

# PATENT SPECIFICATION

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## (54) ELECTRICAL CONNECTORS

(71) We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, of 1, Stanhope Gate, London, W1A 1EH., a British Company, we pray that a patent may be granted to do hereby declare the invention, for which us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrical connectors for establishing electrical connections between individual insulated conductors of a multi-core cable and associated branch conductors.

According to the present invention, an electrical connector for connecting individual insulated conductors of a multi-core cable to associated branch conductors, comprises a plurality of identical electrically insulating members each provided with electrically conductive connector means affording electrical connection to a branch conductor and with further electrically conductive means adjustable in position relative to the insulating member, which further means is capable of penetrating the insulation of one of the conductors of the multi-core cable to establish an electrical connection therewith and is electrically connected to the respective connector means, and a plurality of identical means for mechanically linking the electrically insulating members together around the multi-core cable, each such linking means being adjustable whereby to locate each insulation penetrating means adjacent a respective one of the insulated conductors of the cable.

Each electrically insulating member may comprise a block of suitable insulating material such as a reinforced thermosetting resin, provided with a recess in which is housed an electrically conductive member having means for connecting a branch conductor thereto and a threaded bore which accommodates a threaded insulation penetrating means.

Preferably each insulation penetrating means comprises a tubular, externally threaded member having a transverse slot at one end which forms a cutter for penetrating the insulation. The other annular end of the tubular member may be provided with a socket or recess shaped to co-operate with a tool, for example an Allen key, for adjusting the position of the member relative to the respective insulating member.

Each linking means may comprise a strap arranged to embrace an electrically insulating member and means for pivotally connecting said strap to the strap or straps embracing the or each adjacent electrically insulating member. Conveniently, each strap may be of steel and may carry at each end a cylindrical bar which is rotatable with respect to the strap to form a hinge and each cylindrical bar being adjustably securable to a cylindrical bar of an adjacent hinge.

The electrical connector may include a plurality of identical insulating spacers which are inserted between the insulated conductors of the cable prior to the assembly of the electrically insulating members around the insulated conductors.

Preferably the insulating spacers comprise rectangular plates provided with serrations for supporting the insulation of the insulated conductors. The plates may have shallow serrations on one portion and deep serrations on another portion, which portions respectively co-operate with paper insulation and with plastics or rubber insulation so that the plate is reversible to cater for these different kinds of insulation.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a perspective view of an electrical connector in accordance with the invention secured to a three core cable;

Figure 2 is a cross-section through the

electrical connector shown in Figure 1;

Figure 3 is a plan view of an insulating spacer shown in Figure 1;

Figure 4 is a side elevation of the insulating spacer shown in Figure 3;

Figure 5 is a section of part of the connector on the line V-V in Figure 2 looking in the direction of the arrows;

Figure 6 is a section of an insulation penetrating element on the line VI-VI in Figure 2 looking in the direction of the arrows; and

Figure 7 is a cross-section of an electrical connector in accordance with the invention secured to a four cored cable.

Referring in the first instance to Figures 1 to 6, the electrical connector comprises three blocks 1, of an electrical insulating material such as a glass reinforced alkyd resin, located at spaced positions around the three insulated conductors 2 of a three core cable 3. Each block 1 is provided with a recess 4 in which is housed a contact piece 5 of brass or other electrically conductive material. One end of each contact piece 5 is provided with two bores 6 arranged to accept branch conductors (not shown) to be connected to an insulated conductor 2 of the three core cable 3. Hexagonal socket set screws 7 are arranged to screw into threaded bores transverse to the bores 6, so as to securely clamp in position branch conductors inserted in the bores 6. Access to the hexagonal sockets 9 of the set screws 7, to enable them to be tightened by an Allen key, is through an aperture 10 in the block 1 surrounded by a peripheral wall 11.

A further threaded bore 13 in each contact piece 5 is arranged to receive a hexagonal socket set screw 14 having a transverse slot 15 in the opposite end to the hexagonal socket 16. The end of the set screw 14 provided with the transverse slot 15 can project from the inner end of the bore 13 into engagement with the insulation 17 of a conductor 2, while the access to the hexagonal socket 16 is through an aperture 18 in the block 1 surrounded by a peripheral wall 19. A pair of spring washers 20 surround the set screw 14 between the contact piece 5 and a facing surface of the block 1.

Each block 1 is provided with a steel strap 21 shaped to embrace the outer surface of the block 1 and having a circular aperture 22 through which the peripheral wall 19 extends. Each strap 21 terminates in two pairs of pierced ears 23 and 24 which respectively receive a cylindrical bar 25 having a transverse plain bore 26 and a cylindrical bar 27 having a transverse threaded bore 28. The pairs of pierced ears 23 and 24 and their associated cylindrical bars 25 and 26 form hinges which permit

pivotal movement of a strap 21 relative to the adjacent straps 21. A hexagonal socket cap screw 29 passes through the plain bore 26 of the cylindrical bar 25 in the strap 21 embracing one block 1 and screw into the threaded bore 28 of the cylindrical bar 27 in the strap 21 embracing an adjacent block 1.

