

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO CONTACTS FOR ELECTRICAL CONNECTORS

(71) We, E.I. DU PONT DE NEMOURS AND COMPANY, a corporation organized and existing under the laws of the State of Delaware, United States of America, of Wilmington, State of Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a connector for a circuit board edge and to a contact particularly but not exclusively for use in such a connector.

It is known to provide a circuit board connector comprising an insulating casing with therein a contact slot, which is open towards the front side, for the edge of a circuit board, which contact slot is divided at its upper and/or lower side by parallel partitions into an upper and/or lower row of receiving spaces, which extend from the front of the casing towards the rear, in which a plurality of identical contacts of conducting metal are accommodated having pin or strip-shaped rear ends passing through holes in the rear wall of the casing, each such contact disposed in the receiving space into the contact slot for clamping and contacting a circuit board edge.

Such a connector is known from DEOS 2 448 349. In this known device, the contacts consist of a pin-shaped rear end, which merges into a curve-shaped bent front part. Said contacts are mounted two by two opposite each other in the casing in such a way, that the bent front parts are movable sideways at their front sides. When a circuit board edge is inserted, it presses the bent front parts away while overcoming a certain spring force, so that the circuit board is clamped between the opposite bent parts, which also form the contact surfaces.

This known connector presents some drawbacks. In order to obtain a good clamping action, it is necessary that the entire con-

tact is made of good quality material, which has sufficient conductivity, whereas the shape of such a contact is rather complicated. Besides, this assembling method is rather vulnerable, as a unilateral load occurs at the rear side of the casing when a circuit board edge is inserted, so that there is a risk of damage. Another drawback is that the contacts make contact at one place only, namely where the curved spring engages the circuit board. On the one hand, this results in electric reliability, and on the other hand, a low mechanical reliability (poor clamping). Finally the casing itself must be rather complicated, as the free front sides of the bent contact parts must be separated by additional wall parts parallel to the slot direction.

It is an object of the present invention to provide a contact which does not have said drawbacks and with which an improved contacting can be obtained, and manufacturing costs can be relatively low. According to the invention there is provided a contact of conductive material for use in an electrical connector, comprising a support member and an elongate plate spring mounted thereon, the ends of the spring being secured, at locations so spaced that the spring is initially arcuate, against longitudinal movement whereby when a mating contact is urged against the convex surface thereof the spring can, in use, resiliently buckle in its central region so that the mating contact is engaged by spring portions at both ends of said central region.

When a curve-stressed plate spring, of which both ends are secured, is loaded gradually by the displacement of a flat circuit board from the one end of the spring towards the other end, this spring, in its attempt to follow the flat plate, will first be dented gradually until, when the board has approximately reached the centre of the spring, this centre begins to resiliently buckle, during which buckling the spring has a negative spring characteristic. When the board is dis-

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placed further, two outwardly bent curve crests will occur symmetrically with respect to the buckled centre, said curve crests pressing resiliently against the board and balancing each other.

An efficient use is made of this phenomenon to contact a circuit board edge. The initial spring characteristic of the relatively slack spring curve is favourable, as thus less force is required to press a circuit board edge into the contact slot. This is of great importance, because this insertion force increases in proportion with the number of contacts present in a circuit board connector, so that with the known devices often intolerably great insertion forces were necessary, which may lead to damage of the circuit board. Said spring characteristic changes during the buckling, and when the circuit board is clamped in its final position, the two outwardly bent spring parts press resiliently against the circuit board, ensuring a sufficiently great contact pressure, which is considerably greater than the initial pressure which had to be overcome at the insertion of the circuit board.

Another advantage is that both bent spring parts form two contact places, so that the contact reliability is increased.

Another advantage is that the material of the support member does not have to contribute to the required spring force, so that conductivity is the only criterion for the choice of said material. The only part which has to be of first class material is the spring itself, which must be conducting as well as provide the desired spring force. Therefore and also because of the fact that both parts of the contact are of simple shape, the costs can be reduced considerably.

Viewed from another aspect the invention provides a circuit board edge connector comprising an insulating housing having a slot therein and a plurality of contacts as set forth above so disposed in the housing that a circuit board inserted into the slot is engaged by the convex surfaces of the contact springs.

