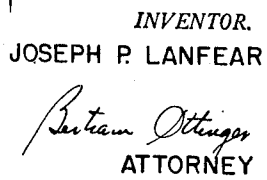


2,680,145

2 Sheets-Sheet 1



UNITED STATES PATENT OFFICE

2,680,145

WIRE CONNECTOR

Joseph P. Lanfear, Jackson Heights, N. Y.

Application July 10, 1951, Serial No. 235,999

5 Claims. (Cl. 174—84)

1

This invention relates to a wire connector, that is to say, to a device for mechanically engaging an end of one or more wires. The term "wire" as used herein is generic to solid, stranded, braided and knitted metal thread, regardless of its diameter and regardless of the presence or absence of a conductive or non-conductive sheath or sheathes. The invention further pertains to a tool for manipulating one form of such a connector.

By way of example, the invention will be described herein with respect to an electrical, i. e. an electromechanical, connector and a non-electrical, i. e. a purely mechanical, connector. However it is to be understood that these specific forms of the invention only are to be considered as illustrative and the invention is not to be deemed as limited thereby, except as and to the extent to which features of such embodiments are pointed out below and are incorporated in the appended claims.

It is an object of my invention to provide a wire connector which will effect an unusually secure mechanical joint.

More specifically it is an object of my invention to provide a wire connector which will speedily and easily form plural, tightly engaged, sharp bends in an end of a wire.

It is another object of my invention to provide a wire electrical connector which, even under adverse conditions such as utter darkness, snow or rain, vibration, high winds, extreme cold, and the inability to use the fingers individually, can effect a secure electrical connection of one or more ends of light gauge wire, e. g. telephone wire or light power wire, in a few seconds.

It is another object of my invention to provide a wire electrical connector wherein the electrical connection is fully insulated and waterproof.

It is another object of my invention to provide a wire electrical connector which can be manipulated to effect the electrical connection of one or more ends of wire by the application of external force directly to but a single element of the connector.

It is another object of my invention to provide a wire electrical connector which, although desirably manipulatable with the aid of a special tool, in an emergency can be operated by any wieldable heavy object such as a hammer or rock.

It is another object of my invention to provide a wire electrical connector which is foolproof and simple to use so that even mechanically unskilled persons or persons without formal school-

2

ing have no difficulty in efficiently making an electrical connection therewith.

It is another object of my invention to provide a wire electrical connector which is rugged and comprises but relatively few and simple parts.

It is another object of my invention to provide a unique tool for manipulating my novel wire electrical connector.

It is another object of my invention to provide a tool of the character described which does not require the use of individual fingers so that it can be operated by a person wearing mittens.

It is another object of my invention to provide a single tool of the character described which will both effect the electrical connection and seal the insulation.

It is another object of my invention to provide a tool of the character described having independent elements for effecting the electrical connection and for sealing the insulation.

It is another object of my invention to provide a single tool of the character described which requires manipulation of different parts for effecting the electrical connection and for sealing the insulation, these parts being such that they cannot be manipulated simultaneously and that the movement of each part to its fully operated position causes a markedly noticeable change in condition of the tool, whereby a person using the tool cannot inadvertently fail to make the connection and seal the insulation.

Other objects of my invention will in part be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the constructions hereinafter described, and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings, in which are shown various possible embodiments of my invention,

Fig. 1 is an exploded perspective view of a wire electrical connector constructed in accordance with the present invention;

Fig. 2 is a perspective view of said connector ready for use;

Fig. 3 is a perspective view of said connector and a manipulating tool therefor, the same being shown in open position;

Fig. 4 is a side, partly broken away, view of said connector and tool, the same being shown after the tool has been operated to close the connector;

Fig. 5 is a side, partly broken away, view of

3

said connector and tool, the same being shown after the tool has been operated to close the connector and seal the insulation;

Fig. 6 is an enlarged sectional view taken substantially along the line 6—6 of Fig. 3, and showing a longitudinal sectional view through the connector in open position;

Fig. 7 is a view similar to Fig. 6, but showing the connector closed;

Fig. 8 is a view similar to Fig. 6, but showing the connector closed and the insulation sealed;

Fig. 9 is a bottom view of the connector with its insulation removed;

Fig. 10 is a sectional view taken substantially along the line 10—10 of Fig. 6;

Fig. 11 is a sectional view taken substantially along the line 11—11 of Fig. 7;

Fig. 12 is a sectional view taken substantially along the line 12—12 of Fig. 1; and

Fig. 13 is a side, partially broken away view of a non-electrical connector embodying a modified form of my invention.

