Sealing member for electrical connectors

The invention relates to a sealing member (100) for an electrical connector (1) that comprises a layer seal portion (110) for sealing a cable guiding passage (301) of the electrical connector (1), having a front side (111) and a rear side (112). The layer seal portion (110) comprises at least one channel (113) adapted to receive a single electrical cable (400), and further at least one tubular cable seal portion (120) aligned with said channel (113), for sealing the at least one channel (113) of the layer seal portion (110) against a received cable (400), wherein the tubular cable seal portion (120) protrudes from the rear side (112) of the layer seal portion (110).
Description

1. Field of the invention

[0001] The invention relates to sealing members for electrical connectors comprising a layer seal portion and at least one tubular cable seal portion that protrudes from the rear side of the layer seal portion.

2. Background

[0002] Sealing members for electrical connectors are known in the art and shall prevent the intrusion of moisture or other contaminants such as dust into the housing of an electrical connector. Therefore, sealing members known in the art are usually of a flat shape ("matte-seal") and are arranged within a cavity of the connector and have through-holes, though which the cables are inserted.

[0003] Electrical connectors known in the art comprise a connector housing that has a plurality of receptions for retaining electrical contacts. The electrical contacts are typically shaped as socket or as pin and are connected electrically with respective cables. In order to assemble the electrical connector, the cables and the thereto connected electrical contacts have to be inserted in the receptions of the electrical connector housing. Thereby, the electrical contacts and the cables have to be guided through the holes in the seal member of the electrical connector. If different cable diameters are used, different sealing through-hole diameters have to be provided in order to achieve suitable sealing properties.

[0004] Further, seals formed of a flat layer of silicon or any other suitable elastomeric material that provide through holes for the cables, often suffer severe deformation when the cables are inserted. This deformation leads to increased insertion forces of the cables, since those through holes that still have to be equipped with cables are diminished due to the expanding deformation of the already cable-equipped through holes. Further, the expanding deformation of the cable-equipped through-holes leads to a displacement of the through-holes that still have to be equipped. While the through-holes are superposed with the retainers of the connector housing in an unequipped state, the position of the through holes can shift during the insertion of the cables. Thus, to enable an automated insertion of the cables, a defined sequence of insertion has to be followed.

[0005] Still further, seals known in the art tend to be damaged during the insertion of the terminals, respectively the cables. During the insertion of a terminal and/or cable, a conventional seal is first pushed in axial direction of the cable, before the terminal/cable begins to penetrate the seal. This axial movement of the seal can result in a pinching of the seal material between the terminal and a wall the connector cavity. This pinching may lead to an irreversible deformation of the seal or to shearing out parts of the seal or to cutting the seal. Thus, the seal can be severely damaged. To avoid such damages of the seal, the insertion velocity has to be reduced, so that the axial deformation of the seal is reduced during the insertion of the cables/terminals.

[0006] As can be seen, there is a need in the art to provide a sealing member for electrical connectors that overcomes or reduces the drawbacks illustrated.

3. Summary of the invention

[0007] The object of the present invention is solved by providing a sealing member according to claim 1. In particular, the object is solved by providing a sealing member for an electrical connector comprising: a layer seal portion for sealing a cable guiding passage of the electrical connector, having a front side and a rear side, which layer seal portion comprises at least one channel extending from the front side to the rear side and being adapted to receive a single electrical cable, and at least one tubular cable seal portion (i.e. a portion with a tubular shape) aligned with that channel, for sealing the at least one channel of the layer seal portion against a received cable, wherein the tubular cable seal portion protrudes from the rear side of the layer seal portion. In other words: the layer seal portion is preferably a flat matte-type seal where the front side and rear side are substantially flat surfaces that are parallel to each other and the tubular cable seal portion has a cylindrical shape and protrudes perpendicular from the rear side respectively surface.

