United States Patent [19]

Clements

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[54] **ELECTRICAL CONNECTOR**

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[52] **U.S. Cl.**.....**339/75 MP,** 339/17 F, 339/176 MF

[51] **Int. Cl.**.....**H01r 13/54**

[58] **Field of Search**.....339/17, 18, 19, 75 R, 339/75 M, 75 MP, 175 C, 174

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[57] **ABSTRACT**

Apparatus for connecting flexible flat conductored cables each to the other and for connecting the conductors of a cable selectively to the conductors of a multilayered cable at particular points along the conductors.

1 Claim, 6 Drawing Figures

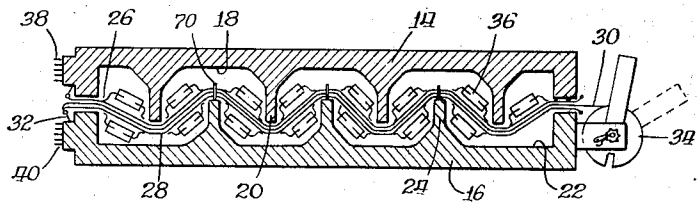


Fig. 1.

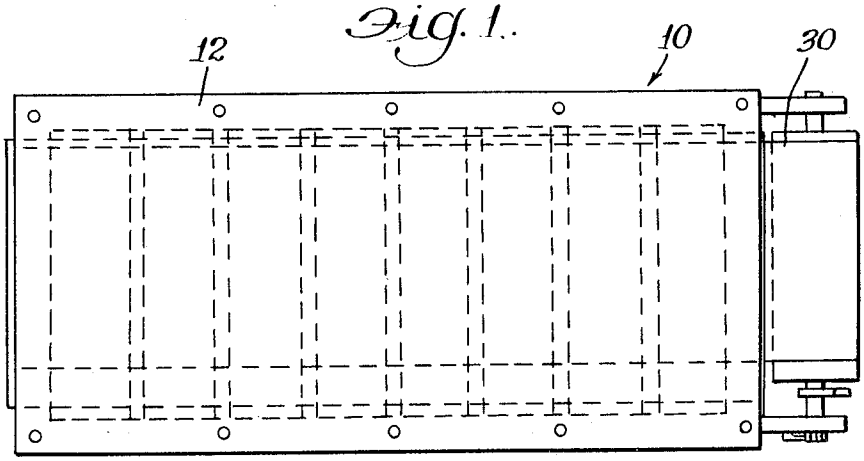


Fig. 2.

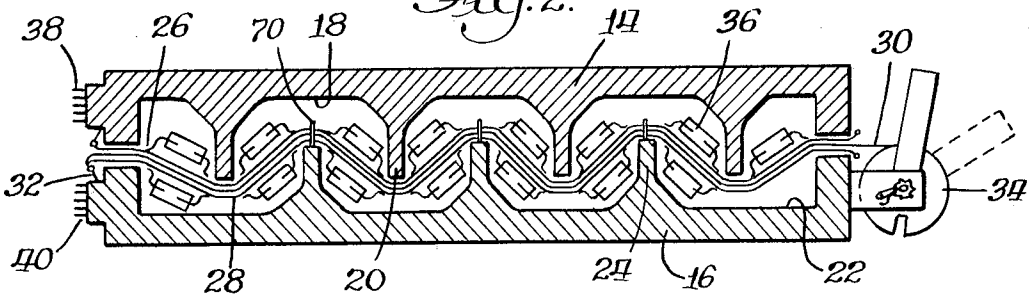


Fig. 3.

