(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 May 2022 (27.05.2022)

WIPO | PCT

(10) International Publication Number
WO 2022/106952 A1

(51) International Patent Classification:
H01R 13/631 (2006.01) *H01R 13/6477* (2011.01)

(21) International Application Number:
PCT/IB2021/060279

(22) International Filing Date:
05 November 2021 (05.11.2021)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
17/100,222 20 November 2020 (20.11.2020) US

(71) Applicant: **TE CONNECTIVITY SOLUTIONS GMBH** [CH/CH]; Mühlenstrasse 26, 8200 Schaffhausen (CH).

(72) Inventor; and

(71) Applicant *(for SC only)*: **GINGRICH III, Charles Raymond** [US/US]; 2900 Fulling Mill Road, Middletown, Pennsylvania 17057 (US).

(72) Inventors: **SMITH JR., Graham Harry**; 2900 Fulling Mill Road, Middletown, Pennsylvania 17057 (US). **CINA, Michael Frank**; 2900 Fulling Mill Road, Middletown, Pennsylvania 17057 (US).

(74) Agent: **STROUD, Adam L.**; 4550 Linden Hill Road, Suite 140, Wilmington, Delaware 19808 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN,

(54) Title: NESTED HOUSING INTERFACE FOR IMPEDANCE MATCHING

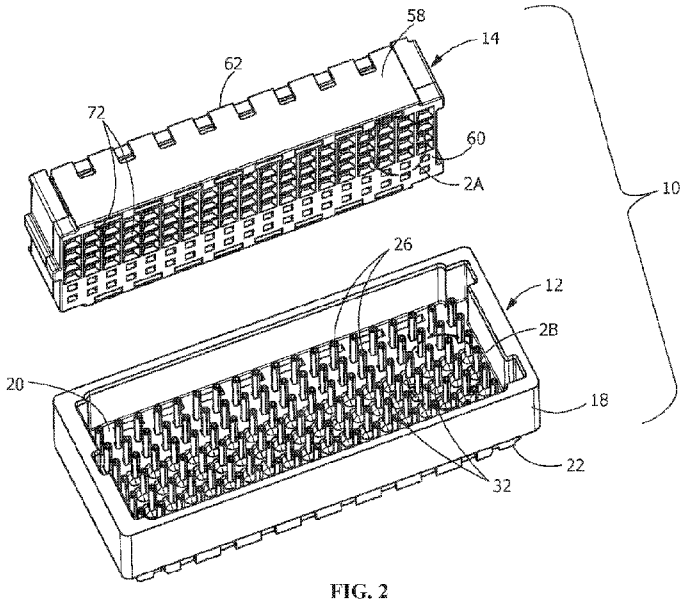

FIG. 2

(57) Abstract: An electrical connector of an electrical connector assembly. The electrical connector includes a housing with a mating face for mating with a mating electrical connector. Contact receiving cavities extend into the housing from the mating face. Contacts are provided in the contact receiving cavities. Mating portions of the contacts extend from the mating face in a direction away from the housing. Protrusions extend from the mating face in a direction away from the housing. The protrusions extend proximate edges of the mating portions of the contacts. The protrusions form reverse chamfers which cooperate with lead- in chamfers provided in a surface of the mating electrical connector. The positioning of the protrusions in the lead-in chamfers fills in air gaps provided by the lead-in chamfers to provide an impedance match along the mating portions of the contacts when the electrical connector is mated with the mating electrical connector.

WO 2022/106952 A1

[Continued on next page]

KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

NESTED HOUSING INTERFACE FOR IMPEDANCE MATCHING

[0001] The present invention is directed to an electrical connector housing with protrusions extending from a mating face for impedance matching. In particular, the invention is directed to an electrical connector housing with protrusions which that nest with lead-in chamfers in the mating face of a mating connector to fill in the air gaps around the lead-in chamfers.

[0002] In many electrical connectors, contacts are provided in contact receiving openings provided in the housing of the connector. In order to accommodate mating of the electrical connector with a mating electrical connector, it is common for connectors to have a lead-in chamfer molded into the plastic housing on the socket side of the connector mated pair. This allows the housing on the socket side to guide the pin contacts into the socket contacts to pre-align the pins relative to the sockets. The chamfer area creates an air space around the pin contact when the connector set is fully mated. This air space causes a mis-match in the impedance compared to the adjacent areas where the pins are surrounded by housing's plastic material.

[0003] It is therefore desirable to provide a pin housing with molded-in protrusions extending up along the sides of the pin contact edges that form a reverse chamfer form along all sides of the pin. The reverse chamfer protrusions on the pin housing create nested plastic forms that fill in the air gaps around the lead-in chamfer on the socket housing.

[0004] The solution is provided by an electrical connector which includes a housing with a mating face for mating with a mating electrical connector. Contact receiving cavities extend into the housing from the mating face. Contacts are provided in the contact receiving cavities. Mating portions of the contacts extend from the mating face in a direction away from the housing. Protrusions extend from the mating face in a direction away from the housing. The protrusions extend proximate edges of the mating portions of the contacts. The protrusions form reverse chamfers which cooperate with lead-in chamfers

provided in a surface of the mating electrical connector. As the electrical connector is mated with the mating electrical connector, the protrusions are positioned in the lead-in chamfers of the mating electrical connector. The positioning of the protrusions in the lead-in chamfers fills in air gaps provided by the lead-in chamfers to provide an impedance match along the mating portions of the contacts when the electrical connector is mated with the mating electrical connector.

[0005] Other features and advantages of the present invention will be apparent from the following more detailed description of the illustrative embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

[0006] FIG. 1 is a perspective view of an illustrative male electrical connector of the present invention mated with a female mating electrical connector.

[0007] FIG. 2 is a perspective view of the male electrical connector removed from the mating female electrical connector, the connectors are positioned to show the mating interface of both connectors.

[0008] FIG. 2a is an enlarged perspective view of a portion of the female electrical connector.

[0009] FIG. 2b is an enlarged perspective view of a portion of the male electrical connector.