[0008] Providing a layer seal portion and at least one tubular cable seal portion is advantageous, since sealing against the cable guiding passage of the electrical connector and the sealing against a received cable can be assigned to different functional portions of the sealing member. Whereas the layer seal portion can be shaped flat and substantially thin, the at least one tubular cable seal portion protrudes from the rear side of the layer seal portion and can be shaped in order to achieve high contact pressure and therefore improved sealing properties with the inserted cable. A typical layer seal portion thickness is less than 5 mm, preferably less than 4 mm, even more preferably less than 3 mm and most preferably less than 2 mm.

[0009] Providing a protruding tubular cable seal portion is advantageous, since the radial deformation that occurs due to the insertion of cables will not occur in the layer seal portion, i.e. between the front and rear side thereof, but mostly in the tubular cable seal portion that protrudes from the rear side. Thus, the radial deformation of the cable seal portion is decoupled from the deformation of the layer seal portion. Therefore, the tubular cable seal portions and the channels remain superposed (aligned) with the receptions of the electrical connector. Further, since the deformation of the layer seal is reduced and/or avoided, the insertion force of the terminals/cables can be reduced significantly. Thus, no specific insertion sequence of the cables has to be followed.

[0010] Preferably, the at least one tubular cable seal
portion has a cylindrical shape and has an inner surface, whereby the largest inner diameter of the inner surface of the tubular seal portion is smaller than the smallest diameter of the corresponding channel of the layer seal portion. Providing a smaller diameter in the tubular cable seal portion than in the channel of the layer seal portion is advantageous, since the expansion of the channel of the layer seal portion during the insertion of a terminal cable is significantly reduced compared to the expansion of the tubular cable seal portion. The reduced expansion in the layer seal portion will lead to reduced deformation of the layer seal portion and therefore to reduced insertion forces. Further the displacement of the channels, as described above, can be reduced or even prevented. Still further, the contact pressure that is applied onto the cable can be adjusted by designing the inner diameter of the tubular cable seal portion. Thus, suitable contact pressure and sealing properties can be achieved.

[0011] Preferably, the at least one tubular cable seal portion can expand radially up to 300 % and preferably up to 500 % during the insertion of the cable. Providing elastic material such as silicon or other elastomeric materials is advantageous, since high expansion rates can be achieved. Therefore, a relatively small inner diameter of the tubular cable seal allows the insertion of a wide range of cable diameters, while still providing suitable sealing properties.

[0012] Preferably, the received cable is within the range of 0.08 - 0.35 mm2, preferably within the range of 0.05 - 0.52 mm2 and most preferably within the range of 0.03 - 0.82 mm2. Providing sealing properties for a wide range of cable diameters is advantageous, since the sealing can be used also in application where different cable diameters are used. For example, signal cables can have a significantly smaller diameter than power transmitting cables. With providing a seal for different cable diameters, the seal is suitable for various types of electrical connector applications.

[0013] Preferably, the channel of the layer seal portion is conically formed and tapers from the front side to the rear side of the layer seal portion and ends behind the rear side in the corresponding tubular cable seal portion. Providing a conically formed channel is advantageous, since the cables/terminals can be easily inserted. Further, the cables/terminals are guided towards the tubular seal portion and thus, a wider tolerance of the orientation of the cables before the insertion is allowable.

[0014] Further, by guiding the cables, the axial deformation of the sealing member can be reduced. Thus, it becomes unlikely that a portion of the sealing member is pinched between the cable/terminal and the housing member of the connector and thus, the risk of damaging the sealing member can significantly be reduced. Still further, a conically formed channel that ends behind the rear side in the tubular cable seal portion is advantageous, since the sealing of the tubular cable seal portion against the cable will take place behind the rear side of the layer seal portion, i.e. the sealing against the cable is separated from the layer seal portion. Therefore, the sealing and the expansion of the seal during the sealing is separated from the layer sealing portion and achieved by the tubular cable seal portion. Thus, also the displacement of the channels is significantly reduced and the insertion force can be reduced and remains essentially stable over the insertion of the several cables. Further, the reduced deformation in axial direction is directly linked to the reduced risk of damaging the seal and therefore increased insertion velocities can be used during the assembly of the connector.

