Aug. 8, 1961 W. GIBBON 2,995,615

ELECTRIC CONNECTORS

Filed June 13, 1956

Fig. 1.

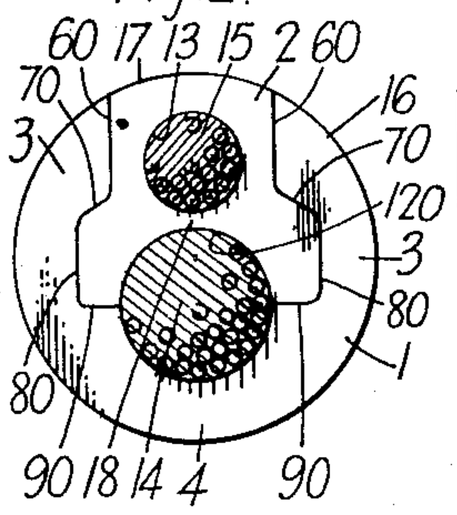


Fig. 2

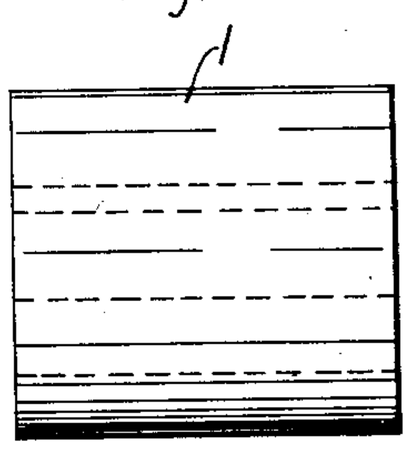


Fig. 3.

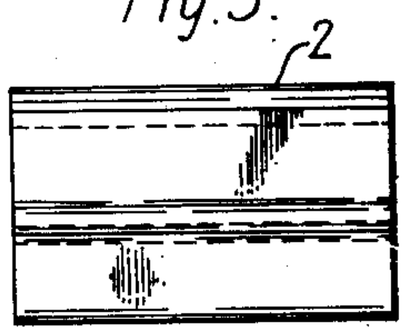


Fig. 4.

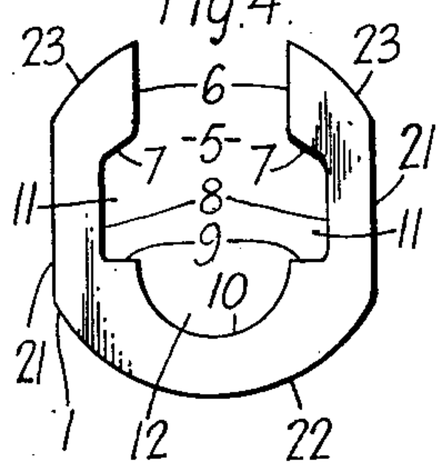


Fig. 5.

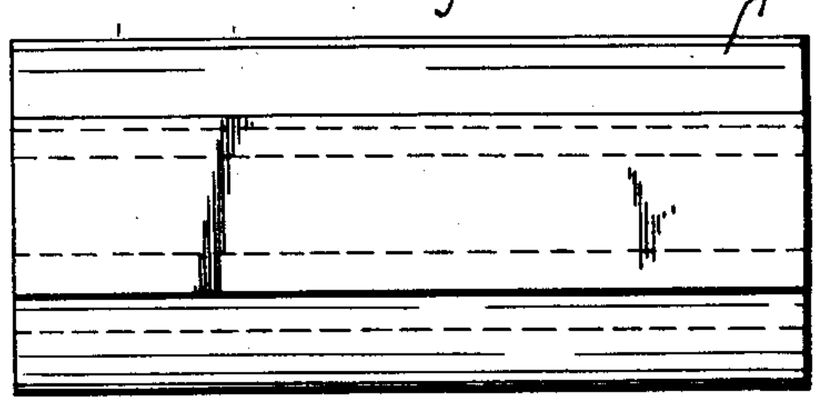


Fig. 6.