[0010] FIG. 3 is a cross-sectional view taken along line 3-3 of FIG. 1, showing the male electrical connector and mating female connector in a mated position.

[0011] FIG. 4 is a perspective view of an alternate illustrative embodiment of the male electrical connector removed from the mating female electrical connector, the connectors are positioned to show the mating interface of both connectors.

[0012] FIG. 5 is a cross-sectional view of the male electrical connector and mating female electrical connector of FIG. 4, showing the male electrical connector and mating female connector in a mated position.

[0013] FIG. 6 is a cross-sectional view of a first known prior art male electrical connector and known mating female electrical connector, showing the electrical connector and mating connector in a mated position.

[0014] FIG. 7 is a cross-sectional view of a second known prior art male electrical connector and known mating female electrical connector, showing the male electrical connector and mating female electrical connector in a mated position.

[0015] An embodiment is directed to an electrical connector which includes a housing with a mating face for mating with a mating electrical connector. Contact receiving cavities extend into the housing from the mating face. Contacts are provided in the contact receiving cavities. Mating portions of the contacts extend from the mating face in a direction away from the housing. Protrusions extend from the mating face in a direction away from the housing. The protrusions extend proximate edges of the mating portions of the contacts. The protrusions form reverse chamfers which cooperate with lead-in chamfers provided in a surface of the mating electrical connector. As the electrical connector is mated with the mating electrical connector, the protrusions are positioned in the lead-in chamfers of the mating electrical connector. The positioning of the protrusions in the lead-in chamfers fills in air gaps provided by the lead-in chamfers to provide an impedance match along the mating portions of the contacts when the electrical connector is mated with the mating electrical connector.

[0016] An electrical connector assembly having a first electrical connector and a second electrical connector. The first electrical connector includes a first housing having a first mating face. First contact receiving cavities extend into the first housing from the first mating face. First contacts are positioned in the

first contact receiving cavities. First mating portions of the first contacts extend from the first mating face in a direction away from the first housing. Protrusions extend from the first mating face in a direction away from the first housing. The protrusions extend proximate edges of the first mating portions of the first contacts. The protrusions form reverse chamfers. The second electrical connector includes a second housing having a second mating face. Second contact receiving cavities extend into the second housing from the second mating face. Second contacts are provided in the second contact receiving cavities. Second mating portions of the second contacts extend from the second mating face in a direction into the second housing. Lead-in chamfers are provided in the second mating face of the second housing. The lead-in chamfers extend from the second mating face in a direction into the second housing. As the first electrical connector is mated with the second electrical connector, the protrusions of the first electrical connector are positioned in the lead-in chamfers of the second electrical connector. The positioning of the protrusions in the lead-in chamfers fills in air gaps provided by the lead-in chamfers to provide an impedance match along the first mating portions of the first contacts when the first electrical connector is mated with the second electrical connector.

[0017] As shown in FIGS. 1 and 2, an electrical connector assembly 10 includes a male pin connector 12 and a mating female socket connector 14.

[0018] The male pin connector 12 has a housing 18 with a mating surface or face 20 and an oppositely facing wire receiving or mounting face 22. Contact receiving cavities 24 (FIG. 3) extend from the mating face 20 to the mounting face 22.

[0019] As shown in FIG. 3, contacts 26 are positioned in the contact receiving cavities 24. The contacts 26 have first portions 28 which are positioned in the contact receiving cavities 24 and second portions or mating portions 30 which extend from the first portions 28. The first portions 28 are configured to position and maintain the contacts 26 in position relative to the male pin connector 12.

The particular configuration of the first portions 28 may vary without departing from the scope of the invention. Securing features (not shown), such as barbs or shoulders, may be provided to facilitate the retention of the first portions 28 in the contact receiving cavities 24. The mating portions 30 extend from the mating face 20 in a direction away from the housing 18. In the illustrative embodiment shown in FIGS. 2 and 3, the mating portions 30 have square cross-sections.

[0020] Protrusions 32 extend from the mating face 20. The protrusions 32 extend in a direction away from the mating face 20 and the housing 18. In the illustrative embodiment, the protrusions 32 are molded into the housing 18. The protrusions 32 form reverse chamfers, as will be more fully described. Various configurations of the protrusions 32 may be provided. For example, the protrusions 32 may be provided on at least two sides of each of the mating portions 30 of the contacts 26 or the protrusions 32 may be provided on at all sides of each of the mating portions 30 of the contacts 26.

[0021] In the illustrative embodiment shown in FIGS. 2 and 3, the protrusions 32 form a truncated pyramid shape with an opening 34 provide in the center. The openings 34 are configured to allow the mating portions 30 to extend therethrough. Walls 36 of the openings 34 are dimensioned to be proximate to or engage edges 38 of the mating portions 30 of the contacts 26. The walls 36 are configured to have the same cross-sectional shape as the mating portions 30 of the contacts 26. In the illustrative embodiment shown in FIGS. 2 and 3, each of the protrusions 32 have four side walls 40 which are sloped from the mating face 20 to the center opening 34. The angle of inclination of the side walls 40 from the mating surface 20 may vary, but will generally be between 35 degrees and 60 degrees as measured from the mating face 20.

[0022] The female socket connector 14 has a housing 58 with a mating surface or face 60 and an oppositely facing wire receiving or mounting face 62. Contact receiving cavities 64 extend from the mating face 60 to the mounting face 62.

[0023] Contacts 66 are positioned in the contact receiving cavities 64. The contacts 66 have mating contact receiving portions 68 which are positioned in the contact receiving cavities 64. The mating contact receiving portions 68 are configured to position and maintain the contacts 66 in position relative to the female socket connector 14. The mating contact receiving portions 68 are also configured to receive the mating portions 30 of the contacts 26 therein, when the male pin connector 12 is mated to the female socket connector 14. The particular configuration of the mating contact receiving portions 68 may vary without departing from the scope of the invention. Securing features (not shown), such as barbs or shoulders, may be provided to facilitate the retention of the mating contact receiving portions 68 in the contact receiving cavities 64. The mating contact receiving portions 68 extend from the mating face 60 toward the mounting face 62. In the illustrative embodiment shown in FIGS. 2 and 3, the mating contact receiving portions 68 and the contact receiving cavities 64 have square cross-sections.

