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3,185,955

MULTIPLE WIRE ELECTRICAL CONNECTOR

Filed March 21, 1963

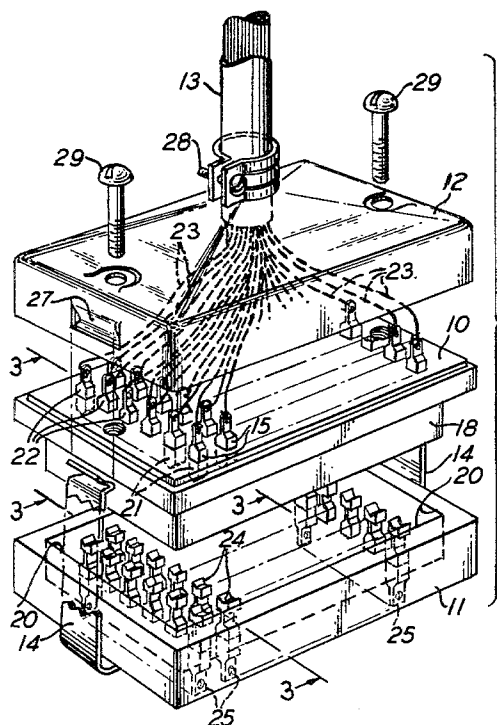


FIG. 1

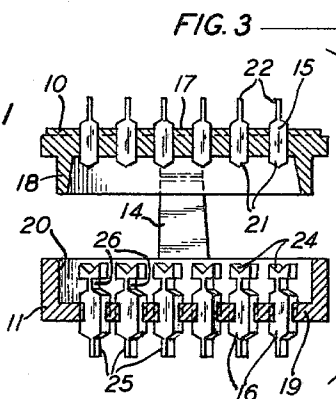


FIG. 3

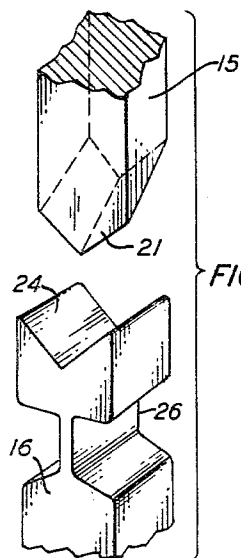


FIG. 2

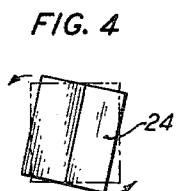


FIG. 4

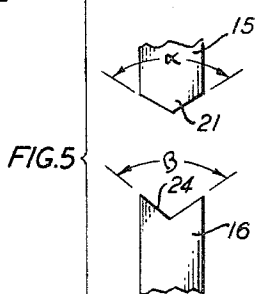


FIG. 5

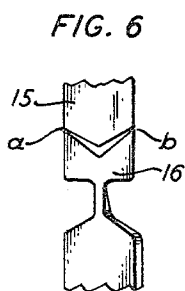


FIG. 6

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1

2

3,185,955

MULTIPLE WIRE ELECTRICAL CONNECTOR

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This invention relates to devices for making connections between electrical conductors and more specifically to electrical devices having mating terminals wherein the contact pressures therebetween are determined by torsional forces.

In general, multicircuit connectors comprise two mating insulating blocks having a plurality of complementary metallic terminals positioned within the blocks in a predetermined geometric pattern. The terminals usually make contact with each other during the process of mating the two blocks and depend upon some type of spring force to supply adequate contact pressure.

Such devices include inherent disadvantages. For example, during the process of mating the two blocks, the paired terminals are usually required to touch and slide over each other a considerable distance before the blocks mate with each other. Such a requirement is intended to insure a cleansing of contact surfaces or an adequate buildup of contact pressure but may result in excessive wear on the terminals and their subsequent damage. In addition, other connectors, in order to insure electrical continuity, include intricately shaped terminals having precious metal multiple spring contacts. These complex shapes require expensive manufacturing processes, not only to shape the terminals, but also to guarantee the dimensional tolerances required to give adequate spring pressures.

