

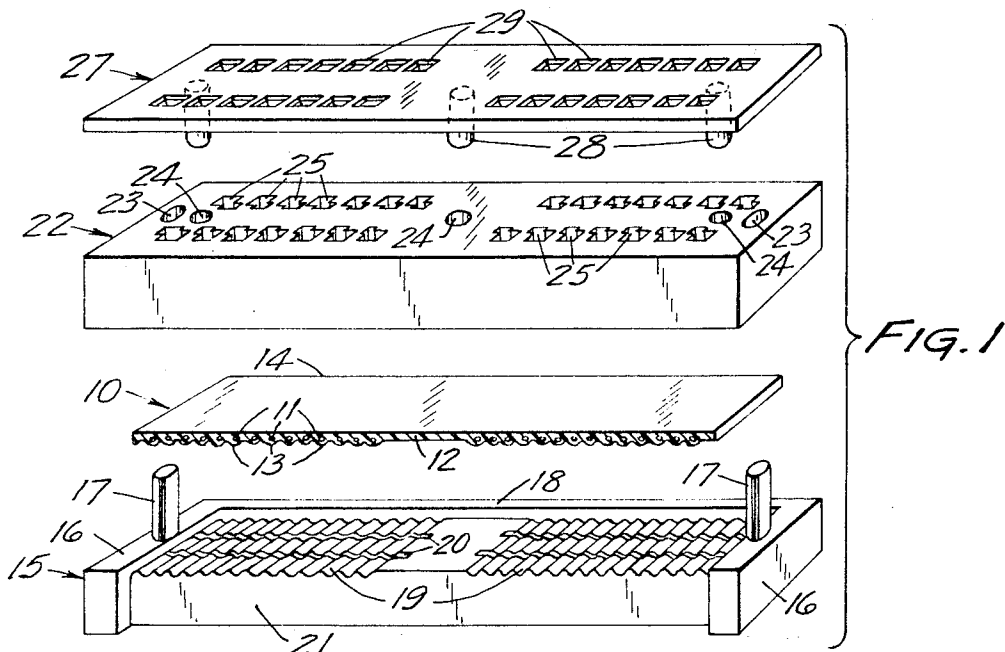
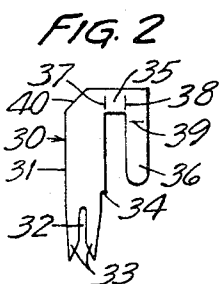
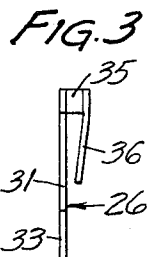
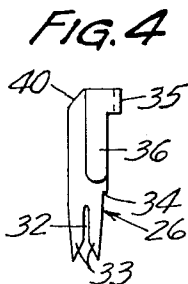
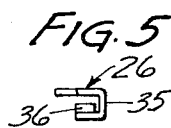
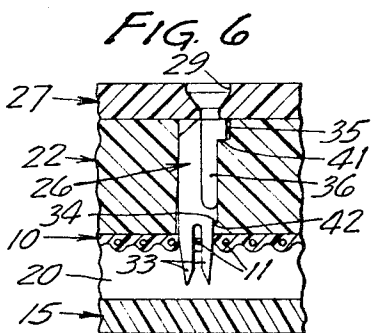
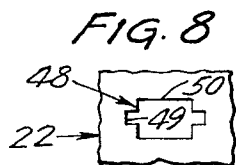
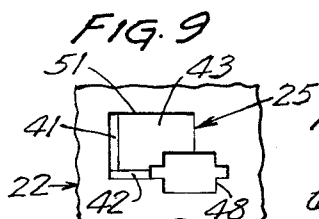
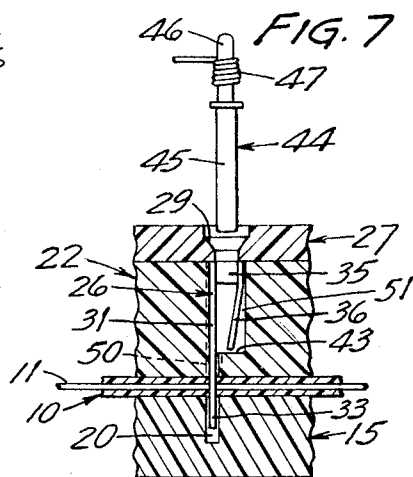
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3,434,093

SOLDERLESS CONNECTOR FOR MULTIPLE-CONDUCTOR FLAT CABLE

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SOLDERLESS CONNECTOR FOR MULTIPLE-CONDUCTOR FLAT CABLE

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7 Claims

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ABSTRACT OF THE DISCLOSURE

A connector for making solderless contact with any or all of the parallel wires in a longitudinally ridged multiple-conductor flat cable includes a close-fitting correspondingly grooved and transversely slotted base and an aligned body carrying U-shaped contact elements in line with the slots.