[0024] Lead-in chamfers 72 are provided in the mating face 60. The lead-in chamfers 72 are provided to guide help align and guide the mating portions 30 of the contacts 26 with the mating contact receiving portions 68 of the contact 66 when the male pin connector 12 and the female socket connector 14 are mated.

[0025] The lead-in chamfers 72 extend in from the mating face 60 in a direction toward the mounting face 62. In the illustrative embodiment, the lead-in chamfers 72 are molded into the housing 58. The lead-in chamfers 72 has the same shape of the protrusions 32 of the mating male pin connector 12. A circumference of a chamfer base 73 of each of the lead-in chamfers 72 as measured at the mating face 60 is larger than a circumference of a protrusion base 33 of each of the protrusions 32 as measured at the mating face 20. Various configurations of the lead-in chamfers 72 may be provided. For examples, the lead-in chamfers 72 may be provided on at least two sides of each of the mating contact receiving portions 68 of the contact 66 or the lead-

in chamfers 72 may be provided on at all sides of each of the mating contact receiving portions 68 of the contact 66.

[0026] In the illustrative embodiment shown in FIGS. 2 and 3, the lead-in chamfers 72 form an inverted truncated pyramid shape with an opening 74 provide in the center. The openings 74 are configured to allow the mating portions 30 to extend therethrough. Walls 76 of the openings 74 are dimensioned to be proximate to or engage edges 38 of the mating portions 30 of the contacts 26. The walls 76 are configured to have the same cross-sectional shape as the mating portions 30 of the contacts 26. In the illustrative embodiment shown in FIGS. 2 and 3, each of the lead-in chamfers 72 have four side walls 80 which are sloped from the mating face 60 to the center opening 74. The angle of inclination of the side walls 80 from the mating face 60 may vary, but will generally be between 35 degrees and 60 degrees as measured from the mating face 60, and will be generally equal to or approximately equal to the angle of inclination 42 of the sidewalls 40 of the protrusions 32.

[0027] In the illustrative embodiment shown in FIGS. 4 and 5, the mating portions 30 of the contacts 26 of the male pin connector 12 have round cross-sections. However, the mating portions 30 may have other cross-sectional shapes, such as, but not limited, to oval, rectangular, or rounded square.

[0028] In the illustrative embodiment shown in FIGS. 4 and 5, the protrusions 32 form a truncated cone shape with an opening 34 provide in the center. The openings 34 are configured to allow the mating portions 30 to extend therethrough. Walls 36 of the openings 34 are dimensioned to be proximate to or engage edges 38 of the mating portions 30 of the contacts 26. The walls 36 are configured to have the same cross-sectional shape as the mating portions 30 of the contacts 26. In the illustrative embodiment shown in FIGS. 4 and 5, each of the protrusions 32 has a side wall 40 which is sloped from the mating face 20 to the center opening 34. The angle of inclination 42 of the side walls 40 may vary, but will generally be between 35 degrees and 60 degrees as measured from the mating face 20.

[0029] In the illustrative embodiment shown in FIGS. 4 and 5, the lead-in chamfers 72 form an inverted cone shape with an opening 74 provide in the center. The openings 74 are configured to allow the mating portions 30 to extend therethrough. Walls 76 of the openings 74 are dimensioned to be proximate to or engage edges 38 of the mating portions 30 of the contacts 26. The walls 76 are configured to have the same cross-sectional shape as the mating portions 30 of the contacts 26. In the illustrative embodiment shown in FIGS. 4 and 5, each of the lead-in chamfers 72 have side walls 80 which are sloped from the mating face 60 to the center opening 74. The angle of inclination 82 of the side walls 80 may vary, but will generally be between 35 degrees and 60 degrees as measured from the mating face 60, and will be generally equal to or approximately equal to the angle of inclination 42 of the sidewalls 40 of the protrusions 32.

[0030] Regardless of the particular configurations of the protrusions 32 and the lead-in chamfers 72, when the male pin connector 12 and the mating female socket connector 14 are properly mated, the protrusions 32 are positioned or nested in the lead-in chamfers 72. With the protrusions 32 properly positioned or nested in the lead-in chamfers 72, the material, such as, but not limited to plastic, of the protrusions 32 fills in air space or gaps 90 (FIGS. 3 and 5) that are created by the lead-in chamfer 72 on the socket connector 14. The protrusions 32 fill in the air gaps 90, causing a better impedance match in the area between the pin connector 12 and the socket connector 14.

[0031] Referring to FIG. 6 a first connector assembly 100 according to the prior art has a male pin connector 112 and a female socket connector 114. In this embodiment, no protrusions or lead-in chamfers are provided. Referring to FIG. 7, a second connector assembly 200 according to the prior art has a male pin connector 212 and a female socket connector 214. In this embodiment, no

protrusions are provided on the male pin connector 212, but lead-in chamfers 272 are provided on the female socket connector 214.

[0032] In each of FIGS. 3, 6 and 7, a first plane 300 and a second plane 302 are shown. The first plane 300 is spaced from the mating face 20, 120, 220 of the male pin connector 12, 112, 212 the same distance 304 in all embodiments. The second plane 302 is provided proximate to the mating face 20, 120, 220 of the male pin connector 12, 112, 212.

[0033] In illustrative testing of the connector assemblies 10, 100, 200, the impedance was measured as follows:

POSITION OF MEASURMENT	CONNECTOR ASSEMBLY 10 IMPEDANCE (ohms)	CONNECTOR ASSEMBLY 100 IMPEDANCE (ohms)	CONNECTOR ASSEMBLY 200 IMPEDANCE (ohms)
Plane 302 (FIG. 3, 5 and 6)	141.3	191.2	179.3
Plane 300 (FIG. 3, 5 and 6)	127.4	131.9	149.3
Average of Plane 302 and Plane 300	134.35	161.55	164.3

[0034] As shown from the illustrative numbers in the table above, connector assembly 100 has very high impedance across plane 2 because there is no plastic between the pins. The impedance across plane 1 is lower than the impedance across plane 2, as the pins are surrounded by plastic. Consequently, there is a large difference or mismatch between the impedance of plane 1 and plane 2, which can adversely affect the signal transmission of the contacts. The average impedance between plane 2 and plane 1 remains high.

