May 27, 1969 E. BECK 3,447,122

CONNECTOR FOR ELECTRICAL CONDUCTORS

Filed Sept. 20, 1967

FIG. 2

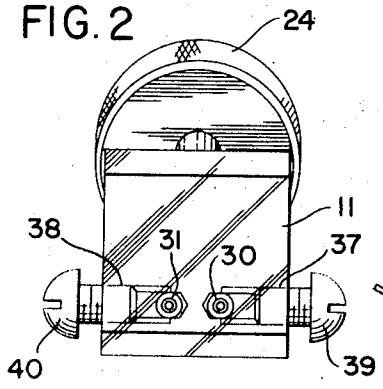


FIG. 1

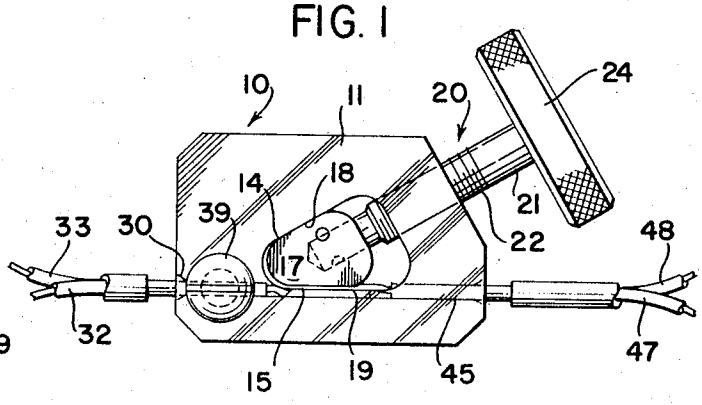


FIG. 3

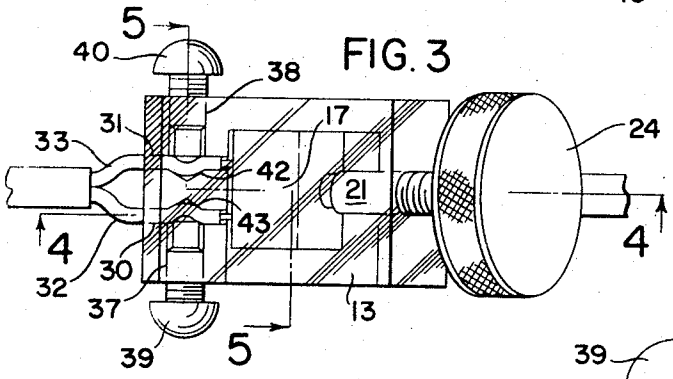
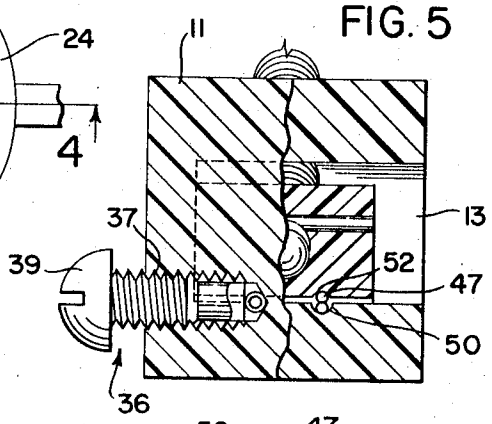


