

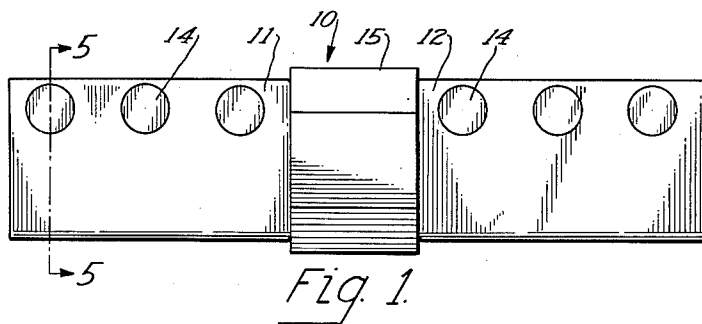
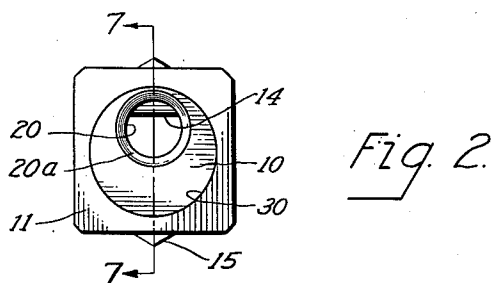
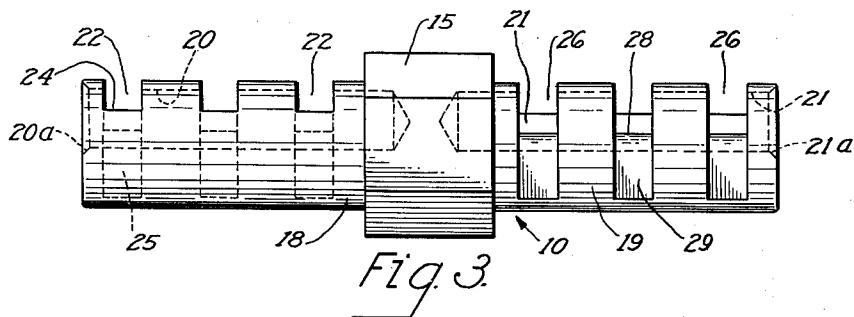
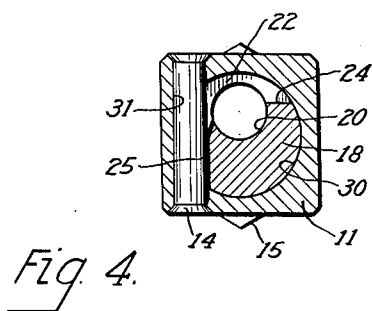
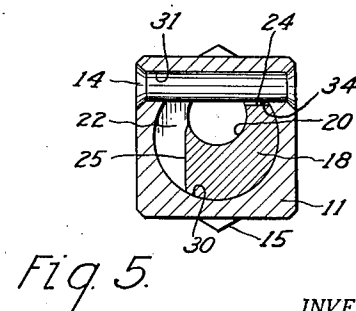
March 25, 1952

E. E. NOYES
WIRE CONNECTOR

2,590,789

Filed Aug. 31, 1949

2 SHEETS—SHEET 1



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E. E. NOYES
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2 SHEETS—SHEET 2