[0015] Preferably, the inner surface of the tubular cable seal portion provides a cylindrically formed region, and this cylindrically formed region has preferably a ratio of diameter to length from at least 1:1, more preferably from at least 1:5, even more preferably from at least 1:10 and most preferably from at least 1:20, in the unexpanded state. Generally preferred, the tubular cable seal portion is essentially a hollow cylinder.

[0016] The cylindrically formed region is preferably the sealing region and therefore allows by adjusting the diameter and length to improve contact pressure and therefore the insertion force and sealing properties. Thus, a wide range of cable diameters can be used while still providing suitable sealing properties.

[0017] Preferably, the sealing member comprises a collar portion extending circumferential between the front and rear side of the layer, wherein the collar portion protrudes from the rear side of the layer seal portion perpendicular to the plane of the layer seal portion so that a front end of the collar portion protrudes beyond a front end of the tubular cable seal portion.

[0018] Providing a collar portion that protrudes beyond the front end of the tubular cable seal portion is advantageous, since a defined distance in axial cable direction between the front end of the tubular cable seal portion and a housing member of the electrical connector can be achieved. This distance is advantageous, since a pinching of the sealing member between the cable/terminal and a housing member of the connector can be avoided if the protrusion of the collar is designed larger than the maximum occurring axial deformation of the sealing member during the insertion of the cables. Thus, the risk of damaging the seal can be significantly reduced and thus higher insertion velocities become possible. Still further, the collar improves the sealing properties of the seal against the housing of the electrical connector and increases the stability.

[0019] Preferably, the collar provides at least one circumferential sealing lip. Providing sealing lips is advantageous, since the sealing properties of the sealing member against the connector housing can be further improved.

[0020] Preferably, the sealing member further comprises a rigid plastic frame that is arranged within the inner surface of the collar, wherein the rigid plastic frame preferably protrudes beyond a front end of the tubular cable seal portion. The plastic frame stabilizes the seal...
and thus allows an easier assembly of the seal in the connector. Further, the rigid plastic frame also stabilizes the collar and with protruding beyond the front end of the tubular cable seal portion, the distance between the connector housing and the front end of the cable seal can be securely achieved. This distance is advantageous, since the risk of damaging the seal is reduced and therefore higher insertion velocities can be achieved.

[0021] Still further, a stabilized seal further reduces the deformation of the sealing member and thus reduces the overall insertion forces. The rigid plastic frame can be designed as separate plastic part or can be integrally formed with a housing member of the connector. In this case, the sealing member is at least partly imposed on the plastic frame in order to assemble the sealing member and the rigid plastic frame. Providing a rigid plastic frame that is integrally formed with the housing of the connector is advantageous, since the parts of the connector assembly can be reduced and therefore the installation of the connector assembly is facilitated.

[0022] Preferably, the rigid plastic frame comprises a thermoplastic material. Even more preferably, the sealing member and the rigid plastic frame are integrally formed by multi-component molding. Providing a thermoplastic material is advantageous, since commonly known manufacturing techniques such as injection molding or extrusion can be used to manufacture the plastic frame. An integrally formed sealing member and rigid plastic frame formed by multi-component molding is particularly advantageous, since the assembly of rigid plastic frame and sealing member has not to be assembled in a separate assembling step, i.e. the assembled element is produced in one single manufacturing step. Further, by using multi-component molding, a strong and secure connection between the rigid plastic frame and the sealing member can be achieved that provides excellent sealing properties.

[0023] Preferably, the layer seal portion provides at least two channels, more preferably eight channels and even more preferably at least 64 channels. However, any other number of channels can be provided, as a connector requires. Since the deformation of the improved sealing member is reduced, a plurality of cables can be sealed without exceeding the allowable number of cables. Thus, a high number of cables can be sealed with the improved sealing member. This is advantageous, since the number of cables used in electrical or electronic product continuously increases, with the complexity of those products. Thus there is a need in the art to provide connectors and in particular sealed connectors with increased numbers of electrical contacts and therefore an increased number of cables that have to be sealed.

