

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO CONNECTORS FOR INSULATED CONDUCTORS

(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 plurality of insulated wires or conductors and to a method of assembling connectors on the conductors.

German Offenlegungsschrift No. 2,439,910 describes a connector for simultaneously contacting a number of loose, insulated current wires, arranged in rows.

The connector comprising a contact holder of insulated material, which is subdivided on one outer side into a row of parallel spaces, which are separated by parallel partitions, in each of which spaces is accommodated a wire piercing contact with cutting edges directed towards each other. The wire piercing contact has a contact slot for receiving and contacting the core of a current wire, the wire insulation being cut by said cutting edges. The current wire piercing contacts are arranged in the spaces with their contact slots turned towards an end wall which is at a right angle to the partitions, which end wall has at each space a notch, which is in line with the contact slot of the current wire piercing contact placed in that space, said notch being a clamping notch for the insulated current wire to be contacted in that space.

Such a connector can be used as an end

contact for a row of loose insulated current wires, which substitute for a so-called flat cable. Flat cables, in which a number of parallel insulated current cores are arranged on a common substrate of insulating synthetic material, are used in the printed circuit plate technique as connection means for connecting several circuit plates to each other or to other devices. A disadvantage, however, is that they are rather expensive, whereas the standard relative distances of the insulated cores on such a flat cable usually are too small to connect such a cable without preliminary treatment to a common contact. As a number of loose current wires are considerably less expensive than a flat cable, and as the relative distance between loose current wires can be chosen at will beforehand, attempts are being made to substitute, where that is possible, flat cables by a row of loose wires.

In the connector according to said German Offenlegungsschrift 2 439 910 the contact holder essentially consists of a flat plate, at the top side of which open spaces are formed by means of said partitions. In each open space is provided a conducting metal strip with an erect U-shaped bent part, which is divided so as to form two opposite contact brackets, which form a current wire piercing contact. By piercing contact is understood in general a contact with two cutting means, between which there is a slot, and which, when placed on an insulated current core, cuts the core insulation, whereas the bare wire core is clamped between both cutting means, so that contact is established. Said spaces can further be provided with an end wall at one side, into which end wall notches are cut in line with

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the slots of the piercing contacts, so that when current wires are inserted in the individual spaces and contacted there by the piercing contacts, they are also clamped in said end wall, so that a suitable pull-relieve is obtained. In this way it is possible to contact a row of individual contact wires to one single contact device of said type, said conducting strips being carried out at one end as edge contacts for a printed circuit plate.

Although it is possible with this known connector to contact a number of loose current wires simultaneously by means of a suitable tool, it is less suitable for automatic processing on a large scale. For substituting flat cables, there is a great demand for pre-treated current wire rows, which are connected at both their ends to multiple connectors. Such a pre-product can be substituted without any problem for a corresponding length of flat cable and be connected to circuit plates or other devices. For the contacting of the multiple connector according to German Offenlegungsschrift 2 439 910 it is necessary, however, either to cut the current wires to length beforehand, or to cut the wires directly after the contacting to such a connector as said wires must not extend over the front side of the device, where the edge contacts for printed circuit plates are situated.

It is an object of the present invention to provide a connector for a plurality of insulated conductors which reduces the disadvantages outlined above.

According to a first aspect of the present invention there is provided a connector for a plurality of insulated wires, comprising a housing having two spaced side walls made of insulating material and a plurality of aligned spaced channels extending there-through parallel with respect to one another from one side wall to the other, a contact device of conducting material being received in each channel, each contact device having a wire receiving slot defined in a portion thereof, each wire receiving slot having at least one pair of skiving elements associated therewith, each side wall of the housing having a plurality of wire clamping slots formed therein, one clamping slot in each side wall being aligned with a respective wire receiving slot so that there is a wire clamping slot at both ends of each channel.

It is possible to place and assemble such a connector on a plurality of insulated wires directly and there is no need to cut the wires to size. Thus, a number of connectors could be assembled along a length of the wires, the wires and connectors then stored and a length of wires with the appropriate number of connectors detached therefrom when required.

In an embodiment each contact device

has at one end two resilient contact fingers, which are directed forwards and taper towards each other, and holes are provided in the rear wall of the housing of the connector, which together with said contact fingers form receiving contacts for plug pins.

Further it is possible that each contact device has outwardly projecting, resilient lips which, when the contact devices are assembled in the channels, snap into holes provided in one or both side walls of the housing. Thus an efficient locking of the contact device in the housing can be obtained in a simple way when the contact devices are slid into their respective channels.