Essentially a connector embodying my invention comprises a block having two intersecting openings oriented at a substantial angle, e. g. a right angle, to one another. At least one of the openings terminates at a face of the block to admit an end of a wire. The other opening rotatably accommodates a plug which turns about an axis at a substantial angle to the longitudinal axis of the wire admitting opening. The plug has a transverse opening which is in registry with the wire admitting opening in one position of the plug and which is disaligned with said wire admitting opening when the plug is turned from said one position. The surface of the plug and the mating surface of the plug-accommodating opening in the block are formed to mutually define a passageway extending from the opening in the plug when the plug is turned from its said one position, said passageway snugly receiving a wire on the external surface of the plug when the connector is closed. The connector further includes means to turn the plug, said means being of such construction that, where more than one plug is employed, more than one plug can be turned simultaneously by operation of said means.

Referring now in detail to the drawings, and more particularly to Figs. 1-12, the reference numeral 20 denotes a wire electrical connector embodying my invention, and the reference numeral 22 a special tool for manipulating said connector.

The connector includes an elongated block 24 which, like all the other parts of the connector except the insulation, desirably is made of metal. An axial bore 26 runs inwardly from one end of the block terminating at a closed bottom 28 near the longitudinal center of the block. A similar bore 30 is provided at the other end of the block, the two bores preferably being in alignment and their bottoms 28, 32 being near one another. To facilitate insertion of a wire end in the bores, the ends of the block are dished to converge on the mouths of the bores.

Each bore is crossed by a cylindrical opening 34, 36 which extends from front to back of the block and is at right angles to the bore. Preferably the longitudinal axis of each bore intersects the longitudinal axis of its associated opening and the openings are parallel to one another.

Rotatable in each opening is a plug 38, 40. Since the plugs are mirror images of one another, only one plug will be described in detail and the same reference numerals will be used for both

4

plugs. Each plug is cylindrical and snugly fits in its associated opening, its ends being substantially flush with the front and back of the block. The plug is formed with a through transverse aperture 42 which is at right angles to the longitudinal axis of the plug and which rotates with the plug in a plane including the associated bore 26, 30 so that in a certain angular position of the plug, hereinafter referred to as the "inoperative" position, the aperture 42 is in alignment with and forms a straight line connection between the two portions of a bore 26, 30 interrupted by the opening 34, 36 in which the plug is disposed.

The opposite end edges of the plug are fashioned to provide gear teeth 44. These teeth need cover only a fraction of the end periphery of the plug, up to 180° being sufficient. The teeth extend axially inwardly from the end of the plug for but a short distance, enough to form flanks on the teeth of appropriate breadth to mesh with other gear teeth soon to be described.

An annular groove 46 is formed on the surface of the plug in a plane at right angles to the longitudinal axis of the plug and including the longitudinal axis of the aperture 42. An arcuate transverse slot 48 is formed on the surface of each opening 34, 36, said slot and the groove 46 defining a passageway for the reception of a wire inserted in the connector. The slot 48 starts from the point where the entry end of the transverse aperture 42 joins the bore 26, 30 when the plug is in inoperative position. Said slot extends in the direction the plug is turned from inoperative to operative position, and the slot terminates at a point spaced from its starting point by any selected angle substantially short of 180° in order to leave a bearing surface for the plug. In the preferred form of my invention the slot covers an arc of slightly less than 90°. The slot and groove are of appropriate cross-section to mutually form a passageway in which the wire to be connected is tightly engaged. For example the groove may be of semi-circular transverse cross-sectional shape and the radius of the slot and depth of the groove equal to one another and substantially equal to the radius of the inserted wire.

A second arcuate transverse slot 50 is formed on the surface of each opening 34, 36. Said slot, like the slot 48, with the annular groove 46 defines a passageway for the reception of a wire inserted in the connector. The slot 50 starts from the point where the exit end of the transverse aperture 42 joins the bore 26, 30 when the plug is in inoperative position. The direction of extension, shape and dimensions of the slot 50 are the same as those of the slot 48.

The plug is provided with a step 52 on its cylindrical surface, the radial surface of the step facing in a direction opposite to that in which the plug moves when turning from inoperative to operative position. For convenience, the step is adjacent the exit end of the aperture 42.

To turn the plugs I provide a bridge 54 of U-shaped transverse cross-section comprising a base 56 and a pair of parallel legs 58, 60. Said bridge straddles the block 24 with the legs 58, 60 located at the front and back, respectively, of the block in transverse shallow broad grooves 62. The width of the grooves is equal to the length of the legs, the depth of the grooves is equal to the thickness of the legs, and the space between the bottom of the grooves is equal to the space between the inner surfaces of the legs so that the bridge is guided for slidable move-

ment in an up-and-down direction on the block. The ends of the legs are shaped to form rack gears 64 of proper contour to mesh with the plug teeth 44 and the plug openings 34, 36 are so positioned that the rack gears will engage said teeth. The bridge prevents the plugs from shifting axially.