FIG. 5



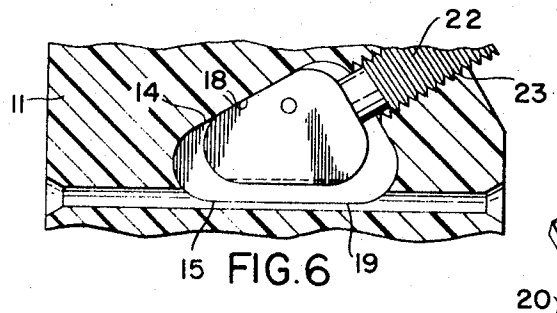


FIG. 6

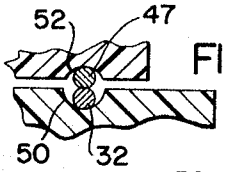


FIG. 7

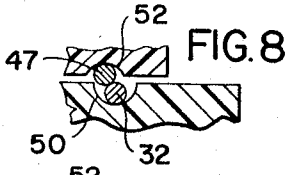


FIG. 8

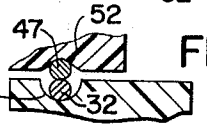


FIG. 9

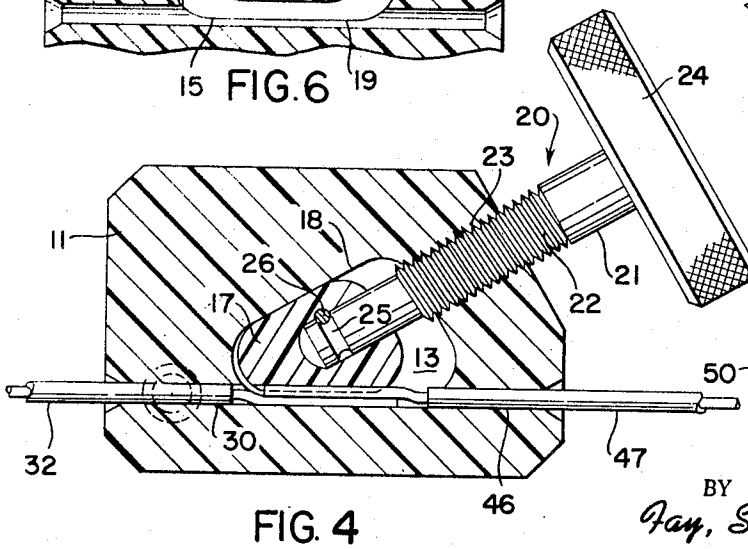


FIG. 4

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CONNECTOR FOR ELECTRICAL CONDUCTORS

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ABSTRACT OF THE DISCLOSURE

A connector for electrical conductors which includes a reciprocally actuated, insulating clamping block containing converging surfaces to provide a wedging relationship for joining the conductors within an insulating connector body. Means are provided for wedging the clamping block against the connector body to connect and disconnect the axially aligned conductors. The clamping block is reciprocally actuated by a threaded bolt having a knurled cap communicating through the wall of the body with the clamping block within the cavity. Means for securedly fixing one end of the conductors to be connected and alternative means for guiding and positioning the conductors within the block in the body of the connector are also disclosed.

Background of the invention

This invention relates to a mechanical connector for electrical conductors. More particularly, this invention relates to an insulating connector which is particularly suited to repeated connection and disconnection of electrical conductors. In addition, this invention relates to an insulating mechanical connector for electrical conductors which is particularly suited to the repeated connection and disconnection of a plurality of conductors by reciprocal actuation of a portion of the connector having converging surfaces contained therein to provide a wedging relationship between the connector and conductors, thereby to secure the conductors in an electrically conductive relationship.

The prior art has long recognized the desirability of quickly and conveniently securing electrical conductors in proper electrical contact. The simpler solutions to this problem have included merely twisting the conductors in a random fashion and covering the area of electrical contact with a suitable insulating material, such as friction tape, dielectric tape, or suitable wire nuts.

Such a solution has proved undesirable because of the inconvenience and resultant damage to the conductors in the cases of repeated connection and disconnection. Moreover, the difficulty of utilizing this type of connection is compounded where conductors of different sizes, i.e., of different current-carrying capabilities, are to be joined. Another shortcoming of such connection is the likelihood of inadvertent release of the electrical conductors because of the inherent lack of mechanical strength, particularly in the axial direction, in this type of connection.