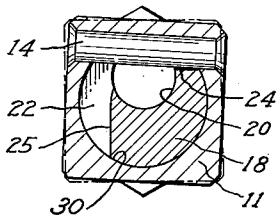


Fig. 6

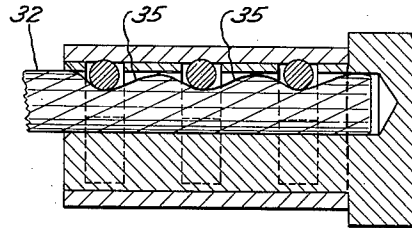


Fig. 7

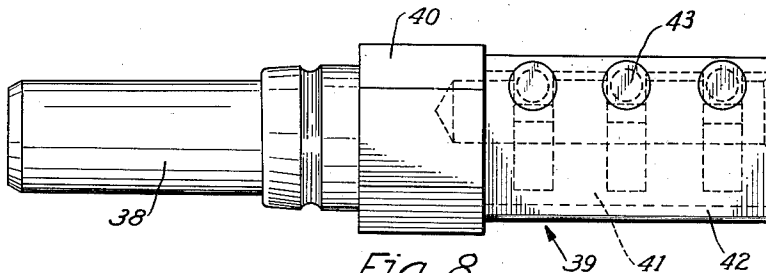


Fig. 8

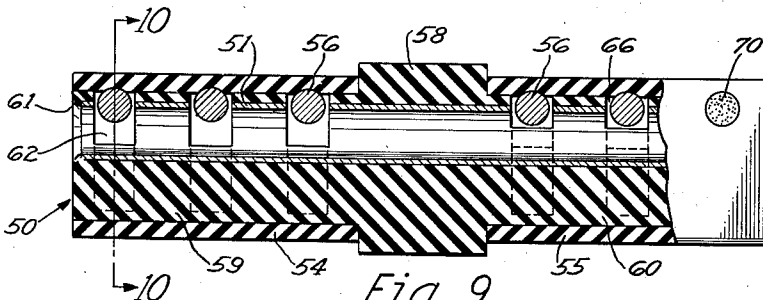


Fig. 9

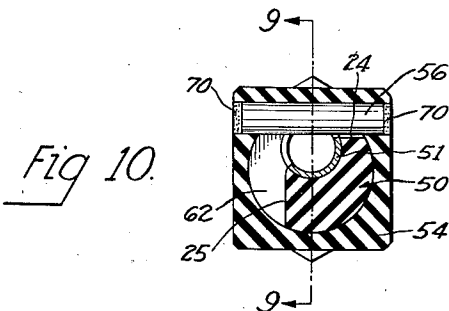


Fig. 10

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UNITED STATES PATENT OFFICE

2,590,789

WIRE CONNECTOR

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Application August 31, 1949, Serial No. 113,408

10 Claims. (Cl. 24—81)

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This invention relates to improvements in detachable connectors for rods, cables, wires, and the like, hereinafter referred to generally as wires, and has for its principal object the provision of a simple yet rugged wire connector of improved design capable of making a good electrical connection that cannot be loosened by twisting or pulling of the wire and capable of being readily connected to and disconnected from the wire by easily accomplished relative movements between parts of the connector and in which both of such relative movements are positively opposed by a force resulting from the resiliency of the wire.

Although it has many applications, the improved connector has been found ideally suited for the making of connections between the terminal leads of a lifting magnet and the flexible power supply wires that are usually wound upon a reel mounted on the crane handling the magnet. Connectors when used for this purpose are exposed to all kinds of weather and abuse, including submersion in water, and are subjected to large pulling and twisting forces suddenly and repeatedly applied, but nevertheless must at all times maintain a good electrical connection, particularly because a circuit interruption while the magnet is energized results in high induced voltages capable of causing permanent damage to the magnet winding.

Ease of intentional connection and disconnection is also important because lifting magnets are often not used continuously on a crane, but are repeatedly taken off and laid aside to permit use of the hoist hook alone as the varied material to be handled by the crane requires.

Even though a connector for lifting magnets must withstand such severe service conditions while maintaining a good connection, yet it must be simple in operation and require only readily available tools to connect and disconnect a wire to and from the connector, and must be capable of being easily connected and disconnected intentionally but almost incapable of being accidentally disconnected.

Furthermore, a detachable connector for lifting magnet service should not have separable parts one or more of which are apt to become lost, but instead should be a unitary device capable of being fastened to the ends of one or two wires of appropriate size at any time.