In order to facilitate the assembly at the wire clamping slots, these clamping slots may have receiving parts with side walls narrowing towards each other, which end into a slightly widened wire receiving portion, arranged so that a straight middle part with parallel side walls extends between the tapering and narrowing part and the receiving part. In this way said clamping slots are given a certain resilience, which facilitates the insertion. This resilience can be increased even more, in that in the one and/or the other side wall of the housing recesses are provided at the first end between the clamping slots and opposite the partitions, the depth of said recesses corresponding to that of the clamping slots.

As stated above, the connector is particularly suitable for an automatic assembling process. The invention therefore also relates to a method for assembling the connectors to insulated current wires for obtaining a pre-product.

According to a further aspect of the invention there is provided a method of assembling connectors as hereinbefore described on insulated wires, comprising the steps of positioning a plurality of insulated wires to extend parallel with respect to one another, guiding the positioned wires through an assembly station, operating said assembly station to press at least two connectors onto the positioned wires adjacent to one another so that the wires enter the wire clamping slots and the wire receiving slots thereof.

This method can be arranged to provide a plurality of parallel insulated wires on which adjacent pairs of connectors are arranged at regular distances. The wires can then be wound up and supplied as a pre-product. Alternatively, a length with connectors at each end can be obtained by cutting the current wire row near successive pairs of connectors between the two connectors of such a pair.

In an embodiment the two adjacent connectors are pressed onto opposite sides of the wires, so that an alternating contacting

takes place, which fulfills an existing need.

Embodiments of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows a perspective view of an embodiment of a connector of the invention;

Figure 2 shows a perspective view of a contact device used therewith;

Figure 3 shows a perspective view the connector of Figure 1 with insulated current wires assembled therewith; and

Figure 4 shows a perspective view of an embodiment of apparatus for assembling connectors according to the invention on wires.

First, an embodiment of the connector according to the invention will be described with reference to Figures 1, 2 and 3.

As shown in the drawings, a preferred embodiment of a connector comprises a housing 1 made of insulating material, having the external shape of a flat block. In this block there are a plurality of aligned spaced channels 2, which extend from the front side of the block to the rear side, defined by the upper wall 3, the lower wall 4 and partitions 5. At the front side (top side in Figures 1 and 3), slots 6, 7 are provided in the upper and lower wall S respectively, which slots have a receiving part with tapering walls 8, a straight middle part with parallel walls 9, and a slightly widened lower part 10, which serves as a receiving hole for an insulated wire.

In each channel 2, a contact device 11 of conducting metal is accommodated, which is shown entirely in Figure 2. This contact device has at its front side two pairs of sharply pointed ends 12, 13, which define contact slots 14 and which form, in a known way, core piercing contacts. At the rear side, the contact device 11 has resilient, inwardly bent strips 15 and 16, which together with holes provided in the rear wall of the holder form receiving contacts for plug pins. The contact device further has an outwardly projecting resilient lip 18 which, when the contact device 11 is inserted into a channel 2, is locked in a corresponding hole 19 provided in the upper wall of the contact holder 1.

At the front side, the contact slots 14 are aligned with the slots 6 and 7 in the upper and lower walls 3 and 4.

When the front side of the thus formed connector is placed against a row of parallel insulated current wires 22, these can be contacted without cutting of the wires being necessary. The piercing contact ends 12 and 13 penetrate into the core insulation 24 of the current wire to be contacted, where by the core 25 is contacted in the contact slots 14. A clamping takes place simultaneously

at both sides of this contact place in the slots 6 and 7 in the upper and lower wall S respectively, which slots serve as clamping slots and assure a pull-relieve for the respective current wire at both sides of the piercing contact. Recesses 20 are provided between the clamping slots 6 in the upper wall, situated at the height of the partitions 5, which recesses 20 ensure that the clamping slots have a spring force action, so that the assembly of the connector on a set of current wires is facilitated.

One partition 21 is thicker, which is intended to separate the signal wires 22 from an earth core 23.

Figure 4 shows an embodiment of an assembling machine, with which such connectors can be assembled on a row of wires, for obtaining a pre-product which can be stored for further processing.

The assembling machine comprises a number of wire reels 26, which each supply a separate, insulated wire to a guiding jig 31, which consists of an upper plate 32 and a lower plate 33, wherebetween wires can be guided parallel and horizontally via guiding holes defined by the plates. Between the guiding jig 31 and the wire reels there is a blocking means 28, consisting of guide rolls 29, which are placed under the row of insulated wires and helps to guide these, and a set of eccentric discs 30, provided above the wire row, and which prevents a return movement of the wires to the reels. The actual contacting of the wires with the connectors takes place at an assembly station where an upper pressure part 35 and a lower pressure part 36 are provided, arranged one above the other on each side of the wire row. Both pressure parts are movable towards and away from each other by means of a lever mechanism 37, which is connected to a pull rod 38, which is driven pneumatically by a pressure cylinder 39.