Further problems, in most cases, are encountered in endeavoring to insure that the terminals of one block will properly pair or come in contact with the terminals of the other block when the blocks are mated. Suggestions of the prior art include "floating" or mounting the contacts loosely or building in sufficient play in the blocks to allow the contacts to find one another. Both ideas, and others similar to them, multiply the dimensional problems already mentioned. Also, when wired into circuits, the "floating" action may be reduced or lost with consequent loss of performance.

It is an object of this invention to simplify and improve the structure of these devices.

Another object of the invention is to obviate the necessity for requiring strict dimensional requirements in order to insure the proper mating of insulating blocks and terminals.

Another object is to reduce the contact force between the mating terminals without loss of reliable performance by minimizing wear products due to the reduced sliding action of the mating contacts.

A further object of the invention is to obtain multiple point contact between the terminals of two mating insulating blocks.

A still further object of the invention is to supply adequate contact pressure through the incorporation of torsional forces.

The invention basically comprises two mating insulating blocks containing, in a predetermined geometric pattern, a plurality of securely mounted mating terminals. The latter are elongated and so mounted in the blocks and shaped on their contacting extremities that one induces a rotational displacement and a consequent torque in the other when the blocks are brought together. The extremities of the terminals in one block are V-shaped similar to a chisel while those of the other block are notch-

shaped approximating the complement of the chisel-shaped terminals. Because of the shape of the extremities and the induced torque, two contact areas and an adequate contact force are provided when the blocks are mated.

In addition, the contact force can further be preset by changing the cross sections of the terminals and their relative placement in the blocks.

An advantage of the device is that a very small movement of one terminal with respect to its mating terminal is required to induce a torque of sufficient magnitude to provide adequate contact force. A related advantage is that miniature connector designs of high reliability are possible.

Another advantage is that the chisel and notch-shaped extremities are simple and inexpensive to manufacture and such dimensional tolerances that are deemed necessary can be easily maintained by existing standard machine shop practices and equipment.

A feature of the invention is a connector wherein strict dimensional tolerances are minimized.

Another feature of the invention is that the interaction of the two mating terminals automatically provides two contact surfaces to insure electrical continuity between them.

Other objects, advantages, and features of the invention will be obvious and understood from the following detailed description when read in conjunction with the drawing, in which:

FIG. 1 is an exploded perspective view of one embodiment of the invention;

FIG. 2 is an enlarged perspective view of the extremities of the terminals contained in the mating blocks;

FIG. 3 is an enlarged section view taken generally along the lines 3—3 of FIG. 1;

FIG. 4 is an enlarged plan view illustrating the contacting extremity of the female terminal and shows the free position of the terminal in solid lines and the rotationally displaced position of the terminal in broken lines;

FIG. 5 is an enlarged elevation view of the contacting extremities of the terminals; and

FIG. 6 is an enlarged elevation view of the contacting extremities of the terminals when they are mated showing the two contact points *a* and *b*.

As shown in the various figures of the drawing, the invention comprises basically two mating insulating blocks 10 and 11 having a plurality of electrical terminals solidly mounted therein. The insulating block 10 further comprises a mounting member 17 having projecting at right angles therefrom four continuous side walls 18. The male terminals 15 of the connector are solidly fixed in the member 17 such that the terminals 15 extend through it a predetermined distance on each side of the member 17.

The insulating block 11 also includes a mounting member 19 and four side walls 20 but the side walls 20 are so located that the side walls 18 of the block 10 will fit inside the walls 20 of block 11. When the two blocks 10 and 11 are brought together, they form, generally, a rectangular block.

The fit between the side walls 18 and 20 must be dimensionally close enough to prevent the two blocks 10 and 11 from rotationally moving with respect to each other when the blocks are subjected to subsequent forces and torques.

Solidly fixed in the mounting member 19 of block 11, is a plurality of female terminals 16. The terminals 16 are so placed that they will pair with the geometrically patterned terminals 15 of block 10 when the two blocks 10 and 11 are mated with each other.