Broadly the wire connector comprises a pair of relatively movable clamping jaws between which a wire is to be clamped and which are moved positively toward each other to their point of closest approach upon movement of certain op-

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erating means in one direction to a given position and relatively slightly apart from said closest position upon continued movement of the same operating means in the same direction to a point at which the operating means is positively stopped, whereby the wire, having been compressed in the closest position of the jaws, is released slightly and expands partway so that movement of the operating means in the reverse direction for completely separating the jaws requires recompression of the wire.

The connector in its preferred form comprises a core member having a non-circular portion for receiving a wrench or similar tool and a cylindrical end portion having an axially directed eccentric trough or bore slightly larger than the wire to be received therein for connection. A plurality of axially-spaced, circumferential slots formed in the cylindrical end portion intersect the eccentric trough or bore on the side thereof furthest from the axis of the core member and extend slightly more than 180° around the periphery of the bore. A non-circular locking member, rotatably received on the cylindrical end portion, is provided with a plurality of axially spaced transverse bores which receive respective pins, the transverse bores being so spaced that the pins can enter the respective slots in the core member. In one extreme relative turned position of the locking member, the pins do not intersect the eccentric bore in the core member, and a wire may then be inserted therein or removed therefrom. In a different turned position, the pins intersect the eccentric trough or bore and each exerts a clamping and deforming action on the inserted wire at a different location. An additional novel feature resides in the fact that the position of the slots circumferentially of the core member with respect to the eccentricity of the trough or bore in the core member is so selected that a point in the relative turned positions can be reached at which the pins are the maximum distance in the slots permitted by the selected eccentricity and said point can be passed slightly upon continued turning in the same direction before the relative turning is positively stopped. Turning past this point or dead center position moves the pins outwardly with respect to the axis of the eccentric bore thus relieving slightly the pressure on the wire exerted by the pins. Thereupon, the deformed wire returns toward its original position and shape due to its inherent elasticity. Hence, to loosen the wire by returning the locking member toward its initial turned or releasing position, the wire must again be deformed

the additional small amount in order for the pins to pass through their position of maximum entry into the slots. Since considerable force is required to effect this small amount of additional reformation, accidental loosening of the wire is practically impossible.

Accordingly, a further object is to provide an electrical connector meeting each of the foregoing requirements and operating as above described, and which comprises a very limited number of operating parts and is easily manufactured and assembled.

Another object is to provide a detachable connector for wires in which the pressure on the wire is applied at a plurality of points along the connecting portion of the wire.

A more detailed object is to provide a connector having an eccentrically mounted pin carrying member which is rotatable to move the pin further into a complementary slot thereby to provide a clamping action on a wire disposed transversely of the pins and slots.

Other objects and advantages will become apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a side elevation of an electrical connector in accordance with the invention;

Fig. 2 is an end elevation of the connector of Fig. 1;

Fig. 3 is a side elevation of the core member of the connector of Fig. 1 when disassembled therefrom;

Figs. 4, 5, and 6 are sectional views taken generally along the line 5—5 of Fig. 1 with the connector in its fully released position, in a position just prior to movement into its locked position, and in its locked position, respectively;

Fig. 7 is a fragmentary sectional view taken generally along the line 7—7 of Fig. 2 with a stranded wire in locked position;

Fig. 8 is a side elevation of a modification;

Fig. 9 is a section of a further modification taken generally along the line 9—9 of Fig. 10, and

Fig. 10 is a section taken generally along the line 10—10 of Fig. 9.

Referring to Fig. 1 through Fig. 7 of the drawings, the connector therein illustrated comprises an elongated core member 10, a pair of locking members in the form of sleeves 11 and 12, and a plurality of locking elements or pins 14 some carried by each of the locking members.

