

Description

This invention relates to connectors of the type which receive the end portion of a flat conductor cable.

A widely used type of flat cable comprises a plurality of flat conductors in side-by-side parallel relationship which are covered on each side with insulating film, such as polyethylene terephthalate. When electrical connections must be made to the ribbon-like conductors in the cable, a portion of the insulation is removed to expose one surface of each conductor. Some known types of connectors for flat connector cable are disclosed in U.S.—A—3,989,336 and 3,629,787. The connector shown in U.S.—A—3,989,336 comprises an insulating housing having a hinged lid and containing contact terminals which have opposed contact surfaces that are on each side of the cable when the cable is inserted into the cable-receiving face of the connector. When the hinged lid is closed, the lid is moved against the terminals and presses the contact surfaces of the terminals against the conductors of the cable. The cable is, therefore, inserted under zero insertion force conditions and the contact force is developed only upon closure of the hinged lid. U.S. Patent 3,629,787 comprises a housing which is held on the surface of a circuit board by a fastener such as a screw. The contact force is developed by spring members which bear against the cable and force the cable conductors against conductors on the circuit board. This connector is also of the zero insertion force type, since the connector housing may be removed from the circuit board and assembled to the springs and the circuit board, after the cable conductors are placed against the circuit board conductors. The screw fastener is then tightened to clamp the springs against the cable and thereby press the cable conductors against the circuit board conductors.

The use of a zero insertion force connector with flat cable as described above is often required for the reason that the cable is highly flexible and when it is attempted to insert the cable into a connector and between contact surfaces of terminals, the cable will tend to buckle and refuse to enter the connector. It would be desirable, however, to have a connector for flat conductor cable which does not require the hinged lid of the connectors shown in US—A—3 989 336 or the fastener in the connector housing as shown in US—A—3 629 787. In other words, it would be desirable to produce a connector for flat cable of simple construction and which would simply receive the end of the flexible cable upon mere insertion of the cable into the connector housing. It would, of course, be necessary for a connector having these characteristics to be satisfactory from an electrical standpoint. The present invention is directed to the achievement of a relatively simple connector for flat cable which does not require a hinged lid or other features which would complicate the design of the connector.

FR—A1—2 368 202 discloses a multi-contact electrical edge connector of the type comprising an insulating housing having a flat circuit receiving face and having a trough-like flat circuit receiving opening extending into the flat circuit receiving face, first and second contact terminals in the opening in spaced apart relation along the opening each of the terminals having a contact spring arm which is deflected by the flat circuit when the flat circuit is inserted into the opening, each spring arm having a contact portion which is against, and in electrical contact with the flat circuit when the flat circuit is fully inserted into the opening, the contact portion of the first and second contact terminals being located respectively in first and second rows, extending along a side of the opening, the contact portions of the first terminals being proximate to the flat circuit receiving face and spaced inwardly from said flat circuit receiving face by a predetermined distance, the contact portions of the second terminals being spaced inwardly from said flat circuit receiving face by a distance which is greater than the said predetermined distance whereby, insertion of the flat circuit into said opening, sequentially deflects the contact portions of the first and second terminals to obtain the final contact force.

In the connector disclosed in the above document, contact portions of both adjacent and opposite terminals are staggered in the insertion direction in relation to the circuit receiving face, and the connector is adapted for use with a rigid printed circuit board.

It is an object of the invention to provide a connector adapted for use with a flat flexible cable.

In a connector having the features acknowledged from FR—A1—2 368 202 above, but for use with flat flexible cable, each terminal comprises a generally channel-shaped portion formed by a web and terminal sidewalls, the contact spring arm of each terminal extending from one of the terminal sidewalls away from the housing opening towards the other terminal sidewall and the housing opening having opposed sidewalls, the terminal sidewalls being substantially against the housing sidewalls, so that the spring arm bears against the other terminal sidewall which provides an abutment surface for the contact portion, each such abutment surface extending across the rows of contact portions in the insertion direction whereby both surfaces of an inserted cable are clamped between the terminal sidewalls with said final contact force.

