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(54) APPARATUS FOR THE SIMULTANEOUS INSERTION OF A PLURALITY OF ELECTRICAL CONDUCTORS INTO SLOTS IN INDIVIDUAL TERMINALS OF AN ELECTRICAL CONNECTOR

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, 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:—

This invention relates to apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals.

Many forms of slotted electrical terminals and electrical connectors utilising such terminals are well known; with such terminals an insulated electrical conductor is forced into the slot in the terminal such that the edges of the slot penetrate the insulation of the conductor and make electrical connection to the conductive core of the conductor.

Further, many forms of apparatus for simultaneously producing a plurality of such conductor to terminal connections are well known.

For example, in Patent Application No. 11852/74 (Serial No. 1463829) there is described an electrical connector utilising such terminals, and an apparatus for connecting the connector to a plurality of conductors, the apparatus comprising a base having holding means to hold the connector thereon, conductor locating means arranged to locate the conductors relative to a connector mounted on the holding means for insertion into the slots in the terminals of the connector, and an insertion

tool which is removably mountable on the base and which has an insertion slide which, with the tool mounted on the base, is movable relative to the base to urge the conductors located by the locating means, into the slots in the terminals of the connector mounted on the holding means.

In this known apparatus a connector is clamped to the base by a clamping screw while the conductors are urged into the terminals of the connector, and after connection of the conductors to the terminals the clamping screw is released and the connector, with the conductors connected thereto, removed from the apparatus.

With this known apparatus there is no facility for testing the connections formed between the conductors and the terminals of the connector, and such testing may be difficult if not impossible to carry out at a later time, particularly if the conductors and connector are part of a large harness as found in automobiles and domestic equipment.

According to this invention there is provided apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals, the apparatus comprising a base having mounting means to mount the connector thereon; conductor locating means arranged to receive and locate the conductors relative to the connector mounted on the mounting means, for insertion into the slots in the terminals of the connector; and an insertion tool which is removably mountable on the base and which has an insertion blade which, with the tool mounted on the base, is movable

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relative to the base to urge the conductors located by the locating means into slots in the terminals of the connector mounted in the mounting means, wherein the mounting means is constituted by means adapted to mate with the connector.

Preferably the mounting means includes electrical conductors which, when the connector is mated with the mounting means, are electrically connected to the terminals of the connector.

With such apparatus test means can be connected to the conductors of the mounting means whereby the electrical connections between the electrical conductors and the terminals established by the apparatus can be tested immediately they are established.

If the connector is a printed circuit board edge connector the mounting means can comprise a printed circuit board the conductors of which constitute the electrical conductors of the mounting means.

The apparatus of this invention has the advantages that a connector can be easily and accurately mounted on the mounting means due to the mating relationship between the connector and the mounting means, and that the connections established by the apparatus can be fully tested before the connector is removed from the apparatus.

Preferably the mounting means is readily removable from the base whereby one mounting means can be removed and replaced by a further mounting means adapted to mate with a different connector, the advantages of such apparatus being readily apparent.

An embodiment of apparatus according to the invention will now be described by way of example with reference to the drawings, in which:—

Figure 1 is a perspective view of the apparatus in an unloaded condition;

Figure 2 is a view similar to that of Figure 1 but with the apparatus in a loaded condition;

Figure 3 is a side elevation of part of the apparatus of Figures 1 and 2 in the Figure 1 condition.

Figure 4 is a sectional side elevation of the apparatus after use; and

Figure 5 is an exploded perspective view of part of the apparatus of Figures 1 and 2.

The apparatus to be described is for simultaneously inserting an individual electrical conductor into a slot in an individual one of a plurality of terminals of an electrical connector of the type described in Patent Application No. 11852/74 (Serial No. 1463829). As described in that application each connector comprises a housing of electrically

insulating material having a plurality of cavities extending therethrough, each cavity containing a terminal formed to provide a conductor-receiving slot accessible from outside the housing. To connect an insulated conductor to a terminal of the connector the conductor is urged into the terminal slot such that the walls of the slot penetrate the insulation of the conductor and establish electrical connection to the conductive core of the conductor, and the apparatus of the invention serves this purpose for a plurality of conductors simultaneously.