The male terminals 15 of block 10 are elongated, and rectangular cross section and terminate on the electrically contacting extremity in a cam, wedge or V-shaped chisel

point 21. The other extremity 22 has an appropriately shaped wire receiving configuration for receiving the individual wires 23 of a cable 13. The configuration of the extremity 22 depends upon the wire connecting method desired and, as an example, may include means for soldering, crimping, wire wrapping, solderless quick clip connecting and other various well-known prior art connecting processes.

The terminals 16 of the block 11 have on their contacting extremity 24 a receiving, interfitting or V-shaped notch that is approximately the complement of the chisel-shaped extremity 21 of terminals 15. However, the angle β shown in FIG. 5 formed by the notch-shaped extremity 24 is slightly smaller than the angle α (also shown in FIG. 5) formed by the chisel-shaped extremity 21. Thus, when the two terminals 15 and 16 are mated, two contact areas *a* and *b* are assured as shown in FIG. 6.

The terminals 16, like the electrical terminals 15, have a rectangular cross section and are elongated, having an electrically contacting extremity 24 previously described and a cable wire receiving extremity 25. End 25, as is end 22 of terminal 15, is appropriately shaped according to the numerous known means for connecting the incoming wires of a cable or to provide for other types of electrical connections.

In contrast to the terminals 15, the cross section of the terminals 16 are reduced in a portion 26 near the contacting extremity 24. The reason or purpose for the cross sectional reduction will subsequently be apparent.

As previously mentioned, the terminals 15 of block 10 are fixed solidly through the mounting plane 17 in a predetermined geometric pattern. The terminals 16 of the block 11 are also fixed solidly through the mounting member 19 and so positioned that they will mate with the appropriately paired terminals 15 of the other block 10 when the two blocks 10 and 11 are mated. However, as shown in FIG. 3, the terminals 16 are so placed that the line formed by the apex of the V-shaped chisel point 21 is rotationally displaced from the line formed from the bottom of the notched extremity 24. In other words, when the blocks 10 and 11 are mated, the terminals contained in one block will be skewed with respect to the axis common to it and its mating terminal. Thus, when the two blocks 10 and 11 are mated, the V-shaped chisel point 21 will tend to rotate or align the notch-shaped extremity 24 with it. This rotational displacement causes a resistive torque which tends to rotate the end 24 back to its free position. FIG. 4 shows the end 24 of terminal 16 in its free position in solid lines and shows its mated rotationally displaced position in dashed lines. The torque caused by the rotation of the end 24 furnishes the contact force required to insure adequate electrical contact pressure at the contact areas *a* and *b* shown in FIG. 6.

It now becomes apparent that the contact force can be controlled and preset by the amount of the reduction of the cross sectional area portion 26 of the terminals 16. The contact force is directly proportional to the torque required to twist the terminal shank. That torque is in turn proportional to the cross sectional area of the terminal. Hence, the contact force generated at contact areas *a* and *b* is proportional to the cross sectional area 26 of the terminal 16.

The preferred embodiment of the invention has been shown in FIGS. 1, 2, and 3 with the terminals 16 having the reduced cross sectional area portion 26. This has been done merely to demonstrate the principle of the invention and it is contemplated by the inventor that the terminals 15 may also have a reduced cross sectional area portion in order to adequately preset the torque generated when the terminals 15 and 16 are mated. The amount of the cross sectional area reduction, if any, is determined by the amount of contact force desired.

Although the preferred embodiment of the invention contemplates that the electrical contacting extremities 21

and 24 will be V-shaped and complementary, it is obvious that if end 24 was generally concave or U-shaped and end 21 was generally convex or rounded in a relatively large radius, or was rectangular and fit within the U-shaped notch that similar results would be obtained. The V-shaped chisel and notched ends were used to simplify the disclosure of the principle used for obtaining the contact force. It is also obvious that the electrical properties of the contacting surfaces can be enhanced by plating or coating them with precious metal such as gold or silver.

Because of the shape of the contacting extremities 21 and 24 of the terminals 15 and 16, and the rotational displacement of the terminals 16 with respect to the other terminals 15, the same force that creates the contact torque has a component tending to separate the blocks 10 and 11. In order to prevent the separation, a snap clamp 14, in this instance, is used to hold the blocks 10 and 11 together. The clamp 14 snaps into an appropriately located indentation 27 in the protective cover 12. The cover 12 has a fastener 28 that clamps onto the incoming cable 13 to prevent the individual wires from being torn from the wire receiving extremities 22, and is secured to block 10 by the screws 29.

