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(54) **Title**: HIGH PROFILE ELECTRICAL CONNECTOR

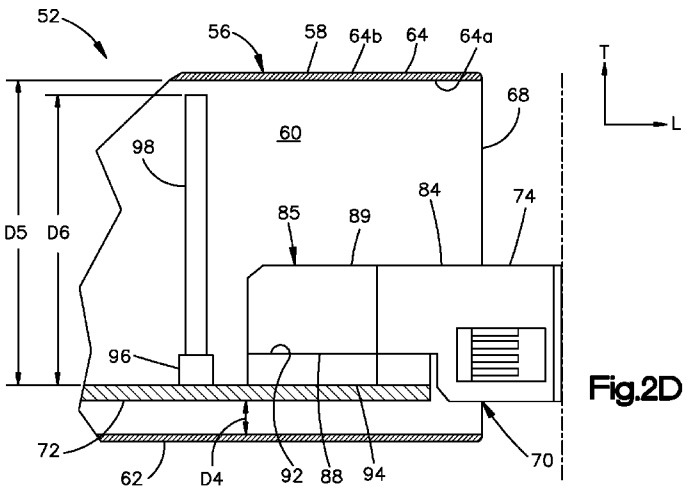

Fig.2D

(57) **Abstract**: A high profile electrical connector is system compatible with first and second different DIMM electrical connectors in a system whereby another electrical connector that is not high profile is not system compatible with the first and second different DIMM electrical connectors in the system. The second DIMM electrical connector is taller than the first DIMM electrical connector, and is less expensive to manufacture than the first DIMM electrical connector.

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HIGH PROFILE ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This claims priority to U.S. Provisional Patent Application Serial Number 62/088,011 filed December 5, 2014, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein.

BACKGROUND

[0002] Electrical connectors typically include a connector housing and electrical contacts that are supported to the connector housing and configured to mate with electrical contacts of a complementary electrical connector. In one electrical equipment system 18, the electrical contacts are mounted on respective printed circuit boards and mated to each other so as to place the printed circuit boards in electrical communication with each other. For instance, as illustrated in Figs. 1A-1E, the electrical equipment system 18 includes a plurality of first electrical connectors 20 that can be mounted to a first printed circuit board 22 that is configured as a daughter card. The electrical equipment system 18 further includes a board assembly 25 that includes a second printed circuit board 26, and a second plurality of electrical connectors 24 that can be mounted on the second printed circuit board 26. The second printed circuit board 26 can be configured as a backplane or a midplane. The first electrical connectors 20 can be configured as right-angle receptacle connectors, and the second electrical connectors 24 can be configured as vertical header connectors configured to mate with respective ones of the receptacle connectors. The first and second electrical connectors 20 and 24 can be configured as described

in U. S. Patent No. 7,331,800 dated February 19, 2008, which is incorporated by reference as if set forth in its entirety herein. It should be appreciated, of course, that the first and second electrical connectors 20 and 24 can be constructed in accordance with any suitable embodiment as desired. The electrical equipment system 18 includes a canister 28 that supports the daughter card with the plurality of first electrical connectors 20 mounted thereto.

[0003] The canister 28 includes a canister body 29 that defines an interior 30. The canister body 29, in turn, can include a base 31 and an upper wall 32 that is spaced from the base 31 along a transverse direction T. The canister body 29 further includes side walls 33 that are spaced from each other along a lateral direction A that is perpendicular to the transverse direction T. The canister body 29 further includes a rear end 34 and a front end 35 spaced from the rear end 34 along a longitudinal direction L that is perpendicular to each of the transverse direction T and the lateral direction A. The front end 35 can define an opening 36. Thus, it can be said that the canister 28 defines an opening 36 that extends through the front end 35 of the canister body 29.

[0004] The first printed circuit board 22 is supported in the interior 30 between the base 31 and the upper wall 32, such that the first printed circuit board 22 is oriented along a plane that is defined by the lateral direction A and the longitudinal direction L. The plurality of first electrical connectors 20 are mounted to the first printed circuit board 22 so as to be disposed adjacent the opening 36. The electrical equipment system 18 defines a first distance D1 from the first printed circuit board 22 to the upper wall 32 along the transverse direction T. The first distance D1 can be between approximately 28 mm and approximately 31 mm, such as approximately 28.5 mm.

[0005] Referring now to Fig. 1F, each of the first electrical connectors 20 can include a connector housing 21 and a plurality of electrical contacts 23 supported by the connector housing 21. The connector housing 21 defines a mating interface 21a configured to engage a complementary mating interface of the second electrical connector 24 when the first and second electrical connectors 20 and 24 are mated to each other. The connector housing 21 defines a bottom end 21b that faces or can abut the first printed circuit board 22 when the first electrical connector 20 is mounted to the first printed circuit board 22. The electrical contacts 23 can define respective mating ends 23a that are configured to mate with complementary electrical contacts of the second electrical connector 24, and mounting ends 23b that extend out from the bottom end 21b along the transverse direction T and are configured to be mounted to the first printed circuit board 22.

[0006] As illustrated in Fig. 1E, the first electrical connector 20 is positioned such that when the mounting ends 23b are mounted to the first printed circuit board 22, the equipment system 18 defines a second distance D2 from the first printed circuit board 22 to the base 31 along the transverse direction T. The second distance D2 can be between approximately 4 mm and approximately 6 mm, such as approximately 5 mm. The sum of the first distance D1, the second distance D2, and the thickness of the first printed circuit board 22 along the transverse direction T equal a distance from the base 31 to the upper wall 32 along the transverse direction T. Thus, the sum of the first distance D1, the second distance D2, and the thickness of the first printed circuit board 22 along the transverse direction T can be between approximately 32 mm and approximately 39 mm, such as between approximately 35 mm and 36 mm, for instance approximately 35.6 mm.

[0007] Referring now to Figs. 1A and 1B, the electrical equipment system 18 can further include an enclosure 37 that defines at least one canister slot 38 sized to receive the canister 28. The enclosure 37 can further support the board assembly 25, such that the canister 28 is disposed at a fixed location with respect to the second printed circuit board 26 with respect to the transverse direction T. As a result, when the canister 28 is inserted into the canister slot 38, the first electrical connectors 20 are aligned to mate with respective ones of the second electrical connector 24 along a first direction that is substantially parallel to the first printed circuit board 22. The first direction can be along the longitudinal direction L. When the first electrical connectors 20 are mated with the respective ones of the second electrical connectors 24, the first printed circuit board 22 is placed in electrical communication with the second printed circuit board 26. The electrical equipment system 18 is described and illustrated in Storage Bridge Bay (SBB) Specification Version 2.1, dated April 20, 2011, which is included herein at Appendix B and otherwise incorporated by reference as set forth in its entirety herein.

[0008] Thus first plurality of electrical connectors 20 are configured to mate with the second plurality of electrical connectors 24 along the first direction. Referring also to Fig. 1E, the electrical equipment system 18 further includes a third electrical connector 40 (schematically illustrated at Fig. 1E) that is mounted to the first printed circuit board 22 and configured to mate with an electrical component 41 (schematically illustrated at Fig. 1E) along a second direction that is perpendicular to the first direction. The second direction can be defined by the transverse direction T. For example, the electrical component 41 can be a dual inline memory module (DIMM). Thus, the third electrical connector 40 is a DIMM connector. The third electrical connector 40 and the DIMM combine to define a distance in the transverse direction T such that, when the DIMM is mated with the third electrical connector 40, and the third electrical connector

40 is mounted onto the first printed circuit board 22, the third electrical connector 40 and the DIMM combine to define a third distance D3 from the first printed circuit board 22 in the transverse direction T. For instance, the third electrical connector 40 can define a socket height of approximately 1.1 mm to 2 mm. The DIMM is constructed as a very low profile (VLP) DIMM having a height of 18 mm. Thus, the socket height and the VLP DIMM have a combined height that defines the third distance D3 of 19.1 mm to 20 mm in the transverse direction T. As a result, the third distance D3 is less than the first distance D1, such that the DIMM extends from the third electrical connector 40 toward the upper wall 32 without causing mechanical interference with the upper wall.

[0009] It is a constant desire in the fabrication of electrical equipment systems to reduce manufacturing costs. Typically, with electronic device miniaturization becoming increasingly prevalent, fabrication of smaller low profile connectors has been a significant factor in connector design.