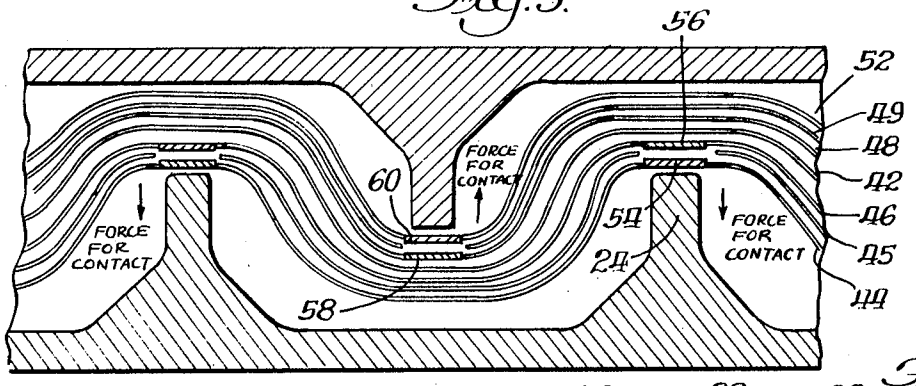
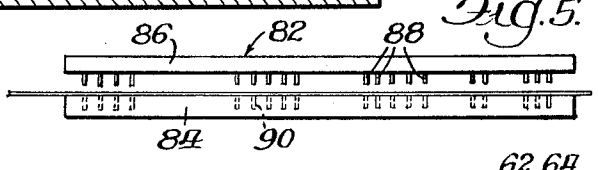


Fig. 5.



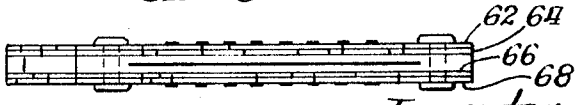
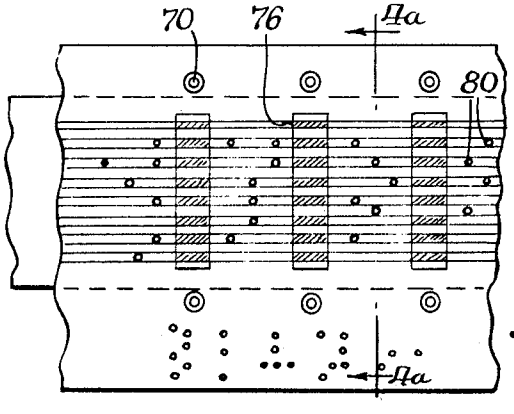


Fig. 4.



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ELECTRICAL CONNECTOR

CROSS REFERENCES TO RELATED APPLICATIONS

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SUMMARY

Apparatus for electrically connecting multi-conductored flat cables to each other and to multi-layered multi-conductored cables in a manner that the conductors of the several layers of the multi-layered cables are selectively electrically connected to the conductors of adjacent layers and to the surface conductors of another cable. The invention contemplates the provision of multi-layered cables which function in much the same manner as printed circuit cards. Integrated microcircuits, thin and thick film circuits may be directly mounted to outer cable surfaces by soldering, welding, or metallic particle deposition. Firm electrical contact is afforded by disposing the several cables in a tensioned abutting relationship. It is contemplated also to provide thermoelectric cooling and contemplates further the use of a heat-shrinkable irradiated plastic film layer for internal tensioning of the multi-layered cable. The several layers are precisely aligned each to the other and means are provided for modifying the electrical paths through the pre-set, multi-layered cable by the addition of a coded contact modifier strip which may be accurately aligned with respect to the multi-layered cable and which may be provided with a plurality of coded apertures for selective mating contact of particular micro-circuits of the multi-layered cable with particular circuits of a single layered cable having conductors on one side. Alternately the contact modifier strip may itself contain conductive contact areas and flat runs which may be coded to attain desired electron flow. The surface layers of the multi-layered cables may have multiple integral rows of contacts to which access may be obtained by the interconnection of certain of the conductor runs. Conductor runs on either face of a multi-layered cable can be conveniently electrically connected to the conductor runs on the opposite face of the cable, if desired.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an electrical connector made in accordance with the present invention;

FIG. 2 is an elevational sectional view of the connector of FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view of the connector of FIGS. 1 and 2 with a plurality of conductor cables illustrated in spaced relation for the sake of clarity;

FIG. 4 is a plan view of a multi-layered cable having interconnections between the conductors of the several layers;

FIG. 4A is an elevational sectional view taken substantially on line 4A—4A of FIG. 4; and

FIG. 5 is an elevational view of a press for piercing selective layers of a multi-layered multi-conductored cable of the type illustrated in FIGS. 4 and 4A.