Block 11 has not been shown with a cover 12 or incoming cable 13 as it is contemplated that the device might find application where the block 11 is made a part of another piece of apparatus. It is deemed to be well within the capabilities of those familiar with the art to make modifications wherein the device may be fitted with two covers, no covers, different clamps, and various ways of holding the blocks 10 and 11 to auxiliary structures without departing from the essence of the invention.

It will be obvious to those skilled in the art that various changes or alterations of the preferred embodiment of the invention shown in the various figures of the drawing can be made, such as changing the means for keeping the blocks together, using the contacts in structure other than for multiple wire connectors, or changing the physical configurations of the terminals and their mating extremities. However, such changes are obvious and do not depart from the scope of the invention disclosed above and the appended claims.

What is claimed is:

1. An electrical connector comprising an insulating block having terminals mounted therein, the latter having cam means on one end, and; a second insulating block having mounted therein a plurality of terminals, the latter having cam receiving means on one end, said second block adapted to mate with said first-mentioned block, the terminals rigidly mounted in both blocks such that when said blocks are mated, said cam means cooperate with said cam receiving means, said cooperation comprising the inducing of rotational displacement of said cam receiving means by said cam means without rotationally displacing said terminals with respect to said blocks, said displacement causing a resistive torque which creates contact pressure between said cam means and said cam receiving means.

2. The connector of claim 1 wherein said blocks are held in a mating relationship by securing means.

3. The connector of claim 2 wherein said cam means comprises a V-shaped chisel point and said cam receiving means comprises a V-shaped notch.

4. A connector according to claim 3 wherein at least one of the terminals includes a reduced cross-sectional area portion adjacent the mating end for controlling the torque necessary to rotationally displace said end and the consequent contact pressure.

5. An electrical connector comprising a first insulating block having electrical terminals fixed therein in a geometric pattern, said terminals being elongated, rectangular in cross-section and having a V-shaped chisel point on one extremity, a second insulating block adapted to mate with said first block, said second block having mounted therein electrical terminals in a pattern to

5

match said first-mentioned pattern so that when said blocks are mated, said terminals of said blocks will mate, the terminals in said latter block being elongated, rectangular in cross-section and having a V-shaped notch on one end approximating the complement of said chisel point, said notched terminals being mounted in a rotationally displaced attitude with respect to the chisel-pointed terminals so that when said blocks are mated, the chisel-pointed terminals will cause said notched terminals to be rotationally deflected to align the chisel and notch ends, said deflection generating a resistive torque that supplies contact force between the two terminals.

6. A connector according to claim 5 wherein the blocks include means to prevent rotational displacement of one with respect to the other when they are subjected to subsequent forces and torques.

7. The connector described in claim 6 wherein the blocks are held in mating relationship by securing means.

8. A connector according to claim 7 wherein the terminals having the notch-shaped end also include a reduced cross-sectional area portion adjacent the notched end for controlling the torque necessary to rotationally deflect said end and the consequent contact force.

9. The connector described in claim 8 wherein the insulating blocks and terminals are protected by covering means.

10. A connector comprising two mating blocks of insulation, a plurality of terminals secured to each block in a pattern of mating pairs of terminals having facing interfitting portions that are respectively concave and

6

convex, the concave portions each having the configuration of a notch and the convex portions reversely corresponding, the terminals of each pair being relatively skewed about their common axis to present interacting mating surfaces, the interaction of which causes twisting of said interfitting portions about said axis and consequent torsional stresses forcing the surfaces into intimate contact.

11. A connector comprising mating blocks of insulation each supporting an array of terminals in mating pairs, the terminals of one block each having a wedge-shaped end and of the other block a corresponding notch, the terminals of each pair being relatively skewed to cause interaction between the walls of the wedge and of the notch, the interaction of these walls causing rotational displacement of said notch with respect to the terminal and imparting torsional stresses to the terminals keeping the notch and wedge-shaped walls in intimate contact.

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