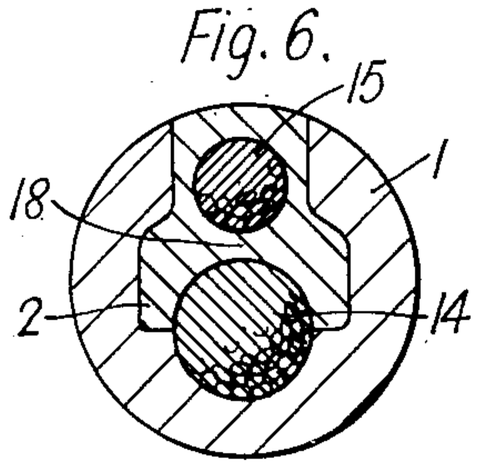


Fig. 7.

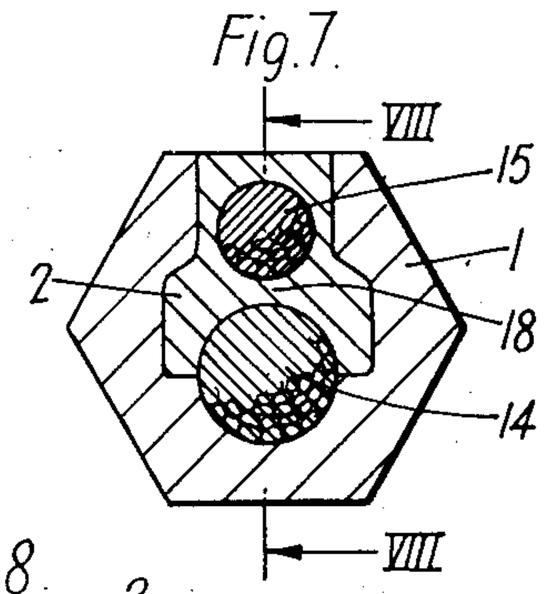
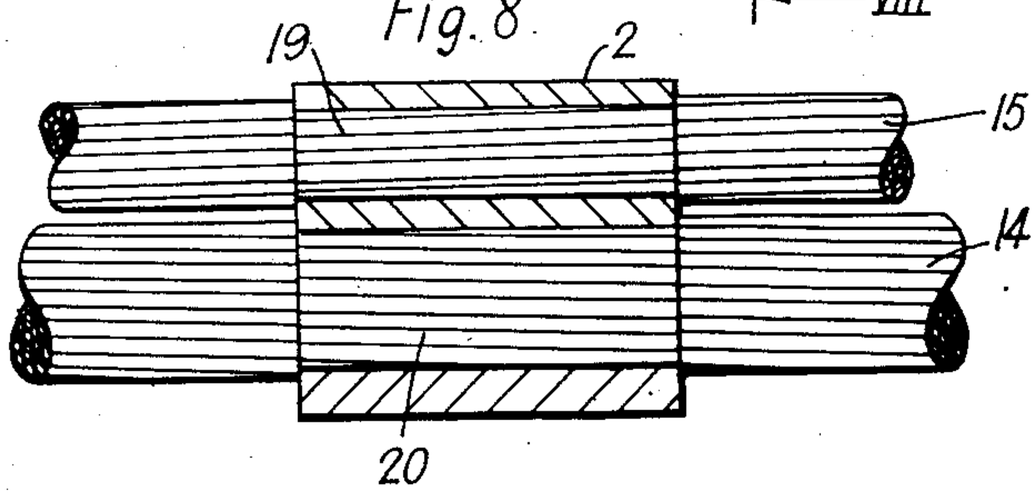


Fig. 8.



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ELECTRIC CONNECTORS

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1 Claim. (Cl. 174—90)

This invention relates to improvements in electrical connectors which, although intended primarily for making a connection between an overhead conductor and a tapping therefrom, may be used for making a connection between other conductors, for example, a main conductor and a branch conductor in an underground system. The connector can be used to make the connection without cutting the main conductor.

According to the present invention an electrical connector comprises two deformable metal members, one of which is adapted to be fitted within the other by a relative axial sliding movement of the two members. When the two members are thus brought into engagement, their engaging surfaces are such as to prevent any substantial relative movement of the two members both radially outwards and also radially inwards. Each of the two members is provided with a groove and when the two members are brought into engagement, the two grooves co-operate to provide a single longitudinally extending through passage for the reception of one of the conductors. The inner of the two members is also provided with a longitudinally extending passage for the reception of the other conductor, the two conductors thus being separated by an intervening portion of the inner member of the connector.

