PROTECTION OF ELECTRICAL CONNECTOR CONTACT FINS

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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The present invention relates generally to electrical connectors and more particularly to protecting contact pins in electrical connectors. In the past, contact pins have often been sufficiently bent or splayed out of alignment so as to prevent proper engagement with pin receiving sockets in mating connector components. This problem of improperly mated connectors is of growing concern in the electronic industry, since a bent or splayed contact pin may readily cause the failure or decrease the reliability of an entire electronic system.

Normally, contact pins in electrical connector plugs or receptacles are mounted in an insulating insert in such a manner that a considerable length of each contact pin extends beyond the insert so as to facilitate mating with suitable pin receiving sockets in another connector portion. This "free length" of the pin is relatively unprotected, thus leaving it vulnerable to damage by being bent during connector fabrication, handling, storage and while the connector is being readied for connection to test equipment. Bent pins are generally caused by careless handling of the connectors and improper mating procedures and are more commonly found on connectors with glass seals or rigid inserts. When a connector pin becomes bent, such as shown in the accompanying drawings, it is no longer parallel to the major axis of the connector because of a bend in the pin somewhere between the engaging end of the pin and the solder cup end. The non-parallelism is so great that some part of the exposed or "free-length" of the pin is not within the positional tolerance specified by the connector manufacturer. Moreover, part of the exposed length of the pin is usually parallel to the major axis of the connector while the remaining part of the pin is non-parallel.

The exposed length of the pin, when not held in its correct position, also facilitates the occurrence of another undesirable pin orientation during connector fabrication or processing. This problem is referred to as "pin-splaying" which is a straight pin that is not parallel to the major axis of the connector such as shown in the accompanying drawings. The splayed pin is not normally bent and has essentially the same extent of non-parallelism as the bent pin. Splayed pins are common to connectors with resilient inserts (e.g., rubber of about 75-80 durometer hardness) and are caused by improper connector processing methods, i.e., when lead wires are wrapped or attached to solder cups on the pins, or while cable assemblies are being molded or potted to the connector. Cable assemblies with sharp bends next to the connector and those which require high temperature or pressure molding processes are especially vulnerable.

Normally, bent and splayed pins occur in connectors using 20 gauge (.040 inch) pins or less, though connectors using 16 gauge pins such as 16 gauge (.062 inch) are also susceptible. Bent and splayed pins usually do not allow with the pin receiving sockets in the mating connector portion, thus causing the pins to not only damage the insert in the mating connector by piercing and rupturing the insert as illustrated in the drawings, but oftentimes prevent the establishment of an electrical path through the connector. In fact, it is possible that a connector may be mated without apparent difficulty only to later find that a system failed due to a pin piercing the insert and missing its engagement with its mating socket. In some instances a bent or splayed pin may be so far out of alignment that as it pierces the insert, it contacts an adjoining socket in the insert.

It is, therefore, a principal object of the present invention to provide protecting and fixture means for maintaining proper alignment of connector contact pins from the connector origin through subsequent handling, storage and processing to ultimate connector use.

Another object of the present invention is to provide a rigid, non-conducting insert which is adapted to engage and support essentially the full exposed length of electrical connector contact pins and thereby prevent bending and splaying thereof.

A further object of the present invention is to provide means for holding connector contact pins in position during connector processing, i.e., when wires of cable assemblies are being attached to contact pin solder cups and subsequently wrapped, and/or while cable assemblies are being molded or potted to the connector.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiments about to be described, or will be indicated in the appended claim, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

Preferred embodiments of the invention have been chosen for purposes of illustration and description. The preferred embodiments illustrated are not intended to be exhaustive nor to limit the invention to the precise forms disclosed. They are chosen and described in order to best explain the principles of the invention and their application in practical use to thereby enable others skilled in the art to best utilize the invention in various embodiments and modifications as are best adapted to the particular use contemplated.

In the accompanying drawings:

FIG. 1 shows a conventional electrical connector component with bent and splayed contact pins;

FIG. 2 shows another conventional electrical connector component illustrating the improper coupling and insert damage caused by bent or splayed contact pins of a mating connector component;

FIG. 3 shows one embodiment of a contact pin protector of the present invention adapted to protect contact pins in a plug portion of an electrical connector;

FIG. 4 is a sectional view showing the embodiment of FIG. 3 prior to mating with a plug portion of an electrical connector;

FIG. 5 is a sectional view similar to FIG. 4 but showing the contact pin protector of the present invention in its proper mating position with wrapped lead wires of a cable assembly soldered to the contact pin and shown encapsulated or potted cable assembly;

FIG. 6 shows another embodiment of a contact pin protector of the present invention for use with an electrical connector receptacle;

FIG. 7 is a section view showing the embodiment of FIG. 7 being mated to an electrical connector receptacle.