[0035] As shown from the illustrative numbers in the table above, connector assembly 200 has very high impedance across plane 2 because there is no plastic between the pins. The impedance across plane 1 is lower than the

impedance across plane 2, as the pins are separated by plastic. Consequently, there is a large difference or mismatch between the impedance of plane 1 and plane 2, which can adversely affect the signal transmission of the contacts. However, a larger air gap is provided in connector assembly 200 than connector assembly 100, the impedance across plane 2 is higher in connector assembly 200 than connector assembly 100. The average impedance between plane 2 and plane 1 of connector assembly 200 remains high.

[0036] In contrast to the prior art connector assemblies 100, 200, the connector assembly 10 of the present invention lower impedance in both zones and similar impedance in each zone. As shown from the illustrative numbers in the table above, connector assembly 10 has lower impedance across plane 2 than either connector assembly 100 or connector assembly 200. As the protrusions 32 are nested in the lead-in chamfers, there is plastic between the mating portions 30 of the contacts 26 and there is no directed gap between the mating portions 30 of the contacts 26. The connector assembly 10 also has lower impedance across plane 1 than either connector assembly 100 or connector assembly 200. As the protrusions 32 are nested in the lead-in chamfers, there is more plastic between the mating portions 30 of the contacts 26 and the air gaps 90 between the mating portions 30 of the contacts 26 are minimized. The average impedance between plane 2 and plane 1 of connector assembly 10 is also significantly lower than the aver impedance of connector assembly 100 or connector assembly 200.

[0037] As the impedance between plane 2 and plane 1 are similar or matched in connector assembly 10, high speed signal transmission can occur without significant loss pf power and with minimal signal reflection.

CLAIMS

1. An electrical connector comprising:

a housing (18, 58) having a mating face (20, 60, 120) for mating with a mating electrical connector, contact receiving cavities (24, 64) extending into the housing (18, 58) from the mating face (20, 60, 120);

contacts (26, 66) in the contact receiving cavities (24, 64), mating portions (30) of the contacts (26, 66) extending from the mating face (20, 60, 120) in a direction away from the housing (18, 58);

protrusions (32) extending from the mating face (20, 60, 120) in a direction away from the housing (18, 58), the protrusions (32) extending proximate edges of the mating portions (30) of the contacts (26, 66), the protrusions (32) forming reverse chamfers which cooperate with lead-in chamfers (72) provided in a surface of the mating electrical connector;

wherein, as the electrical connector is mated with the mating electrical connector, the protrusions (32) are positioned in the lead-in chamfers (72) of the mating electrical connector, the positioning of the protrusions (32) in the lead-in chamfers (72) fills in air gaps (90) provided by the lead-in chamfers (72) to provide an impedance match along the mating portions (30) of the contacts (26, 66) when the electrical connector is mated with the mating electrical connector.

2. The electrical connector as recited in claim 1, wherein the protrusions (32) have a truncated pyramid shape with an opening (74) in the center.

3. The electrical connector as recited in claim 1, wherein the protrusions (32) have a truncated cone shape with an opening (74) in the center.

4. The electrical connector as recited in claim 1, wherein the protrusions (32) have side walls (40, 80) with angles of inclination as measured from the mating face (20, 60, 120) of between 35 degrees and 60 degrees.

5. The electrical connector as recited in claim 1, wherein cross-sectional areas of the mating portions (30) of the contacts (26, 66) are round.

6. The electrical connector as recited in claim 1, wherein cross-sectional areas of the mating portions (30) of the contacts (26, 66) are oval.

7. The electrical connector as recited in claim 1, wherein cross-sectional areas of the mating portions (30) of the contacts (26, 66) are square.

8. The electrical connector as recited in claim 1, wherein cross-sectional areas of the mating portions (30) of the contacts (26, 66) are rectangular.

9. An electrical connector assembly comprising:

a first electrical connector comprising:

a first housing (18, 58) having a first mating face (20, 60, 120), first contact receiving cavities (24, 64) extending into the first housing (18, 58) from the first mating face (20, 60, 120);

first contacts (26, 66) in the first contact receiving cavities (24, 64), first mating portions (30) of the first contacts (26, 66) extending from the first mating face (20, 60, 120) in a direction away from the first housing (18, 58);

protrusions (32) extending from the first mating face (20, 60, 120) in a direction away from the first housing (18, 58), the first protrusions (32) extending proximate edges of the first mating portions (30) of the first contacts (26, 66), the protrusions (32) forming reverse chamfers;

a second electrical connector comprising;

a second housing (18, 58) having a second mating face (20, 60, 120), second contact receiving cavities (24, 64) extending into the second housing (18, 58) from the second mating face (20, 60, 120);

second contacts (26, 66) in the second contact receiving cavities (24, 64), second mating portions (30) of

the second contacts (26, 66) extending from the second mating face (20, 60, 120) in a direction into the second housing (18, 58);

lead-in chamfers (72) provided in the second mating face (20, 60, 120) of the second housing (18, 58), the lead-in chamfers (72) extending from the second mating face (20, 60, 120) in a direction into the second housing (18, 58);

wherein, as the first electrical connector is mated with the second electrical connector, the protrusions (32) of the first electrical connector are positioned in the lead-in chamfers (72) of the second electrical connector, the positioning of the protrusions (32) in the lead-in chamfers (72) fills in air gaps (90) provided by the lead-in chamfers (72) to provide an impedance match along the first mating portions (30) of the first contacts (26, 66) when the first electrical connector is mated with the second electrical connector.

10. The electrical connector assembly as recited in claim 9, wherein the protrusions (32) of the first electrical connector have side walls (40, 80) with first angles of inclination as measured from the first mating face (20, 60, 120) of between 35 degrees and 60 degrees.