This invention relates to electrical connectors and more particularly to solderless connectors for making simultaneous permanent electrical connection with multiple conductors of a flat cable containing a number of parallel conductors within a common insulating cover.

Solderless connection to multi-conductor flat cables has been previously described, for example in U.S. Patent No. 3,235,833. Metal U-shaped connector elements, having the general form of two-tined sharp-pointed forks, are forced through the insulation and over the conductor wires, stressing the metal and providing permanent electrical contact. Particularly where large numbers of very small wires are present, it is important that exact alignment of wires and connectors be achieved, so that each connector will make contact only with its corresponding wire and without undue distortion. Alignment is achieved in accordance with the above patent by means of spaced apertures in the cable and corresponding pins on the connector body. The connector of U.S. Patent No. 3,189,863 employs similar U-shaped connector elements but obtains alignment solely by contact with the outer edges of the cable.

The present invention presents a much simpler system for establishing exact alignment between wire and connector, which is particularly effective where large numbers of closely spaced small-diameter wires are involved.

It has now been found that precise alignment of connector elements with individual wires of a flat multi-conductor cable may be conveniently achieved by employing a cable having a uniformly ridged insulative surface corresponding to the underlying conductors, in conjunction with a two-part connector body fixedly supporting the said connector elements and having a conformingly uniformly grooved cable-supporting surface against which the ridged cable surface is tightly held.

Flat cables of the type indicated, and methods of making them, have been disclosed, see for example Gore Patent No. 3,082,292. A typical example of a cable as used for much electronic circuitry consists of two groups of small parallel closely spaced copper wires, each group consisting of fourteen No. 30 copper wires spaced on .050 inch centers, the two groups being spaced apart and from the edges of the cable. The entire cable is but 1 3/4 inches (4 1/2 cm.) in width and .031 inch in over-all thickness. The cable, and the components of a connector for use therewith, are illustrated in the accompanying drawing, in which

FIGURE 1 is an exploded view of a connector and a portion of a cable in position for connective assembly;

FIGURE 2 is a plan view of a contact element blank, and FIGURES 3, 4 and 5 are side and front elevation and top plan views respectively of a contact element;

FIGURE 6 is a partial front sectional view of an assembled connector, and FIGURE 7 is a partial end sectional view showing a wire-trap connector pin in position for entry; and

FIGURES 8 and 9 are bottom and top plan views of a portion of the body member of the connector, showing the shape of the access openings for the contact element.

As illustrated in FIGURE 1, the cable 10, of which only a terminal portion is shown, consists of two groups of closely spaced parallel wires 11 enclosed within a plastic flexible insulating body 12 having a flat surface and an opposite ridged surface, the ridges 13 conforming to the wires. The end 14 of the cable is square-cut for insertion in the connector.

The connector is comprised of a base 15, a body 22 including contact elements 26, and a cap 27. The base, body and cap are formed of plastic insulating material, a presently preferred material being "Lexan" No. 101-7004 polycarbonate resin, which is a firm, tough, resilient thermoplastic molding resin.

The base 15 consists of an elongate block of resin having a flat lower surface when viewed in the position shown in FIGURE 1. The recessed upper cable-supporting surface is in the form of a series of lateral troughs or rounded grooves 19 corresponding with the ridges 13 of the cable 10. Deep narrow slots or channels 20 are provided in the base across the grooves. The ends 16 and back edge 18 extend slightly above the slotted and grooved cable-supporting surface, to a plane just slightly below the plane of the flat surface of a cable-segment having its ridged surface pressed into close-fitting contact with the grooved surface of the base. Elliptically cross-sectioned pins 17 extend centrally above the ends 16. The forward edge of the base 15 as seen in FIGURE 1 is recessed between ends 16 to provide a smoothly contoured face 21 around which the cable may be bent if desired.

