatively to the thimble is

20 made possible. I will state here that I do not mean to imply by this description that such curved surfaces are necessarily truly cylindrical or even nearly approaching to

25 that form. It is sufficient for the purposes of this part of the invention that any form be given to the contacting abutting surfaces of the clamp members, at the side opposite to the gripping surfaces, which will allow

30 the inner member to rock relatively to the outer member.

When the connector thus described is put to use, a looped part of the wire passing through the thimble or outer clamp member

35 and around the pipe *a* is held gripped between the inclined wall of the same and the inclined face of the wedge, and the bight of the loop is engaged with the hook *f*. The screw bears at one end against the pipe and

40 exerts such pressure on the wedge that the clamp members are pressed against the ends of the loop and the wire passing around the pipe is held under tension. In this description the ends of the loop are considered

45 to be the two parts or lengths *b'* and *b²* of the wire which passes between the inclined faces of the clamp members. Of these the part *b'* is the actual end of the wire, and *b²* is an integral intermediate part between the

50 loop and the balance of the wire. The sides of the loop, between such ends and the bight, make bends which embrace and partly surround the pipe, and are spread apart to occupy planes on respectively opposite sides

55 of the take-up screw, as appears clearly in Fig. 2. I claim also as part of my invention the method of making a connection with the aid of the device thus described, or of an equivalent connector, comprised within

60 the following statement of the complete series of steps. The wire having first been laid bare of insulation, if previously insulated, is doubled to form a narrow loop

65 other conductor with which connection is to be made and to engage with the hook *f* and pass entirely through the thimble as to both ends, as shown. The loop so made is passed through the thimble from the small end thereof, the inner clamp having been

70 removed or partially withdrawn. Then the inner clamp is inserted into the outer clamp or thimble, the connector with the wire loop in it placed near the pipe, and the loop then bent around the pipe and caught over the

75 hook *f*. Before doing this, the screw *e* or take-up member has been backed off to allow the connection to be placed close to the pipe. Then the slack of the loop is taken up by pulling its ends through the thimble.

80 Finally the take-up screw is screwed down against the pipe and turned until first the ends of the loop are clamped between the clamp members, and thereafter the loop is drawn tight against the pipe. At this time

85 the wedge is enabled, by virtue of the construction already described, to rock upon its tangent contact bearing on the thimble in order to bear upon both parts of the interposed wire loop with equal force, in case

90 such rocking be made necessary either by inequalities in thickness of different parts of the wire or irregularities in the opposed clamping faces.

The order of the foregoing steps may be

95 modified without departure from the essence of the invention herein protected so far as modification or re-arrangement is physically possible. Thus, for example, in case the

100 wire should be so large and stiff that it can not easily be brought around the pipe and engaged with the hook after having been passed through the thimble, it may, of course, be sent into the required final form by any means prior to being placed in the

105 thimble and on the pipe.

It is to be understood of course that various modifications may be made in the proportions, dimensions, and form of the connector, provided the essential characteristics set forth in the following claims are preserved. For example, in Fig. 5 I have shown a modification which consists in beveling the corners of the clamp wedge at the

110 boundaries of the inclined face; thereby providing surfaces *h* which face the inner corners or angles of the outer clamp. Such beveled corners have the effect of applying gripping pressure to each end of the loop at

115 three points instead of two, and also of insuring and maintaining separation between such ends; but they are not essential for practical utility. They illustrate, however, one form of channel or wire way which may

120 be provided at desired locations in the gripping face of the wedge to confine and fix the location of the wire.

Figs. 6 and 7 illustrate the essential idea of the invention applied in a form in which

125 there is provided, instead of a hook such as

130

the hook *f* previously described, a second inclined gripping wall *c*³ on the outer member or thimble of the connector, and a complementary inclined surface *d*² on the inner member or wedge. In other respects this modification is like the form first described, and the same reference characters are used to designate like parts. The modification permits use of the connector without first forming an elongated loop in the wire, for the single end of the wire may be passed between the clamp members at one side around the pipe, and back through the clamp members at the other side, then secured and drawn tight against the pipe *a* by screwing down the take-up screw *e*. In order to prevent the entire connector slipping up along the stretches of the wire without binding, as might happen in the case of a large gage and, consequently, relatively stiff wire, the extreme end of the wire may be bent over the wall *c*³, thereby serving as an anchorage to hold back the outer clamp member until the inner member or wedge has been caused to grip the wire. However, with this form of connector also, the wire may first be bent into the elongated loop form already described and engaged with the connector and passed around the pipe and the bight of the loop bent over the wall *c*³ as last described. The formation of the wire into a loop in this way gives additional security to the connector, inasmuch as the sides of the loop are disposed in planes on opposite sides of the take-up screw, as already described, whereby they prevent the connector from being tipped over by a sidewise pressure or blow. Tipping over of the connector in this manner, when engaged with a single length of the wire, has the effect of loosening the grip which is exerted upon the pipe between the wire and the take-up screw.