The invention will now be described by way of example, with reference to the accompanying partly diagrammatic drawings, in which:—

FIGURE 1 is a perspective view of a connector in accordance with the invention mounted on a circuit board.

FIGURES 2, 3 and 4 are views taken along the lines 2—2, 3—3 and 4—4 of Figure 1.

FIGURE 5 is a perspective view of a portion of a strip of contact terminals.

FIGURE 6 is a semi-diagrammatic view illus-

trating the conditions which are obtained when a cable is inserted into a connector in accordance with the invention.

FIGURE 7 is a sectional view of a connector mounted in an alternative orientation.

FIGURE 8 is a side view of a connector of the type shown in Figure 1 having a housing latching means integral therewith.

FIGURE 9 is a view looking in the direction of the arrows 9—9 of Figure 8.

FIGURE 10 shows a set of curves which illustrate the insertion forces required for inserting cable into a connector in accordance with the invention, and into a typical prior art connector.

A connector 2 in accordance with the invention serves to connect conductors 4 on the upper surface 6 of a flexible cable 8 to conductors 10 on the underside 12 of a circuit board 14. As shown in the drawing, the insulation has been stripped from the upper surface of the cable at its end to expose the conductors 4. The connector 2 is mounted on the upper surface 16 of the circuit board which is provided with openings as shown for the terminal tabs of the terminals in the connector.

The connector comprises an insulating housing 18 having a cable receiving face 20, a rearward face 22, upper and lower sidewalls 24, 26 and external endwalls 28. A trough-like cable receiving opening 30 extends into the face 20 and has upper and lower opening sidewalls 32, 34 and opening endwalls 36. A plurality of spaced-apart barrier walls 38 are provided in the opening which extend transversely across the opening, and which divide the opening into a plurality of side-by-side terminal receiving cavities. A contact terminal of one of the types shown at 40, 40' and 40" is mounted in each of the cavities. These three types of terminals are substantially similar and differ only in certain dimensions, as will be described below.

Each terminal is generally channel-shaped and has a web 42 and parallel sidewalls 44, 46 extending forwardly as viewed in Figure 5 from the web. The solder tab or post 48 is formed from the upper sidewall 44 and from the web 42 so that an opening as shown at 49 is provided in the upper sidewall and the web.

The upper sidewall is reversely bent at its outer end to provide a spring arm 50 which extends obliquely towards the surface of the lower sidewall 46. The end portion of the spring arm 50 is reversely bent at 52 so that its external surface serves as a contact surface which resiliently bears against an elongated boss 54 formed in the lower sidewall 46.

As clearly shown in Figures 2—4, each of the terminals 40 has a contact portion which is proximate, as compared with the contact portions of the other terminals, to the cable receiving face 20. The contact portions of the terminals 40' are located inwardly in the opening from the contact portions of the terminals 40, while the contact portions of the terminals 40" are located still further inwardly from the cable receiving face 20.

The contact portions of the terminals 40 thus form a first row, as shown at 68 in Figure 6, while the contact portions of the terminals 40' and 40" form second and third rows as shown at 70 and 72 respectively.

The terminals are manufactured as a continuous strip, as shown in Figure 5, and the stamping die is constructed such that every third terminal has the dimensions of the terminals 40 in Figure 5, the terminals adjacent to terminal 40 have the dimensions of terminals 40' and the remaining terminals have the dimensions of the terminals 40". The terminals of the strip are integral with a continuous carrier strip 56 which is severed from the terminals of the strip when the terminals are assembled to the housing. Assembly is carried out by merely moving the required number of terminals into the opening 30 until they are properly located in their respective cavities. The solder tab portions 48 will then project through opening 51 in the back wall 64 of each cavity and ribs 58 in each cavity will project into opening 49 of the terminals, as shown in Figures 2—4. The solder tabs can then be bent downwardly so that they will extend normally with respect to the sidewall 26. Spaced-apart slots 62 are provided in the face 22 for the solder tabs. The connector is assembled to the circuit board by simply inserting the solder tabs through the openings in the circuit board and soldering the lower ends of the tabs to the conductors 10 on the underside of the circuit board.