In the inoperative position of the connector (Fig. 6) the bridge is in raised position, ready to be shifted downwardly for turning both plugs to operative position (Fig. 7). The top of the block is provided with a transverse shallow broad groove 66 for accommodating the base 56 of the bridge when the latter is fully depressed. The bridge is normally held in its raised inoperative position by wings 68 extending angularly downward from and integral with the ends of the base of the bridge. The lines of junction between the wings and bridge are weakened as by scoring 70 for a purpose which later will be apparent. In the inoperative position of the bridge the tips of the wings rest on the top of the block (Fig. 6).

The under surface of the base of the bridge carries a pair of pendant piercing tines 72 in alignment with vertical holes 74 that extend downwardly from the top of the block and transect the bores 26, 30 between their bottoms and the openings 34, 36. The tines are sufficiently long to extend well into the bores or even cross the same when the bridge is in operative position (Fig. 7).

The bottom of the block is fashioned with an elongated shallow longitudinal groove 76 whose opposite ends run into the openings 34, 36. A leaf spring 78 is seated on the base of said groove. The end portions 80 of said spring are arcuately indented downwardly to clear wires lying in the annular grooves of the plugs. The tips 82 of the spring ride on the cylindrical surfaces of the plugs. The spring is so positioned that in the idle position of the connector the tips 82 are forced downwardly, bowing the ends of the spring away from the base of the groove 76. When the plugs reach operative position in the fully depressed position of the bridge the steps 52 will just have cleared the tips of the springs (Fig. 7) which thereupon will have snapped up to prevent reverse movement of the plugs and thereby lock the plugs in operative position.

Lateral projections 84 at the sides of the spring are received in notches 86 on the bottom of the block, the sides of the notches being staked, as at 87, to hold the spring in place.

To prevent wires from accidentally slipping out of the axial bores while the plugs still are in inoperative position, a short bowed leaf spring 88 is associated with each bore. Each spring is forced into a slot 89 running parallel to the associated bore. The slot intersects the bore chordwise near its periphery and the convex side of the spring protrudes into the bore to lightly frictionally engage a wire inserted into the connector.

The elongated block, together with its plugs and bridge are sheathed in an open-ended tube 90 of impermeable flexible material, e. g. rubber, whose ends extend beyond the ends of the block. It may be noted that, in addition to its waterproofing and insulation functions, the tube serves to prevent disengagement of the bridge from the block. The tube may include constricted necks 92 adjacent its ends. Encircling the tube adjacent its ends, e. g. in the necks, are annular bands 94 of soft metal, e. g. a lead-tin alloy, that, con-

veniently, are held in position by an interconnecting strap 96. The bands and necks are sufficiently large to permit a wire end freely to be inserted there through and into the axial bores 26, 30 of the block.

To use the connector, the ends of wires W simply are thrust all the way into the bores 26, 30, the bridge 56 depressed and the bands 94 crimped, the last step being omitted if the connector is not to be waterproofed. Fully depressing the bridge turns the plugs to operative position (Fig. 7) in which two sharp bends are formed in the wire and portions of the wire are tightly engaged between the annular groove 46 and the arcuate slots 47, 50, the plugs being locked by the springs 78 and step 52 in operative position. As the bridge reaches operative position, the wings 68 shear off at the score 70 and the tines 72 pierce the conductive core of the wire even should the same be in an insulating cover. Where the cores are solid the ends of the covers preferably are stripped and the tines omitted.

Although the particular kinematic train shown and described in detail for turning the plugs upon shifting of a single member is highly desirable because of its compactness, ease of manufacture and low cost, it will be understood that any other suitable kinematic train, e. g. slotted cranks on the plugs and a translatable pin and rod engaging said cranks, may be substituted in its stead. It also is noted that where but a single wire is to be engaged and therefore, only one plug employed, such plug can be turned by a gear sector rotatable on the block.

Closing of the illustrated connector is expedited by the tool 22. Said tool includes an anvil jaw 98 and a clinching jaw 100 pivoted on a shaft 102 and integral with handles 104, 106, respectively. A restoring spring (not shown) urges the handles apart. The anvil jaw is shaped to receive the bottom of the connector and the clinching jaw is shaped to engage the base of the bridge. Squeezing the handles 104, 106 together depresses the bridge.

One of the clinching handles, e. g. the handle 106 mounts a pair of spaced resilient fingers 108 whose facing surfaces define a slot 110 having a narrow tip 112 adjoining the upper end of a broad section 114. The lower end of this section runs into an opening 116 that is joined to the section by a narrow passageway 118. The surfaces 120 of the passageway adjacent the section are angularly divergent. The other handle mounts a pin 122 which rides in the slot 110. When the handles are in inoperative position the pin 122 is adjacent the narrow tip of the slot. As the handles approach operative position the pin engages the divergent surfaces 120 to cam the fingers apart and permit entry of the pin into the opening 116 when operative position is reached. Release of manual pressure on the handles does not allow the handles to be moved apart by the restoring spring since retractive movement of the pin is blocked by the narrow passageway 118.