The core member 10 is preferably made of brass and has an enlarged central portion 15 of hexagonal or other configuration permitting a turning moment to be easily applied to the member 10 about its longitudinal axis. The central portion 15 is intermediate of opposite cylindrical end portions 18 and 19 (Fig. 3) having respective longitudinal wire receiving troughs. In the illustrative example, these troughs are in the form of bores 20 and 21 extending inwardly from the outer ends of the core member 10. The bores 20 and 21 preferably extend into the central portion 15 and are co-axial with respect to each other and offset from and parallel to the axis of the cylindrical portions 18 and 19. However, if desired, the eccentricity of each of the bores 20 and 21 may be provided by arranging their axes at an angle to the axes of the portions 18 and 19. Chamfers 20a and 21a formed at the outermost ends of the bores 20 and 21, respectively, facilitate insertion of the wire to be connected, which wire is preferably slightly smaller than the bores 20 and 21.

The end portion 18 has a plurality of longitudi-

nally spaced, circumferential slots 22 each of which intersects the bore 20 throughout slightly more than 180 degrees of its periphery principally on the side thereof most remote from the axis of the end portion 18. The end walls of each of the slots 22 define, respectively, a pair of angularly disposed shoulder or stop surfaces 24 and 25. In the form illustrated, the stop surfaces 25 lie in a common plane which is substantially parallel to a plane common to the axes of the cylindrical end portion 18 and the eccentric bore 20 and which is spaced slightly outwardly from a position wherein it would be tangent to the bore 20. The stop surfaces 24 lie in a common plane which is substantially normal to the plane of the stop surfaces 25.

The end portion 19 has a plurality of longitudinally spaced, circumferential slots 26, similar to the slots 22, each of which intersects the bore 21 to define a pair of stop surfaces 28 and 29 similar to the surfaces 24 and 25, respectively. It should be noted, looking from the left in Fig. 3, that the stop surfaces 24 are spaced clockwise from the stop surfaces 25 along the slots 22, and, looking from the right in Fig. 3, that the stop surfaces 28 also are spaced clockwise from the stop surfaces 29 along the slots 26. The end portions 18 and 19 are thus identical with each other except for the reversed arrangement of their slots 22 and 26, which as will become apparent, permits both of the members 11 and 12 to be rotated in a clockwise, or right-hand direction, for clamping a wire when the end of the connector receiving the wire is faced by the user.

The locking members or sleeves 11 and 12 are identical and have a non-circular cross-section, preferably square as shown, to facilitate the application of turning moments thereto as by a wrench. The members 11 and 12 have respective central circular bores 30 and rotatably receive the end portions 18 and 19, respectively, of the core member 10. A plurality of longitudinally spaced transverse bores 31 chamfered at outer ends are provided in each of the locking members 11 and 12. The bores 31, when the members 11 and 12 are mounted on the core member 10, are aligned with the respective slots 22 and 26, one pair of aligned bores 31 with each slot. Each one of each pair of bores 31 receives one of the ends of a pin 14 which is restrained from axial displacement by upsetting the ends of the pin in chamfered portions at the outer ends of the bores 31. The pins 14 carried by the locking member 11 enter the respective slots 22 and the pins 14 carried by the locking member 12 enter the respective slots 26. Thereby the pins substantially prevent axial movement of the locking members 11 and 12 relative to the member 10. Hence, once being assembled, the complete connector remains in one piece at all times.

When the locking member 11 is turned to the position shown in Fig. 4 with the pins 14 thereof against the respective stop surfaces 25, the pins 14 do not intersect the bore 20. A wire 32 (Fig. 7) may then be inserted into the eccentric bore 20. To secure the wire 32 in the connector, the locking member 11 is turned clockwise, as viewed in Fig. 2 and Fig. 4, causing the pins 14 to intersect the bore 20 and move toward the bottom wall thereof and thus engage the wire 32 and deform it at a plurality of areas between the bottom wall and pins, as indicated in Fig. 7. The pressure exerted by the pins 14 on the wire 32 as the locking member 11 is turned forces the wire into inti-

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mate electrical contact with the bottom wall of the bore 20 opposite the pins.