Figures 6 and 10 demonstrate the advantages achieved with connectors in accordance with the invention when the cable 8 is inserted into the connector. During insertion, the leading end 66 of the cable first encounters the contact portions 52 of the terminals 40 which are disposed in the row 68 which is proximate to the cable receiving face 20. At this time, the cable must be pushed with sufficient force to overcome the spring arms 50 of the terminals 40 and deflect the spring arms so that the cable can pass beneath the contact portions 52. Since only one third of the total number of terminals in the housing are encountered, the required force is not excessively high. Upon further insertion of the cable, the leading edge 66 encounters the contact portions of the terminals 40' in row 70 and the insertion force must thereby be increased to overcome the spring arms of these terminals. However, at this stage, the cable will be clamped by the contact portions 52 of the terminals 40 in the first row 68 and this clamping of portions of the cable discourages buckling in the vicinity of the terminals in the second row 70. Similarly, when the cable encounters the contact portions of the terminals 40", the insertion force must be further increased, but at this stage, the cable will be clamped by the contact portions of the terminals in the first row 68 and in the second row 70 so that buckling of the leading edge of the cable will again be discouraged. The technician must increase the thrust he imparts to the cable but he can do this by simply gripping the cable very close to the face 20

while he pushes the cable into the connector.

Figure 10 shows 76 the relationship between the force required to push a cable into a connector (vertical axis in kg) and the distance the cable is pushed (horizontal axis in mm). The solid line curve 74 is the curve for a connector in accordance with the present invention. The broken line curve 76 is the curve for a connector having all of the terminals equally spaced from the cable-receiving face.

When all of the terminals are equally spaced from the cable-receiving face (curve 76) the insertion force required rises abruptly to a maximum level, as shown at 90, and the technician must push the cable with a force sufficient to overcome the contact springs of all of the terminals. After the cable has past the contact portions of the terminals, the force to push the cable a further distance levels off and may fall slightly at 92. The operation of pushing the cable past the contact portions of the terminals is difficult and partial insertion, rather than, complete insertion may result.

The curve 74 demonstrates that by the practice of the invention only a relatively low insertion force is required at 78 and 80 to push the cable past the first row of terminals. The insertion force must be increased as shown at 82 and 84, to push the cable past the second row of terminals and a further increase is required as shown at 86 and 88, to push the cable past the third row of terminals. While the actual amount of work required to insert the cable is probably about the same for the prior art connector as it is for the present connector, the insertion operation proceeds much more smoothly when the contact terminals have staggered contact portions in accordance with the invention.

Figure 7 shows a modified connector in accordance with the invention, which is intended to be mounted on the surface 16 of the circuit board with the rearward face 22 of the connector against the circuit board. The housing in this embodiment has standoff members 96 which elevate the face 22 above the surface 16 to permit cleaning of the board after the soldering operation has been carried out. The solder tab 48, in this embodiment, extends normally from the face 22 through an opening 51 and directly into the opening in the circuit board.

Figures 8 and 9 show an embodiment similar to the embodiment of Figure 1 but having separate latching members 98 adjacent to the face 20 of the housing. The provision of these latching members is desirable if the connector is destined for abusive handling for the reason that in the embodiment of Figure 1, the mechanical connection of the housing to the circuit board is by means of solder tabs 48 and the soldered connections to the conductors 10. Careless handling of the circuit boards or the connectors could result in damage to the soldered connections in some circumstances, and the latching members 98 will avoid this problem.