Soldering is another solution to the problem of rapid connection of conductors. However, soldering is particularly unsuitable where it is desired that the connection be easily replaceable, or where it is desired that another conductor be easily substitutable for one in the connection, or where it is required that one or both of the conductors be readily connected and disconnected without special tools. It can be understood that, for soldering, both the connection and disconnection processes require special tools and equipment, such as a soldering tool, special fluxes, and suitable soldering material.

Both of the above described means for mechanically connecting electrical conductors are inconvenient or require special tools and both result in injury to the conductor as a result of successive connection and disconnection. In a typical instance, a conductor is surrounded by one or more layers of suitable insulating material. When a connection is made, the insulation is stripped back for a predetermined length from the end of the conductor and the conductor is secured in any one of the manners described above or in any other suitable manner known to the prior art. As a result of disconnecting one of the conductors from the connections described above, the end of the conductor which has been stripped of its insulator will be deformed, cut, or in other ways unsuitable for connection to still a third conductor.

Various mechanical devices are currently known in the prior art which are directed to occasions where repeated connection and disconnection of conductors is a likelihood. In testing apparatus, for example, where a conductor is representative of a particular parameter to be sensed, one of the simpler means known to the prior art for conveniently connecting and disconnecting the conductor is the well-known binding post. However, the stripped end of a conductor which has been repeatedly connected and disconnected to such a binding post tends to fold, crease, and break, requiring a successive restripping of the insulating material from the conductor. Where it is desired to use a binding post for the connection of a plurality of conductors, each of the conductors so associated with the binding post suffers the same malady. Each occasion which requires a restripping of the insulating material from the conductor requires an expenditure of labor and time, thus increasing the cost of performing the operation.

Other mechanical contrivances which seek an effective solution to the problems as pointed out hereinabove have resulted in a combination of mechanical elements, one of which may be readily losable by the operator in its day-to-day use. Such arrangements have included portable binding posts, wherein a nut is screwed down upon a base to place pressure upon the connection between the conductors. However, in this arrangement the parts may become disassociated and thereafter misplaced. Still others have required particular arrangements wherein one or more of the portions of the mechanical conductor are separable from the combination and thus amenable to misplacement.

Another consideration in the prior art which requires attention in the connection process arises in the measurement of temperature by a thermocouple. A thermocouple basically senses a difference of potential which exists between two metals that are placed in contact. When one junction of the dissimilar metals is heated, its EMF is increased and the resultant current flow may be measured. In general, thermocouples are small, light, relatively reasonable in cost, and can be mounted at a considerable distance from the indicating instrument. Moreover, thermocouples can be used in places inaccessible to ordinary thermocouples, such as in the field coils of electrical machines, bearings, heat exchangers of ovens and furnaces, and the like.

Because of the nature of a thermocouple, attention must be given to the different combinations of metals. Typical thermocouples include copper-constantan, iron-constantan, Chromel-Alumel, and platium-platinum-rhodium type thermocouples. In order to provide a connection for the measurements of the EMF generated by such thermocouples, it is necessary to pay strict attention to maintaining adherence to like metals in any current path to prevent inadvertent creation of additional thermocouple joints.

Summary of the invention

The invention according to this disclosure is directed to an immediate and effective solution to the foregoing problems of the prior art. The device comprises a connector for electrical conductors which includes a body of transparent insulating material, for example, clear plastic, which has a cavity located therein. The cavity is defined by a pair of walls, at least a portion of each wall being in a converging relationship. A clamping block is disposed within the cavity, made of suitable insulating material and capable of reciprocal movement within the cavity. The block includes at least a pair of surfaces which are in a converging relationship similar to the manner in which the walls of the cavity converge. Thus, upon actuation of the clamping block within the cavity, the converging surfaces coact with the converging walls of the cavity to provide a wedging action to secure the conductors in proper electrical contact.

An aperture, or a plurality of apertures, is disposed within the body for receiving the conductors. The apertures are in communication between the exterior of the body and the cavity within the body. Means may be provided in a direction generally transverse to the apertures for securing a conductor within the body before contact with the second conductor to prevent inadvertent axial withdrawal from the body of the connector.