In FIG. 1 of the drawings there is shown a conventional electrical connector in which some of the contact pins mounted in caniavier fashion therein have been forced out of their desired alignment to thereby prevent proper reception in their respective mating sockets in a mating connector component. For example, the contact pins indicated by numeral 10 have been bent out of alignment by careless handling or improper mating procedures while the contact pins indicated by numeral 11 have been splayed during the connector processing.

When coupling an electrical connector portion con-
containing bent or splayed contact pins to a contact pin receiving connector portion such as shown in FIG. 2, the misaligned contact pins may engage the insulating insert adjacent the pin receiving sockets and thereby damage the insert. The damage to the insert may result in the piercing or rupturing thereof as indicated by numerals 12 and 13 respectively, so as to prevent the proper mating of the contact pins with the sockets, which may in some instances result in preventing the connector from performing its intended function.

Thus, as briefly mentioned above, the present invention contemplates providing pin-bearing connector receptacles and plugs with pin protecting and fixture caps capable of being secured to the connector in such a manner that essentially the full "free-length" of each individual pin is rigidly held in its proper position by an insert portion of the cap until such time the connectors are to be tested or attached to a mating connector portion.

Described more particularly and with reference to FIGS. 3 to 8 of the drawings, one embodiment of the present invention comprises an electrical plug connector protective cap and fixture generally indicated at 16 in FIG. 3 adapted for use with connectors having bayonet-type locks. The cap 16 may be made of any suitable rigid nonconducting material, such as, for example, di- allyl phthalate plastic or neoprene rubber, which may be molded or otherwise formed into the desired shape. The cap shown comprises a generally disk-shaped portion 17 of a diameter greater than the connector body to which the cap is to be attached and a pair of coaxially arranged body portions 18 and 19 extending from a central portion of the cap 16 therewith. The disk-shaped portion 17 is shown provided with lugs 20 spaced about its circumference for enabling the cap 16 to be readily mated to a connector plug. The body portion 18 is preferably solid and includes therein a plurality of openings or sockets 21 each to receive a contact pin 22 of a mating plug connector (FIG. 4). These sockets 21 may be provided in any suitable manner such as by molding or drilling and are preferably held within tolerances which enable a good interfit with the pins 22 without excessive play therebetweent. For example, desirable socket dimensions for a 20 gauge pin (.040 inch) would be about .060 inch in diameter and of a length slightly greater than the exposed length of the pin 22. Locations of the sockets 21 are preferably held to about .005 positional tolerances on the diameter and, of course, are dependent upon the location and size of the pins in the plug connector, thus necessitating the use of a particular protective cap for a particular array and size of pins.