As an alternative to the latching members 98,

an apron or lip can be provided on one or both of the faces 20, 22 of the housing adjacent to the lower sidewall 26. The aprons would be located such that they would bear against the surface 16 of the circuit board 14 and thereby prevent rocking of the housing with respect to the circuit board thereby preventing damage to the solder connections.

A variety of types of connectors having types of contact terminals other than those shown can be used. The terminals illustrated herein are of the general type disclosed in U.S. Patent 4,060,296.

Terminals of this type are preferable to some other types for the reason that the contact portion 52 of each terminal bears against the lower arm 46. The cable is therefore clamped between two portions of the terminal and contact will be made with the conductors of the cable regardless of which side of the cable is against the ends of the spring arms 50.

Claims

1. A multi-contact electrical edge connector (2) of the type comprising an insulating housing (18) having a flat circuit receiving face (20) and having a trough-like, flat circuit receiving opening (30) extending into the flat circuit receiving face (20), first and second contact terminals (40, 40') in the opening (30) in spaced-apart relation along the opening (30) each of the terminals having a contact spring arm (50) which is deflected by the flat circuit (8) when the flat circuit is inserted into the opening (30), each spring arm (50) having a contact portion (52) which is against, and in electrical contact with the flat circuit (8) when the flat circuit is fully inserted into the opening (30), the contact portion (52) of the first and second contact terminals (40, 40') being located respectively in first and second rows (68, 70), extending along a side of the opening (30), the contact portion (52) of the first terminals (40) being proximate to the flat circuit receiving face (20) and spaced inwardly from said flat circuit receiving face by a predetermined distance, the contact portions (52) of the second terminals (40') being spaced inwardly from said flat circuit receiving face (20) by a distance which is greater than the said predetermined distance whereby, insertion of the flat circuit (8) into said opening (30), sequentially deflects the contact portions (52) of the first and second terminals (40, 40') to obtain the final contact force, characterised in that, for use with flat flexible cable (8), each terminal (40, 40') comprises a generally channel-shaped portion formed by a web (42) and terminal sidewalls (44, 46), the contact spring arm (50) of each terminal extending from one of the terminal sidewalls (44) away from the housing opening (30) towards the other terminal sidewall (46) and the housing opening (30) having opposed sidewalls (32, 34), the terminal sidewalls being substantially against the housing sidewalls (32, 34), so that the spring arm (50) bears against the other terminal sidewall (46) which provides an abutment surface (54) for the

(14)

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contact portion (52), each such abutment surface (54) extending across the rows of contact portions (52) in the insertion direction whereby both surfaces of an inserted cable (8) are clamped between the terminal sidewalls with said final contact force.

2. A multi-contact electrical edge connector according to claim 1 characterised in that, each abutment surface (54) is constituted by an embossment on said other terminal sidewall (46).

3. A multi-contact electrical connector (2) according to claim 1 or claim 2 characterised in that the housing (18) of the connector has a plurality of third contact terminals (40'') therein, third contact portions (52) of the third contact terminals (40'') being arranged in a third row (72) which extends parallel to the first (68) and second (70) rows, the contact portions (52) of the third contact terminals (40'') being spaced inwardly from the cable receiving face (20) by a distance which is greater than the distance between the cable receiving face (20) and the contact portions (52) of the second contact terminals (40'), adjacent third contact terminals (40'') in said third row (72) being separated by one first contact terminal (40) and one second contact terminal (40') in said first and second rows.