In Fig. 5 the member 11 has been rotated until the axes of the pins 14 are normal to the plane common to the axes of the end portion 18 and of the eccentric bore 20 and the pins 14 have entered a maximum distance into the bore 20 making their closest approach to the bottom wall thereof. As shown by the space 34 in Fig. 5, the parts are so dimensioned that the pins 14 have not yet engaged the respective stop surfaces 24 but are about 1° therefrom. Therefore, further turning of the member 11 in the same direction causes the pins 14 to recede slightly from the bottom wall of the bore 20 before they engage the respective stop surfaces 24 as shown in Fig. 6, and thereby arrest further turning of the member 11 in the same direction. The pressure on the wire 32 is thus relieved slightly and the wire returns toward its original configuration due to its inherent resiliency. The connection between the wire 32 and the connector is now completed. The wire 32 is restrained from axial displacement both by the friction between the wire 32 and the wall of the bore 20 and pins and also by the mechanical interlocking action of grooves, indicated at 35 in Fig. 7, formed in the wire by the pins 14.

To remove the wire 32 from the connector, it is necessary to rotate the locking member 11 in the opposite direction, which is counter-clockwise as viewed in Fig. 4, to the position illustrated in Fig. 4. However, as the member 11 is turned from its locked position, shown by Fig. 6, to the maximum open position of Fig. 4, it must pass through the position of maximum entry of the pins, as illustrated in Fig. 5. To reach this position it necessarily must redeform those portions of the wire 32 on which the pressure was relieved as the pins first receded slightly from their closest approach to the bottom of the bore 20. Thus the wire itself opposes this redeformation and provides a locking means for the connector.

A wire similarly may be received in the bore 21 and locked therein by turning of the locking member 12. Viewing the connector from the right-hand end in Fig. 1, this turning action is also clockwise because of the reversed relation of the slots 22 and 26 hereinbefore described and accordingly the portion 19 and locking member 12 cooperate in the manner identical with the portion 18 and locking member 11.

The bore 20, where intersected by the slots 22, is in operating effect a trough the wall of which exposed toward the pins cooperates therewith to provide a pair of clamping jaws.

When the connector is used to connect a lifting magnet lead to a crane power supply wire, it may be covered with tape or may be enclosed in a rubber hose telescoped about the lead, the ends of the hose only being taped after the connection is made.

Although the connector has been shown as connecting a stranded wire or cable, similar results are obtained with solid copper wire provided the degree of eccentricity is properly selected. It has been found that for a stranded wire which is just slightly smaller than the bore 20, the eccentricity can be such that the pins 14, in their maximum position of entry into the bore, block about one-third of the area of the bore. A solid copper conductor of the same current carrying capacity as a cable that fits snugly into the bore 20 is sufficiently smaller than the cable that the same degree of eccentricity can be used, the grooves formed in the copper being considerably

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shallower but with steeper sides than those formed in the cable. Since solid and stranded wires of the same current carrying capacity can be secured in the same connector, the connector can be marked with a wire size such as No. 6 or No. 8 and no distinction made between solid and stranded wires. Thus, for solid wires, the amount of eccentricity should be selected so that the pins 14, which may be of very hard steel, form pronounced but shallow grooves in the wire. However, the solid wire also has sufficient elasticity to provide the desired locking action.

Although the connector thus far described has comprised a device for interconnecting two wires by having substantially identical opposite end portions, many other forms of the connector are possible. For example, in Fig. 8, a snap plug 38 for receptions into a receptacle (not shown) is shown as formed integrally with a connector 39 comprising an enlarged hex-position 40 and a cylindrical portion 41 receiving a locking member 42 having pins 43. The cylindrical portion 41 is in all respects like the right-hand portion 19 of the connector of Fig. 1.

Although the connector has been shown herein as receiving a circular wire, wires of other shape can be secured also with or without changing the configuration of the bore 20.

The exterior peripheries of the central portion of the core member and of the locking members have been shown non-circular so that the connector can be tightened and loosened by means of a pair of common wrenches. If desired the core members could be made cylindrical throughout and the locking members likewise could be made cylindrical and the surfaces could be knurled where necessary to facilitate the application of turning moments.