The body 22 has parallel flat upper and lower surfaces and is provided with a number of perforations or channels. Elliptically cross-sectioned channels 23 pass completely through the body and are very slightly constricted toward their mid-points to provide a retentive force fit for pins 17. Circularly cross-sectioned channels 24 likewise pass through the body and are centrally constricted.

Perforations 25 as seen from the upper surface of the body 22 in FIGURE 1 are generally L-shaped and are arranged in two longitudinal rows, the foot of the L being offset toward one end in the farther row and toward the other end in the nearer row. The form of each opening 25 is more clearly shown in FIGURE 9 to include a centrally enlarged narrow elongate slot 48 forming the foot of the L and passing entirely through the body 22, and a square-sectioned opening 51 extending only partly through the body 22 and forming the leg of the L. The entry to the slot 48 from the lower surface of the body 22 is shown in FIGURE 8 to include a narrow slot 49 with an enlarged central portion 50, the latter being present only as a result of reinforcing the thin and otherwise readily deformed removable mold member which defines the slot 49 during formation of the piece by injection molding, and serving no functional purpose in the connector body.

The shape of the opening 25 within the block 22 is further indicated in FIGURES 6 and 7. Opening 51 is there shown to extend from the upper surface of the block 22 to the inner surfaces 41, 42, 43.

A thin flat cap or top member 27 fits over the top of the body 22 and is held in place by pegs 28 which are aligned with, and are forced into, the circularly cross-sectioned channels 24 in the body. The cap 27 has two rows of perforations 29, each aligned with the square-sectioned opening 51 of a corresponding channel 25 and

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each being square in cross-section and diminishing from a somewhat larger opening at the upper surface to slightly smaller than the opening 51 at the lower surface, thus forming a slant-sided or funnel-like access opening. The body 22, contact elements 26, and cap 27 when assembled form a unitary connector body structure.

The contact elements 26 are best made from flat spring brass strip or the like by stamping and folding, followed by annealing, hardening, plating, or other treatment as desired. A typical blank 30 is illustrated in FIGURE 2 as comprising an elongate shank 31 terminating in a bifurcate or fork-like cable-contacting section defining a narrow straight-sided open wire-receiving slot 32 between two pointed prongs 33. The shank 31 is widened along approximately one-half its length opposite the prongs 33 to form a shoulder 34 and at the end is further extended to form a spacer section 35 leading to a spring leaf section 36 parallel with the shank. The opposite upper corner of the blank is desirably removed to leave a slant edge 40 and to provide increased distance between the edge and the spacer 35 of the next adjacent element.

The blank 30 is formed into a contact element by folding the metal along fold lines 37, 38, 39 into the shape indicated in FIGURES 3-5. The elements thus formed are inserted into the channels 25 in the body 22 as best illustrated in FIGURES 6 and 7. The prongs 33 pass through the slot-like opening 49 (FIGURE 8) and extend below the lower surface of the base, the outer edges of the prongs being sufficiently spaced from the end walls of the slot to permit slight resilient separation of the prongs on forcing a wire therebetween. The shoulder 34 rests against the surface 42 and the lower edge of the spacer section 35 rests against the surface 41 within the channel 25, while the spring member 36 is movably suspended within the open portion of the channel. The element is retained within the channel 25 by the overlapping edges of the cap 27 defining the perforations 29.

The offsetting provided by the positioning of the contact elements within the oppositely directed L-shaped channels permits contact with each of the several wire conductors of the cable 10 while still permitting both longitudinal and transverse alignment of the access openings 29. The contact elements are firmly held in position yet are permitted sufficient resilient movement to assure completely effective electrical contact. The force fitting provided for the close-fitting resilient plastic pins 17, 28 assures that the connector, once assembled, will remain an essentially unitary structure.

Final assembly of the connector on the flat cable requires forceful penetration of the cable insulation by the pointed prongs of the contact elements, forcing of the wires between the prongs, and forcing of the pins 17 into the channels 23. Accurate positioning of the cable is assured by the close fit between the ridges 13 of the cable and the grooves 19 of the base 15; and this effect is obtained both with cables which, as here illustrated, fill the entire space between the end walls 16, as well as with those of lesser width but having similar surface ridges. The cable is tightly held between the base 15 and body 22 so that contact-weakening movement between the wires and the contact elements is largely or completely prevented, and fully effective electrical contact is maintained.