11. The electrical connector assembly as recited in claim 10, wherein the lead-in chamfers (72) of the second electrical connector side walls (40, 80) with second angles of inclination as measured from the second mating face (20, 60, 120) of between 35 degrees and 60 degrees.

12. The electrical connector assembly as recited in claim 9, wherein the protrusions (32) are provided on at least two sides of each of the first contacts (26, 66).

13. The electrical connector assembly as recited in claim 12, wherein the lead-in chamfers (72) are provided on at least two sides of each of the second contacts (26, 66).

14. The electrical connector assembly as recited in claim 9, wherein the protrusions (32) are provided on all sides of each of the first contacts (26, 66).

15. The electrical connector assembly as recited in claim 14, wherein the lead-in chamfers (72) are provided on all sides of each of the second contacts (26, 66).

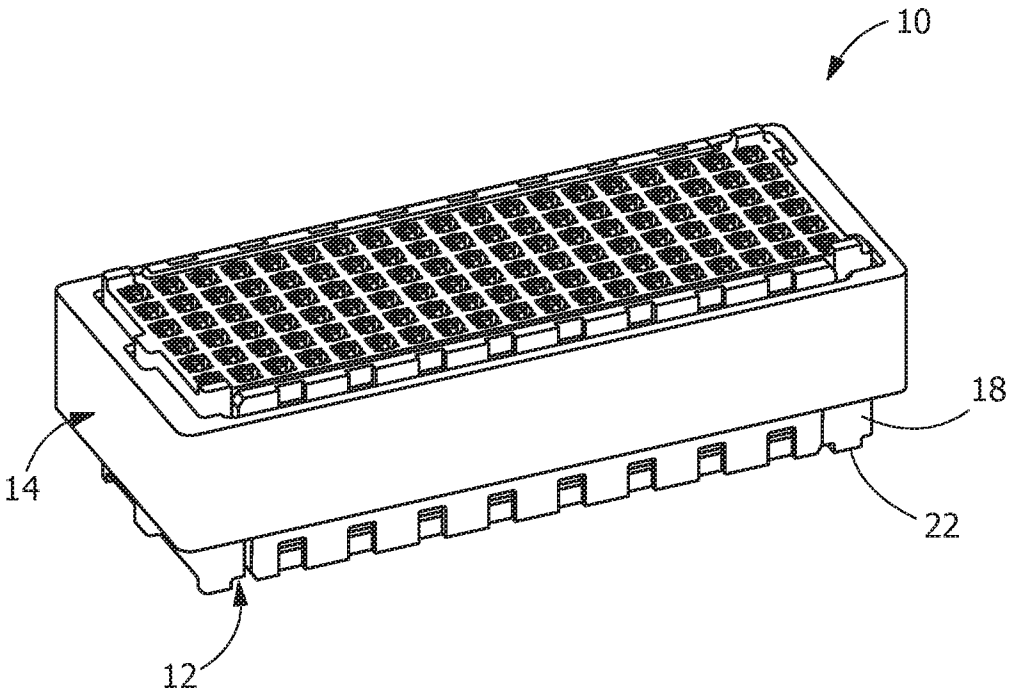

FIG. 1

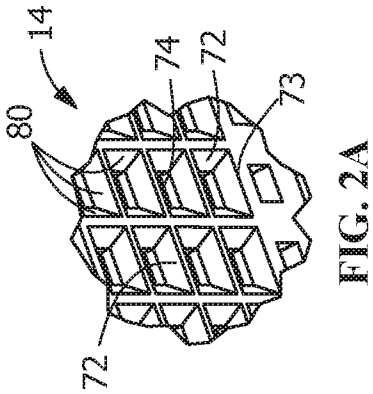

FIG. 2A

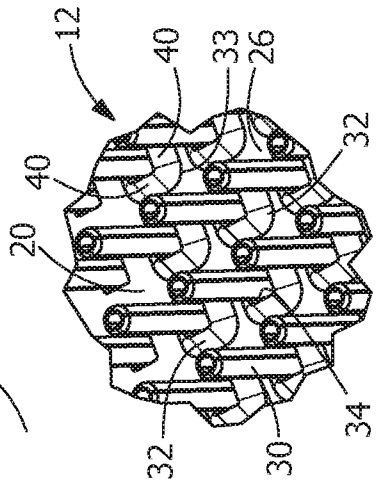

FIG. 2B

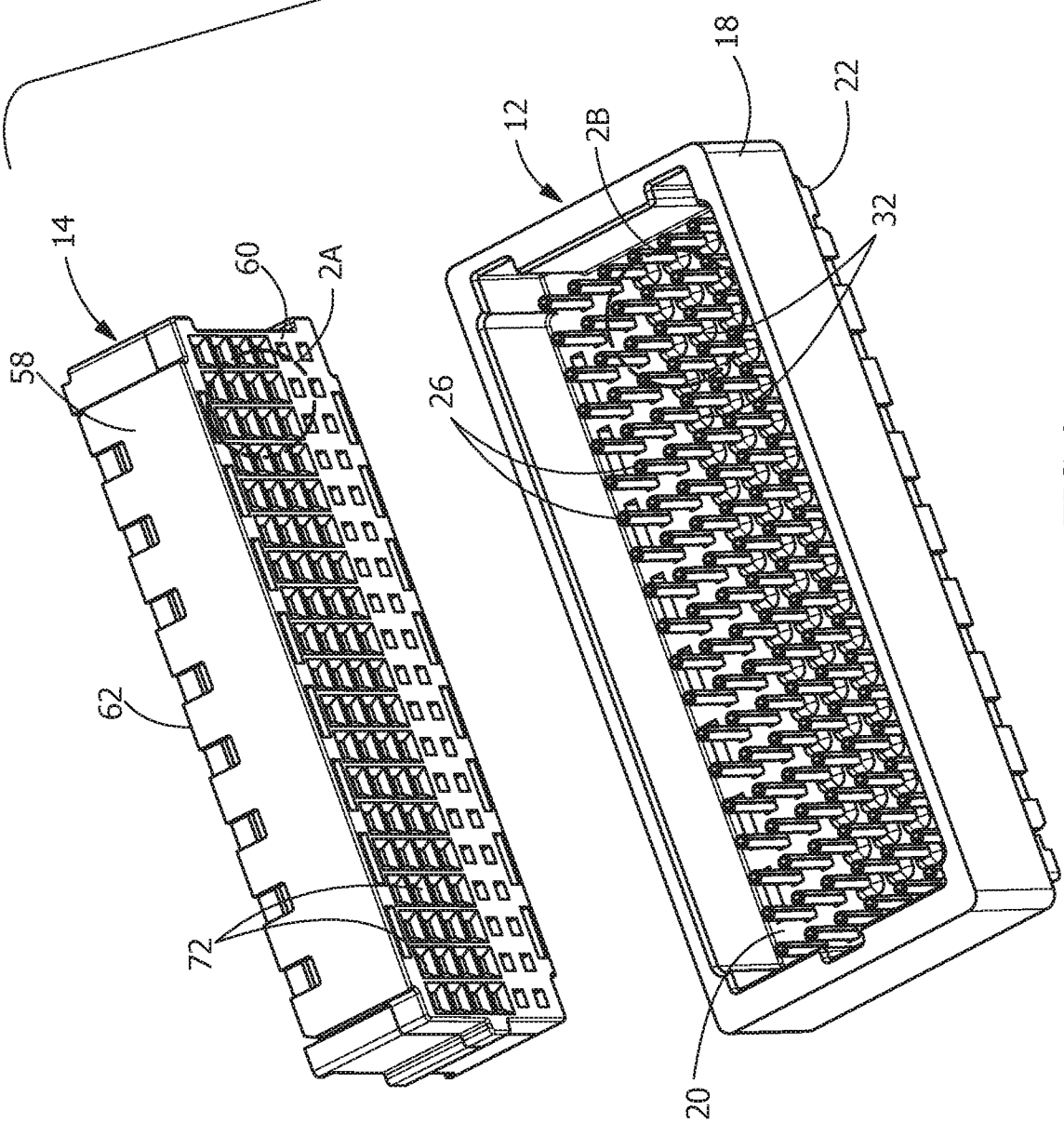

FIG. 2

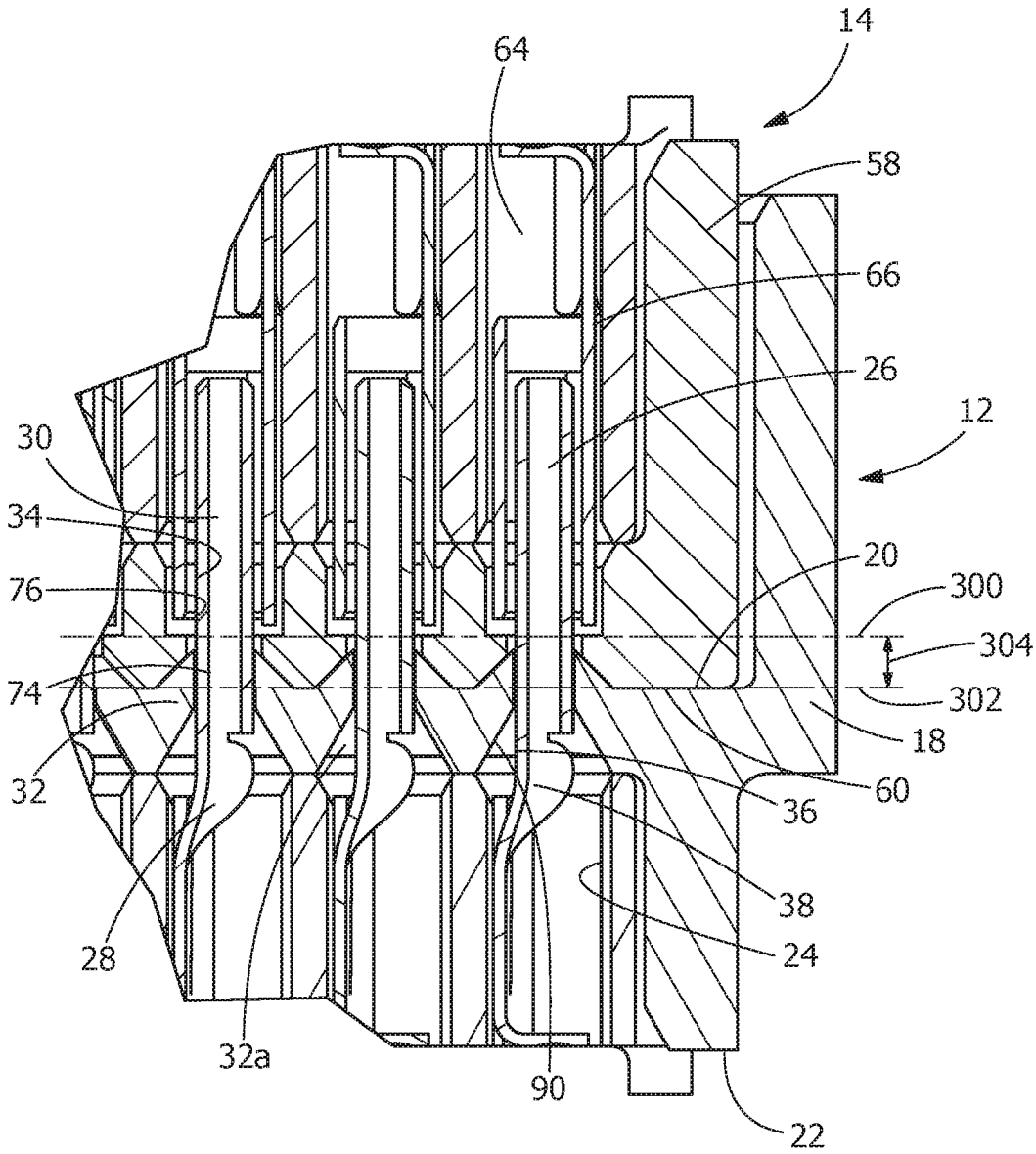
14
64
58
66
26
12
30
34
20
76
300
304
74
302
18
32
60
36
38
24
28
32a
90
22