SUMMARY

[0010] In accordance with one aspect of the present disclosure, a method is provided to reduce the cost of an electrical equipment system. The method can include the step of increasing the height of an electrical connector such that the electrical connector is system compatible with an unassociated electrical connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Fig. 1A is a top plan view of a portion of an electrical equipment system of the prior art, including an enclosure and a canister configured for insertion into a canister slot of the enclosure;

[0012] Fig. 1B is a perspective view of another portion of the electrical equipment system illustrated in Fig. 1A;

[0013] Fig. 1C is a perspective view of the canister of the assembly illustrated in Fig. 1A;

[0014] Fig. 1D is a front elevation view of the canister illustrated in Fig. 1C;

[0015] Fig. 1E is a partial view of the assembly illustrated in Fig. 1A, including a sectional side elevation view of a portion of the canister;

[0016] Fig. 1F is a perspective view of an electrical connector of the assembly illustrated in Fig. 1E;

[0017] Fig. 2A is a top plan view of a portion of an electrical equipment system in accordance with one aspect of the present disclosure, including an enclosure and a canister configured for insertion into a canister slot of the enclosure, constructed in accordance with the prior art;

[0018] Fig. 2B is a perspective view of another portion of the electrical equipment system illustrated in Fig. 2A;

[0019] Fig. 2C is a perspective view of the canister of the assembly illustrated in Fig. 2A;

[0020] Fig. 2D is a partial view of the assembly illustrated in Fig. 2A, including a sectional side elevation view of a portion of the canister;

[0021] Fig. 2E is a perspective view of an electrical connector of the assembly illustrated in Fig. 2D; and

[0022] Fig. 2F is a sectional side elevation view of a portion of an upper wall of the canister illustrated in Fig. 2A, but constructed in accordance with an alternative embodiment.

DETAILED DESCRIPTION

[0023] The present disclosure recognizes, although electrical connectors having a low profile has been an important design consideration for electrical connectors, electrical connectors having an increased profile can have particular utility in certain applications. As will become apparent from the description below with reference to Figs. 2A-2E, an electrical equipment system 50 can be constructed substantially as described above with respect to the electrical equipment system 18, except for the differences described below. For instance, the electrical equipment system 50 can include a plurality of first electrical connectors 74 having a high profile with an increased height in the transverse direction T with respect to the first electrical connectors 20. Accordingly, the first printed circuit boards 72, on which the first electrical connectors 74 are mounted, are disposed closer to the base of the canister, and consequently the third electrical connectors can have an increased height (and can be manufactured less expensively). Because the daughter cards are disposed closer to the base of the canister with respect to the daughter cards of the conventional electrical equipment system 18, the DIMM connector having an increased height can nevertheless mate with the DIMM without causing the DIMM to mechanically interfere with the upper wall of the canister. Unless otherwise specified, all dimensions shown in Figs. 1A-1E are in millimeters. Thus, the electrical equipment system does not require a specialized and expensive VLP DIMM of the type used in the conventional electrical equipment system 18.

[0024] Referring now to Figs. 2A-2E, the electrical equipment system 50 includes at least one canister assembly 52 and a board assembly 54. The canister assembly 52 includes a canister 56 having a canister body 58 that defines an interior 60. The canister body 58, in turn, can include a base 62 and an upper wall 64 that is spaced from the base 62 along a transverse direction T. The canister body 58 further includes first and second side walls 63 that are spaced from each other along a lateral direction A that is perpendicular to the transverse direction T. The canister body 58 further includes a rear end 66 and a front end 68 spaced from the rear end 66 along a longitudinal direction L that is perpendicular to each of the transverse direction T and the lateral direction A. The front end 68 can define an opening 70. Thus, it can be said that the canister 56 defines an opening 70 that extends through the front end 68 into the interior 60 along the longitudinal direction L.

[0025] The canister assembly 52 further includes a first printed circuit board 72 and at least one first electrical connector 74, such as a plurality of first electrical connectors 74, that is configured to be mounted to the first printed circuit board 72 such that mating ends of electrical contacts of the first electrical connectors 74 are aligned with the opening 70 along the longitudinal direction L. As will be described in more detail below, the first printed circuit board 72 can be configured as a daughter card. The first electrical connectors 20 can be configured as right-angle receptacle connectors, and the first printed circuit board 72 can be oriented along a plane defined by the longitudinal direction L and the lateral direction A.

[0026] The board assembly 54 includes a second printed circuit board 76 and at least one second electrical connector 78 configured to be mounted onto the second printed circuit board 76. The second printed circuit board 76 can be configured as a backplane or a midplane. The second printed circuit board 76 is oriented along a plane that extends in the lateral direction A and the transverse direction T. The first and second electrical connectors 74 and 78 can be configured as receptacle connectors and header connectors, respectively, as described in U. S. Patent No. 7,331,800, which is hereby incorporated by reference as if set forth in its entirety herein. It should be appreciated, of course, that the first and second electrical connectors 74 and 78 can be constructed in accordance with any suitable embodiment as desired. As will be described below, the first and second electrical connectors 74 and 78 are configured to mate with each other, thereby placing the first printed circuit board 72 and the second printed circuit board 76 in electrical communication with each other.

[0027] The electrical equipment system 50 can further include an enclosure 80 that defines at least one canister slot 82 sized to receive the canister 56. For instance, the enclosure 80 can define a pair of canister slots 82 each sized to receive a respective one of a corresponding

pair of canisters 56. The enclosure 80, and thus the canister slot 82, is disposed at a fixed location with respect to the second printed circuit board 76 with respect to the transverse direction T. The enclosure 80 is further configured to support the board assembly 54, such that the canister 56 is disposed at a fixed location with respect to the second printed circuit board 76 with respect to the transverse direction T. Accordingly, the second electrical connectors 78 are aligned with the first electrical connectors 74 when the canister 56 is disposed in the canister slot 82. For instance, when the second electrical connectors 78 are mounted onto the second printed circuit board 76 and the canister 56 is inserted into the canister slot 82, the opening 70 is aligned with the second electrical connectors 78 along the longitudinal direction L. Accordingly, when the canister 56 is inserted into the canister slot 82, and the first electrical connectors 74 are mounted to the first printed circuit board 72, the first electrical connectors 74 are aligned to mate with respective ones of the second electrical connectors 78 along a mating direction when the second electrical connectors 78 are mounted to the second printed circuit board 76. The mating direction can be defined by the longitudinal direction L, which is parallel to the first printed circuit board 72 and normal to the second printed circuit board 76. When the first electrical connectors 74 are mated with the respective ones of the second electrical connectors 78, the first printed circuit board 72 is placed in electrical communication with the second printed circuit board 76. When the canister 56 is disposed in the canister slot 82, the canister 56 defines a relative position with respect to the second electrical connector 78 mounted onto the second printed circuit board 76 with respect to the transverse direction T that is the same as the relative position between the canister 28 and the second electrical connector 24 mounted onto the second printed circuit board 26 with respect to the transverse direction T when the canister 28 is disposed in the canister slot 38 described above. The enclosure 80, the canister 56, and the board assembly 54 can be constructed as described and illustrated in Storage Bridge Bay (SBB) Specification Version 2.1, dated April 20, 2011, which is hereby incorporated by reference as set forth in its entirety herein.

[0028] As described above, the first electrical connectors 74 can be modified with respect to the first electrical connectors 20 of the electrical equipment system 18 described above. For instance, the first electrical connectors 74 can define a different height than the first electrical connectors 20 along the transverse direction T. In particular, the first electrical connectors 74 can define an increased height with respect to the first electrical connectors along the transverse direction T. As described and illustrated in U. S. Patent No. 7,331,800 dated February 19, 2008, each of the first electrical connectors 74 can be configured as right-angle electrical connectors each having a connector housing 84 that includes a dielectric or electrically

insulative housing body 85 and a dielectric or electrically insulative spacer 92 that extends down from the housing body 85 along the transverse direction T. The housing body 85, and thus the connector housing 84, defines a mating interface 86 configured to engage the respective one of the plurality of second electrical connectors 78, and a bottom end 88. The bottom end 88 and the mating interface 86 are oriented orthogonal with respect to each other. The housing body 85 can further define an upper end 89 that is opposite the bottom end 88 along the transverse direction T.

[0029] The first electrical connectors 74 further include electrical contacts 90 that include signal contacts and ground contacts. Adjacent ones of the signal contacts along a column can define a differential signal pair. Adjacent differential signal pairs along the column can be separated by a ground contact. For instance, the first electrical connectors 74 can include a plurality of leadframes that each includes a leadframe housing and a plurality of electrical contacts supported by respective ones of the leadframe housings. The leadframe housings can be overmolded onto the electrical contacts to define insert molded leadframe assemblies IMLAs. The leadframe housings can define the bottom end 88 in accordance with some embodiments. Each leadframe assembly defines a respective column. Because the leadframe housings support the electrical contacts, and the leadframe assemblies are supported by the housing body 85, it can be said that the electrical contacts are supported by the housing body 85.