The inner member, preferably, is located wholly within the outer member in a direction at right angles to the axis of the connector, the conductor housed in the inner member being then located wholly within the outer member. Location of the inner member wholly within the outer member is preferable since the inner and outer members can then be so constructed as to provide for a smooth continuation of the adjacent portions of the exterior surfaces of the outer member over the exterior surface of the inner member. This facilitates the application of compression jaws of simple construction to the outer member for the purpose of effecting the deformation of the two members to provide a joint between the two conductors. The application of insulating material to the connector after completion of the joint, should such application be required, is also facilitated.

The invention will be described further with the aid of the accompanying drawings illustrating examples of construction in accordance with the invention.

It will be understood that in each case the connector comprises two deformable metal members adapted to be brought into engagement by a relative axial sliding movement.

FIGURE 1 is an end elevation of one form of connector ready for compression, the inner and outer members and the two conductors to be connected being shown assembled.

FIGURES 2 and 3 are side elevations of the outer and inner members respectively.

FIGURE 4 is an end elevation of a somewhat modified form of outer member as compared with that shown in FIGURES 1 and 2.

FIGURE 5 is a side elevation of the outer member shown in FIGURE 4.

FIGURE 6 is an end sectional elevation illustrating the effect of circular compression applied to an electrical connector having an outer member constructed in the manner shown in FIGURE 7.

FIGURE 7 is a sectional end elevation of a connector which has been compressed into a non-circular cross-section.

FIGURE 8 of the drawing is a longitudinal view of the device taken along line VIII—VIII of FIGURE 7.

Reference will be made first of all to FIGURES 1–3 from which it will be seen that the connector has an outer member **1** and an inner member **2**. These are both made of metal and are brought into engagement by a relative axial sliding movement. The outer member **1** has three walls, two of these being designated by the reference numerals **3** and the other wall, by the reference numeral **4**. For convenience of description the walls **3** will be referred to as the side walls of the outer member and the wall **4** as the lower wall of the outer member **1**. The two side walls **3** are spaced apart by an appropriate distance and merge into the lower wall **4**. The two side walls and the lower wall thus co-operate to form between them a channel-shaped member having a channel **5**, shown in FIGURE 4, which extends from one end of the outer member **1** to the other end. The channel is symmetrical on opposite sides of the mid-longitudinal plane of the outer member **1** and is bounded at its upper part by a pair of flat parallel surfaces **6** (see FIGURE 4) and at its central part by a pair of flat parallel surfaces **8**, the latter being spaced apart laterally by a distance substantially greater than the distance by which the parallel surfaces **6** are spaced apart. The surfaces **6** and **8** are connected by surfaces **7** which are inclined upwardly and inwardly towards one another. The surfaces **6** and **8** are parallel with the longitudinal mid-plane of the outer member **1**. Towards the lower end of the channel **5**, the surfaces **8** are continued as surfaces **9** which extend inwards at right angles to the surfaces **8** and the surfaces **9** are connected by a semicircular surface **10**. From the above description it will be seen that the boundary surfaces of the channel **5** are such as to provide the two side walls **3** of the outer member **1** with two oppositely disposed recesses **11** and that the surface **10** provides a groove **12** in the lower wall **4** of the outer member **1**.

Referring to FIGURE 1, the outer surface **16** of the outer member **1** forms the major portion of a cylinder. The inner member **2** has an exterior surface which is so shaped as to be complementary to the inner surface of the outer member **1**. The inner member thus has two oppositely disposed parallel surfaces **60**, two oppositely disposed parallel surfaces **80** and inclined surfaces **70** connecting surfaces **60** and **80**, and surfaces **90**, surfaces **60**, **70**, **80** and **90** of the inner member corresponding respectively to the surfaces **6**, **7**, **8** and **9** of the outer member **1**. The inner member is also provided with a groove **120** of semicircular shape in cross-section and which is adapted to be brought into registration with the groove **12** of the outer member **1**. The inner member also has a through passage **13** of circular cross-section.

The inner member is so dimensioned as to be capable of making a sliding fit in the outer member the engagement of the two members being brought about by a relative axial movement of the members. When thus brought into engagement a through passage is provided by the cooperation of the grooves **12** and **120** for the reception of a stranded conductor **14** and the through passage **13** provides for the reception of a stranded conductor **15**.