The upper pressure part has a casing 40, which is open at the lower side turned towards the wire row, and two parallel shock plates 41 and 42 at a right angle to the wire row, of which the first is countersunk in the casing and the second projects therefrom. The lower pressure block has a similar casing 43, which is open at the upper side turned towards the wire row, and which also has a countersunk shock plate 44 and a projecting shock plate 45. The shock plates in the upper and lower pressure parts are situated alternately with respect to each other, so that the countersunk shock plate 41 of the upper casing 40 is situated opposite of the projecting shock plate 45 of the lower casing 43, whereas the projecting shock plate 42 of the upper casing 40 is situated opposite of the countersunk shock plate 44 of the lower casing 43. The shock plates 41, 42 and 44, 45 can be pressed against the

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spring force of springs which are not shown in the drawing into their respective casings. Between the two shock plates 41 and 42 of the upper casing 40 there is a separately operable knife 46, with which the wire row can be cut at will.

The figure further shows two supply gutters 47 and 48 which are connected to vibrating filling means 49 and 50. Via these supply gutters, multiple contact devices according to the invention can be supplied to the pressure parts 35 and 36. The connectors 51 manufactured according to the invention are supplied via the supply gutter 47 with their contacting front side directed downwards until above the wire row to be contacted, where a connector 51 to be contacted is placed under the countersunk shock plate 41 of the upper pressure part 35. In the same way, connectors 52 manufactured according to the invention are supplied via the supply gutter 48 with their contacting front side directed upwards until below the wire row to be contacted, where a connector 52 to be contacted is placed above the countersunk shock plate 44 of the lower pressure part 36.

The assembling machine further comprises a first wire gripping device 53, which has a supporting frame 54 which is guided via horizontal guiding beams 55 and 56. By means of clamping blocks 57 and 58, said frame 54 is clamped to an endless toothed belt 59, which is guided by foremost and hindmost toothed wheels 60 and 61, of which the hindmost toothed wheel is mounted to the driving shaft 62 of an electrically driven gear motor 63. Said supporting frame 54 carries upper and lower wire clamping blocks 64 and 65, which at their surfaces turned towards each other are provided with clamping slots 67 for gripping the insulated current wires. Said wire clamping blocks are operated by a lever system 68, to which a pull rod 69 is connected, which is driven pneumatically by means of a pressure cylinder 70.

After the pressure parts 35 and 36 there is a second wire gripping device 71, which has a fixed position. The wire gripping device also has two wire clamping blocks 72 and 73, which are provided in a similar way with clamping slots 74, said wire clamping blocks being driven pneumatically by a pressure cylinder 75. The above-described assembling machine works as follows. Insulated wires 27 supplied by the wire reels 26 are arranged by means of the guiding jig 31 horizontally at a constant relative distance into a horizontal row of wires. Said wire row is guided by means of the hindmost and foremost gripping devices between the pressure parts 35 and 36, which are each

provided with a respective contact device 51, 52. By means of a pneumatic signal, the corresponding lever system 37 is operated, so that the pressure parts are pressed together. As a result the two contact devices 51 and 52 make contact simultaneously with the wire row at each side thereof. The countersunk shock plates 41 and 44 serve as shock hammers, whereas the projecting shock plates 42 and 45 form movable anvils, which mobility is necessary to ensure that the wires 27 are pressed into the contact slots 14 and the clamping slots 6 and 7. In this way two connectors are contacted simultaneously. During this contacting the gripping device 53 is in its closed position, in which the clamping blocks 64 and 65 are pressed on each other and grip the wires of the wire row. At the same time the fixed gripping device 71 is open, the clamping blocks 72 and 73 being away from each other. After the pressure parts 35 and 36 have moved apart, the geared motor 63 is switched on and the gripping device 53 is moved by means of the toothed belt until beyond the second gripping device 71, carrying the wires with the connectors assembled thereon over a fixed and adjustable distance, which depends on the adjustable initial position of the gripping device 53. Subsequently the clamping blocks 64 and 65 are opened and the clamping blocks 72 and 73 are closed, so that the wire row is now held by the gripping device 71. As soon as this change of grip has taken place, the geared motor is switched into the opposite rotation direction, so that the toothed belt moves the gripping device 53 with the clamping blocks 64 and 65 spaced apart along the guiding rails 55 and 56 to its original position. There the clamping blocks 64 and 65 are closed on each other again, whereas the clamping blocks 71 and 72 move away from each other, so that the grip on the wire row is changed again. Subsequently the above-described steps are repeated in cycles, until product of desired length is obtained. The wire row between two contact devices is then cut at the same time as the contacting operation at a chosen moment, by means of a separately operable knife 46, which can be operated mechanically. Thus an end product is obtained, which consists of a desired wire length of a row of insulated current wires, on which pairs of connectors pressed onto opposite sides of the wires are assembled at regular distances. Such a wire row can replace flat cable efficiently. When used, such a wire row is always cut off between two adjacent connectors so that a length of wire is obtained which is terminated at both front and rear ends by a connector according to the invention. The one end can be assembled easily to a printed circuit plate, whereas the other