[0030] The electrical contacts 90 define mating ends 90a disposed proximate to the mating interface 86, and mounting ends 90b opposite the mating ends 90a. The mounting ends 90b extend out from the bottom end 88 of the housing body 85. The mounting ends 90b can be configured as press-fit tails configured to be inserted into respective vias of the first printed circuit board 72, thereby mounting the first electrical connector 74 to the first printed circuit board 72. Alternatively, the mounting ends 90b can be configured to be surface mounted onto the first printed circuit board 72.

[0031] The housing body 85 defines a height along the transverse direction T from the bottom end that is equal to the height of the connector housing of the first electrical connectors 20 of the conventional electrical equipment system 18. Thus, the bottom end 88 of the housing body 85 can be positioned at the same location in the canister 56 as the bottom end 21b of the connector housing 21. The spacer 92 can be disposed adjacent the bottom end 88 of the housing body 85. The spacer 92 can define a bottom end 93 that defines a mounting interface 94 of the first electrical connector 74. The mounting interface 94 can be disposed between the mounting ends 90b of the electrical contacts 90 and the bottom end 88 of the housing body 85. The spacer 92 can have any suitable height along the transverse direction T. For instance, the height can be

in the range of approximately 2 mm and 5 mm, such as approximately 3 mm, such that the first printed circuit board 72 does not interfere with the base 62 of the canister 56. As a result, the first electrical connectors 74 can define a height from the upper surface of the connector housing 84 to the bottom end of the spacer 92 a distance within the range of approximately 13 mm and approximately 18.5 mm, such as 14.45 mm. Furthermore, the electrical contacts 90 are lengthened in the transverse direction T, with respect to the electrical contacts of the first electrical connectors 20, such that the mounting ends 90b extend down along the transverse direction T from the mounting interface 94 defined by the spacer 92. In particular, the mounting ends 90b extend down with respect to the spacer 92 a sufficient distance such that the mounting ends 90b are configured to be mounted to the first printed circuit board 72. In one example, the electrical contacts 90 are lengthened in the transverse direction T a distance between approximately 2 mm and 5.5 mm, such as approximately 3 mm, with respect to the electrical contacts of the first electrical connectors 20 of the electrical equipment system 18. The mounting ends 90b can extend down from the spacer 92 a distance along the transverse direction T that is equal to a distance that the mounting ends of the first electrical connectors 20 extend down from the bottom end of the respective connector housings. Distances described herein as "approximate" are intended to fall within manufacturing tolerances.

[0032] In one example, the spacer 92 can be integral and monolithic with the housing body 85 so as to define a single-piece structure. Alternatively, the spacer 92 can be separate from the housing body 85 and attached to the housing body 85 using any suitable attachment mechanism as desired. Alternatively still, the spacer 92 can be placed adjacent the bottom end 88 of the housing body 85 so as to be disposed between the first printed circuit board 72 and the housing body 85 with respect to the transverse direction T. The spacer 92 can include apertures, and one or more up to all of the mounting ends 90b can extend through the apertures. In one example, the spacer 92 can be overmolded onto the electrical contacts 90. Alternatively or additionally, the spacer 92 can be segmented, such that one or more up to all of the mounting ends 90b can extend between respective segments of the spacer 92. Alternatively still, the spacer 92 can be disposed outboard with respect to the mounting ends 90b along a plane that is defined by the lateral direction A and the longitudinal direction L. In this regard, it is appreciated that the mounting ends 90b of all electrical contacts 90 are arranged in a footprint, and the spacer 92 can be disposed outside the footprint.

[0033] It should be appreciated that when the first electrical connector 74 is mounted to the first printed circuit board 72, and the mating interface 86 is aligned with the opening 70 in the longitudinal direction L, the increased profile of the first electrical connector 74 in the

transverse direction T causes the first printed circuit board 72 to be spaced from the base 62 a distance in the transverse direction T that is less than the second distance D2 defined by the electrical equipment system 18. For instance, the first printed circuit board 72 can be spaced from the base 62 in the transverse direction T a distance D4. The distance D4 can be between approximately 0.5 mm and approximately 3 mm, such as approximately 2 mm. Because the canister 56 has the same dimensions as the canister 28 of the conventional electrical equipment system 18, the first printed circuit board 72 is spaced from a lower surface 64a of the upper wall 64 in the transverse direction T a distance D5. The distance D5 is greater than the distance D1 illustrated in Fig. 1E. In one example, the distance D5 can be between approximately 30 mm and approximately 33.5 mm, such as approximately 31.5 mm. The distance D5 can alternatively be approximately 32.5 with an appropriately sized spacer 92 of approximately 4 mm in the transverse direction T.

[0034] As described above, the first printed circuit board 72 is supported in the interior 60 between the base 62 and the upper wall 64, such that the first printed circuit board 72 is oriented along a plane that is defined by the lateral direction A and the longitudinal direction L. The plurality of first electrical connectors 74 are mounted to the first printed circuit board 72 such that the respective mating interfaces 86 are aligned with the opening 70 in the longitudinal direction L. For instance, the first printed circuit board 72 can be supported in the interior of the canister at the desired height spaced from the base 62 by the distance D4, using any suitable support member in the interior of the canister as desired.

[0035] The canister assembly 52, and thus the electrical equipment system 50, can further include a third electrical connector 96 (schematically illustrated at Fig. 2D) that is mounted to the first printed circuit board 72. The canister assembly 52, and thus the electrical equipment system 50, can further include an electrical component 98 that is configured to mate with the third electrical connector 96 to place the electrical component 98 in electrical communication with the first printed circuit board 72. For instance, the electrical component 98 can mate with the third electrical connector 96 along the transverse direction T. The electrical component can 98 be a dual inline memory module (DIMM). Thus, the third electrical connector 96 can be a DIMM connector that is configured to be mounted to the first printed circuit board 72 and mated with the DIMM.

[0036] The present disclosure recognizes that the increased profile of the first electrical connectors 74 along the transverse direction T, and correspondingly lower location of the first printed circuit board 72, can allow the third electrical connector 96 to have a greater height in the transverse direction T than the height of the third electrical connector 40. Accordingly, the third

electrical connector 96 need not be configured as a VLP DIMM connector. For instance, the third electrical connector 96 can be a standard DDR 4 DIMM connector having a seat plane that is 1.1mm tall in the transverse direction T. In one example, the third electrical connector 96 can, for instance, be a Lotes ADDR0084-K001C, commercially available from LOTES Co., Ltd. Having a place of business in Keelung, Taiwan. The DIMM can be a DDR4 having a 31.25 mm height in the transverse direction T. Thus, the third electrical connector 96 and the DIMM have a combined height D6 that can be between approximately 32 and approximately 33 mm, such as approximately 32.35 mm. Accordingly, when the DIMM is mated with the third electrical connector 96, and the third electrical connector 96 is mounted onto the first printed circuit board 72, the third electrical connector 96 and the DIMM combine to define a height of 32.35 from the first printed circuit board 72 toward the upper wall 64 in the transverse direction T. The distance D6 can thus be less than the distance D5 from the first printed circuit board 72 to the upper wall 64.

As illustrated in Fig. 2F, in instances where the distance D6 is greater than D5, the upper wall 64 can define a slot 65 that extends into the lower surface 64a toward an upper surface 64b that is opposite the lower surface 64a along the transverse direction T. The slot 65 can be sized to receive an upper free end of the DIMM. For instance, the slot 65 can be between approximately 0.85 mm and 0.95 mm in the transvers direction T. The upper wall 64 can have a thickness in the transverse direction T from the lower surface 64a to the upper surface 64b of 1 mm, such that the slot 65 does not extend entirely through the upper wall 64 along the transverse direction T. Rather, the slot 65 can terminate with respect to the transverse direction T at a location between the lower surface 64a and the upper surface 64b. Alternatively, as described above, the spacer 92 can have a height sufficient such that the DIMM does not contact the upper wall 64 when the upper wall 64 does not include the slot 65. Because the DIMM terminates at a location below the upper wall 64, and in particular below the upper surface 64b, the first electrical connector 74 can be said to be system compatible with the third electrical connector 96 and the DIMM. At the same time, it is to be understood that the first electrical connector 74 is not associated with the third electrical connector 96. That is, the first electrical connector 74 is not configured to mate with the third electrical connector 96. The mating ends 90a of the electrical contacts 90 are not arranged in such a manner so as to mate with the third electrical connector 96. Because the DIMM would interfere with the upper wall 64 when mated with the third electrical connector 96 when the first electrical connector 20 is mounted onto the first printed circuit board 72, the first electrical connector 20 is not system compatible with the third electrical connector 96 and the DIMM.