Present invention is concerned with the connection of conductored flat cable with electrical components. The cable may be what is known as the "flex-film" or the "flex-print" type and are commonly made of Mylar, or similar plastic dielectric material, of a thickness of approximately 0.001 to 0.005 inches. The conductors may be formed in any suitable manner such as electrodeposition, photochemical etching or the erosion of copper in preselected areas by means of ferric chloride after deposition of a masking compound such as Kodak photo-etch resist solution. The rows of spaced conductors may be covered by a thin dielectric film layer or coating.

The invention contemplates a complete electrical system in which a multi-layered cable having a plurality of conductors on each layer may be connected temporarily or permanently to other electrical elements. To this end, it is contemplated that multi-layered cable be modified for selective electrical interconnection between the conductors of one layer of the cable and the conductors of another layer of the cable. This interconnection may be effected by means of selective piercing of certain of the layers followed by electrodeposition of conductive materials, soldering, metallic particle deposition or percussive welding. This interconnection of layers of multi-layered cable may be used not only to connect the conductors of certain This invention contemplates the connection of uncoated conductored cable with other electrical elements and also contemplates the connection of coated cables to electrical elements by the utilization of preselected portions of the conductors by stripping the coating or film layer at selected points. This stripping may be accomplished mechanically or chemically by erosion of the coating or layer after application of a suitable protective coating. These stripped areas may be formed into contacts by means of the deposition of conductive metallic materials such as gold, palladium, rhodium, tin, lead, nickel, kovar, silver, or the like. layers of the cable each with the other, but also to connect certain of the conductors of certain layers with the integral contact rows on the outer cable surface. The invention also contemplates the provision of contact modifier strips having electrical connection between contact areas on one side thereof and certain other contact areas on the other side thereof.

The invention also contemplates the provision of an electrical connector in which a housing is provided in which may be received a plurality of superposed conductored cables of the type above described with means for exerting a tension force on said cables so that a component compressive force is exerted between the several superposed cables and other electrical components. It is contemplated that these interconnections be effected in an inert atmosphere.

The invention contemplates the provision of dielectric layers of sheet material between the conductored layers of cable and contemplates bonding of these layers each to the other by epoxy type resins or the like. To prevent strain and possible breakage of the internal layers of the electrical interconnections, it is contemplated that rigid adhesive reinforcing be provided in certain areas and flexible adhesives or resins in other areas repeatedly.

Referring now to the drawings, and more particularly to the FIG. 1, the electrical connector of the present invention is indicated generally by reference numeral 10 and includes a housing 12 having an upper cored section 14 and a lower cored section 16. The section 14 is formed with a plurality of transversely extending cores 18 delineated by spaced depending projections 20, while the section 16 is formed with a plurality of transversely extending cores 22 delineated by upwardly extending projections 24. The projections 24, as best seen in FIG. 2, are interposed between the projections 20 so as to form a tortuous path therethrough from left to right, as viewed in FIG. 2. Extending through the path thus formed are a pair of conductored cables 26 and 28. Between these cables is a tension strap 30 which is secured at the left end, as viewed in FIG. 2, to the lower section 16 at 32 and secured at the right end thereof to a tensioner 34, which is illustrated as being of the cam type.

The conductors 26 and 28 are desirably formed with external contact rows as seen best in FIGS. 3 and 4. To the external contact rows of the cables 26 and 28 may be secured electrical elements such as microcircuit wafers 36. Plugs 38 and 40 are provided to connect the housing 12 to other suitable electrical units. It will be appreciated that the cables may emerge from the housing 12 and be connected to other interconnection panels or other equipment.

In FIG. 3 is illustrated a slightly modified form of invention in which a tension strap 42 is interposed between a plurality of multi-layered cables 44, 46, and 52. It will be appreciated that these cables are illustrated in spaced relation for the sake of clarity. The layer 44 has a plurality of longitudinally extending transversely spaced contact areas 54 which are illustrated in a position for electrical contact with a similar series of contact areas 56 on the cable 46. In like manner the cable 48 has a series of surface contact areas 58 for engagement with contact areas 60 on layer 52 when tension is exerted on the strap 42. It will be appreciated that compressive forces as indicated by the arrows are exerted when the strap 42 is tensioned.