The apparatus of the invention comprises a base 1 which is secured by fasteners 2 over and in a hole 3 in a base board 4, and an insertion tool 5 is removably mountable on the base 1 as will be described.

The base 1 carries locating means comprising a first, fixed, conductor-aligning comb 6, and a second, movable conductor-aligning comb 7. The comb 7 is carried by two arms 8 which are pivotally connected by pins 9 to two arms 10 of the base 1, whereby the comb 7 is movable between an open position (as shown in Figures 1 and 3) and a closed position (as shown in Figures 2 and 4). The comb 7 can be latched in either of its positions by means of manually operable spring-loaded latch arms 11 which are biased by means of compression springs 12 (Figure 3) to engage complementary surfaces of the base 1.

The pins 9 are received in bosses 13 on the arms 8 and the inwardly facing ends of the pin-receiving holes 14 in the bosses 13 receive lugs 15 on a printed circuit board 16 (as shown in Figure 5), the lugs 15 being introduced into the holes 14 by way of slots 17 in the bosses 13 extending normally to the arms 8. Thus, the printed circuit board 16 can be mounted on the bosses 13 such that it can pivot relative to the base 1 independently of the movement of the arms 8, and thus the comb 7.

An edge connector 18 is mounted on the bottom (as shown in Figures 1 to 4) edge of the printed circuit board 16, and serves to connect conductors on the board 16 to leads 19 which lead to test equipment (not shown).

Mounted on the base 1 beneath the comb 6 is a rectangular cross-section bar 20 on which the comb 6 is mounted. Also mounted on the bar 20 are a spacer bar 21 and shear bar 22, the bars 21 and 22 being mounted on the bar 20 by means of set screws 23 (Figure 4) which permit the bars 21 and 22 to be accurately positioned relative to the bar 20 in the direction towards and away from their printed board 16 as seen in Figure 4.

The insertion tool 5 comprises a housing 24 having a pair of depending legs 26

arranged to be received in channels 27 in side members 28 of the base 1. The free ends of the legs 26 are formed with hooks 29 which engage under complementary surfaces of the base 1, and with holes 30 in which are received spring biased pins 31 thereby to secure the insertion tool 5 to the base 1 in the position shown in Figure 2 and 4. The housing 24 contains an insertion blade 32 which is slidable relative to the housing 24 by means of a cam 33 mounted on the housing 24 and a cam follower 34 mounted on the blade 32. The cam 33 has a manually operable handle 35 connected thereto whereby the cam 33 can be rotated relative to the housing 24 thereby to urge the blade 32 downwards (as seen in Figure 4) relative to the housing 24. The blade 32 carries at its free end an insertion member 36 having a plurality of pairs of insertion fingers 37, each pair being aligned with an individual slot in each of the combs 6 and 7 when the insertion tool 5 is mounted on the base 1 as described. The blade 32 is normally biased upwardly (as seen in Figure 4) by a spring (not shown) and is moved downwardly as described against the action of the spring by the handle 35. The right-hand (as seen in Figure 4) leading edge 38 of the blade 32 serves as a shearing edge and co-operates with the shear bar 22 as will be described.

For use of the above described apparatus the base 1 is mounted on the board 4 by means of the fasteners 2 as shown.

The insertion tool 5 is then mounted on the base 1 as described, the blade 32 being held in its upper position as shown in Figure 4 by the spring (not shown).

The latch arms 11 are then released and the arms 8 and comb 7 swung to their open condition as shown in Figures 1 and 3.

The printed circuit board 16 can now be pivoted about its lugs 15 relative to the arms 8 to the position shown in Figure 3.

A connector 100 as described above is then mated with the printed circuit board 16 by being mounted on the upper (as seen in the drawings) edge of the printed circuit board 16 with the terminals of the connector 100 connected to the conductors on the board 16, and thus to the test apparatus (not shown) by way of the connector 18 and the leads 19.

The printed circuit board 16 is then pivoted to the position shown in Figure 4 and the arms 8 then swung into the position shown in this Figure and latched in that position by the arms 11.

The connector 100 is now accurately positioned and held between the comb 7 and the spacer bar 21, with the slots in the terminals of the connector 100 each individually aligned with a slot of the comb 6 and a slot of the comb 7.