[0024] Preferably, the minimum distance between the centers of the channels of the layer seal portion is at most 3 mm, preferably at most 2 mm, even more preferably 1.8 mm and most preferably at most 1 mm. Since the radial expansion of the cable sealing occurs in the protruding tubular cable seal, and not in the layer seal, the channels of the layer seal can be arranged in close proximity to each other. The smaller the distance is, the more cables can be provided on a smaller area and thus, the connectors can be designed smaller. Therefore, the sealing member is suitable for connectors with reduced available space.

[0025] Preferably, the protruding tubular seal portion has an essentially cylindrical shape. A cylindrical shape is advantageous, since it is easy to manufacture and provides an even contact pressure around the circumferential surface. Thus, the typically round cables can be sealed beneficially.

[0026] The objects of the invention are further solved by an electrical connector assembly comprising a housing member, having a cable guiding passage for guiding at least one cable, and a sealing member as described above, wherein the sealing member is preferably provided in the cable guiding passage of the electrical connector or even more preferably imposed on the housing member of the connector. Providing the sealing member in the cable guiding passage is advantageous, if the connectors are used in a rough environment. Thus, the sealing member can be protected by the surrounding connector housing. Imposing the sealing member on the connector housing is advantageous if there is a reduced space in the cable guiding passage, thus the sealing member can be provided behind the cable guiding passage. Therefore, also connectors with reduced available space can be sealed.

[0027] Preferably, the sealing member is molded onto the housing member, wherein the housing member and the sealing member are preferably integrally formed by multi-component molding. Molding the sealing directly onto the housing member is advantageous, since direct multi-component molding leads to a secure and sealed connection. Further, the assembly of the sealing member is significantly facilitated. Still further, the connector housing can be made of any suitable material such as plastics or metals. Using multi-component molding is advantageous, since several plastic materials and silicon or elastomeric materials can be combined in one manufacturing step. Thus, a secure and sealed connection between the housing and the sealing member can be achieved. Still further, the assembly of the sealing member is facilitated.

4. Description of the figures

[0028] In the following, the invention is described in relation to certain example embodiments shown in the figures, wherein:

Fig. 1 shows a front view of the sealing member,
Fig. 2 shows a rigid plastic frame,
Fig. 3 shows a partially cut view of the sealing member assembled with the rigid plastic frame in a rear view,
Fig. 4 shows a partially cut view of the sealing member of Figure 3 in a front view.

Fig. 5 shows a detail of an electrical connector assembly comprising a sealing member, and

Fig. 6 shows a cut view of the electrical connector assembly.

[0029] Figure 1 shows an example embodiment of an inventive sealing member 100. The sealing member 100 has a layer seal portion 110 and eight tubular cable seal portions (not visible in Fig. 1). The layer seal portion 110 is of the matte-seal type and has a front side respectively surface 111 and a parallel rear side respectively surface 112 and comprises eight channels 113 that are arranged in two rows of four channels 113. Further, the sealing member 100 comprises a collar portion 140 extending circumferential between the front 111 and rear side 112 of the layer seal portion 110. The collar portion 140 also protrudes from the rear side 112 of the layer seal portion 110 into the layer sealing plane 115. The collar portion provides two sealing lips 141 and 142 that improve the sealing properties of the sealing member against a cable guiding cavity of a housing member of an electrical connector.

[0030] Figure 2 shows an example embodiment of a rigid plastic frame 200 that is formed e.g. by injection molding. The rigid plastic frame has a circumferential surface 220 and a front end 210. As can be seen in Figure 3, the rigid plastic frame 200 can be arranged within the inner surface of the collar 140 of the sealing member 100. The front end 143 of the collar portion 140 protrudes beyond a front end 122 of tubular cable seal portions 120. Further, also the front end 210 of the rigid plastic frame 200 protrudes beyond a front end 122 of the tubular cable seal portion 120. This is advantageous, since a defined distance between the front end 122 of the tubular cable seal portion 120 and the connector housing can be achieved and thus, the risk of damaging the sealing member during the insertion of cables can be significantly reduced. Further, the collar portion 140 is arranged circumferential on the layer seal portion 110 and protrudes from the rear side 112 of the layer seal portion 110 perpendicular to the plane of the layer seal portion 110.