The modification of Fig. 9 and Fig. 10 is an insulated connector better adapted for connecting relatively small wires. It has an elongated core member 50 molded from suitable insulating material, such as Bakelite, a cylindrical metal tube 51 preferably of copper molded eccentrically within the core member 50, a pair of insulated locking members 54 and 55 also preferably formed from Bakelite, and a plurality of metal pins 56 some carried by each of the locking members 54 and 55.

The core member 50 has an enlarged hexagonal central portion 58 between opposite cylindrical end portions 59 and 60 which rotatably receive the respective locking members 54 and 55. The tube 51 is preferably somewhat shorter than the core member 50 so that during the molding operations lip portions 61 may be formed at opposite ends of the core member to retain the tube 51 against axial displacement, the lip portions 61 having chamfered surfaces as shown to facilitate entry of wires into opposite ends of the tube 51.

The end portion 59 has a plurality of longitudinally spaced, circumferential slots 62 which intersect the tube 51 and its opening to define angularly displaced shoulders 64 and 65, and likewise the end portion 60 has a plurality of slots 66 which intersect the tube and its opening to define angularly displaced shoulders similar to the shoulders 28 and 29 of the embodiment of Figs. 1 through 7, the shoulders 64 and 65 being similar to the shoulders 24 and 25.

The locking members 54 and 55 are identical and have longitudinally spaced transverse openings which, when the members are mounted on the end portions 59 and 60 of the core member 50, receive the respective pins 56 which also enter

the respective slots 52 and 56. The pins 56 are slightly shorter than the width of the locking member 54 and 55, suitable insulating cement 70 being used to fill opposite end portions of the openings after the pins have been inserted.

Further details and the operation of the connector of Figs. 9 and 10 are apparent from the preceding description of Fig. 1. It is to be noted that all current carrying parts of the connector of Figs. 9 and 10 are fully covered with insulating material.

Having thus described my invention, I claim:

1. A wire connector comprising a pair of relatively movable clamping jaws adapted to clamp a wire therebetween, means operatively connected to at least one of the jaws for moving the jaws relatively toward each other to their point of closest approach upon movement of said means in one direction to a first position and to move said jaws relatively slightly apart from said closest position upon continued movement of said means in the same direction to a second position, and stop means for stopping the movement of the first means in said direction at a predetermined position, characterized in that said first means and said stop means are related to each other so that said predetermined position is said second position.

2. A wire connector comprising a member having a generally longitudinally extending trough which is open at one end and is adapted to receive a wire endwise, a member movable in a fixed path relative to the first member, a clamping element in fixed position relative to the second member and movable thereby toward the bottom of the trough, upon movement of the second member in one direction, to a first position in which the element is closest to the bottom of the trough and removable by the second member slightly away from said closest position, upon the continued movement of the second member in the same direction, to a second position after said closest approach of the element to the bottom of said trough, and stop means for stopping the relative movement of the members in said direction at a predetermined position, characterized in that said first and second members and said stop means are related to each other so that said predetermined position is said second position.

3. A wire connector comprising a member having a cylindrical bearing portion and a generally longitudinally extending wire receiving bore eccentric to the axis of the bearing and a trough in the form of a cylindrical segment coaxial with said bore and beyond the inner end of the bore and open at the end nearest thereto for receiving through its open end a wire inserted endwise through the bore, a sleeve rotatably mounted on said bearing portion, a transverse element carried by, and movable by, the sleeve part way toward the bottom of the trough, upon rotation of the sleeve in one direction, to a first position in which the element is closest to the bottom of the trough, and movable by the sleeve slightly away from the bottom of the trough, upon continued rotation of the sleeve in the same direction, to a second position, and abutment means carried by the member and sleeve, respectively, and engageable with each other for stopping relative rotation of the sleeve and member in said direction in a predetermined position, characterized in that said abutment means are positioned relative to each other so that said predetermined position is said second position.

