

Aug. 4, 1970

J. W. CLEMENTS
ELECTRICAL CONNECTOR

3,522,484

Filed July 10, 1967

2 Sheets-Sheet 1

FIG. 1

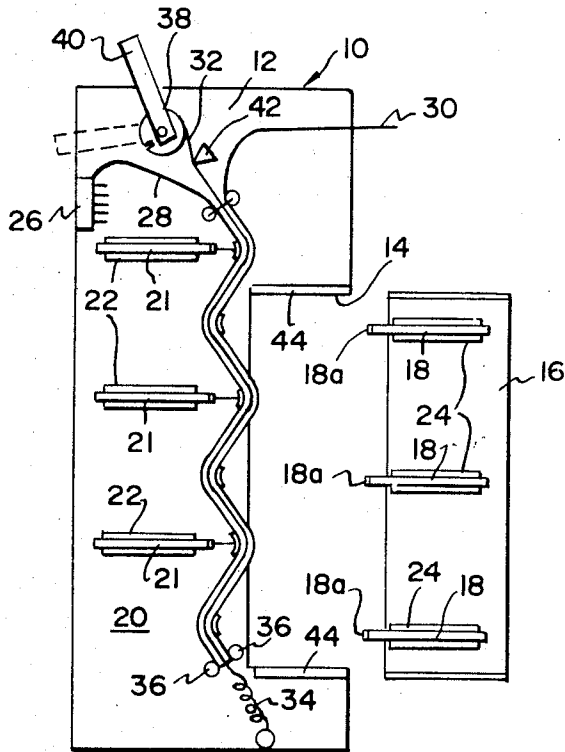


FIG. 2

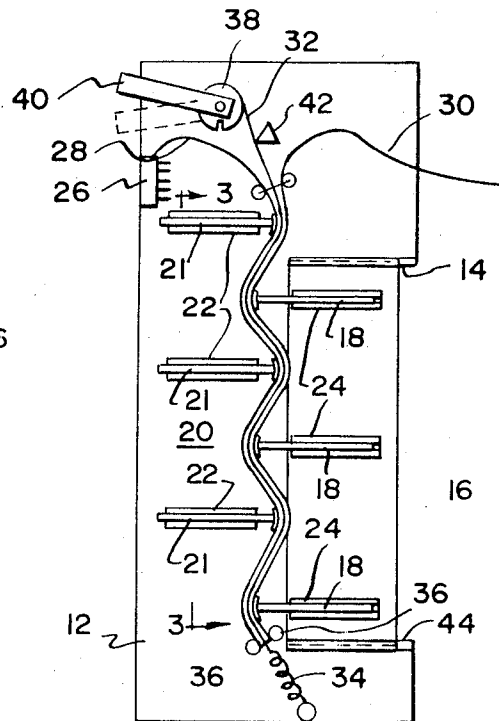


FIG. 1A

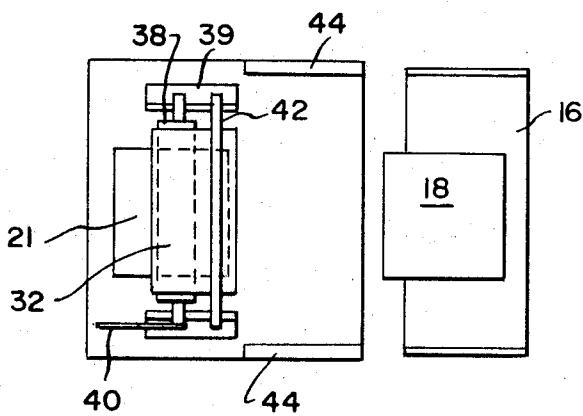
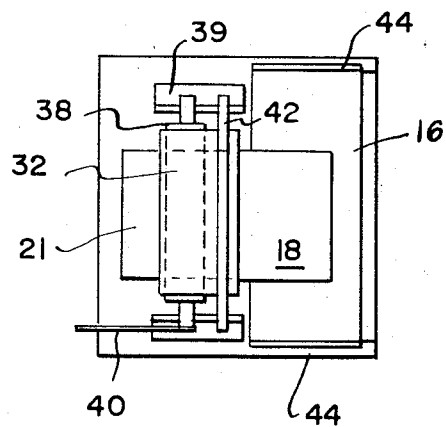