The three insulated conductors 2 of the three core cable 3 are separated by spacers 30 of insulating material which lie at an angle of substantially 120 degrees to each other. Each spacer 30 (see Figures 4 and 5), comprises a substantially rectangular plate having, on each side, a series of serrations or teeth 31. Also provided on each side of the rectangular plate is a series of substantially flat rectangular platforms 33 extending from a position adjacent one edge 34 to a position partway across the width of the rectangular plate. The flat upper surfaces 35 of the rectangular platforms 33 are close to the peaks of the teeth 31 so that they reduce the effective heights of the teeth 31 in the region of the platforms 33. The part of the spacers 30 with the platforms 33 is inserted between the conductors 2 when their insulation 17 is paper and the part of the spacers 30 without the platforms 33 is inserted between the conductors 3 when their insulation 17 is of plastics material or a rubber compound.

To connect the individual insulated conductors 2 of a three core cable 3 to associated branch conductors by means of the electrical connector, the outer insulating sleeve (not shown) of the cable is first removed along a short length of the cable to expose the three insulated conductors 2. One of the hexagonal socket cap screws 29 is unscrewed from its associated cylindrical bar 27 by an Allen key inserted in the hexagonal socket 36, and the electrical connector is opened out, the other cylindrical bars 25 and 27 and the co-operating pairs of pierced ears 23 and 24 acting as hinges.

Three insulating spacers 30 are then inserted between the adjacent insulated conductors 2 with their longitudinal edges 32 mutually abutting so that the teeth 31 engage the insulation 17 of the insulated conductors 2. The electrical connector is then placed around the three insulated conductors 2 so that each block 1 is aligned with one of the insulated conductors 2 and the slots 16 in the set screws 15 face the insulation 17. The hexagonal socket cap screw 29 is then screwed into the cylindrical bar 27 from which it was removed and the other hexagonal socket cap screws 29 adjusted, as necessary, so that the electrical connector surrounds and grips the three insulated conductors 2 of the three core

cable with each set screw 14 located on the centre line of a conductor 2.

The branch conductors are then inserted in the bores 6 and the hexagon socket set screws 7 tightened to clamp the branch conductors in the bores 6. The set screws 14 are then tightened so that the ends with the slots 15 cut and penetrate the insulation 17 of the conductors 2 and establish electrical connections between each conductor 2 and its associated branch conductors. The pairs of spring washers 20 act to ensure positive contact between each set screw 14 and the associated conductor 2. The electrical connector and adjoining portions of the three core cable are then enclosed in a housing (not shown) of electrically insulating material. Conveniently, the hexagonal sockets 9 in the set screws 7, the hexagonal sockets 16 in the set screws 14 and the hexagonal sockets 36 in the cap screws 29 are of the same size so that a single Allen key can be used to assemble the electrical connector.

It is an advantage of the electrical connector of the invention that the same standard parts as described above for establishing electrical connections between the insulated conductors 2 of a three core cable 3 and associated branch conductors, can also be used with multi-core cables having more than three cores. For example, as shown in Figure 7, an electrical connector for connecting the four individual insulated conductors 40 of a four core cable 41 to associated branch conductors utilizes four blocks 1 and four spacers 30 together with four straps 21 and their associated parts as previously described. The only modification is that the hexagon socket cap screws 29 are shorter than those used with the connector for a three core cable.

#### WHAT WE CLAIM IS:

1. An electrical connector for connecting individual insulated conductors of a multi-core cable to associated branch conductors, comprising a plurality of identical electrically insulating members each provided with electrically conductive connector means affording electrical connection to a branch conductor and with further electrically conductive means adjustable in position relative to the insulating member, which further means is capable of penetrating the insulation of one of the conductors of the multi-core cable to establish an electrical connection therewith and is electrically connected to the respective connector means, and a plurality of identical means for mechanically linking the electrically insulating members together around the multi-core cable, each such linking means being adjustable whereby to locate each insulation penetrating means adjacent a respective one of the insulated conductors of the cable.

2. An electrical connector as claimed in Claim 1, wherein each electrically insulating member comprises a block of insulating material provided with a recess in which is housed an electrically conductive member having means for connecting a branch conductor thereto and a threaded bore which accommodates a threaded insulation penetrating means.

3. An electrical connector as claimed in Claim 1 or Claim 2, wherein an insulation penetrating means comprises a tubular, externally threaded member having a transverse slot at one end which forms a cutter for penetrating the insulation.

4. An electrical connector as claimed in Claim 3, wherein the other end of the tubular member is provided with a socket or recess shaped to co-operate with a tool for adjusting the position of the member relative to the respective insulating member.

5. An electrical connector as claimed in any preceding claim, wherein each linking means comprises a strap embracing a respective electrically insulating member and means for pivotally connecting said strap to the strap or straps of the or each adjacent electrically insulating member.

6. An electrical connector as claimed in Claim 5, wherein each strap carries at each end a cylindrical bar which is rotatable with respect to the strap to form a hinge, and each cylindrical bar is adjustably securable to a cylindrical bar of an adjacent hinge.