[0031] As one can take from Figures 3 and 4, each of the eight channels 113 is aligned with one tubular cable seal portion 120 that protrude from the rear side 112 of the layer seal portion 110. The tubular cable seal portions 120 have the form of a hollow cylinder. The channels 113 are conically formed and taper from the front side 111 to rear side 112 of the layer seal portion 110. As shown, the conically formed channels end behind the rear side 112 in the corresponding tubular cable seal portion 120. Thus, tubular cable seal portions 120 provide cylindrically formed regions 121 that are aligned with the respective channels 113. The cylindrically formed regions 121 serve as sealing surface for an inserted cable. Thus, the expansion of the tubular cable seal portion 120 that occurs due to insertion of a cable mainly takes place in the tubular cable seal portion 120 and outside of the layer seal portion.

[0032] Figure 4 shows a front view of the sealing member shown in Figure 3. The collared channels 113 of the layer seal portion 110 extend from the front side 111 in direction of the rear side 112 and ends beyond the rear side 112 in the tubular cable seal portion 120. The cylindrical region of a tubular cable seal portion is aligned with said channel 113.

[0033] Figure 5 shows a detail cut view of the sealing member 100 with a rigid plastic frame 200 that is arranged in a cable guiding passage 301 of an electrical connector 300. Further, cables 400, 401 are inserted in the channels 113 of the sealing member 100. The sealing against the housing of the electrical connector 300 is mainly achieved by the sealing lips 141, 142 of the collar portion 140 of the sealing member 100. The sealing against the cables 400, 401 is achieved by the tubular cable seal portions 120.

[0034] The sealing of the cables occurs mainly in the cable sealing plane 125. The sealing is achieved by expanding the circular region 121 of the tubular cable seal portion 120 in the direction of expansion 126. The restoring force of the sealing material creates a contact pressure against the cable and therefore the sealing properties are achieved. The sealing against the connector housing is achieved in the layer sealing plane 115 by the compression of sealing lip 141. Since the front end 143 of the collar 140 and the front end 210 of the frame 200 extend beyond the front ends 122 of the tubular cable seals, a defined distance to the inner walls of the connector housing 300 is achieved. This distance is advantageous, since the risk of damaging the sealing member is significantly reduced.

[0035] Figure 6 shows an electrical connector assembly 1 with an installed sealing member 100 and a rigid plastic frame 200 that are installed in the cable guiding channel 301 of the housing member 300 of the electrical connector assembly 1. The cables 400, 401 that are inserted in the connector assembly are electrically connected to terminals 500, 501. As can be seen, the terminals 500, 501 have a greater diameter than the cables 400, 401. Thus, to achieve sealing properties in the sealing member, the channels and the tubular cable seal portion have to be expandable so that the terminals can pass the sealing. After the terminals 500, 501 have passed, the expansion of the inner diameter has to go back to a smaller level, so that sealing of the cable is achieved.

List of reference signs

[0036] 1: Electrical connector assembly
      100: Sealing member
      110: Layer seal portion
      111: Front side of the layer seal portion
112: Rear side of the layer seal portion
113: Channel
115: Layer sealing plane
120: Tubular cable seal portion
121: Cylindrically formed region
122: Front end of the tubular cable seal portion
125: Cable sealing plane
126: Direction of expansion
140: Collar portion
141, 142: Sealing lips
143: Front end of the collar portion
200: Rigid frame
210: Front end of the rigid frame
220: Circumferential outer surface of the rigid frame
300: Housing member of the electrical connector
301: Cable guiding passage of the electrical connector
400, 401: Cables
500, 501: Terminals

Claims

1. Sealing member (100) for an electrical connector (1) comprising:
   a layer seal portion (110) for sealing a cable guiding passage (301) of the electrical connector (1), having a front side (111) and a rear side (112), which layer seal (110) portion comprises at least one channel (113) adapted to receive a single electrical cable (400; 401); and at least one tubular cable seal portion (120) aligned with said channel (113), for sealing the at least one channel (113) of the layer seal portion (110) against a received cable (400; 401), wherein the tubular cable seal portion (120) protrudes from the rear side (112) of the layer seal portion (110).