[0037] It should be appreciated that the first electrical connector 74 and the first electrical connector 20 are footprint compatible with each other. That is, both the first electrical connector 74 and the first electrical connector 20 define a mounting interface of the same size along the lateral and longitudinal directions A and L, and can thus be mounted to the same array of mounting locations of the first printed circuit board 72. As described above, the mounting locations can be defined by vias, contact pads, or both that are configured to electrically connect with the electrical contacts 90 and 23, respectively, of the first electrical connectors 74 and 20.

[0038] It is recognized that the third electrical connector 96 is significantly less expensive to manufacture than the lower profile third electrical connector 40. As a result, the high profile of the first electrical connectors 74 significantly reduces the cost to manufacture the canister assembly 52, and thus the electrical equipment system 50. At the same time, the first electrical connector 74 is system compatible with the less expensive third electrical connector 96, while the first electrical connector 20 is not system compatible with the less expensive third electrical connector 96. While the first electrical connector 74 can be more expensive to manufacture than the first electrical connector 20 that does not include the spacer 92, the difference in manufacturing costs is less than the difference in the manufacturing costs between the third electrical connector 96 and the third electrical connector 40. For example, the cost to manufacture the third electrical connector 40 can be at least substantially 30% greater than the cost to manufacture the third electrical connector 96.

[0039] It should be appreciated that the third electrical connector 40 and the third electrical connector 96 are footprint compatible with each other. That is, both the third electrical connector 40 and the third electrical connector 96 define the same mounting interface along the lateral and longitudinal directions A and L, respectively, and can thus be mounted to the same array of mounting locations of the first printed circuit board 72. As described above, the mounting locations can be defined by vias, contact pads, or both that are configured to electrically connect with the electrical contacts of the third electrical connectors 40 and 96. Further, both the third electrical connector 40 and the third electrical connector 96 can mate with the same DIMM. Accordingly, the first electrical connector 74 can be used with the third electrical connector 40 or the third electrical connector 96 that are structurally different than each other, but are footprint compatible with each other.

[0040] In accordance with one aspect of the present disclosure, a method can be provided for reducing the cost of an electrical equipment system. The method can include the step of increasing the height of an electrical connector such that the electrical connector is system compatible with an unassociated electrical connector. The step of increasing can include

incorporating a spacer into the electrical connector such that mounting ends of electrical contacts of the electrical connector extend beyond the spacer a sufficient distance such that the mounting ends are configured to be mounted to the printed circuit board. The step of incorporating can include fabricating a connector housing that includes a housing body that supports the electrical contacts, and a spacer monolithic with the housing body. The step of incorporating can include attaching the spacer to a housing body of a housing of the electrical connector that supports the electrical contacts. The step of incorporating can include the step of positioning the spacer between the mounting ends and a housing body of a housing of the electrical connector, wherein the housing body supports the electrical contacts.

[0041] The method can further include the step of mounting the electrical connector and the unassociated electrical connector onto the same common printed circuit board. The method can further include the step of supporting the electrical connector, the unassociated electrical connector, and the printed circuit board in an interior of a canister, such that the electrical connector is aligned for mating through an opening of the canister. The method can further include the step of mating the electrical connector with a complementary electrical connector mounted on a backplane or midplane. The method can further include the step of mating a DIMM with the unassociated electrical connector. The step of mating the DIMM with the unassociated electrical connector can cause the printed circuit board, the unassociated electrical connector, and the DIMM to be disposed in the interior of the canister having a height of between 30 mm and approximately 36 mm from the printed circuit board to an upper wall of the canister. The method can further include the step of inserting the canister into a canister slot of an enclosure, such that the opening is aligned with the complementary electrical connector along a direction that is parallel to the printed circuit board.

[0042] In accordance with one aspect of the present disclosure, a method can be provided to reduce the cost of an electrical equipment system. The method can include the step of identifying first, second, and third different electrical connectors, the second and third of which are structurally different from each other but are footprint compatible with each other, wherein the first electrical connector is not footprint compatible with either of the second and third electrical connectors. The method can further include the step of increasing the height of the first electrical connector such that the first electrical connector and a less expensive one of second and third electrical connectors can be used in the electrical equipment system. The step of increasing can include incorporating a spacer into the electrical connector such that mounting ends of electrical contacts of the electrical connector extend beyond the spacer a sufficient distance such that the mounting ends are configured to be mounted to the printed circuit board.

The step of incorporating can include fabricating the spacer monolithic with a housing body of the electrical connector that supports the electrical contacts. The step of incorporating can include attaching the spacer to a housing body of the electrical connector that supports the electrical contacts. The step of incorporating can include positioning the spacer between the mounting ends and a housing body of the electrical connector that supports the electrical contacts.

[0043] The less expensive one of the second and third electrical connectors is a taller one of the second and third electrical connectors. The method can include the step of mounting the first electrical connector and the less expensive one of the second and third electrical connectors to the same printed circuit board. The method can include the step of supporting the first electrical connector, the less expensive one of the second and third electrical connectors, and the printed circuit board in an interior of a canister, such that the first electrical connector is aligned for mating to a complementary electrical connector through an opening of the canister. The method can include the step of mating the first electrical connector with the complementary electrical connector mounted on a backplane or midplane. The method can include the step of mating a DIMM with the less expensive one of the second and third electrical connectors. The step of mating the DIMM with the one of the second and third electrical connectors can cause the printed circuit board, the one of the second and third electrical connectors, and the DIMM to be disposed in the interior of the canister having a height of D5 from the printed circuit board to an upper wall of the canister. The method can include the step of inserting the canister into a canister slot of an enclosure, such that the opening is aligned with the complementary electrical connector along a direction that is parallel to the printed circuit board.

[0044] It is to be understood that the foregoing illustrative embodiments have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the invention. Words which have been used herein are words of description and illustration, rather than words of limitation. Further, although the invention has been described herein with reference to particular structure, materials and/or embodiments, the invention is not intended to be limited to the particulars disclosed herein. Rather, the invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims. Those skilled in the art, having the benefit of the teachings of this specification, may affect numerous modifications thereto and changes may be made without departing from the scope and spirit of the invention in its aspects.

What is Claimed:

1. A method to reduce the cost of an electrical equipment system comprising the step of increasing the height of an electrical connector such that the electrical connector is system compatible with an unassociated electrical connector.

2. The method as recited in claim 1, further comprising the step of mounting the electrical connector and the unassociated electrical connector onto the same common printed circuit board.

3. The method as recited in claim 2, further comprising the step of supporting the electrical connector, the unassociated electrical connector, and the printed circuit board in an interior of a canister, such that the electrical connector is aligned for mating through an opening of the canister.

4. The method as recited in claim 3, further comprising the step of mating the electrical connector with a complementary electrical connector mounted on a backplane or midplane.

5. The method as recited in any one of claims 2 to 4, further comprising the step of mating a DIMM with the unassociated electrical connector.

6. The method as recited in any one of claims 3 to 5, further comprising the step of inserting the canister into a canister slot of an enclosure, such that the opening is aligned with the complementary electrical connector along a direction that is parallel to the printed circuit board.

7. The method as recited in any one of claims 2 to 6, wherein the step of increasing further comprises incorporating a spacer into the electrical connector such that mounting ends of electrical contacts of the electrical connector extend beyond the spacer a sufficient distance such that the mounting ends are configured to be mounted to the printed circuit board.

8. The method as recited in claim 7, wherein the step of incorporating comprises fabricating a connector housing that includes a housing body that supports the electrical contacts, and a spacer monolithic with the housing body.

9. The method as recited in claim 7, wherein the step of incorporating comprises attaching the spacer to a housing body of a housing of the electrical connector that supports the electrical contacts.

10. The method as recited in claim 7, wherein the step of incorporating comprises the step of positioning the spacer between the mounting ends and a housing body of a housing of the electrical connector, wherein the housing body supports the electrical contacts.

11. The method as recited in claim 5, wherein the step of mating the DIMM with the unassociated electrical connector causes the printed circuit board, the unassociated electrical connector, and the DIMM to be disposed in the interior of the canister having a height of between 30 mm and approximately 36 mm from the printed circuit board to an upper wall of the canister.