External connection to any or all of the wires 11 is easily made by means of wire-wrap pins 44 shown as having a square cross-section shank portion 45 surmounted by a wire-wrap section 46, usually of circular cross-section, to which a connector wire 47 may be soldered or otherwise affixed. The square shank portion fits snugly within the aperture 29 and the open top of the contact element, is held at a predefined depth by the inner surface 43, and is held in permanent electrical contact by the leaf spring 36.

What is claimed is as follows:

1. A connector suitable for making solderless electrical connection to conductors of a multiple-conductor flat

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cable having a longitudinally ridged surface, each ridge enclosing one of said conductors, said connector comprising: a base extending across said cable, having a laterally grooved surface conforming to the ridged surface of said cable with a groove for each ridge thereof, and slotted to provide a narrow deep slot extending across each groove; a body for interconnection with said base, having parallel flat surfaces and with open-ended perforations extending between said surfaces in line with said grooves and slots; and contact elements carried by said body in said perforations and comprising a U-shaped portion having closely spaced opposing pointed prongs extending from the perforation for making permanent electrical contact with a conductor forced therebetween, and a spring-connector portion retained within said perforation for making electrical contact with a pin connector inserted into said perforation; said base and body being further provided with interconnecting retaining means for holding the two together on a flat cable section disposed therebetween.

2. A connector as defined in claim 1 wherein said perforations open at the inner one of said flat surfaces as deep L-shaped channels, one leg of the L being in the form of a narrow elongate channel in line with a groove and slot in said base, and wherein said pointed prongs extend from said elongate channel.

3. A connector as defined in claim 1 comprising: a base having a laterally grooved surface conforming to the ridged surface of a longitudinally ridged multiple-conductor cable, said base being deeply narrowly slotted across the ridges, said base having back and end edges extended to a plane above the ridged surface at a distance slightly less than the thickness of said cable, and having alignment and retention pins, one extending centrally above each of said end edges; a perforated body member fitting over said base, having centrally constricted apertures for receiving said pins, centrally constricted apertures for receiving attachment pegs of a cap member, and apertures of generally L-shaped cross-section, the narrow extended foot of each L extending through said body and being in alignment with a slot, and across a different one of the grooves, of said grooved base of said connector, the leg of each L extending part way through said body from the upper surface thereof; contact elements fitting within said L-shaped apertures and each including a bifurcate resilient wire-contacting portion expandably fitting within the narrow extended portion of the aperture, a shank portion wider than said bifurcate portion and including a shoulder-like extension for locating said contact member in position within said aperture, and a leaf spring portion parallel to and biased toward said shank; and a cap member fitting over the top of said body member, having depending pegs for aligning engagement within said peg-receiving apertures, and having square cross-sectioned apertures in alignment with each of said L-shaped apertures for providing access to, and preventing removal of, a contact member therein contained.

4. A connector as defined in claim 1 comprising: a base having a laterally grooved cable-contacting surface with shallow rounded grooves conforming to the ridges of said cable surface and having at least one narrow deep slot extending across and at right angles to said grooves; a body for interconnection with said base, having parallel flat surfaces and with perforations, extending between said surfaces, opening at one surface as deep L-shaped channels, one leg of the L being of substantially square cross-section and extending into, and less than the thickness of, said body, the other leg of the L extending through the thickness of the body and opening at the opposite surface as a narrow elongate channel in line with a groove and a slot in said base; and U-shaped contact elements permanently retained within said body in said L-shaped channels and comprising closely spaced opposing pointed prongs extending from said rectangularly-shaped channel, for making permanent electrical contact with a conductor

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forced therebetween, and a spring-connector element fitting within said square cross-section channel, for receiving and making electrical contact with an external pin connector; said base and body being further provided with interconnecting retaining means for holding the two together on a flat cable section disposed therebetween.

5. A connector as defined in claim 4 wherein the L-shaped channels are disposed in two rows longitudinally of the body and with the narrow legs of the L's of the two rows facing in opposite directions, and with the rectangularly-shaped channels of the two rows being each disposed across a corresponding one of the shallow grooves of the grooved base surface when said base and body are in position for interconnection.

6. A connector as defined in claim 4 wherein the grooved base includes, along each of one side edge and both ends and at the grooved surface, a narrow ridge dimensioned to contain a square-cut cable end, and wherein the other side edge of the base is inset with respect to the ends.

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7. A connector as defined in claim 6 and applied at the square-cut end of a said multiple-conductor flat cable, each said contact element making electrical contact with a different one of the wires of said cable, and said cable-end being protectively enclosed and compressively retained within said connector.

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U.S. Cl. X.R.

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