FIG. 2A



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FIG. 3

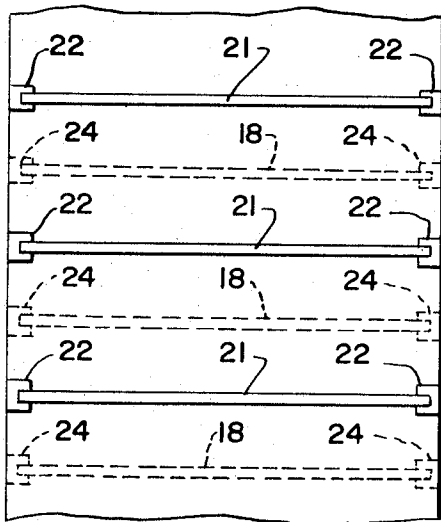


FIG. 4

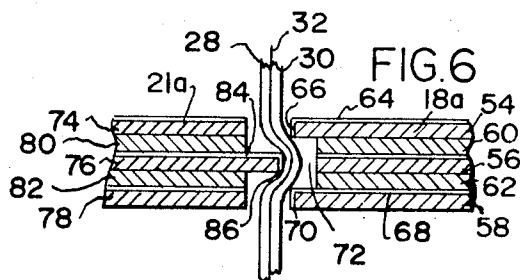
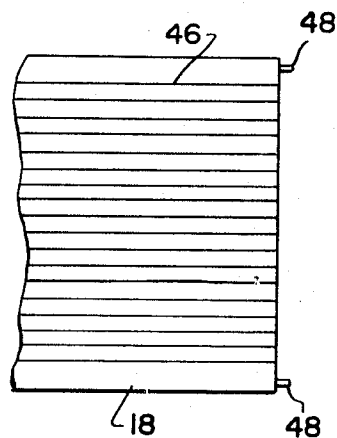


FIG. 5

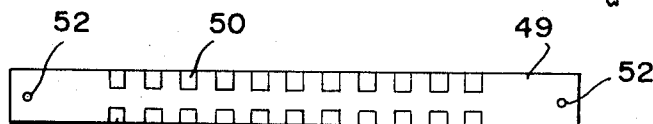


FIG. 5A

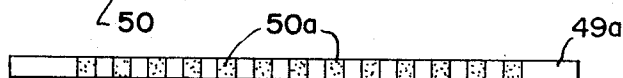
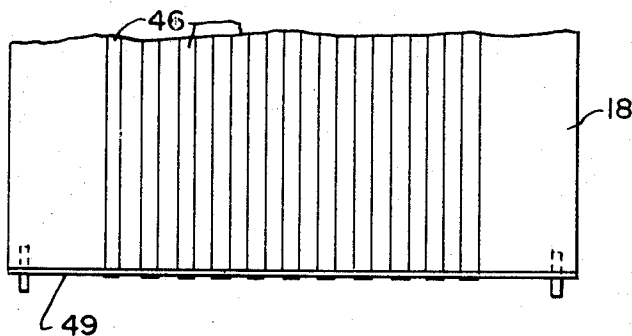


FIG. 5B



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ELECTRICAL CONNECTOR

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12 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for connecting flexible flat conductor cables to each other or to one or more circuit cards.

FIELD OF THE INVENTION

Electrical connector apparatus.

DESCRIPTION OF THE PRIOR ART

Flat multi-conductor cable having flared end portions to accommodate a plurality of contact areas.

SUMMARY

Apparatus for electrically connecting multi-conducted flat cables to the edges of stacked printed circuit cards in which contact is assured by a tension strap. The apparatus also contemplates the electrical connection of a pair of multi-conducted cables in which the conductured surfaces are in confronting relation. The electrical connection has, for its purpose, the supplying of operating voltages and interconnecting signals or pulse inputs and outputs between various electronic apparatus. The present connection is positive and effective and eliminates the need for contacts that depend for their effectiveness upon spring action retentivity. Furthermore, the use of the present connector facilitates interconnection, modification or repairs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical diagrammatic view of a connector made in accordance with the present invention shown in the position it assumes prior to the insertion of electronic circuit cards;

FIG. 1a is a plan view of the connector of FIG. 1;

FIG. 2 is a view similar to FIG. 1 but showing the present connector in the position it assumes with the circuit cards inserted;

FIG. 2a is a plan view of the connector of FIG. 2;

FIG. 3 is a sectional view taken substantially on line 3-3 of FIG. 2;

FIG. 4 is a fragmentary plan view of one of the circuit cards;

FIG. 5 is an elevational view of an automated programmed modifier strip for use in modifying the electrical connection between one of the conductured cables and one of the circuit cards;

FIG. 5a is a view of a modified form of a programmed modifier strip;

FIG. 5b is a fragmentary plan view of a circuit card with the contact modifier strip at FIG. 5 in position; and

FIG. 6 is an enlarged fragmentary sectional view illustrating the use of multiple layered circuit cards with the multi-conducted cables and tension strap of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present connector is constructed and arranged to

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effect efficient and effective connection of electronic circuit cards or module shells containing micro-circuitry packages and a flat flexible cable having a plurality of radially spaced conducting paths on the surfaces thereof.