FIG. 3

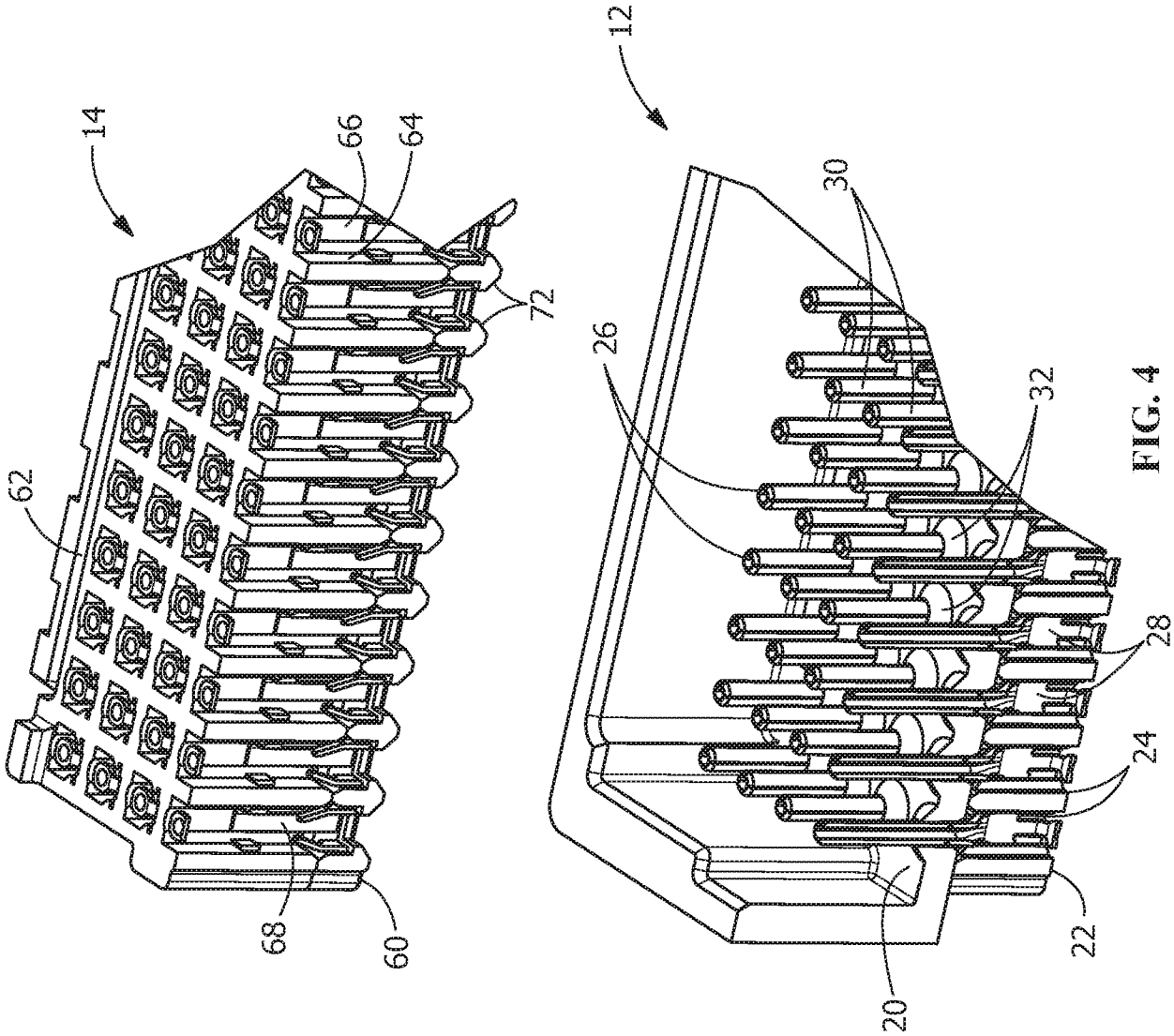

FIG. 4

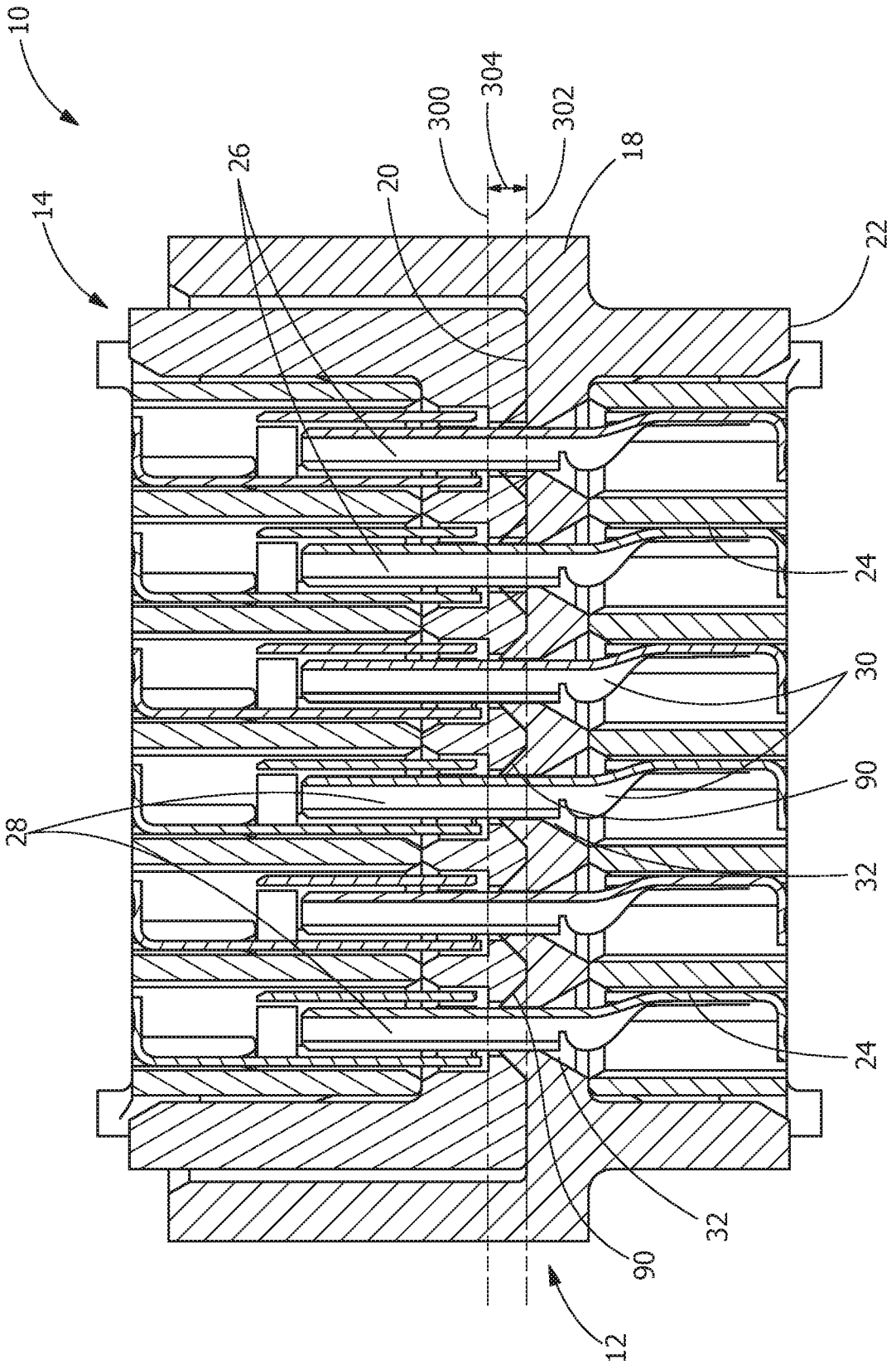

FIG. 5

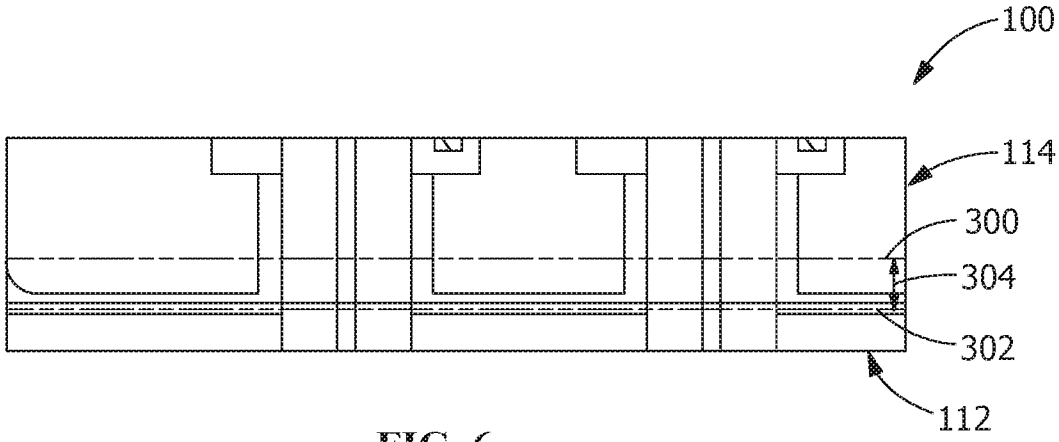

FIG. 6

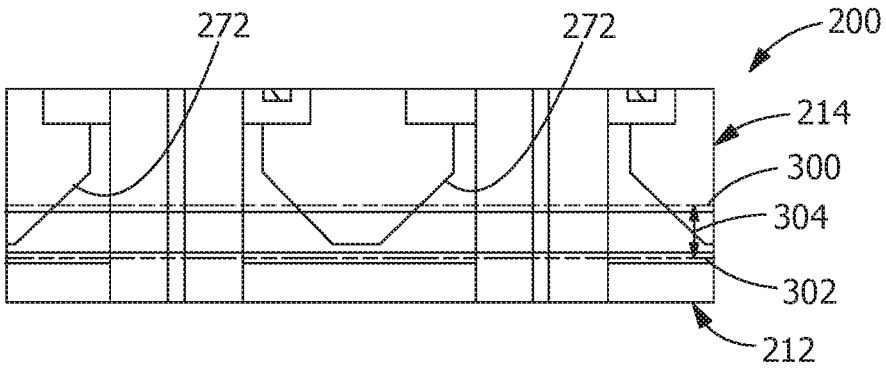

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/060279

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/631 H01R13/6477
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/157812 A1 (GAILUS MARK W [US] ET AL) 23 May 2019 (2019-05-23) paragraphs [0130] - [0132], [0163], [0217] - [0219]; figures 1-7, 15A-15C	1-15
X	US 10 431 936 B2 (TE CONNECTIVITY CORP [US]) 1 October 2019 (2019-10-01) column 12, lines 32-52, figures 1, 2, 4, 5, 10	1,4,9-11
X	US 4 813 891 A (WALTERS GERALD E [US] ET AL) 21 March 1989 (1989-03-21) column 4, lines 21-27, figure 2	1,3-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 February 2022	18/02/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	López García, Raquel

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2021/060279

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2019157812 A1	23-05-2019	CN 107112696 A	29-08-2017
		CN 111641083 A	08-09-2020
		CN 111641084 A	08-09-2020
		US 2016141807 A1	19-05-2016
		US 2017294743 A1	12-10-2017
		US 2019013625 A1	10-01-2019
		US 2019157812 A1	23-05-2019
		US 2021083434 A1	18-03-2021
		WO 2016077643 A1	19-05-2016
US 10431936 B2	01-10-2019	CN 109616791 A	12-04-2019
		US 2019097356 A1	28-03-2019
US 4813891 A	21-03-1989	NONE	