The plug connector may be of any suitable known construction, for example, a bayonet-type lock connector. The plug connector shown in FIGS. 4-6 may comprise an annular metal shell 24 with resilient, or sometimes rigid, insulating insert 25 affixed therein. The insert 25 is disposed in such a location within the shell 24 that a contact pin 22 or a plurality of such pins extending through the insert have a considerable unsupported length (about 0.250 inch for both the 16 and 20 gauge pins) and yet are still confined within the shell. The ends of the pins extending through the insert 25 in the opposite direction may be provided with conventional solder cups 26 for facilitating the attachment of lead wires 27 (FIG. 5) by soldering or the like. A rotatable sleeve 29 having sloping grooves 30 in the inner surface thereof may be provided about the connector portion 24 and sockets 21 in the fixture 16 to move the connector pins relative to the sockets for receiving the sleeve grooves 30. This body portion 19 is radially spaced from the central body portion 18 for providing an annular groove 33 therebetweent for receiving a leading portion of the shell 24. In order to assure that the sockets 21 and the pins 22 are correctly aligned prior to attaching the cap 16 to the connector, the body portion 19 may be of a length slightly greater than the central portion 18 and be provided in the inner surface thereof with a number of axially extending keyways or slots 35 (FIG. 3) for receiving a corresponding arrangement of keys or projections 36 on the outer surface of the connector shell 24. Thus, by mating the keys with the keyways, the sockets 21 in cap 16 are properly oriented with the pins 22 prior to their engagement. When the cap 16 is positioned and locked in place by the sleeve 29 (FIG. 4), the leading edge of the body portion 18 very closely approaches the face of the insert 25 and facilitates the encircling and support of essentially the entire exposed length of each pin 22. The insert 25, particularly when it is of the resilient type, may be provided with a ring-like ridge 31 about the circumference of its face to provide a sealing arrangement with the leading edge of the body portion 18 for preventing foreign matter from reaching the contact pins. Also, to enhance this sealing arrangement, a washer 28 of a suitable material such as silicone or the like may be disposed in the annular groove 33 and be engaged by the leading edge of the shell 24. Proceeding to fabricate the connector by attaching lead wires of a cable assembly to the pins, wrapping them, and subsequently potting the cable assembly thereto, may be readily attained in connectors having resilient inserts and with elimination of the heretofore known problem of pin spacing by initially positioning and locking a suitable protective cap and fixture in place over the "free-length" of the pins 22. The wires 27 may then be soldered to the pin soldering cups in a prescribed manner and thereafter wrapped by suitable binding material 34 into a cable bundle of desirable dimensions (FIG. 5). As the wires are being wrapped, the insert 25 prevents the wires from spaying as the wrapping material 34 bears on the wires is alleviated by the protective cap 16. With the protective cap and fixture 16 still in position, a suitable mold or boot (not shown) may be placed about the cable assembly and a portion of the connector so that a suitable potting material 37 may be molded or otherwise placed about the cable assembly and the connector to hold the cable assembly in a desired orientation with respect to the connector (FIG. 6). With the cap 16 in place, normal shrinkage of the potting material 37 can not spay the pins from their intended positions. A particular advantage of the method and the wires are held in place so that removal of the protective cap will essentially eliminate pin spaying; however, the protective cap is not normally removed at this time, but remains attached to the connector until such time the connector is to be used; e.g., prior to testing or mating with another connector portion.

FIG. 7 shows another embodiment of the present invention particularly adapted for use with a contact pin containing connector receptacle. This embodiment, like the protective cap and fixture 16 of FIGS. 3 to 6, is shown provided with a bayonet-type lock for attachment to a connector portion having such a locking arrangement.

The protective cap and fixture generally indicated at 38 (FIGS. 7 and 8) comprises an insulating body 39 of a material similar to that of cap 16 and includes a plurality of pin receiving openings or sockets 40 extending axially thereinto to a depth slightly greater than the exposed pin receiving openings or sockets 40 extending axially thereinto to a depth slightly greater than the exposed or unsupported length of contact pins. A plurality of axially extending grooves in the insulating body 39 may be provided about the outer surface thereof. A recess 45 axially spaced from the flange. A rotatable connector locking sleeve 46 having sloping projection receiving grooves 47 on the inner surface thereof and an expensively disposed lip 48 on one end thereof is adapted to encircle the insulating body 39 and abut against the insulating body flange 44. With the sleeve 46 in
position over the body 39 a suitable locking ring 50 may be placed in the recess 45 to hold the sleeve 46 in place. While the sleeve 46 is preferably made of metal to ensure a positive connection with the connector receptacle it will appear clear that it may be made of any suitable material such as plastic, hard rubber or the like.

The receptacle connector portion 43, which is adapted to receive the protective cap and fixture 38 as shown in FIG. 1, may comprise a metal sleeve 46 provided with a rigid or resilient contact pin bearing insert 52 therein and a plurality of projections 53 on the outer surface thereof adapted to be received in the sloping grooves 47 of the sleeve 46 for locking the cap to the connector. Insert 52, like the insert in the plug connector of FIGS. 4-6, holds the pins 42 in such a manner that a considerable length of the pins remains unsupported. Thus, the insulated body 39 is adapted to fit into the connector shell 51 until it nearly abuts against the leading face of the insert 52 so as to receive essentially the entire unsupported length of each contact pin. In order to assure that a secure coupling is maintained between the cap 38 and the connector portion 43, a suitable spring 57 such as a wave spring or the like may be disposed between the flange 44 and the lip 49. This spring maintains the coupling by forcing the projections 53 into suitable notches (not shown) in the walls of the recesses 47.