5 The force necessary for effective conductive contact is a tension force provided by exerting a tension force on the tension strap so that the conductive paths of the cable are urged into engagement with the conductive areas of the circuit cards. The resulting contacts of all of the circuit cards with the cables are made simultaneously and may be released in the same manner, if desired. The present connector obviates the need for a connection device which relies upon spring pressure with its concomitant unreliability.

15 The present invention is directed to improvements in connectors for micro-circuitry and particularly the efficient and effective electrical connection of semi-conducted integrated micro-circuits and thin film. Prior art connectors for this purpose have been permanent in nature and have generally involved the use of welding, plating, electro-deposition, soldering, etc. Releasable connectors have been devised to facilitate making rapid circuit changes or repairs. This feature is economically important because of the labor and system down-time failure costs of permanent connectors. These releasable connectors generally are of the pin and socket type or other types relying on spring retentivity for effectiveness. As efforts are made towards increased miniaturization there is a tendency to reduce the cross section of the connectors with resultant decrease in strength. Furthermore, there has been a problem with decreased yield limits for miniaturized electro-mechanical spring contacts, of copper alloy or the like when the demand is for increased numerical density of interconnections.

35 Prior art connectors have been characterized by relatively great expense, inherent critical tolerances, and sensitivity to contact misalignment. The inevitable result of misalignment is a significant quantity of bent or broken contact pins or sockets. Also, even slightly bent pins cause uneven wear on the plated coatings utilized to minimize corrosion of the contacts, as by oxidation. The accretion of oxidation products creates a film on the contact surfaces which is characterized by high electrical resistance. This results in noise, inadvertent disconnection, and even rectification.

40 The spring forces utilized in prior art electrical connectors, while exhibiting low resistance, require forces for insertion and extrication that tend to distort spring connectors, thus shortening their useful lives, and also tend to remove valuable plated coatings by abrasion. The use of connector plugs in micro-circuitry requires expensive procedures such as soldering, welding, wire-wrapping, etc. These plugs increase the cost of the electronic system and defeat the purpose of miniaturization.

55 The present invention is concerned with connecting flat conductured cables having a plurality of longitudinally extending transversely spaced conductive paths formed on a dielectric film, by etching, electrodeposition or the like. These paths or runs are characterized by low impedance and low edge capacitance. As a result, these flat cables show a substantial reduction in standing waves and electronic cross-talk. The present invention contemplates the electrical connection of flat conductured cables with other electronic elements, such as circuit cards, by compressive mating contact forces. The invention contemplates the use of tension forces to produce the compressive forces. Since the exposed flat conductured contacts are a direct

continuum of the parallel spaced flat conductors there is no alteration of line impedances. The nature of the engagement is such that abrasive friction forces are eliminated and interconnection reliability is enhanced.

Referring now to the drawings and more particularly to FIGS. 1 and 2, the connector of the present invention is indicated generally by reference numeral 10 and includes a housing 12 having at one side thereof an opening 14 for reception of a module 16 on which is mounted a plurality of spaced circuit cards 18. Within chamber 20, defined by the housing 10, are a plurality of circuit cards 21 maintained in the spaced relationship illustrated by means of channel-shaped brackets 22, see FIG. 3. The circuit cards 18 are arranged in spaced relation in the module 16 by means of channel-shaped brackets 24, also as shown in FIG. 3. A plug 26 is mounted in one wall of the housing 10 and to this plug is connected a flat conductored cable 28 which passes through the chamber 20 in engagement with the several circuit cards 21. Also disposed within the chamber 20 is a flat conductored cable 30, the free end of which is connected to an appropriate electronic component. Between the cables 28 and 30 is disposed a tension strap 32, the lower end of which is connected to a tension spring 34. A pair of guide rollers 36 maintain the cables 28 and 30 and the strap 32 in the relationship illustrated. Tension may be exerted on the strap 32 by means of a cam 38 having a handle 40. A guide bar 42 is provided for the strap 32. The tensioning of the strap 32 is effected after movement of the module 16 to the position illustrated in FIG. 2. To assure proper alignment of the module 16, guide rollers 44 are provided in the housing 12. If desired, the module 16 may form a door for the opening 14, it being important in this connection only that the edges 18a of the circuit cards 18 are brought to the position shown in FIG. 2.

In FIG. 4 is illustrated a fragmentary plan view of a typical circuit card. The card illustrated has a plurality of spaced parallel conductors 46 and is provided with a pair of guide pins 48 which are received in alignment holes along the marginal edges of the cables 28 and 30. By the arrangement illustrated, compressive forces are exerted between the cables 28 and 30 and the edge contacts of the circuit cards 18 and 21, when the cam 38 is actuated to exert tension on the tension strap 32.