Another reduction in cost is obtained in that the housing of the circuit board connector can be of simple construction, among other reasons because the contacts may be received in spaces which are open receiving spaces, which require no additional closing wall, since the support members are not lying free at their front ends, but against the bottom of their receiving spaces.

Like the connector disclosed in DEOS 2 448 349, the connector can be double-sided, contact receiving slots being provided both at the upper and at the under wall of the edge receiving slot. In that case the contacts at the upper wall and at the under wall of the slot may be arranged in two rows on opposite sides of the slot and preferably in pairs, with their contact springs stressed in the shape of a

curve, so that circuit boards which are printed on two sides can be contacted.

Each support member preferably includes a pair of upstanding spaced walls, each wall having a pair of oppositely inclined notches for receiving the ends of the spring. The support members preferably comprise a mainly U-shaped cross profile. Such a U-profile assures sufficient rigidity and economy of material. In the erect side walls of each U two pairs of opposite notches can be provided, into which the ends of the plate springs are inserted. Preferably these pairs of notches are directed obliquely towards each other in the direction of the bent spring.

For better guiding the deformation of the spring during the transition to the buckling and for better defining the buckling itself, it is preferred that each wall has, between its notches, a recessed section to accommodate the deformation of the spring.

In order to assure a good locking of the support members to the upper and under walls of the slot-shaped space in the housing, locking cams may be provided on the backs of the support members, with which cams said members can be secured in the bottom of the receiving spaces and against the rear wall of the housing. In this way a solid fixed assembly of the members in the housing is obtained.

As has been mentioned in the above, the plate springs serving as contact springs must have mechanical spring force as well as electric conductivity. This can be obtained by choosing a first class spring material, which is gilded at least partly for obtaining the desired conductivity.

The invention will be explained hereinafter with reference to the drawings, in which:

Figure 1 shows a perspective view of an embodiment of a connector having a contact according to the invention;

Figure 2 shows a perspective view of the connector of Figure 1 mounted on a circuit board edge, and

Figure 3 shows a perspective view of the contact used in this embodiment.

The embodiment shown comprises an insulating housing or casing 1 of synthetic material. In the casing 1 there is a receiving slot 2, which is open at the front side, into which a circuit board edge can be inserted. Said slot is limited by the upper wall 3, the under wall 4, the side walls 5 and the rear wall 6. At the upper and lower walls there are parallel opposite partitions 7a and 7b, between which receiving spaces 8a and 8b are defined, which debouch into the hole of the slot.

In these receiving spaces are accommodated contacts 9a and 9b, which are all uniform, and placed opposite of and directed towards each other in opposite pairs of receiving spaces, each pair of contacts 9a and

9b forming together an edge contact for a circuit board. Each contact comprises a support member 10, which has a U-shaped cross-section with a back side 11 and upstanding side walls 12. The back side 11 is further provided with locking cams 13 and 14, with which said support member is kept locked with its back against the upper or lower side of the slot in its receiving space.

The support member 10 comprises a pin-shaped rear part 15, which passes through the rear wall of the casing 1, and a front part 17, whose upstanding side walls are higher than those of the rear part. At the transition of the rear part to the front part, there are thus cross edges 16, which serve as buffer edges during the assembly of the contacts in the casing.

In the front part 17 of the support member 10, two pairs of opposite notches 19 and 20 are provided in the side walls, into which notches the ends of a plate spring 18 are inserted. The relative distance between both pairs of opposite notches 19 and 20 is chosen so, that in assembled position the plate spring 18 is bent and stressed to a certain extent. Both pairs of notches 19 and 20 are directed obliquely towards each other, so that they approximately follow the direction of the spring 18. The plate spring is made of high quality spring material, e.g. spring steel, and serves as contact spring for the contacts 9a and 9b. For that purpose the spring is gilded, at least at those places where contacts have to be made.

Underneath the bent and prestressed contact spring 18, the erect sidewalls of the front part of the support member are recessed as shown to form a central decreased part 21 and beside the centre two increased parts 22 which subsequently decrease again. The purpose of this profiled recess will be explained hereinafter.

The assembly of the connector takes place as follows. After the contact springs 18 in bent position have been inserted into the notches 19 and 20, the thus obtained contacts 9a and 9b are slid into the receiving spaces 8a and 8b, the pin-shaped rear ends 15 passing through holes in the rear wall of the casing until the buffer edges 16 touch the rear wall and the locking cam 14 snaps behind the rear wall. The locking cam 13 then snaps into a snapping hole (not shown) in the upper or lower wall, so that each contact is secured in place.