To assure that the sockets in the protecting cap 38 are properly seated and formed to receive a plurality of axially extending projections or keys 54 may be placed about the surface of the insulating body 39 for reception in suitable keyways or slots 55 in the inner surface of the connector shell 51. To align the keys and keyways prior to the pin engagement with the sockets, the leading edge of the insulating body 39 may be provided with a small ring-like portion or rim 56 which is integral with the insulating body and which extends beyond the ends of the keys 54 so that the body 39 may be easily rotated until the keys and keyways match. A suitable sealing arrangement between the cap and the insert may be attained by providing the face of the insert with a ring-like ridge 58 so that as the cap contacts with the insert it slightly deforms the ring and provides the seal. The insert may also be provided with a small peripheral recess 59 in its face about the ridge 58 to receive the cap rim 56. This recess 59 may be provided with a deformable seal made from such as silicone or the like to enhance the aforementioned seal between the cap and the insert.

The protective cap and fixture 38 may be used in connector processing and fabrication in a manner similar to the protective cap and fixture 16. Also the dimensional tolerances of the sockets 49 are similar to sockets 21 of cap 16 for similarly sized contact pins. While the keys 54 and the keys 36 of the embodiment of FIGS. 4-6 are shown extending a substantial length of the insulating body 39 and the body portion 19 respectively, it will appear clear that keys or projections of any suitable length may be used.

Both protecting cap 16 and cap 38 may be provided with projections or other means on the outer surfaces thereof for facilitating the alignment of the cap sockets with the connector pins and for aiding in connector processing, the connector cable assembly, etc. For example, cap 16 may be provided with a projection 61 on the disk-shaped portion 17 that is in alignment with the largest keyway, while cap 38 may be provided with a small projection 62 on the back of the body portion 39 that is in alignment with the largest key. The caps 16 and 38 are preferably constructed with such dimensions that a key is interposed between the opposite insides of the caps and the walls of the pin bearing connector. While the protective caps and fixtures are shown as being used with connectors having a bayonet-type locking arrangement, it will appear clear that the protective cap and fixture of the present invention may be used with any pin bearing connector configuration regardless of locking features. Furthermore, the present invention is adaptable for use with electrical connectors of other shapes such as square, rectangular, etc.

It will be seen that the present invention provides a relatively simple and inexpensive solution to the splayed and bent connector pin problems that have herebefore been of great concern because of their frequent appearance. The protective caps engage and position the contact pins with respect to the mating portions as will be engaged by a mating connector, i.e., the caps employ cooperating projections and grooves that are the same as will be used on mating connectors to retain connector halves together. Also, the present invention provides an end cap feature for preventing foreign matter from entering the connectors, which is particularly advantageous for field use. The pin protecting caps are readily re-useable and conveniently serve as gauges for determining if the connector portions are mateable prior to their assembly.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

We claim:

A device for detecting inaccurately positioned pins and protecting accurately positioned pins of an electrical connector, comprising an end cap member having a main body formed of a single piece of rigid plastic material with a perforate end and an imperforate end, said perforate end having a planar face and defined by a plurality of mutually parallel sockets penetrating said face and terminating at a localised said ends, each of said sockets being of uniform diameter from said face throughout essentially the entire socket length and the diameters corresponding closely to the diameters of said pins for the walls of plastic material defining said sockets to closely envelop said pins throughout substantially their entire exposed lengths, and said body having an annular laterally outwardly projecting flange integral with said body and disposed intermediate said ends thereof, connecting means to secure said device to a said connector including a portion relatively rotatable with respect to said body and including means overlapping said flange to limit axial movement of said part to providing another portion laterally spaced from said body defining a groove therebetween for housing an annular part of a said connector, guide means aligning said pins with said sockets comprising a plurality of keys of said plastic material each integral with and projecting from an outer surface of said body with an end of each key terminating in a plane substantially common with said planar face with each key to mate with a complementary keyway in the annular part of a said connector, one of said keys being of larger cross-sectional dimension than the others of said keys for mating with a keyway of corresponding cross-sectional dimension to insure orientation of said sockets with said pins, an annular integral ridge extending about said planar face and axially projecting away from said flange terminating in a plane spaced from and overlying both said planar face and the ends of said keys and with said ridge having a diameter intermediate that of the annular part of a said connector and that of a dielectric insert housing said pins in a said connector wherein said ridge initially cooperates with said keys to facilitate alignment of the latter with said keyways and thereafter projects past a leading surface of the dielectric insert to engage a deformable sealing means disposed between the insert and the annular part of a said connector, and an indicator projection integral with and on said imperforate end aligned with said one key for indicating and facilitating alignment of said one key with said one keyway.

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