By the above arrangement, the conductors of the cables 28 and 30 may be as little as .010 to .10" wide with relatively great effectiveness of electrical interconnection due to the relatively high compressive contact resultant forces of the tension force exerted. It will be noted the contacts are positive and direct. There is little likelihood of abrasion from engagement or disengagement. The circuit cards 18 and 21 may bisect the angularly offset rows of conductive paths at an intersecting angle up to 80°. Assuming a 60 pound tensile, a lateral resultant compressive cable contact force of approximately 17.36 pounds is exerted against the contact edges of the circuit cards. It will be appreciated that the interleaved relationship of the circuit cards 18 and 21 is important to attain the desired resultant forces.

The contacts 50 are engaged by either the cable 28 or the cable 30. The obverse side of the strip 49 may be arranged to connect the contacts 50 with other and different conductors. In fact, the strip 49 constitutes a programmer which may be replaced at will.

In FIG. 5a is illustrated a modified form of programmed modified strip 49a. In this form of the invention the edge contacts 50a are in a single row and, since there are no alignment holes, alignment may be effected by arranging the components in operative relationship on a card guide track.

In FIG. 6 is illustrated a modified form of the invention in which a circuit card 18a is brought into the illustrated coplanar position with respect to the fixed circuit card 21a. The circuit card 18a comprises a plurality of con-

ductured layers 54, 56 and 58 separated by dielectric layers 60 and 62. The layer 54 has conductors 64 provided with a downturn end portion 66 while the layer 58 has a conductor 68 formed with a downturn portion 70. The layers 56, 60 and 62 are recessed to form a cavity 72. The circuit card 21a comprises conductured layers 74, 76 and 78 spaced by dielectric layers 80 and 82. The layer 76 extends beyond the plane of the other layers and has conductors 84 with downturn portions 86. Disposed between the confronting circuit cards are conductured cables 28 and 30 tensioned by the tension strap 32. Because of the compressive forces generated, the conductured sections 66 are brought into mating engagement with the conductors of the cable 30 while the conductor portions 86 are brought into mating engagement with the conductors on the cable 28. A series of circuit cards 18a and 21a may be stacked in limited space relation. It will be appreciated that the circuit cards 18 and 21 may also be disposed in limited spaced relation.

The requisite tension may be supplied by the use of a heat-shrinkable strip of material such as polyvinyl, or the like. Shrinking may be effected by irradiation or by conventional electrical resistance, or by any other heat source.

I claim:

1. An electrical connector comprising a housing having an opening, means for mounting a first series of spaced circuit cards within said housing, means for mounting a second series of spaced circuit cards in said housing in partially interleaved relation to said first series, said first series and said second series being movable in parallelism relative to each other, a pair of flat conductured cables adapted to be received in said housing in a tortuous path defined by the electrical contact edges of the circuit cards of said first series and said second series, and tension means for biasing said cables into conductive relation to the circuit cards of said first series and said second series.

2. An electrical connector in accordance with claim 1 wherein said tension means is interposed between said cables.

3. An electrical connector in accordance with claim 2 wherein said tension means comprises a tension strap resiliently connected to said housing.

4. An electrical connector in accordance with claim 3 wherein means are provided for exerting a tension force on said tension strap.

5. An electrical connector in accordance with claim 3 wherein said tension exerting means includes a cam, or the like.

6. An electrical connector in accordance with claim 1 wherein the circuit cards of said second series are removably mounted in spaced relation in a module so that all of the circuit cards of said second series may be brought into interleaved relation with respect to the cards of said first series.

7. An electrical connector in accordance with claim 1 wherein each of said circuit cards comprises a plurality of conductors spaced by one or more dielectric layers, which may support and interconnect individual components and, or, electronic micro-circuits.

8. An electrical connector in accordance with claim 1 wherein guide means are provided to align said conductured cables with respect to said circuit cards.

9. An electrical connector in accordance with claim 7 wherein contact modifier strips are interposed between the edges of at least some of said circuit cards and the associated conductured cable.

10. An electrical connector in accordance with claim 9 wherein at least some of said contact modifier strips comprise a single row of contacts.

11. An electrical connector in accordance with claim 9 wherein at least some of said contact modifier strips are provided with a series of longitudinally spaced contacts at each marginal edge thereof.

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12. An electrical connector in accordance with claim 1 wherein said tension means comprises a heat-shrunk strip.

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J. R. SCOTT, Assistant Examiner

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U.S. Cl. X.R.