The form of the invention which I have first described I consider to be superior to the last described modification on account of the greater ease with which it can be coupled to the wire, and the fact that by reason of the provision for lateral rocking of the plug within the thimble both ends of a loop formed in the wire may be gripped with equal force; however I claim protection for my invention in such scope as to include either form of modification. Both forms possess complementary gripping surfaces which are inclined to the thrust of the take-up screw and are forced by the latter into firm bearing upon opposite sides of the wire, and both also have means for anchoring the extremity of that part of the wire which is passed around the pipe. In one case such extremity is the bight of the loop, which is caught over the hook *f*, and in the other case it is either the end of the wire, or the extremity of a loop, which is gripped between the complementary clamping members.

Among the useful features and advantages of my invention may be named the following:

(1) It supplies a connection between conductors which is very substantial, both mechanically and electrically, since the wire is both gripped tightly by the clamp and held in close contact with the pipe.

(2) The tensions on the parts of the bend or bends on opposite sides of the pipe are substantially equal. This is due to the fact that in the preferred construction of the connection the hook *f* is at approximately or nearly the same distance from the screw at one side that the base of the wedge is at the other side, and that in the modification the wedge is preferably symmetrical at opposite sides of the screw. The same fact causes the pressure of the screw to be applied squarely against the pipe.

(3) Connectors of one size are applicable to pipes, etc., of all sizes. This, of course, is due to the fact that the connector is not required to fit the pipe, but that only the wire need do so, and a loop or bend of any length may be formed in the wire and connected as described.

(4) The same size of connector may be used with wires of a number of different sizes, because the inner clamp may be placed at a variety of positions within the outer clamp, whereby the width of the space between the inclined clamping faces may be increased or diminished.

(5) The connector may be set up to draw the wire against the pipe with any tension (within the limit imposed by the strength of the wire) because the pressure exerted through the screw which draws the wire against the pipe also causes the grip of the clamping members on the wire to be tightened. The gripping pressure is in fact proportional to the tension.

(6) Both ends of the wire loop are gripped with equal force by the clamping members, due to the fact that the sides of both members opposite to the gripping surfaces are so formed and the inner member is so loosely fitted in the outer member that the inner member may turn slightly therein. If there are any inequalities in the gripping surfaces, or in the width or thickness of the wire such inequalities are thereby compensated for.

(7) The connector may be set up and the coupling completed without need of soldering and without the use of any tools except the common and ever present screw-driver.

(8) In case the pipe or other conductor with which the wire must be electrically connected is covered with paint or enamel or such like insulating coating, the action of the screw point bearing on the pipe cuts away the enamel and thus forms a clean surface establishing electrical contact. And

also while setting up the device and after initial tension has been applied to the wire loop, the whole connection may be turned about the pipe with the effect of abrading such insulating coating and making a clean conductive surface. In other words, it is not absolutely essential for the operator first to take care to remove any such coating before making the connection.

In the entire combination of which the pipe and the wire form parts, the pipe is a relatively rigid conductor, the wire is a relatively flexible conductor, and the connector is a clamping device with which the stretches or lengths of the flexible conductor passing to opposite sides of the rigid conductor are engaged, and by which the two conductors are caused to bear one against the other in forcible contact. In this use of the terms "rigid" and "flexible", I have not intended to imply any positive limitations as to the degree of flexibility or rigidity to be possessed by either conductor. All that is required of the relatively rigid conductor is that it be sufficiently resistant to collapse or displacement under externally applied pressure that it will sustain the compressive force applied by the screw and so react as to enable the desired tension to be applied to the other conductor even though, as in the case of a lead-sheathed cable, a pressure distributing plate be required beneath the screw to prevent its collapse or penetration; and as to the degree of flexibility required of the other conductor all that is necessary is that it may be bent around the complementary conductor, whether by manipulation with the human fingers or by other means is not important.