A second aperture, or a plurality of apertures, is disposed within the body and communicates from the exterior of the body to the cavity within the body of the connector in a direction generally coaxial with the first aperture or plurality of apertures.

Conductor guide means are provided on a wall of the cavity for interconnecting the inner ends of the first and second plurality of apertures. In addition, means for positioning the conductors are disposed on the lower surfaces of the clamping block, in register with the conductor guide means, so that upon the placement and securing of the first conductor or set of conductors, insertion of the second conductor or second conductor or second plurality of conductors within the clamping block brings the appropriate pairs of conductors into proper alignment for wedging contact. The body and the clamping block are preferably transparent to permit visual observation of the connection between the appropriate pairs of conductors.

In a preferred embodiment, means for reciprocally actuating the clamping block within the cavity include a threaded bolt extending from the exterior of the body of the connector through a wall of the cavity and is connected to the clamping block in such a manner that rotation of the threaded bolt reciprocally actuates the clamping block within the cavity in the manner desired. The threaded bolt includes a circumferential groove near an end wherein the groove is situated within the clamping block. A pin is located within the groove and within the clamping block for retaining the bolt and clamping block in cooperative relationship, so that upon rotation of the threaded bolt the clamping block may be reciprocally actuated within the cavity.

Accordingly, it is an object of this invention to provide a connector for electrical conductors.

It is a still further object of this invention to provide a rapid and convenient means for connecting and disconnecting conductors, which is novel and unobvious.

It is a still further object of this invention to provide a connector for electrical conductors which permits a pressure of relatively high magnitude to be applied to the conductors to secure a low-resistance, high-conductivity connection.

It is a still further object of this invention to provide a connection which is transparent to permit observation of the electrical connection.

It is a still further object of this invention to provide a connection which a conductor or plurality of conductors is secured within a cavity in the body of the connector for ultimate contact with another conductor or plurality of conductors by a wedging action between coacting pairs of converging surfaces.

Other objects and features of this invention will become more apparent upon a consideration of the detailed description and study of the accompanying drawings.

Brief description of the drawings

In the drawings:

FIG. 1 is a side elevational view of the connector illustrating a pair of conductors in electrical contact;

FIG. 2 is a front elevational view of the connector depicting means for securing a first pair of conductors within the body of the connector;

FIG. 3 is a top view of the connector according to the invention;

FIG. 4 is a cross-sectional view taken along line **4—4** of FIG. 3;

FIG. 5 is a cross-sectional view as seen along line **5—5** of FIG. 3;

FIG. 6 is an enlarged side view of a portion of the connector which illustrates the relationship of respective apertures, guide means, and clamping block;

FIG. 7 is a longitudinal cross-sectional view along the axis of the conductors illustrating one relationship between the apertures and guide means for providing one manner of contact between the conductors;

FIG. 8 is a view similar to FIG. 7 illustrating an alternative relationship for producing another manner of contact between the conductors; and

FIG. 9 is another view similar to FIG. 7 illustrating a third alternative relationship to produce the desired contact between the conductors.

Description of the preferred embodiments

In FIG. 1, a connector for electrical conductors is shown generally at **10** as comprising a body **11**, manufactured from a suitable insulating material. A cavity **13**, located within body **11**, is defined by a pair of walls **14** and **15**, wherein at least a portion of one of the pairs of walls converges with at least a portion of the other of the pair of walls in a somewhat wedge-like relationship.

A clamping block **17**, similarly of suitable insulating material, is disposed within cavity **13**. Block **17** includes a pair of surfaces **18** and **19** so arranged that a portion of one of the pair of surfaces converges with at least a portion of the other of the pair of surfaces to provide a somewhat wedge-like relationship, similar to the manner in which walls **14** and **15** of cavity **13** are likewise related.