7. An electrical connector as claimed in Claim 6, wherein there is further provided a threaded member extending through a transverse bore in each of two adjacent cylindrical bars so as to provide the adjustment for locating an insulation penetrating means relative to an insulated conductor.

8. An electrical connector as claimed in Claim 7, wherein the threaded member extends through a plain bore in one cylindrical bar and screws into a threaded bore in the other.

9. An electrical connector as claimed in any preceding claim, including a plurality of identical insulating spacers for insertion between the insulated conductors of the cable prior to the assembly of the electrically insulating members around the insulated conductors.

10. An electrical connector as claimed in Claim 9, wherein each insulating spacer comprises a plate provided with serrations for supporting the insulation of the insulated conductors.

11. An electrical connector as claimed in Claim 9 or Claim 10, wherein each insulating spacer comprises a rectangular plate having a series of serrations on each side, and also having, on each side, a series of platforms extending partway across the



able with each set screw 14 located on the centre line of a conductor 2.

The branch conductors are then inserted in the bores 6 and the hexagon socket set screws 7 tightened to clamp the branch conductors in the bores 6. The set screws 14 are then tightened so that the ends with the slots 15 cut and penetrate the insulation 17 of the conductors 2 and establish electrical connections between each conductor 2 and its associated branch conductors. The pairs of spring washers 20 act to ensure positive contact between each set screw 14 and the associated conductor 2. The electrical connector and adjoining portions of the three core cable are then enclosed in a housing (not shown) of electrically insulating material. Conveniently, the hexagonal sockets 9 in the set screws 7, the hexagonal sockets 16 in the set screws 14 and the hexagonal sockets 36 in the cap screws 29 are of the same size so that a single Allen key can be used to assemble the electrical connector.

It is an advantage of the electrical connector of the invention that the same standard parts as described above for establishing electrical connections between the insulated conductors 2 of a three core cable 3 and associated branch conductors, can also be used with multi-core cables having more than three cores. For example, as shown in Figure 7, an electrical connector for connecting the four individual insulated conductors 40 of a four core cable 41 to associated branch conductors utilizes four blocks 1 and four spacers 30 together with four straps 21 and their associated parts as previously described. The only modification is that the hexagon socket cap screws 29 are shorter than those used with the connector for a three core cable.

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1. An electrical connector for connecting individual insulated conductors of a multi-core cable to associated branch conductors, comprising a plurality of identical electrically insulating members each provided with electrically conductive connector means affording electrical connection to a branch conductor and with further electrically conductive means adjustable in position relative to the insulating member, which further means is capable of penetrating the insulation of one of the conductors of the multi-core cable to establish an electrical connection therewith and is electrically connected to the respective connector means, and a plurality of identical means for mechanically linking the electrically insulating members together around the multi-core cable, each such linking means being adjustable whereby to locate each insulation penetrating means adjacent a respective one of the insulated conductors of the cable.

2. An electrical connector as claimed in Claim 1, wherein each electrically insulating member comprises a block of insulating material provided with a recess in which is housed an electrically conductive member having means for connecting a branch conductor thereto and a threaded bore which accommodates a threaded insulation penetrating means.

3. An electrical connector as claimed in Claim 1 or Claim 2, wherein an insulation penetrating means comprises a tubular, externally threaded member having a transverse slot at one end which forms a cutter for penetrating the insulation.

4. An electrical connector as claimed in Claim 3, wherein the other end of the tubular member is provided with a socket or recess shaped to co-operate with a tool for adjusting the position of the member relative to the respective insulating member.

5. An electrical connector as claimed in any preceding claim, wherein each linking means comprises a strap embracing a respective electrically insulating member and means for pivotally connecting said strap to the strap or straps of the or each adjacent electrically insulating member.

6. An electrical connector as claimed in Claim 5, wherein each strap carries at each end a cylindrical bar which is rotatable with respect to the strap to form a hinge, and each cylindrical bar is adjustably securable to a cylindrical bar of an adjacent hinge.

7. An electrical connector as claimed in Claim 6, wherein there is further provided a threaded member extending through a transverse bore in each of two adjacent cylindrical bars so as to provide the adjustment for locating an insulation penetrating means relative to an insulated conductor.

8. An electrical connector as claimed in Claim 7, wherein the threaded member extends through a plain bore in one cylindrical bar and screws into a threaded bore in the other.

9. An electrical connector as claimed in any preceding claim, including a plurality of identical insulating spacers for insertion between the insulated conductors of the cable prior to the assembly of the electrically insulating members around the insulated conductors.

10. An electrical connector as claimed in Claim 9, wherein each insulating spacer comprises a plate provided with serrations for supporting the insulation of the insulated conductors.

11. An electrical connector as claimed in Claim 9 or Claim 10, wherein each insulating spacer comprises a rectangular plate having a series of serrations on each side, and also having, on each side, a series of platforms extending partway across the

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plate to reduce the effective height of the serrations in the area over which the platforms extend.

12. An electrical connector substantially  
5 as hereinbefore described with reference to the accompanying drawings.

For the Applicants,

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