Insulated conductors 101 are then positioned each through aligned slots in the combs 6 and 7 as shown in Figure 2, each conductor 101 thus being positioned over the slot in an individual terminal of the connector 100.

The handle 35 is then operated to urge the blade 32 downwards (as seen in Figure 4) whereby the fingers 37 of the insertion member 36 urge the conductors 101 into the slots in the terminals of the connector 100 and thus electrically connect the conductors 101 to the terminals as described above. During this action the edge 38 of the blade 32 co-operates with the shear bar 22 to cut all of the conductors 101 such that the newly formed free ends of the conductors are finally positioned in the connector 100. The cut-off portions of the conductors 101, shown in Figure 4, can be discarded as scrap.

After the insertion operation is completed the handle 35 is released, and moves together with the blade 32 to the position shown in Figure 4.

The test apparatus (not shown) can then be used to test the electrical continuity of the circuits formed from the conductors 101, through the connector 100, the printed circuit board 16, the connector 18, and the leads 19.

After such testing the latch arms 11 are released and the arms 8 and board 16 pivoted to the positions shown in Figure 3. The connector 100 with the conductors 101 can then be removed from the apparatus for further handling in dependence upon the results of the testing, and a new connector 100 mounted on the board 16 for a further cycle of operation of the apparatus.

By releasing the latch arms 11 when in the position shown in Figure 3 and pivoting the arms 8 anticlockwise (as seen in Figure 3) to the position shown in Figure 5, the printed circuit board 16 can be removed from the apparatus by moving the lugs 15 on the board 16 through the slots 17 in the bosses 13 on the arms 8. The printed circuit board 16 can thus be replaced by a similar board.

Otherwise the board 16 can be replaced by a board having a different arrangement of conductors whereby the apparatus can be used with a different connector 100; such use may require the replacement of the combs 6 and 7 and the insertion member 36 of the insertion tool 5 by appropriate different members.

The above described apparatus can be used together with a plurality of other similar apparatus for the manufacture of wiring harness as found in automobiles and domestic equipment. For such use all the apparatus can be mounted on a common board 4 in appropriate positions, and the



conductors 101 then laced in the required configuration through connectors 100 mounted on the apparatus. The conductors 101 can then be connected to the connectors 100 as described above, and the harness comprising the connectors 100 and the conductors 101 removed from the board 4.

WHAT WE CLAIM IS:—

1. Apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals, the apparatus comprising a base having mounting means to mount the connector thereon; conductor locating means arranged to receive and locate the conductors relative to a connector mounted on the mounting means for insertion into the slots in the terminals of the connector; and an insertion tool which is removably mountable on the base and which has an insertion blade which, with the tool mounted on the base, is movable relative to the base to urge the conductors located by the locating means into the slots in the terminals of the connector mounted on the mounting means, wherein the mounting means is constituted by means adapted to mate with the connector.

2. Apparatus as claimed in Claim 1, wherein the mounting means includes electrical conductors which, when the connector is mated with the mounting means, are electrically connected to the terminals of the connector.

3. Apparatus as claimed in Claim 2, including test means connected to the conductors of the mounting means whereby the electrical connections between the electrical conductors and the terminals, established by the apparatus, can be tested immediately they are established.

4. Apparatus as claimed in Claim 2 or Claim 3, wherein the mounting means comprises a printed circuit board conductors on which constitute the electrical conductors of the mounting means.

5. Apparatus as claimed in any preceding claim, wherein the mounting means is readily removable from the base whereby one mounting means can be removed and replaced by a further mounting means adapted to mate with a different connector.

6. Apparatus as claimed in any preceding

claim, wherein the locating means comprises two combs carried by the base.

7. Apparatus as claimed in Claim 6, wherein one of the combs is mounted for pivotal movement relative to the base to facilitate insertion and removal of a connector into and from the apparatus.

8. Apparatus as claimed in Claim 7, wherein the mounting means is mounted for pivotal movement relative to the base to facilitate mounting of a connector thereon.

9. Apparatus as claimed in any preceding claim, wherein the insertion tool comprises a housing containing the insertion blade, the housing having a pair of depending legs which are received in channels in the base to position the insertion tool relative to the base.