As can best be seen in FIGS. 1 and 4, means are depicted for reciprocally actuating clamping block **17** within cavity **13** and are illustrated generally at **20**. Means **20** include a cylinder **21** suitably threaded as at **22** and in suitable threaded engagement with body **11** at threads **23**. Means **20** extends from the exterior of the connector through body **11** and through a wall of cavity **13**. Means **20** is connected to clamping block **17** in such a manner that rotation of the threaded cylinder reciprocally actuates the block within the cavity to produce the desired clamping relationship.

Means **20** further includes a knurled cap **24** fixedly secured to cylinder **21** which is of a size to permit convenient grasping and rotation within the fingers of the operator. It can be understood that the threaded cap **24** may similarly be replaced by alternative means for providing the required rotation of threaded cylinder **21**, such as wing nuts, butterfly nuts, and the like.

The axis of the threaded cylinder **21** is preferably angularly disposed with respect to the axis of the conductors to provide freedom for the operator in inserting the conductors beneath the reciprocal actuating means **20**. In the embodiment disclosed in FIG. 4, the axis of threaded cylinder **21** is generally parallel to wall **14** of

cavity 13 to provide a high degree of wedging action between the converging walls and surfaces. In one operative embodiment, wall 14 and the axis of threaded cylinder 21 were inclined at an angle of 30° from the axis of the conductors to provide a particularly effective magnitude of force in securing the conductors.

Threaded cylinder 21 further includes a circumferential groove 25 located near the end of the cylinder within clamping block 17. A pin 26 is situated within the groove and within the clamping block 17 for retaining the cylinder and clamping block in a cooperative relationship so that upon rotation of the threaded cylinder within the body 11, the clamping block 17 may be reciprocally actuated within the cavity 13.

It can be understood, however, that other convenient relationships for producing the desired engagement between the cylinder and clamping block may similarly be provided.

Apertures 30 and 31 are disposed within body 11 for receiving a like number of conductors 32 and 33. It can be understood that the number of apertures is determined by the desired number of conductors to be connected, but preferably are selected in pairs, particularly for use in connecting thermocouple wires.

Means shown generally at 36 are provided for securing conductors 32 and 33 within apertures 30 and 31. Means 36 comprise a plurality of threaded apertures 37 and 38 within body 11, into which a pair of insulated, tipped screws 39 and 40 are arranged. The insulated tip on screws 39 and 40 is desirable to prevent inadvertent electrical malfunction or misreading in the event the insulation on the conductor is pierced.

Apertures 30 and 31 may have suitable indents as shown at 42 and 43 for securedly fixing conductors 32 and 33 within apertures 30 and 31 against inadvertent axial displacement. In operation, conductors 32 and 33 are slidably inserted into apertures 30 and 31. Screws 39 and 40 are secured within openings 37 and 38. The insulating tip, which in its preferable form is blunt to avoid piercing the conductor, securedly engages the conductor to form a loop in the conductor according to the contour of indents 42 and 43. In this manner, the first pair of conductors 32 and 33 are fixed within body 11 to provide additional mechanical strength to the connection, to secure the conductors during the connecting process, and to prevent inadvertent axial displacement therefrom, as heretofore mentioned.

Body 11 contains another plurality of apertures, shown at 45 and 46, for receiving conductors 47 and 48, i.e., the conductors to be secured to conductors 32 and 33. Apertures 45 and 46 extend from the exterior of the body 11, through the body thereof, into communication with cavity 13 in a direction generally opposite to apertures 30 and 31. Preferably, apertures 30 and 31, together with apertures 45 and 46, communicate with cavity 13 at a position substantially adjacent the lower surface of bottom of cavity 13.

As can best be seen in FIGS. 5 through 9, the lower wall or bottom of cavity 13 contains guide means 50 which interconnect the ends of apertures 30 and 31 and 45 and 46, respectively, in the interior of cavity 13. In the embodiment shown in FIG. 6, aperture 30 and aperture 45 are shown in axial alignment, so that conductor guide means 50 in the cavity area is merely part of the coaxial alignment of the aforementioned apertures.