12. A method to reduce the cost of an electrical equipment system comprising the steps of:

identifying first, second, and third different electrical connectors, the second and third of which are structurally different from each other but are footprint compatible with each other, wherein the first electrical connector is not footprint compatible with either of the second and third electrical connectors; and

increasing the height of the first electrical connector such that the first electrical connector and a less expensive one of second and third electrical connectors can be used in the electrical equipment system.

13. The method as recited in claim 12, wherein the less expensive one of the second and third electrical connectors is a taller one of the second and third electrical connectors.

14. The method as recited in any one of claims 12 to 13, further comprising the step of mounting the first electrical connector and the less expensive one of the second and third electrical connectors to the same printed circuit board.

15. The method as recited in claim 14, further comprising the step of supporting the first electrical connector, the less expensive one of the second and third electrical connectors, and the printed circuit board in an interior of a canister, such that the first electrical connector is aligned for mating to a complementary electrical connector through an opening of the canister.

16. The method as recited in claim 15, further comprising the step of mating the first electrical connector with the complementary electrical connector mounted on a backplane or midplane.

17. The method as recited in any one of claims 12 to 16, further comprising the step of mating a DIMM with the less expensive one of the second and third electrical connectors.

18. The method as recited in claim 17, wherein the step of mating the DIMM with the one of the second and third electrical connectors causes the printed circuit board, the one of the second and third electrical connectors, and the DIMM to be disposed in the interior of the canister at a height of between approximately 32 and approximately 33 mm from the printed circuit board to an upper wall of the canister.

19. The method as recited in any one of claims 15 to 18, further comprising the step of inserting the canister into a canister slot of an enclosure, such that the opening is aligned with the complementary electrical connector along a direction that is parallel to the printed circuit board.

20. The method as recited in any one of claims 14 to 19, wherein the step of increasing further comprises incorporating a spacer into the electrical connector such that mounting ends of electrical contacts of the electrical connector extend beyond the spacer a sufficient distance such that the mounting ends are configured to be mounted to the printed circuit board.

21. The method as recited in claim 20, wherein the step of incorporating comprises fabricating the spacer monolithic with a housing body of the electrical connector that supports the electrical contacts.

22. The method as recited in claim 20, wherein the step of incorporating comprises attaching the spacer to a housing body of the electrical connector that supports the electrical contacts.

23. The method as recited in claim 20, wherein the step of incorporating comprises the step of positioning the spacer between the mounting ends and a housing body of the electrical connector that supports the electrical contacts.

24. An electrical connector comprising:

a right angle electrical connector that can be used with two other electrical connectors that are footprint compatible with each other in a system that includes a 1) canister having a canister body that defines base and an upper wall spaced from the base a distance of approximately 35.6 mm, and an opening that extends through the canister body, and 2) a printed circuit board configured to be supported in the canister at a location such that (a) when the right angle electrical connector is mounted to the printed circuit board, a mating interface of the right angle electrical connector is aligned with the opening to be mated with a complementary electrical connector, and (b) when either of the two other electrical connectors is mounted to the

printed circuit board and mated with a DIMM, the DIMM terminates at a location between the base and the upper wall,

wherein a first one of the two other electrical connectors has a first height, and a second one of the two other electrical connectors has a second height that is greater than the first height.

25. The electrical connector as recited in claim 24, wherein the second one of the two other electrical connectors is less expensive to manufacture than the first one of the two other electrical connectors.

26. The electrical connector as recited in any one of claims 24 to 25, wherein each of the first and second ones of the two other electrical connectors comprise DIMM electrical connectors.

27. The electrical connector as recited in any one of claims 24 to 26, wherein the right angle electrical connector includes a housing body and a plurality of electrical contacts supported by the connector housing, each of the plurality of electrical contacts defining a mating end and a mounting end, the right angle electrical connector further including a spacer disposed between the housing body and the mounting ends of the plurality of electrical contacts, such that the mounting ends of the electrical contacts extend out with respect to the spacer a sufficient distance so as to be mounted onto the printed circuit board.

28. The electrical connector as recited in claim 27, wherein the spacer is monolithic with the housing body.

29. The electrical connector as recited in claim 27, wherein the spacer is attached to the housing body.

30. The electrical connector of any one of claims 27 to 29, wherein the spacer has a height of at least 3 mm.

31. An electrical equipment system comprising:

the canister;

the printed circuit board;

the right angle electrical connector as recited in any one of claims 24 to 30; and

at least one of the two other electrical connectors.

32. The electrical equipment system as recited in claim 31, wherein the right angle electrical connector and the at least one of the two other electrical connectors are each mounted onto the printed circuit board such that the right angle electrical connector is aligned to be mated with a complementary electrical connector through the opening.

33. The electrical equipment system as recited in claim 32, further comprising the complementary electrical connector.

34. The electrical equipment system as recited in claim 33, further comprising a midplane or backplane, wherein the complementary electrical connector is mounted to the midplane or backplane.

35. The electrical equipment system as recited in any one of claims 32 to 34, further comprising an enclosure having a canister slot, wherein the canister is configured to be inserted into the canister slot such that the opening is aligned with the complementary electrical connector.

36. The electrical equipment system as recited in any one of claims 31 to 35, wherein the second one of the two other electrical connectors has a manufacturing cost that is at least 30% less than the first one of the two other electrical connectors.

37. An electrical connector comprising:

a right angle electrical connector that can be used with two other electrical connectors that are footprint compatible with each other in a system that includes a 1) canister having a canister body that defines base and an upper wall spaced from the base a distance of approximately 35.6 mm, and an opening that extends through the canister body, and 2) a printed circuit board configured to be supported in the canister at a location such that (a) when the right angle electrical connector is mounted to the printed circuit board, a mating interface of the right angle electrical connector is aligned with the opening to be mated with a complementary electrical connector, and (b) when either of the two other electrical connectors is mounted to the printed circuit board and mated with a DIMM, the DIMM terminates at a location between the base and the upper wall,

wherein a first one of the two other electrical connectors has a first cost of manufacture, and the second one of the two other electrical connectors has a second cost of manufacture that is at least 30% smaller than the first cost of manufacture.

38. The electrical connector as recited in claim 37, wherein each of the first and second ones of the two other electrical connectors comprise DIMM electrical connectors.

39. The electrical connector as recited in any one of claims 37 to 38, wherein the right angle electrical connector includes a connector housing and a plurality of electrical contacts supported by the connector housing, each of the plurality of electrical contacts defining a mating end and a mounting end, the right angle electrical connector further including a spacer disposed between the connector housing and the mounting ends of the plurality of electrical contacts, such that the mounting ends of the electrical contacts extend out with respect to the spacer a sufficient distance so as to be mounted onto the printed circuit board.

40. The electrical connector as recited in claim 39, wherein the spacer is monolithic with the connector housing.

41. The electrical connector as recited in claim 39, wherein the spacer is attached to the connector housing.

42. The electrical connector of any one of claims 39 to 41, wherein the spacer has a height of at least 3 mm.

43. An electrical equipment system comprising:
the canister;
the printed circuit board;
the right angle electrical connector as recited in any one of claims 37 to 42; and
at least one of the two other electrical connectors.

44. The electrical equipment system as recited in claim 43, wherein the right angle electrical connector and the at least one of the two other electrical connectors are each mounted onto the printed circuit board such that the right angle electrical connector is aligned to be mated with a complementary electrical connector through the opening.

45. The electrical equipment system as recited in claim 44, further comprising the complementary electrical connector.

46. The electrical equipment system as recited in claim 45, further comprising a midplane or backplane, wherein the complementary electrical connector is mounted to the midplane or backplane.

47. The electrical equipment system as recited in any one of claims 44 to 46, further comprising an enclosure having a canister slot, wherein the canister is configured to be inserted into the canister slot such that the opening is aligned with the complementary electrical connector.

48. A right angle electrical connector comprising:

a housing body and a plurality of electrical contacts supported by the housing body, each of the plurality of electrical contacts defining a mating end and a mounting end, the right angle electrical connector further including a spacer disposed between the housing body and the mounting ends of the plurality of electrical contacts, such that the mounting ends of the electrical contacts extend out with respect to the spacer a sufficient distance so as to be mounted onto the printed circuit board, wherein the right angle electrical connector is system compatible with both a first DIMM electrical connector and a second DIMM electrical connector that is taller than the first DIMM electrical connector,

wherein the right angle electrical connector is footprint compatible with a second right angle electrical connector that does not include the spacer, and configured to mate with a complementary electrical connector that is also configured to mate with the second right angle electrical connector.