4. A wire connector comprising a cylindrical member having a longitudinal wire receiving bore eccentric to its axis and having a generally transversely extending notch intersecting said bore, a sleeve rotatably fitting said cylindrical member, a transverse locking element in fixed relation to the sleeve and accommodated in the notch in a position such that upon relative rotation of the member and sleeve, in a predetermined direction from a given starting position, the element moves toward the bottom of the bore to an innermost position intersecting the bore, and, upon continued relative rotation of the member and sleeve in the same direction, said locking element recedes a slight distance from said innermost position to a second position in which it still intersects said bore, and cooperating means carried by the member and sleeve, respectively, and engageable upon said continued relative rotation of the sleeve and member in said direction for arresting further relative rotation of the sleeve and member in said direction in a predetermined position, characterized in that said cooperating means are positioned relative to each other so that said predetermined position is said second position.

5. A detachable connector for a wire comprising a member having a cylindrical portion, an eccentric longitudinal bore in said cylindrical portion for receiving an end portion of a wire, a circumferential slot in said cylindrical portion intersecting said bore, a tubular locking member rotatably received on said cylindrical member and having a transverse bore spaced from its longitudinal axis and aligned with said slot, a pin received in said transverse bore and in said slot, and said pin in one turned position of said locking member being spaced from the opposite wall of the longitudinal bore sufficiently to permit free insertion of a wire therebetween into said longitudinal bore and in another position being positioned closer to said opposite wall of said bore.

6. A detachable connector for a wire comprising a member having a cylindrical portion, an eccentric longitudinal bore in said cylindrical portion for receiving an end portion of a wire, a longitudinally extending row of spaced circumferential slots in said cylindrical portion intersecting said bore, a tubular locking member rotatably received on said cylindrical member, and having transversely extending locking elements, displaced from its longitudinal axis, accommodated in said slots, respectively, and said elements in one turned position of said locking member being spaced from the respective opposite wall portions of the bore sufficiently to permit free insertion of a wire between the elements and wall portions into said longitudinal bore and in another position being positioned closer to said opposite wall portions of said bore.

7. A detachable connector according to claim 6 characterized in that said elements are pins, each accommodated at its opposite ends in a pair of aligned bores in the locking member.

8. A detachable connector for a wire comprising a member having a bearing portion, a longitudinal trough in said member for receiving an end portion of a wire, a transverse slot in said member intersecting said trough, a locking member rotatably received on said bearing portion and having a transverse passage spaced from its longitudinal axis and aligned with said slot, a pin secured in fixed position in said transverse passage and received in said slot, and said pin and trough

being positioned relative to the axis of the bearing portion so that the opening defined between the pin and trough is varied from a maximum to a minimum by relative rotation of the said members.

9. A detachable connector for a wire comprising a member having a bearing portion, a longitudinal trough in said member eccentric to said bearing portion for receiving an end portion of a wire, an extending row of circumferential slots in said member and spaced from each other longitudinally of the trough and intersecting said trough, a locking member rotatably received on said bearing portion and having fixed transversely extending locking elements accommodated in said slots, respectively, and said locking elements and trough being positioned relative to the axis of the bearing portion so that each of the openings defined between the locking elements and trough is varied from a maximum to a minimum by relative rotation of the said members and, in one rotated position of the members, all of said openings are greater than minimum and sufficient to permit free insertion into the trough through all of said openings of a wire of greater cross sectional area than the minimum size of any of said openings.

10. A detachable connector for a wire comprising a member having a bearing portion, a longitudinal trough in said member for receiving

an end portion of a wire, a locking member rotatably received on said bearing portion and having a locking element extending transversely of the trough, said element and trough being positioned relative to the axis of the bearing portion so that the opening defined between the element and trough is variable from a maximum to a minimum by relative rotation of said members in one direction and from minimum toward maximum upon continued rotation of the members in the said one direction, and stop means operatively connecting the members for stopping the relative rotation of said members in said one direction at a predetermined position, and characterized in that said members and said stop means are so related to each other that said predetermined position is one in which the members have been rotated in said direction slightly beyond the position in which the opening has increased slightly from minimum.

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