The tool 22 further includes two pair of crimping jaws 124, 126 located beyond opposite ends of the anvil jaws in proper spaced position to engage the bands 94. Said jaws are formed with interleavable sturdy fins having mating V-notches 128 which will constrict the band when the jaws are closed in operative position (Figs. 5 and 8). The lower jaw 124 constitutes one arm of a bell crank lever 130 and the upper jaw 126 one arm of a bell crank lever 132. The two levers are pivoted on a pin 134 mounted on the anvil jaw

96. The other arms 136, 138 of the levers are pivoted to one set of ends of a pair of links 140, 142 whose other set of ends are pivoted on a pin 144 secured to the forward end of a crimping handle 146 that turns about a shaft 148 attached to the anvil handle 104. A restoring spring (not shown) urges the crimping handle 146 to its inoperative position (Figs. 3 and 4).

After the bridge is depressed, the handles 106, 146 are squeezed together thereby closing the crimping jaws. As said handles reach operative position a chisel projection 149 on the handle 146 enters the tip 112 of the slot 110 and spreads the fingers 108 to release the pin 122 and permit the handles 104, 106 to fly apart.

It will be observed that the handles 106, 146 are spaced apart too far in inoperative position to be squeezed together inadvertently and the undersurface of the handle 104 is of an uncomfortable shape so that a user of the tool will naturally first squeeze together the handles 104, 106 and only thereafter the handles 106, 146. Moreover since the handles 104, 106 will fly apart unless moved to operative position and will not separate after complete operation unless the handles 106, 146 thereafter are moved to operative position, closure and sealing of the connector in proper order are assured except as the same may be deliberately avoided.

The connector 150 illustrated in Fig. 13 is essentially similar to the connector 20 except for the omission of the insulating tube 90, tines 72, spring 73 and bands 94, and the provision of a modified means for moving the bridge and detaining the same in operative position. Said connector 150 is designed to provide a purely mechanical wire joint and, therefore, is more sturdily built. Parts similar to those of the connector 20 have been indicated by the same reference numerals primed. The base 56' of the bridge 54' is formed with a central through opening 152 to rotatably pass the threaded shank 154 of a headed bolt 156 which meshes with a tapped bore 158 in the block 24'. A collar 160 pinned or otherwise secured to the bolt against axial movement beneath the bridge captively holds the bridge to the bolt so that the connector is moved between inoperative and operative positions by turning the bolt. Since the threaded shank inherently is a one-direction kinematic train, it will function to detain the bridge in operative position when shifted thereto.

It thus will be seen that I have provided devices which achieve the several objects of my invention and are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matters herein described, or shown in the accompanying drawings, are to be interpreted as illustrative and not in a limiting sense.

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

1. A wire electrical connector comprising an elongated block, a pair of bores extending inwardly from opposite ends of said block, a different opening crossing each bore intermediate the ends thereof, a plug revoluble in each opening, each plug having a through transverse aperture in registry with the associated bore in one position of the plug and disaligned with said bore when the plug is revolved away from said one position, the surface of each plug and the mating surface of the associated opening being formed to define arcuate wire-receiving passageways extending from the ends of the aperture to the ends of the bore at the opening when the plug is revolved from said one position, a single actuating element, means to mount said element for shiftable movement on said block, a kinematic train interconnecting said element with both plugs to revolve said plugs upon movement of said element, a flexible impermeable sleeve ensheathing said block and projecting beyond both ends thereof, and malleable metal bands encircling said projecting ends.

2. A wire electrical connector as set forth in claim 1 wherein the actuating element and kinematic train comprises a bridge slidably embracing the block and provided with rack gear teeth, and gear teeth on the plugs meshing with the rack gear teeth.

3. A wire electrical connector as set forth in claim 1 wherein the bridge has piercing tines and the block is formed with holes registered with the tines and transecting the bores.

4. A wire electrical connector as set forth in claim 1 wherein each plug includes a notch, and wherein a leaf spring is mounted on the block with its tips engageable in the notches when the plugs are revolved to a predetermined position from their one position.

5. A wire electrical connector as set forth in claim 1 wherein the actuating element protrudes from the block when the plugs are in their one position, and wherein readily deformable means is included to hold the actuating element in its protruding position.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
464,942	McKenney	Dec. 8, 1891
868,460	L'Hoest et al.	Oct. 15, 1907
1,336,290	Finklestein	Apr. 6, 1920
1,382,753	Tefft	June 28, 1921
2,086,400	Brenizer	July 6, 1937
2,359,083	Carlson	Sept. 26, 1944
2,435,562	Swengel	Feb. 3, 1948
2,553,341	Stonehill	May 14, 1951