end can be connected to another printed circuit plate or to other devices to be contacted.

In the assembling machine, the knife which periodically cuts the wire row between two adjacent contacted connectors can be provided not in the upper pressure part 35, but elsewhere on the route of the wire, e.g. before the foremost gripping device 71. It is also possible that the knife cuts the wire row in co-operation with the pressure parts 35 and 36 at each working stroke of said pressure parts, so that the product provided by the assembling machine consists of pieces of wire row, which are limited at front and rear side by a connector. Further, the drive does not need to be entirely pneumatic, as in the illustrated embodiment, but it can take place e.g. entirely or partly electrically.

WHAT WE CLAIM IS:-

1. A connector for a plurality of insulated wires, comprising a housing having two spaced side walls made of insulating material and a plurality of aligned spaced channels extending therethrough parallel with respect to one another from one side wall to the other, a contact device of conducting material being received in each channel, each contact device having a wire receiving slot defined in a portion thereof, each wire receiving slot having at least one pair of skiving elements associated therewith, each side wall of the housing having a plurality of wire clamping slots formed therein, one clamping slot in each side wall being aligned with a respective wire receiving slot so that there is a wire clamping slot at both ends of each channel.

2. A connector as claimed in Claim 1, wherein the side walls are connected together at a first end by a first end wall, said channels open into said first end wall and said wire receiving slots are each open at said first end wall.

3. A connector as claimed in Claim 2, wherein said side walls extend substantially parallel with respect to one another and said first end wall extends substantially at right angles to said side walls, and wherein said channels are defined by a plurality of partitions extending parallel with respect to one another between said first and second side walls and arranged substantially at right angles with respect to said side walls and to said end wall.

4. A connector as claimed in Claim 3, wherein the side walls are connected together at their other, second end by a second end wall extending substantially parallel to said first end wall, and said partitions extend from said first end wall to said second end wall to define substantially rectangular channels.

5. A connector as claimed in Claim 4,

wherein each contact device is elongate and extends within the corresponding channel from the first end wall to the second end wall, the wire receiving slot of each contact device being provided in a first end portion thereof adjacent said first end wall, each said end portion being connected to a contact defined by two resilient contact fingers.

6. A connector as claimed in Claim 5, wherein each contact finger of each contact device is supported by a second end portion of said contact device remote from said first end portion, the two contact fingers extend towards said first end portion and towards one another, and wherein apertures are provided in said second end wall of the housing, each aperture being aligned with a contact of a respective contact device.

7. A connector as claimed in any of Claims 3 to 6, wherein a plurality of recesses are provided in one or both of the side walls of the housing, each recess being provided in the first end of the respective side wall between adjacent wire clamping slots in alignment with a respective partition, the depth of each recess being equal to the depth of each clamping slot.

8. A connector as claimed in any of Claims 2 to 7, wherein each wire receiving slot is defined between a pair of arms extending towards the first end wall, the free ends of the arms being pointed and forming the skiving elements of the wire receiving slot.

9. A connector as claimed in any of Claims 2 to 7, wherein each wire receiving slot is defined by two aligned pairs of arms extending towards the first end wall, the free ends of the arms being pointed and forming the skiving elements of the wire receiving slot.

10. A connector as claimed in any preceding Claim, wherein outwardly projecting resilient lips are provided on each contact device, said lips being received in locking holes provided in one or both side walls of the housing.

11. A connector as claimed in any preceding Claim, wherein each wire clamping slot has a tapered lead-in in the first end of the respective side wall, and a wire receiving portion, the lead-in and the wire receiving portion being connected by an intermediate portion having substantially parallel walls.

12. A connector for a plurality of insulated wires substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 3 of the accompanying drawings.

13. A method of assembling connectors as claimed in any preceding Claim on insulated wires, comprising the steps of positioning a plurality of insulated wires to extend parallel with respect to one another,

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end can be connected to another printed circuit plate or to other devices to be contacted.