10. Apparatus as claimed in Claim 9, wherein the channels contain spring-biased pins which are received in holes in the legs of the housing of the insertion tool to lock the insertion tool to the base.

11. Apparatus as claimed in Claim 9 or Claim 10, wherein the insertion blade carries a cam follower which co-operates with a cam carried by the housing such that rotation of the cam by means of a handle connected thereto, relative to the housing, causes the insertion blade to move relative to the housing.

12. Apparatus as claimed in Claim 9, Claim 10 or Claim 11, in which the insertion blade provides a shear edge which, during use of the apparatus, co-operates with a shear bar carried by the base, to cut the conductors being connected to the connector such that the newly formed free ends of the conductors are positioned within the connector.

13. Apparatus as claimed in any preceding claim, wherein the base carries a spacer bar which is movable and lockable relative to the base and which serves accurately to position a connector mounted on the mounting means relative to the insertion tool.

14. Apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals, substantially as hereinbefore described with reference to the drawings.

For the Applicants:
R. G. STUART-PRINCE,
Chartered Patent Agent.



conductors 101 then laced in the required configuration through connectors 100 mounted on the apparatus. The conductors 101 can then be connected to the connectors 100 as described above, and the harness comprising the connectors 100 and the conductors 101 removed from the board 4.

WHAT WE CLAIM IS:—

1. Apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals, the apparatus comprising a base having mounting means to mount the connector thereon; conductor locating means arranged to receive and locate the conductors relative to a connector mounted on the mounting means for insertion into the slots in the terminals of the connector; and an insertion tool which is removably mountable on the base and which has an insertion blade which, with the tool mounted on the base, is movable relative to the base to urge the conductors located by the locating means into the slots in the terminals of the connector mounted on the mounting means, wherein the mounting means is constituted by means adapted to mate with the connector.

2. Apparatus as claimed in Claim 1, wherein the mounting means includes electrical conductors which, when the connector is mated with the mounting means, are electrically connected to the terminals of the connector.

3. Apparatus as claimed in Claim 2, including test means connected to the conductors of the mounting means whereby the electrical connections between the electrical conductors and the terminals, established by the apparatus, can be tested immediately they are established.

4. Apparatus as claimed in Claim 2 or Claim 3, wherein the mounting means comprises a printed circuit board conductors on which constitute the electrical conductors of the mounting means.

5. Apparatus as claimed in any preceding claim, wherein the mounting means is readily removable from the base whereby one mounting means can be removed and replaced by a further mounting means adapted to mate with a different connector.

6. Apparatus as claimed in any preceding

claim, wherein the locating means comprises two combs carried by the base.

7. Apparatus as claimed in Claim 6, wherein one of the combs is mounted for pivotal movement relative to the base to facilitate insertion and removal of a connector into and from the apparatus.

8. Apparatus as claimed in Claim 7, wherein the mounting means is mounted for pivotal movement relative to the base to facilitate mounting of a connector thereon.

9. Apparatus as claimed in any preceding claim, wherein the insertion tool comprises a housing containing the insertion blade, the housing having a pair of depending legs which are received in channels in the base to position the insertion tool relative to the base.

10. Apparatus as claimed in Claim 9, wherein the channels contain spring-biased pins which are received in holes in the legs of the housing of the insertion tool to lock the insertion tool to the base.

11. Apparatus as claimed in Claim 9 or Claim 10, wherein the insertion blade carries a cam follower which co-operates with a cam carried by the housing such that rotation of the cam by means of a handle connected thereto, relative to the housing, causes the insertion blade to move relative to the housing.

12. Apparatus as claimed in Claim 9, Claim 10 or Claim 11, in which the insertion blade provides a shear edge which, during use of the apparatus, co-operates with a shear bar carried by the base, to cut the conductors being connected to the connector such that the newly formed free ends of the conductors are positioned within the connector.

13. Apparatus as claimed in any preceding claim, wherein the base carries a spacer bar which is movable and lockable relative to the base and which serves accurately to position a connector mounted on the mounting means relative to the insertion tool.

14. Apparatus for the simultaneous insertion of a plurality of electrical conductors into slots in individual terminals of an electrical connector thereby electrically to connect the conductors to the terminals, substantially as hereinbefore described with reference to the drawings.

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