On the lower surface of clamping block 17, conductor positioning means 52 are disposed in register with conductor guide means 50 on the wall of cavity 13.

As can best be seen by FIGS. 7 through 9, alternative manners of relating the conductor guide means 50 and the conductor positioning means 52 in register are illustrated. In FIG. 7, for example, the guide means 50 and the positioning means 52 are located in a relatively vertical alignment so that the conductors are initially in a vertical relationship for entering into a wedging engagement by virtue of the reciprocal actuation of block 17 via actuating means 20. In the alternative, as shown in FIG. 8, the positioning means 52 are offset transversely to the axis of the guide means 50 so that conductors 32 and 47 are slightly offset. This arrangement permits the conductors 47 and 32, when in the wedged relationship, to assume a somewhat side by side relationship.

As can be seen in FIGS. 7 and 8, both guide means 50 and positioning means 52 are shown in a substantially semicircular or arcuate configuration. In FIG. 9, however, positioning means 52 is shown as comprising a wedge-like configuration. It can be understood that the particular relationship or configuration of either of both guide means 50 and positioning means 52 may assume whatever configuration is particularly suitable to the conductors to be joined.

In order further to increase the degree of electrical contact between conductors 47 and 32, the preferred manner of relating the guide means with the positioning means 52 is as follows: the reciprocal actuating means 20 is operated to bring the clamping block 17 and surfaces 18 and 19 thereon into a relatively secure clamping or wedge-like relationship with walls 14 and 15 of cavity 13. Upon its most secure position, aperture 30 and aperture 45 are formed in body 11 by drilling an opening therethrough. Thereupon, clamping block 17 is removed from cavity 13, and a portion of the lower surface 19 of the clamping block 17 is removed, such as by planning the lower surface of the body.

Thus, as shown in FIG. 7, guide means 50 is shown as a full semicircle, whereas the positioning means 52 is illustrated as an arc of what was theretofore a portion of the similar semicircle. It can be seen, however, that alternate methods of forming the apertures according to desired configuration are possible.

The operation of the connector is as follows: the ends of the conductors are stripped of insulation, where used, for a predetermined desired length. The free end of the conductors, such as 32 and 33, is inserted into body 11 via apertures 30 and 31. Screws 39 and 40 are actuated to secure conductors 32 and 33 within the body 11. A complementary pair of conductors are inserted into apertures 45 and 46 in a direction generally opposite to conductors 32 and 33 until free ends of conductors 47 and 48 are in axial alignment with the free ends of conductors 32 and 33.

Thereupon, the knurled cap is actuated by the hand of the operator, reciprocally actuating clamping block 17 to bring clamping block 17 into its wedging relationship, via the surfaces 18 and 19 and walls 14 and 15, with conductors 47 and 48. In this manner, rigid electrical contact is effectuated, as can be seen in FIG. 4.

For ease of description, the principles of the invention have been set forth in connection with several illustrated embodiments. It is not intended that the illustrated embodiments nor the terminology employed in describing them be limiting inasmuch as variations in these may be made without departing from the spirit of the invention.

I claim:

1. A connector for electrical conductors comprising:
a body of insulating material,
a cavity located within said body, said cavity being defined by at least a pair of walls, at least a portion of one of said pair of walls converging with at least a portion of the other of said pair of walls,
a clamping block of insulating material located within said cavity, said block being capable of reciprocal movement within said cavity, said block further including at least a pair of surfaces, at least a portion of one of said pair of surfaces converging with at least a portion of the other of said pair of surfaces,
means for reciprocally actuating said clamping block within said cavity,
a first aperture disposed within said body for receiving

a first conductor, said first aperture being in communication with said cavity and the exterior of said body,

a second aperture disposed within said body for receiving a second conductor, said second aperture being in communication with said cavity and the exterior of said body in a direction generally opposite said first aperture, both said first and second apertures communicating with said cavity at a position substantially adjacent the bottom of said cavity,