2. The sealing member (100) of claim 1, wherein the at least one tubular cable seal portion (120) has an inner surface, and wherein the largest inner diameter of the inner surface of the tubular cable seal portion (120) is smaller than the smallest diameter of the channel (113) of the layer seal portion (110).

3. The sealing member (100) of claim 1, wherein the at least one tubular cable seal portion (120), can expand radially up to 300% and preferably up to 500% during insertion of the cable (400; 401).

4. The sealing member (100) of any preceding claim, wherein the received cable (400; 401) can be within the range of 0.08 to 0.35 mm², preferably within the range of 0.05 to 0.52 mm² and most preferably within the range of 0.03 to 0.82 mm².

5. The sealing member (100) of any preceding claim, wherein the channel (113) of the layer seal portion (110) is conically formed, and tapers from the front side (111) to the rear side (112) of the layer seal portion (110) and ends behind the rear side (112) in the tubular cable seal portion (120).

6. The sealing member (100) of any preceding claim, wherein the inner surface of the tubular cable seal portion (120) provides a cylindrically formed region (121), and wherein the cylindrical formed region (121) has preferably a ratio of diameter to length from at least 1:1, more preferably from at least 1:5, even more preferably from at least 1:10 and most preferably from at least 1:20, in the unexpanded state.

7. The sealing member (100) of any preceding claim, further comprising a collar portion (140) extending circumferential between the front and rear side of the layer seal portion (110), wherein the collar portion (140) protrudes from the rear side (112) of the layer seal portion (110) perpendicular to the plane of the rear side (112) of the layer seal portion (110), so that a front end (143) of the collar portion (140) protrudes beyond a front end (122) of the tubular cable seal portion (120).

8. The sealing member (100) of the preceding claim, wherein the collar (140) provides at least one circumferential sealing lip (141; 142).

9. The sealing member (100) of claim 7 or 8, further comprising a rigid plastic frame (200) that is arranged within the inner surface of the collar (140), wherein the rigid plastic frame (200) preferably protrudes beyond a front end (122) of the tubular cable seal portion (120).

10. The sealing member (100) of claim 9, wherein the rigid plastic frame (200) comprises a thermoplastic material, and wherein the sealing member (100) and the rigid plastic frame (200) are integrally formed by multi component molding.

11. The sealing member (100) of any preceding claim, wherein the layer seal portion is a flat matte-type seal and the front side and rear side are substantially flat surfaces that are parallel to each other and the tubular cable seal portion has a cylindrical shape and protrudes perpendicular from the rear surface.

12. The sealing member (100) of any preceding claim, wherein the minimum distance between the centers of the channels (113) of the layer seal portion (110) is at most 3 mm, preferably at most 2 mm, even more preferably 1.8 mm and most preferably at most 1 mm.

13. The sealing member (100) of any preceding claim,
wherein the protruding tubular seal portion (120) has an essentially cylindrical shape.

14. Electrical connector assembly (1) comprising:

   a housing member (300), having a cable guiding passage (301) for guiding at least one cable (400; 401); and
   a sealing member (100) according to any of the preceding claims, wherein the sealing member is preferably provided in the cable guiding passage (301) of the electrical connector (300), or even more preferably imposed on the housing member of the connector.

15. Electrical connector assembly (1) according to claim 14, wherein the sealing member (100) is moulded onto the housing member, and wherein the housing member and the sealing member (100) are preferably integrally formed by multi component molding.
# DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims.

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CATALOGUE OF CITED DOCUMENTS

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The Hague 18 August 2015 Vautrin, Florent
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