Referring now more particularly to FIGS. 4 and 4A the multi-layered cable of the present invention is illustrated as comprising a plurality of superposed dielectric layers 62, 64, 66 and 68. Through all of these layers extend a plurality of longitudinally spaced alignment ferrules 70 for reception of alignment pins 72, see FIG. 2. The layer 62, in this instance, is a dielectric film having a plurality of longitudinally spaced stripped areas 76 exposing a plurality of longitudinally extending transversely spaced conductor 78 on the surface of the layer 64. The exposed conductor 78 form surface contact areas similar to areas 54, 56, 58 and 60 in FIG. 3. In addition, the layer 62 may be precisely pierced as at 80 to afford electrical communication to the other layers depending upon the depth of the depression formed. In FIG. 5 is illustrated a typical punch which may be utilized to effect this selective piercing. The punch is indicated generally by reference numeral 82 and includes an anvil 84 and a die 86. The die 86 has a plurality of pins 88 arranged to afford a preselected piercing pattern. The anvil 84 has corresponding apertures 90 to receive the pins 88. The multi-layered cable may take the form of a flattened sleeve in which electrical communication is provided between certain of the layers before the sleeve is flattened. Alternately the area 76 may be eliminated and the layer 62 may be stripped only in the areas of the conductor 78. In that event the slits thus formed may be filled with conductored material by electrodeposition or the like.

Programmed modifier strips 59 may be maintained on the projections 24 to modify the electron flow through the spaced contact areas 54.

The electrical connector of the invention exhibits important advantages over electrical connectors heretofore known. For instance, positive electrical contact may be made between the cables and other electrical components by compressive forces which are component forces of a tension force exerted by the tension strap. Accurate alignment is assured by means of the alignment pins. The electrical connection thus afforded may be quickly disconnected as desired and replaced by other and different cables. Thus, the present connector functions as a programmer. In addition, the function of a particular cable may be changed in certain respects by the addition of programmed modifier strips.

The electrical connector of the invention functions as an electronic sub-system capable of cooperating operatively with other sub-systems and electronic components. Various electronic components may be secured to the external contact rows of the cables 26 and 28. These may include integrating micro-circuits, thin and thick film circuits and filter capacitors permanently connected to the cable surfaces by any suitable means such as welding, soldering, metallic particle deposition and the like.

The electrical connector of the invention exhibits important advantages over micro-circuit contactors heretofore known. The present connector is characterized by a relatively high level of reliability and ease of impedance matching. Furthermore, there is no need for conventional spring contacts which are bulky and characterized by loss of spring retentivity resulting from intermittent connections. Also, the connector of the invention is capable of effecting electrical connection of a plurality of conductors in a minimum amount of space. The tension strap 30 may have a metallic shielding layer or coating secured thereto, or, in the alternative, the multi-layered cable may have a metallic shielding layer as illustrated in FIG. 4A.

In the form of the invention illustrated in FIG. 3, a shielding layer 45, which may be metallic or dielectric, may be interposed between the cables 44 and 46, and a similar shielding layer 49 may be interposed between the cables 48 and 52. The invention contemplates the provision of a shielding coating or layer on the outer surfaces of the housing 10, if desired.

The contact modifier strip 59 is also capable of altering one or more electrical intraconnections between internal electrical elements contained wholly within any single micro-circuit wafer or package. This makes possible subdivided discretionary wiring with the requisite number of external contacts on the micro-circuit wafers. By this arrangement, a relatively inexpensive multi-purpose micro-circuit may be customized for various applications and field change orders on system equipment may be simplified. By the use of the contact modifier strip of the invention, pressure contacts and short jumper runs may be supported for discretionary wiring, and also thin and thick film circuits may be supported for pressured connection to integrated micro-

circuits. This arrangement in itself produces a new form of hybrid circuitry.

I claim:

1. An electrical interconnection system comprising a housing having a pair of superposed sections, adapted to receive therein a plurality of conductored cables, means for exerting compressive forces at preselected areas of said cables to effect electrical interconnection of said cables with other electrical elements, said cables having preselected exposed contact areas, said last-named means including means for effecting electrical connection of selected contact areas of one cable with selected contact areas of an adjacent cable, said contact areas having electrical components secured thereto and means for effecting electrical connection between the conductors of certain layers of said cables with certain other electrical components by piercing of the multi-layered cable as the connector housing is assembled.

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