a third aperture disposed in said body in a direction generally transverse to said first aperture and in communication therewith from the exterior of said body,

means disposed in said third aperture for positioning the first conductor securedly within said body for contact with said second aperture,

conductor guide means on a wall of said cavity interconnecting the ends of said first and second apertures which communicate with the interior of said cavity, and

conductor positioning means disposed on the surface of the clamping block in register with the conductor guide means on said wall of said cavity,

whereby upon the placement of the first and second conductors in a proper alignment in said apertures guide means, reciprocal actuation of said clamping block fixedly secures the conductors by coaction between said converging walls and said converging surfaces to provide electrical contact therebetween.

2. A connector for electrical conductors comprising:

a body of insulating material,

a cavity located within said body, said cavity being defined by at least a pair of walls, at least a portion of one of said pair of walls converging with at least a portion of the other of said pair of walls,

a clamping block of insulating material disposed within said cavity, said block being capable of reciprocal movement within said cavity, said block further including at least a pair of surfaces, at least a portion of one of said pair of surfaces converging with at least a portion of the other of said pair of surfaces,

means for reciprocally actuating said clamping block within said cavity,

a first plurality of apertures disposed within said body for receiving a first plurality of conductors, said first plurality of apertures being in communication with said cavity and the exterior of said body,

a second plurality of apertures disposed within said body for receiving a second plurality of conductors, said second plurality of apertures being in communication with said cavity and the exterior of said body in a direction generally opposite said first plurality of apertures, both of said first and second plurality of apertures communicating with said cavity at a position substantially adjacent the same wall of said cavity,

conductor guide means on said wall of said cavity interconnecting the ends of said first and second plurality of apertures which communicate with the interior of said cavity, and

conductor positioning means disposed on the surface of the clamping block in register with the conductor guide means on said wall of said cavity,

whereby upon the placement of the first and second plurality of conductors in a proper alignment in said apertures and guide means, reciprocal actuation of said clamping block fixedly secures the conductors by coaction between said converging walls and said converging surfaces to provide electrical contact between the conductors.

3. The connector as defined in claim 2, wherein said body and said clamping block are transparent to permit visual observation of the connection between the first and second plurality of conductors.

4. The connector as defined in claim 2, wherein said means for reciprocally actuating said clamping block include a threaded cylinder extending from the exterior of said body through a wall of said cavity and connected to said clamping block so that rotation of the threaded cylinder actuates said clamping block within said cavity.

5. The connector as defined in claim 4, wherein the axis of the threaded cylinder is angularly disposed with respect to the axis of the first and second plurality of apertures.

6. The connector as defined in claim 5, wherein the axis of the threaded cylinder is further defined as being generally parallel to a wall of said cavity.

7. The connector as defined in claim 4, wherein said threaded cylinder includes a circumferential groove near one end thereof, said groove being situated within said clamping block, and wherein the connector further includes: a pin situated within said groove and within said clamping block for retaining the cylinder and clamping block in a cooperative relationship so that upon rotation of the threaded cylinder, the clamping block may be reciprocally actuated within said cavity.

8. A connector as defined in claim 2, further comprising a third plurality of apertures disposed in said body in a direction generally transverse to said first plurality of apertures and in communication therewith from the exterior of said body, means disposed in said third plurality of apertures for positioning the first plurality of conductors securedly within said body for contact with said second plurality of apertures.

9. The connector as defined in claim 2, wherein both of said guide means and positioning means comprise an arcuate configuration in cross-section, said guide means and said positioning means being in substantially vertical alignment.

10. The connector as defined in claim 2, wherein both of said guide means and positioning means comprise an arcuate configuration in cross-section, said guide means and said positioning means being offset in a direction transverse to the axis of both of said means.

11. The connector as defined in claim 2, wherein said conductor positioning means is of a V-shaped cross-section.

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U.S. Cl. X.R.

287—77; 339—270, 273