When the outer and inner members **1** and **2** are brought into engagement, it will be seen that the cooperation of the surfaces **7** and **70** prevents relative radial outward movement of the two members and that the co-operation of the surfaces **9** and **90** prevents relative radial inward movement of the two members. The two members when fitted together thus provide for the obtaining of a through passage of predetermined cross-sectional area and shape

so that it can be ensured that the connector fits uniformly around the circumference of the conductor **14** housed in the through passage. This is of advantage in ensuring a satisfactory joint between the two conductors when applying a compressive force to the outer surface of the connector as a more uniform interlocking between the conductor **14** and the outer and inner members **1, 2** can be obtained. Furthermore, by providing for a predetermined cross-sectional area and shape of the passage accommodating the conductor **14**, the connector can be more readily designed to accommodate a given size of conductor than would be the case if the members **1** and **2** did not define a passage of definite size and shape.

In use the connector will accommodate a continuous or uncut conductor and a second conductor which can terminate within or outside the connector. Since one end of the conductor **15** has to be inserted into the passage **13** or alternatively, the inner member **2** be threaded over that conductor, it follows that the conductor **14** will be the uncut conductor.

From FIGURE 1 it will be seen that after assembly of the inner member **1** and outer member **2**, the inner member has an exposed surface **17** which forms part of a cylinder and forms a smooth continuation of the cylindrical surface **16**. Although this is not essential since the surface **17** could be disposed either within or outside the surface **16**, the provision of a surface of the inner member **2** to complete the cylindrical periphery of the outer member **1** has the advantage of facilitating the use of a tool having compression jaws of a simple construction and it also facilitates the application of insulating material in tape form around the connector after compression, should that be necessary or desirable. It also facilitates the enclosing of the connector in a casing of more simple construction than would be the case if the inner member were to project radially beyond the periphery of the outer member **1**. As indicated above, however, the inner member **2** may be arranged to project radially outside the outer member and the passage **13** for accommodating the conductor **15** may be disposed radially either wholly outside the cylindrical surface **16** or partly outside that surface and partly within. In the construction illustrated the passage **13** is located wholly within the outer member **1**. From FIGURE 1 it will be seen that the two conductors **14** and **15** are separated by an intervening portion **18** of the inner member **2**. The conductor **15** preferably makes a fairly close sliding fit within the passage **13**.

In order to complete the joint between the conductors **14** and **15** after assembly, a compressive force of an appropriate value is applied to the exterior surfaces **16** and **17** of the outer and inner members **1** and **2** respectively. This compressive force may be effected by the use of a hand or power operated tool, for example, a hydraulically operated tool, having jaws of an appropriate shape.

In FIGURES 4 and 5 there is shown an outer member **1** which is of the same general construction as that shown in FIGURES 1 and 2 but the side walls **3**, instead of having cylindrical outer surfaces, have outer surfaces which are each provided mainly by flat surfaces **21** which are parallel with one another and with the surfaces **6** and **8**. At their lower ends the two surfaces are connected by a surface **22** forming part of a cylinder and providing the exterior surface of the lower wall **4** of the outer member. At their upper ends the flat surfaces **21** are connected to the upper ends of the surfaces **6** by surfaces **23** forming parts of cylinders. The internal shape of the outer member shown in FIGURE 4 and the construction of the inner member are as shown in FIGURE 1, although greater areas of contact between the outer and inner members and between those members and the conductors are provided for by increasing the lengths of the outer and inner members.

By selecting appropriate initial shapes in cross-section of the outer and inner members and using a tool having

appropriately shaped jaws, the final shape in cross-section of the completed joint may be of circular or non-circular cross-section. By applying circular compression to an assembly consisting of an inner and an outer member assembled to enclose a pair of conductors in the manner shown in FIGURE 1, but with the outer member constructed as shown in FIGURE 4, the completed joint may be given a circular configuration in cross-section, as shown in FIGURE 6. Alternatively, by applying a hexagonal compression to the circular configuration shown in FIGURE 1, the final configuration of the completed joint may be as shown in FIGURE 7, from which it will be seen that the connector has been given a hexagonal shape in cross-section. Normally the shape of the connector before compression and the shape of the tool used for making the compression would be such as to result in a circular configuration after compression.