In the assembled position, pairs of contacts 9a and 9b are thus directed towards each other with plate springs 18 stressed in the shape of a curve, as shown in Figure 1. For contacting a circuit board, a circuit board edge 23, which is provided at one or at both sides with connection strips 24, is inserted into the slot 2, not specified measures assuring that the connection strips 24 come to lie

exactly at the height of the pairs of contacts 9a and 9b. The thickness of the circuit board is greater than the shortest distance between opposite contact springs, so that these are first partly dented and bent backwards, and subsequently, when the circuit board edge has passed by the centre of the springs, resiliently buckle, a curve trough 25 occurring in the centre of each spring; said trough in dependence on the thickness of the circuit board is directed to or pressed against the decreased part 21 of the corresponding support member 10, whereas at both sides thereof two curve crests 26 extend themselves approximately over the increased parts 22, which crests resiliently press against a contact strip of the edge of the printed circuit board.

By means of this buckling, the spring characteristics are used very efficiently for the contacting. During the initial insertion of the circuit board edge, first a relatively small spring force is undergone so that the insertion is easy and the circuit board edge is not damaged. Only when the circuit board edge has been slid up to the centre of the springs, the latter buckles and changes via a negative spring characteristic into a composite spring system, of which each individual spring has an increased spring force, which ensures a strong contact pressure at both sides of the circuit board edge and, moreover, at two contact places, which are determined by the curve crests 26 of the buckled spring. Thus, on the one hand a firm clamping is obtained, and on the other hand a good and double contacting, which considerably increases the contact reliability. The curve-shaped profiled part 21 and 22 guides the spring movement in an efficient way and ensures, moreover, that in the final position the contact places of the spring, i.e. the curve crests 26 which are in touch with the circuit board edge, are well defined.

The pin-shaped rear parts 15 of the support members 10 efficiently form contact- or soldering-pins, the chosen U-shape being very efficient, especially in the latter case.

The support member 10 of contact 9a, 9b is made from a malleable metal of high electrical conductivity, e.g. brass, copper or phosphor bronze, and the plate spring 18 is made from a resilient spring metal, e.g. spring steel, beryllium copper or other spring metals or alloys. Both the support member and the plate spring may be plated or coated with a corrosion resistant, conductive metal layer or plating, e.g. gold or tin-lead, to assure good electrical contact with a mating contact. The housing 1 is made from a suitable dielectric material, e.g. nylon or polyester, which may be glass filled or otherwise reinforced.

WHAT WE CLAIM IS:

1. A contact of conductive material for use



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9b forming together an edge contact for a circuit board. Each contact comprises a support member 10, which has a U-shaped cross-section with a back side 11 and upstanding side walls 12. The back side 11 is further provided with locking cams 13 and 14, with which said support member is kept locked with its back against the upper or lower side of the slot in its receiving space.

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WHAT WE CLAIM IS:

1. A contact of conductive material for use

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5 in an electrical connector, comprising a support member and an elongate plate spring mounted thereon, the ends of the spring being secured, at locations so spaced that the spring is initially arcuate, against longitudinal movement whereby when a mating contact is urged against the convex surface thereof the spring can, in use, resiliently buckle in its central region so that the mating contact is engaged by spring portions at both ends of said central region.

10 2. A contact according to Claim 1 in which the support member includes a pair of upstanding spaced walls, each wall having a pair of oppositely inclined notches for receiving the ends of the spring.

20 3. A contact according to Claim 2 in which each wall has, between its notches, a recessed section to accommodate the deformation of the spring.

4. A contact according to Claim 3 in which the spring has a width greater than the spacing between the walls.

25 5. A contact substantially as herein described with reference to the accompanying drawings.

30 6. A circuit board edge connector comprising an insulating housing having a slot therein and a plurality of contacts according to any one of Claims 1 to 5 so disposed in the housing that a circuit board inserted into the slot is engaged by the convex surfaces of the contact springs.

35 7. A circuit board connector according to Claim 6 in which the contacts are arranged in two rows on opposite sides of the slot.

8. A circuit board connector substantially as herein described with reference to the accompanying drawings.

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