Patentansprüche

1. Mehrere Kontakte aufweisender elektrischer Randverbinder (2) des Typs mit einem Isoliergehäuse (18), das eine Flachschtaltungs-Aufnahmeseite (20) sowie eine sich in die Flachschtaltungs-Aufnahmeseite (20) hineinerstreckende rinnenartige Flachschtaltungs-Aufnahmeöffnung (30) aufweist, wobei erste und zweite Kontaktanschlüsse (40, 40') in der Öffnung (30) in gegenseitiger Beabstandung voneinander längs der Öffnung (30) angeordnet sind und jeder der Anschlüsse einen Kontaktfederarm (50) aufweist, der durch die flache Schaltung (8) gebogen wird, wenn die flache Schaltung in die Öffnung (30) eingeführt wird, wobei jeder Federarm (50) einen Kontaktbereich (52) aufweist, der an der flachen Schaltung (8) anliegt und sich in elektrischem Kontakt mit dieser befindet, wenn die flache Schaltung vollständig in die Öffnung (30) eingeführt ist, wobei die Kontaktbereiche (52) der ersten und der zweiten Kontaktanschlüsse (40, 40') jeweils in einer ersten und einer zweiten Reihe (68, 70) liegen, die sich längs einer Seite der Öffnung (40) erstrecken, wobei sich die Kontaktbereiche (52) der ersten Anschlüsse (40) in der Nähe der Flachschtaltungs-Aufnahmeseite (20) befinden und in einem vorbestimmten Abstand von der Flachschtaltungs-Aufnahmeseite in Richtung nach innen beabstandet sind, und wobei die Kontaktbereiche (52) der zweiten Anschlüsse (40') von der Flachschtaltungs-Aufnahmeseite (20) in Richtung nach innen in einem Abstand beabstandet sind, der größer ist als der genannte vorbestimmte Abstand, wodurch beim Einführen der flachen Schaltung (8) in die Öffnung (30) nacheinander die Kontaktbereiche (52) der ersten und der

zweiten Anschlüsse (40, 40') verbogen werden, um die endgültige Kontaktkraft zu erzielen, dadurch gekennzeichnet, daß zur Verwendung mit einem flachen flexiblen Kabel (8) jeder Anschluß (40, 40') einen im allgemeinen kanalförmigen Bereich aufweist, der durch einen Steg (42) und durch Anschlußseitenwände (44, 46) gebildet ist, wobei sich der Kontaktfederarm (50) jedes Anschlusses von einer der Anschlußseitenwände (44) in Richtung von der Gehäuseöffnung (30) weg in Richtung auf die andere Anschlußseitenwand (46) erstreckt und die Gehäuseöffnung (30) einander gegenüberliegende Seitenwände (32, 34) aufweist, wobei die Anschlußseitenwände an den Gehäusesseitenwänden (32, 34) im wesentlichen anliegen, so daß der Federarm (50) gegen die andere Anschlußseitenwand (46) drückt, die eine Widerlagerfläche (54) für den Kontaktbereich (52) schafft, wobei sich jede solche Widerlagerfläche in der Einführrichtung über die Reihen von Kontaktbereichen (52) erstreckt, wodurch beide Oberflächen eines eingeführten Kabels (8) mit der genannten endgültigen Kontaktkraft zwischen den Anschlußseitenwänden festgeklammert sind.

2. Mehrere Kontakte aufweisender elektrischer Randverbinder nach Anspruch 1, dadurch gekennzeichnet, daß jede Widerlagerfläche (54) durch eine Erhebung an der genannten anderen Anschlußseitenwand (46) gebildet ist.

3. Mehrere Kontakte aufweisender elektrischer Randverbinder nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß in dem Gehäuse (18) des Verbinders eine Mehrzahl dritter Kontaktanschlüsse (40'') vorgesehen sind, wobei dritte Kontaktbereiche (52) der dritten Kontaktanschlüsse (40'') in einer dritten Reihe (72) angeordnet sind, die sich parallel zu der ersten (68) und der zweiten (70) Reihe erstreckt, wobei die Kontaktbereiche (52) der dritten Kontaktanschlüsse (40'') von der Kabelaufnahmeseite (20) in Richtung nach innen in einem Abstand beabstandet sind, der größer ist als der Abstand zwischen der Kabelaufnahmeseite (20) und den Kontaktbereichen (52) der zweiten Kontaktanschlüsse (40''), und wobei benachbarte dritte Kontaktanschlüsse (40'') in der dritten Reihe (72) durch einen ersten Kontaktanschluß (40) und einen zweiten Kontaktanschluß (40') in der ersten und der zweiten Reihe voneinander getrennt sind.