49. The electrical connector as recited in claim 48, wherein the second DIMM connector is less expensive to manufacture than the first DIMM connector.

50. The electrical connector as recited in any one of claims 48 to 49, wherein the spacer is monolithic with the housing body.

51. The electrical connector as recited in any one of claims 48 to 49, wherein the spacer is attached to the housing body.

52. The electrical connector of any one of claims 48 to 51, wherein the spacer increases the height of the electrical connector by substantially 3 mm with respect to the second right angle electrical connector.

53. An electrical equipment system comprising:

the electrical connector recited in any one of claims 48 to 52;

a printed circuit board;

at least one of the first and second DIMM electrical connectors.

54. The electrical equipment system as recited in claim 53, wherein the electrical connector and the at least one of the first and second DIMM electrical connectors are each mounted onto the printed circuit board such that the electrical connector is aligned to be mated with a complementary electrical connector through the opening.

55. The electrical equipment system as recited in claim 54, further comprising the complementary electrical connector.

56. The electrical equipment system as recited in claim 55, further comprising a midplane or backplane, wherein the complementary electrical connector is mounted to the midplane or backplane.

57. The electrical equipment system as recited in any one of claims 54 to 56, further comprising an enclosure having a canister slot, wherein the canister is configured to be inserted into the canister slot such that the opening is aligned with the complementary electrical connector.