The effect of the compression is to deform the outer and inner members and to form indentations in the surfaces of the conductors, the indentations being entered by the adjacent parts of the two members and to effect a deformation and compacting of the wires of the conductors. The forming of the indentations and the penetration of the adjacent parts of the connector is illustrated in FIGURE 8, the conductor **15** being shown with a portion **19** of reduced diameter and the conductor **14** being shown with a portion **20** of reduced diameter, the reductions having been brought about by the subjection of a compressive force to the assembly. An interlocking engagement is thus provided between the conductors and the adjacent parts of the connector. The compression also has the effect of forming those portions of the two conductors lying within the connector into bodies which to a large extent are solid masses of metal.

If it be assumed that the conductor **14** is a main conductor forming part of an overhead line distribution system and that the conductor **15** is a conductor to be used for tapping off current from the main conductor, a joint between the two conductors can be made in the following manner. With the inner member **2** removed from the outer member **1**, the latter is brought into position relative to the conductor **14** such that the latter occupies the groove in the outer member. This can be conveniently done by inverting the outer member and placing it over the main conductor so that the latter supports the outer member. The inner member can then be slid axially into the outer member with or without the tapping conductor being already in position. The inner member is retained in position within the outer member. If the branch conductor is not already in position it can be threaded through its passage in the inner member so that its end projects beyond the latter. It may be bent over at its projecting end to prevent it pulling back through the inner member. The joint can then be completed with the aid of a suitable form of compression tool.

By providing the outer and inner members with engaging surfaces which prevent the two members falling apart when assembled, the linesman or jointer can have both hands free to operate the joint forming tool, thus facilitating the making of the joint. By providing the outer and inner members with engaging surfaces preventing relative radial inward movement of the two members, a more uniform distribution of the compressive forces around the circumferences of the two conductors is obtained, overcompression of the main conductor and undercompression of the branch conductor and poor compacting of the wires of the conductors, being avoided.

By housing the two conductors in separate passages a greater degree of uniformity of compression and compacting of the wires of the conductors can be more readily obtained and there is complete circumferential contact between each conductor and the adjacent parts of the connector. Furthermore, it is possible to obtain by the interlocking engagement between the members of the connector and the conductors the maximum possible

surface or cold weld contact between the members and the conductors. These features provide for an improved electrical performance of the joint and are, therefore, beneficial whether the joint is used with overhead or underground conductors. The joint is also sound mechanically.

As will be appreciated the engaging surfaces preventing radially outward and inward movement of the inner and outer members after assembly need not necessarily have the shapes shown in the drawings but may be made of other shapes. The shapes shown, however, have the advantage of simplicity of construction of the connector. Furthermore, the connector may be used for making a joint between conductors of non-circular cross-section and the passages provided for the reception of the conductors be shaped in cross-section to suit that of the conductors to be housed in the passage.

The surfaces of the connector with which the conductors make contact may be milled or otherwise roughened where necessary or desirable to increase the electrical conductivity of the connector. If the conductors are of different metals, for example, copper and aluminum, a liberal coating of a corrosion inhibiting paste or compound may be applied to that conductor made of a metal differing from that of the connector, the paste or compound being also applied to the wall of the passage housing that conductor. Alternatively the whole connector may be encased in a shroud or casing filled with an insulating compound.

What I claim as my invention is:

A two-part compression connector for making an electrical and a mechanical connection between two conductors each composed of wires stranded together, the said connector consisting of an outer part of malleable metal and an inner part of malleable metal, the outer part having two oppositely disposed spaced side walls and a third wall connecting the two side walls, the third wall having a longitudinally extending groove and the three walls forming a recess in the outer part which is open on one side thereof, the inner part having a longitudinally extending groove therein and a longitudinally extending passage separated from the groove in the inner part by a portion of the inner part, the two parts being so dimensioned that upon assembly, the inner part lies substantially wholly within the outer part in a circumferential direction, the two parts having engageable surfaces which prevent engagement of the two parts otherwise than by a relative parallel longitudinal movement of the two parts, the grooves in the two parts, upon assembly of the parts, cooperating to form a single passage for the reception of a conductor and each being of uniform area in cross-section throughout its length and the engageable surfaces of the two parts preventing relative radially outward and radially inward movements of the two parts upon assembly of the parts.

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