Revendications

1. Connecteur électrique (2) de bord à contacts multiples du type comprenant un boîtier isolant (18) présentant une face (20) de réception d'un circuit plat et une ouverture (30), analogue à une gouttière, de réception d'un circuit plat pénétrant dans la face (20) de réception d'un circuit plat, des premières et deuxième bornes de contact (40, 40') situées dans l'ouverture (30) et espacées le long de l'ouverture (30), chacune des bornes comportant une lame de contact (50) à ressort qui est déviée par le circuit plat (8) lorsque celui-ci est inséré dans l'ouverture (30), chaque lame à ressort (50) comportant une partie de contact (52) qui



porte contre le circuit plat (8) et est en contact électrique avec celui-ci lorsqu'il est totalement inséré dans l'ouverture (30), les parties de contact (52) des premières et deuxième bornes de contact (40, 40') étant disposées; respectivement, en des première et deuxième rangées (68, 70) s'étendant le long d'un côté de l'ouverture (30), les parties de contact (52) des premières bornes (40) étant proches de la face (20) de réception d'un circuit plat et espacées vers l'intérieur de ladite face de réception d'un circuit plat, d'une distance prédéterminée, les parties de contact (52) des deuxième bornes (40') étant espacées vers l'intérieur de ladite face (20) de réception d'un circuit plat d'une distance qui est supérieure à ladite distance prédéterminée de manière qu'une insertion du circuit plat (8) dans ladite ouverture (30) fasse fléchir successivement les parties de contact (52) des premières et deuxième bornes (40, 40') pour établir la force finale de contact, caractérisé en ce que, pour une utilisation avec un câble flexible et plat (8), chaque borne (40, 40') comprend une partie globalement en forme de gouttière formée d'une âme (42) et de parois latérales (44, 46) de bornes, la lame de contact à ressort (50) de chaque borne partant de l'une des parois latérales (44) de bornes et s'éloignant de l'ouverture (30) du boîtier, en direction de l'autre paroi latérale (46) de borne, et l'ouverture (30) du boîtier comportant des parois latérales opposées (32, 34), les parois latérales de la borne étant appliquées sensiblement contre les parois latérales (32, 34) du boîtier de manière que la lame à ressort (50) porte contre l'autre paroi latérale (46)

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de la borne qui présente une surface de butée (54) pour la partie de contact (52), chaque surface de butée (54) s'étendant transversalement aux rangées de parties de contact (52), dans la direction d'insertion, de manière que les deux surfaces d'un câble (8) inséré soient bridées entre les parois latérales de la borne sous ladite force finale de contact.

2. Connecteur électrique de bord à contacts multiples selon la revendication 1, caractérisé en ce que chaque surface de butée (54) est constituée par un bossage situé sur ladite autre paroi latérale (46) de la borne.

3. Connecteur électrique (2) à contacts multiples selon la revendication 1 ou la revendication 2, caractérisé en ce que le boîtier (18) du connecteur renferme plusieurs troisièmes bornes de contact (40''), des troisièmes parties de contact (52) des troisièmes bornes de contact (40'') étant agencées en une troisième rangée (72) qui s'étend parallèlement aux première (68) et deuxième (70) rangées, les parties de contact (52) des troisièmes bornes de contact (40'') étant espacées vers l'intérieur de la face (20) de réception du câble d'une distance qui est supérieure à la distance comprise entre la face (20) de réception du câble et les parties de contact (52) des deuxième bornes de contact (40'), des troisièmes bornes de contact adjacentes (40'') dans ladite troisième rangée (72) étant séparées par une première borne de contact (40) et par une deuxième borne de contact (40') située dans les dites première et deuxième rangées.