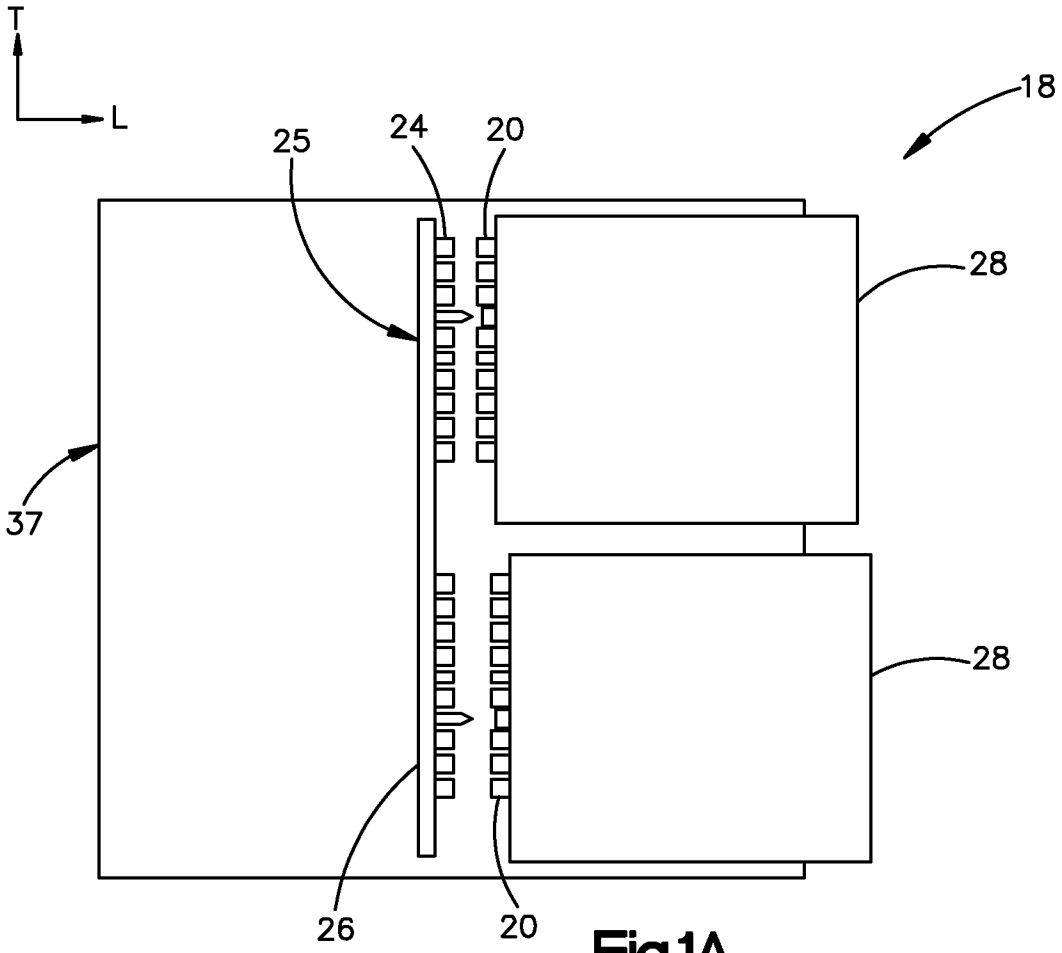

Fig.1A
PRIOR ART

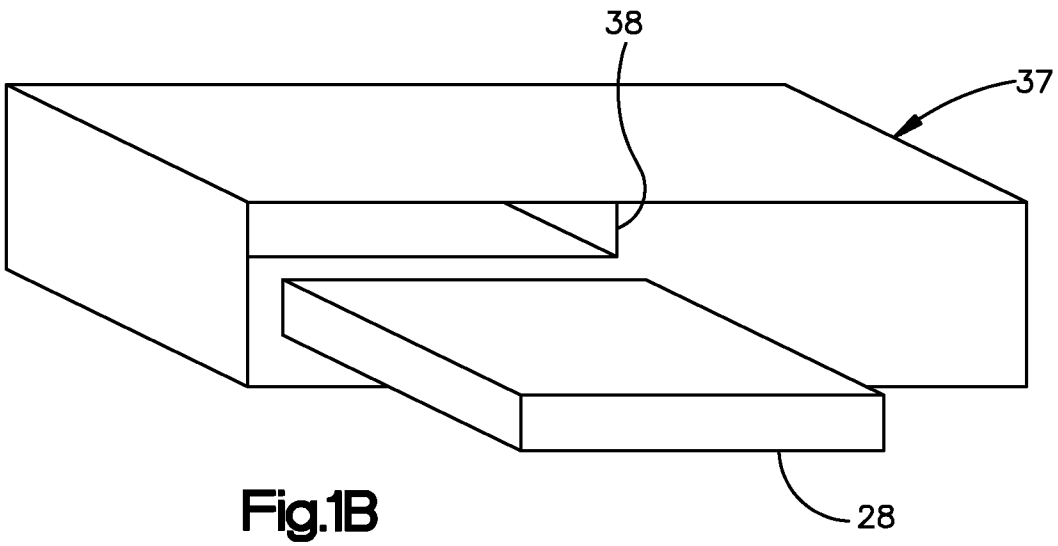

Fig.1B
PRIOR ART

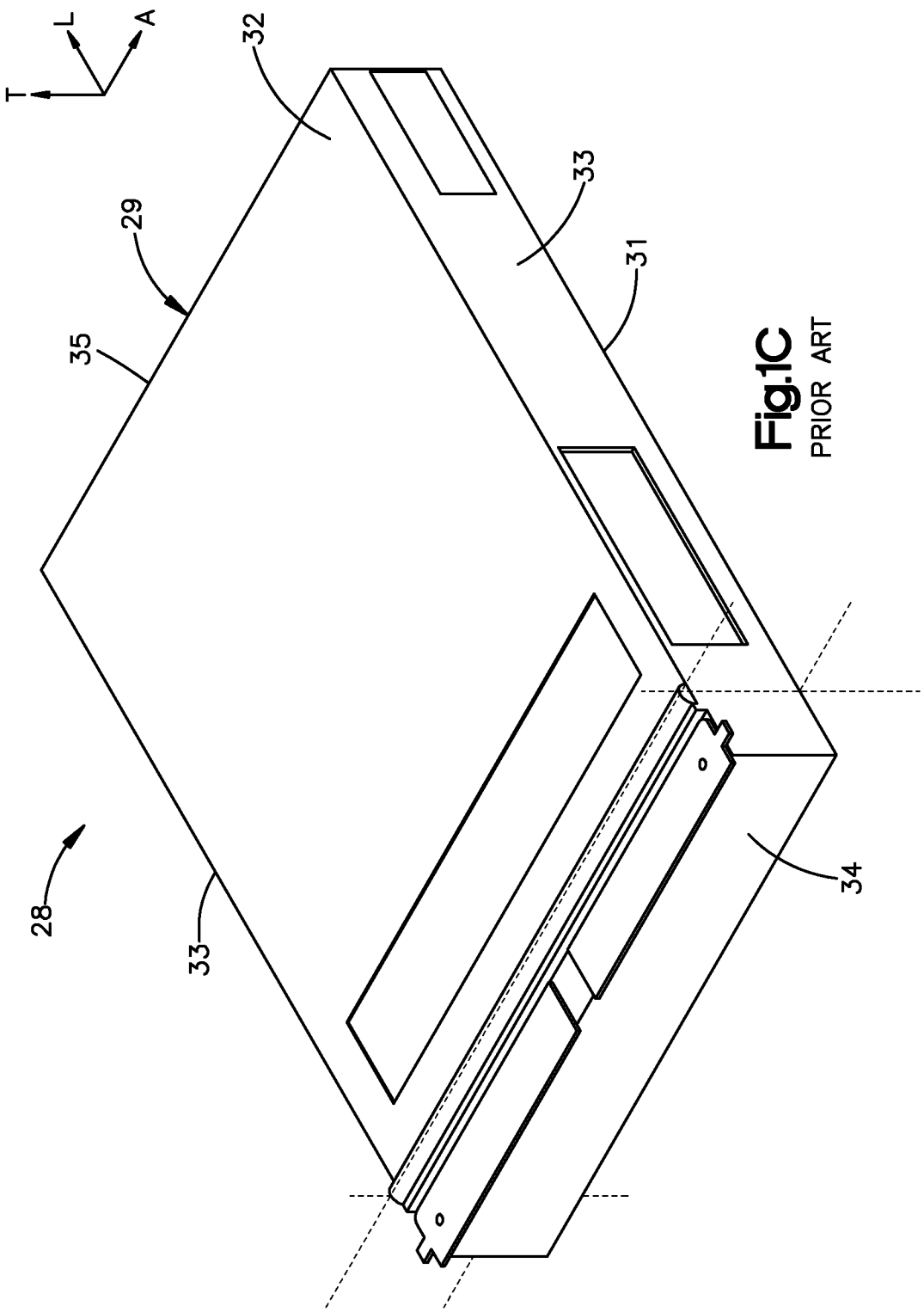

Fig.1C
PRIOR ART

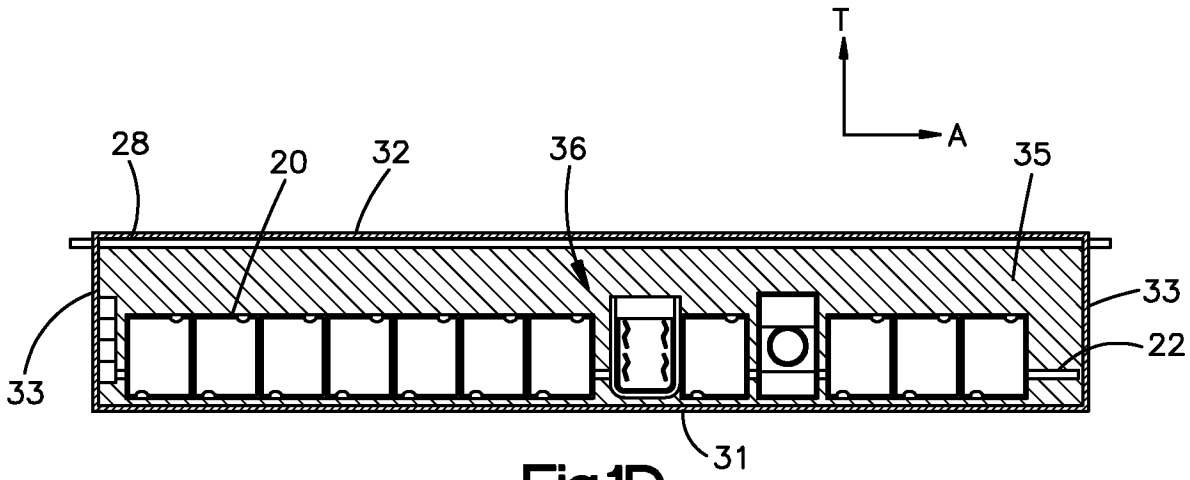

Fig.1D