Having thus explained the principles of my invention and the manner in which they may be applied to use, in connection with the detailed description of a specific embodiment of such invention, but without having attempted to describe all possible forms and modifications thereof, or all the modes of its use, I declare that what I claim and desire to secure by Letters Patent is:

1. A connector comprising complementary clamp members, one of which embraces the other, said members having complementary gripping surfaces at one side inclined to the corresponding surfaces at the opposite side of the clamp members, said members being adapted to receive a wire between their gripping surfaces and having provision also for securing the wire at the side opposite from said surfaces, and a take-up device engaged with one of said members and arranged to apply pressure by thrusting against one of the connected things, and the pressure of said device being exerted upon the gripping surfaces at such an inclination thereto that the latter are caused to bind an interposed wire frictionally by such pressure alone.

2. The combination of two conductors, one of which is passed around the other and is formed with stretches extending from opposite sides thereof, and a connector consisting of complementary clamp members, one of which embraces the other, which members have complementary gripping surfaces adapted to receive one of such stretches between them, and having reaction surfaces at the opposite side from said gripping surfaces and inclined thereto, and the connector being so arranged as to engage and hold said other stretch at the opposite side from said gripping surfaces; and a take up device engaged with one of the clamp members arranged to exert thrust against the aforesaid other conductor in such a direction with respect to the gripping and reaction surfaces that said gripping surfaces are caused to press upon the interposed stretch of the conductor at an angle which causes binding.

3. A connector comprising cooperating clamp members and a take-up element engaged with one of said clamp members and adapted to apply thrust to one of the connected things, said clamp members having complementary opposed gripping surfaces inclined to the line of thrust of said take-up device at one side thereof and adapted to grip a wire between them, and the connector having also provisions to hold the wire at the opposite side of the take-up device from said gripping surfaces.

4. A connector comprising an outer clamp member, an inner clamp member, and a take-up device, said take-up device being engaged with the inner member and adjustable relatively thereto in a given line to apply thrust, said clamp members having cooperating gripping surfaces inclined to the line of thrust so applied, and one of said members also having a bearing against the other at the opposite side of the take-up device from said surfaces.

5. A connector comprising an outer clamp member, an inner clamp member, and a take-up device, said take-up device being engaged with the inner member and adjustable relatively thereto in a given line to apply thrust, said clamp members having cooperating gripping surfaces inclined to the line of thrust so applied, one of said members also having a bearing against the other at the opposite side of the take-up device from said surfaces, and the outer member having a hook at the side of the take-up member opposite to the gripping surfaces.

6. A connector for the purpose set forth comprising a thimble having at one side a wall which is inclined to the opposite side and constitutes an outer clamp, a wedge adapted to enter said thimble and having an inclined face on one side complementary to said inclined wall, and a screw passing through and threaded into said wedge ex-

tending in a line which makes an acute angle with said inclined wall and said inclined face; said connector having also provisions for connection with a wire at the opposite side of the screw from said wall and face.

7. A connector for the purpose set forth comprising a thimble having at one side a wall which is inclined to the opposite side and constitutes an outer clamp, a wedge adapted to enter said thimble and having an inclined face on one side complementary to said inclined wall, and a screw passing through and threaded into said wedge extending in a line which makes an acute angle with said inclined wall and said inclined face; said plug bearing with tangent contact of limited width against the thimble at the side opposite to said inclined wall and face, and being of less width than the thimble, whereby it may rock laterally.

8. A connector for the purpose set forth comprising a thimble having at one side a wall which is inclined to the opposite side and constitutes an outer clamp, a wedge adapted to enter said thimble and having an inclined face on one side complementary to said inclined wall, and a screw passing through and threaded into said plug extending in a line which makes an acute angle

with said inclined wall and said inclined face; the side of the thimble opposite to said inclined wall having a generally cylindrical curvature, and the adjacent surface of the plug being similarly curved but on an arc of shorter radius about a substantially parallel axis and being of less width than the thimble, whereby a tangent abutting contact is established between the thimble and plug permitting the latter to rock laterally with respect to the former.

9. The combination with a conductor, of a wire passing around said conductor, and a connector with which the stretches of the wire at opposite sides of said conductor are engaged, said connector comprising cooperating clamping members having complementary gripping surfaces between which the wire passes, and a screw engaged with one of said members and arranged to bear upon said conductor, exerting thrust thereon with a direction inclined to said gripping surfaces, thereby at the same time crowding said surfaces against the interposed wire and forcibly holding the wire against said conductor.

In testimony whereof I have affixed my signature.

CHARLES J. BARROW.