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10 cuts the wire row in co-operation with the pressure parts 35 and 36 at each working stroke of said pressure parts, so that the product provided by the assembling machine consists of pieces of wire row,
15 which are limited at front and rear side by a connector. Further, the drive does not need to be entirely pneumatic, as in the illustrated embodiment, but it can take place
20 e.g. entirely or partly electrically.

WHAT WE CLAIM IS:-

1. A connector for a plurality of insulated wires, comprising a housing having two spaced side walls made of insulating material and a plurality of aligned spaced channels extending therethrough parallel with respect to one another from one side wall to the other, a contact device of conducting material being received in each channel, each contact device having a wire receiving slot defined in a portion thereof, each wire receiving slot having at least one pair of skiving elements associated therewith, each side wall of the housing having a plurality of wire clamping slots formed therein, one clamping slot in each side wall being aligned with a respective wire receiving slot so that there is a wire clamping slot at both ends of each channel.

40 2. A connector as claimed in Claim 1, wherein the side walls are connected together at a first end by a first end wall, said channels open into said first end wall and said wire receiving slots are each open at said first end wall.

45 3. A connector as claimed in Claim 2, wherein said side walls extend substantially parallel with respect to one another and said first end wall extends substantially at right angles to said side walls, and wherein said channels are defined by a plurality of partitions extending parallel with respect to one another between said first and second side walls and arranged substantially at right angles with respect to said side walls and to said end wall.

50 4. A connector as claimed in Claim 3, wherein the side walls are connected together at their other, second end by a second end wall extending substantially parallel to said first end wall, and said partitions extend from said first end wall to said second end wall to define substantially rectangular channels.

65 5. A connector as claimed in Claim 4,

wherein each contact device is elongate and extends within the corresponding channel from the first end wall to the second end wall, the wire receiving slot of each contact device being provided in a first end portion thereof adjacent said first end wall, each said end portion being connected to a contact defined by two resilient contact fingers.

6. A connector as claimed in Claim 5, wherein each contact finger of each contact device is supported by a second end portion of said contact device remote from said first end portion, the two contact fingers extend towards said first end portion and towards one another, and wherein apertures are provided in said second end wall of the housing, each aperture being aligned with a contact of a respective contact device.

7. A connector as claimed in any of Claims 3 to 6, wherein a plurality of recesses are provided in one or both of the side walls of the housing, each recess being provided in the first end of the respective side wall between adjacent wire clamping slots in alignment with a respective partition, the depth of each recess being equal to the depth of each clamping slot.

8. A connector as claimed in any of Claims 2 to 7, wherein each wire receiving slot is defined between a pair of arms extending towards the first end wall, the free ends of the arms being pointed and forming the skiving elements of the wire receiving slot.

9. A connector as claimed in any of Claims 2 to 7, wherein each wire receiving slot is defined by two aligned pairs of arms extending towards the first end wall, the free ends of the arms being pointed and forming the skiving elements of the wire receiving slot.

10. A connector as claimed in any preceding Claim, wherein outwardly projecting resilient lips are provided on each contact device, said lips being received in locking holes provided in one or both side walls of the housing.

11. A connector as claimed in any preceding Claim, wherein each wire clamping slot has a tapered lead-in in the first end of the respective side wall, and a wire receiving portion, the lead-in and the wire receiving portion being connected by an intermediate portion having substantially parallel walls.

12. A connector for a plurality of insulated wires substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 3 of the accompanying drawings.

13. A method of assembling connectors as claimed in any preceding Claim on insulated wires, comprising the steps of positioning a plurality of insulated wires to extend parallel with respect to one another,

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guiding the positioned wires through an assembly station, operating said assembly station to press at least two connectors onto the positioned wires adjacent to one another, so that the wires enter the wire clamping slots and the wire receiving slots thereof.

14. A method as claimed in Claim 13, further comprising the steps of cutting the wires between the adjacent connectors.

15. A method as claimed in Claim 13 or 14, further comprising the steps of periodically moving the positioned wires through said assembly station, and operating said assembly station cyclically to press two adjacent connectors to the positioned wires to produce a length of parallel extending wires having pairs of connectors spaced along its length.

16. A method as claimed in Claim 13, 14 or 15, wherein one connector of the or each pair is pressed onto one side of the wires and the other connector is pressed onto the other side of the wires.

17. An assembly comprising a plurality of insulated conductors extending parallel with respect to one another and having assembled thereon at least one connector as claimed in any of Claims 1 to 12.

18. A method of assembling connectors on insulated wires substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings.

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