PRIOR ART

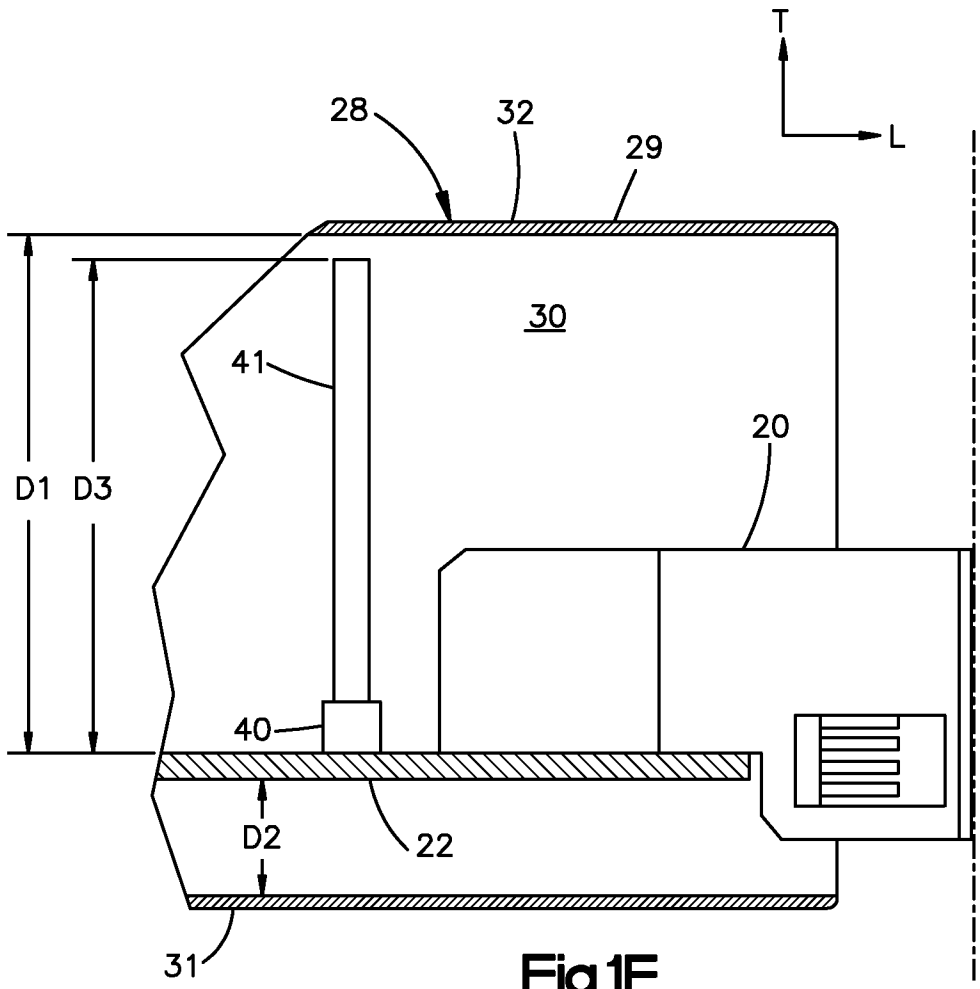

Fig.1E
PRIOR ART

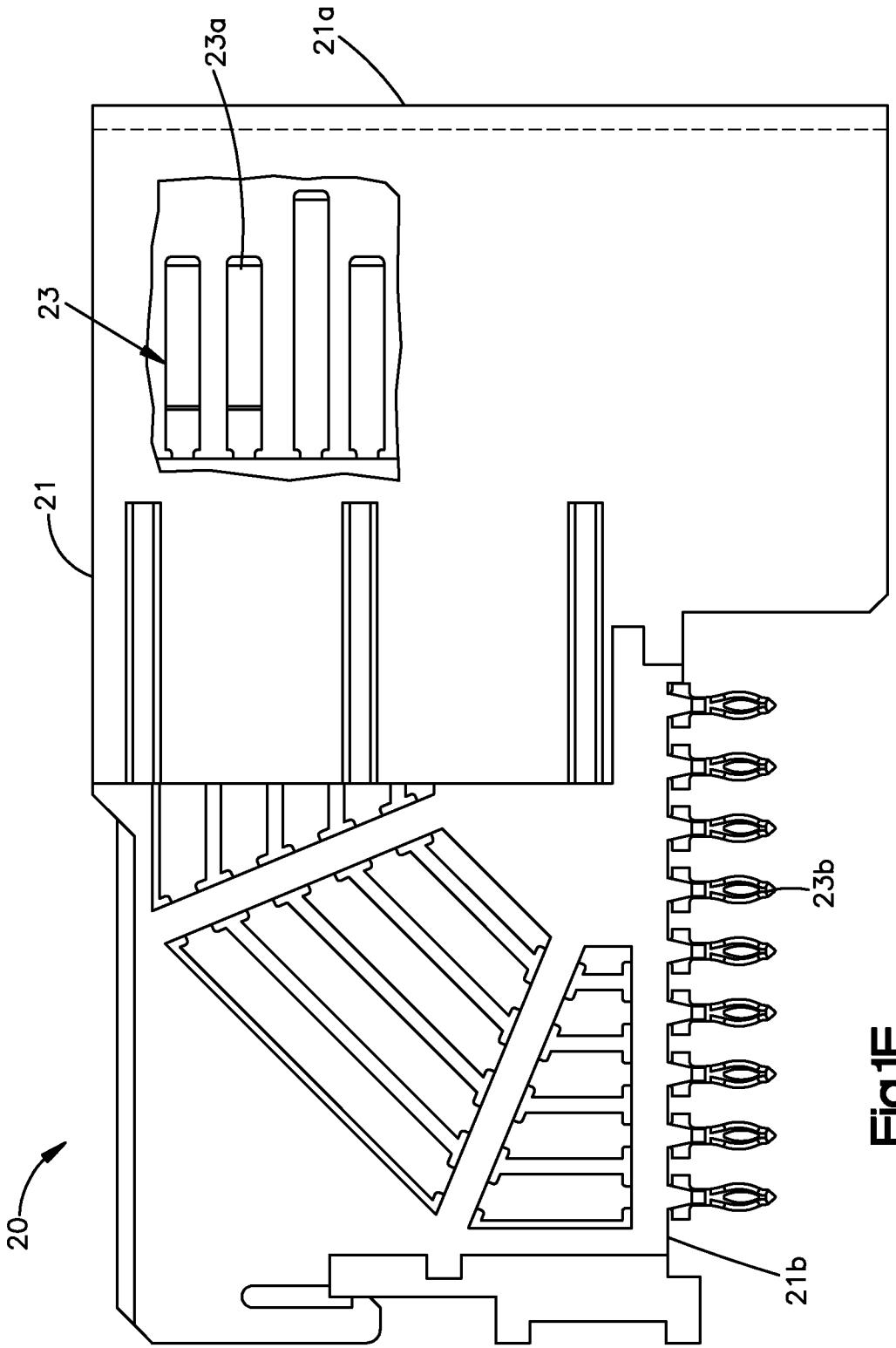

Fig.1F
PRIOR ART

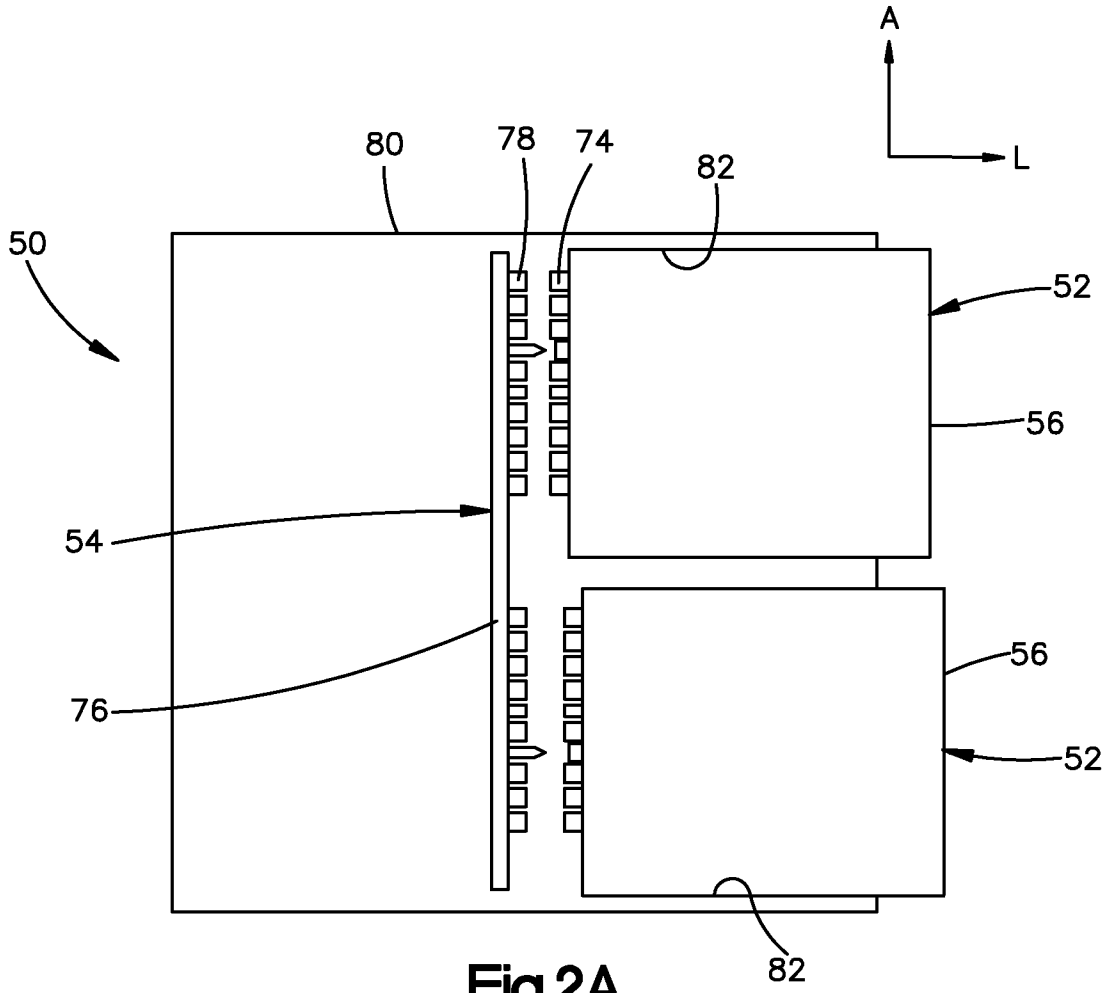

Fig.2A

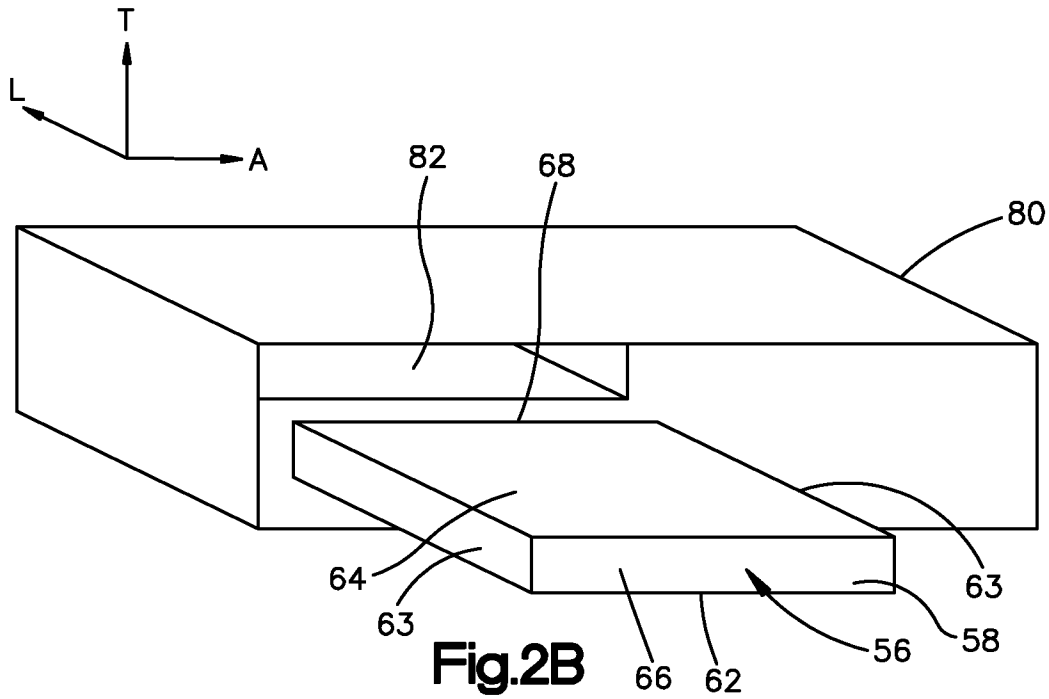

Fig.2B

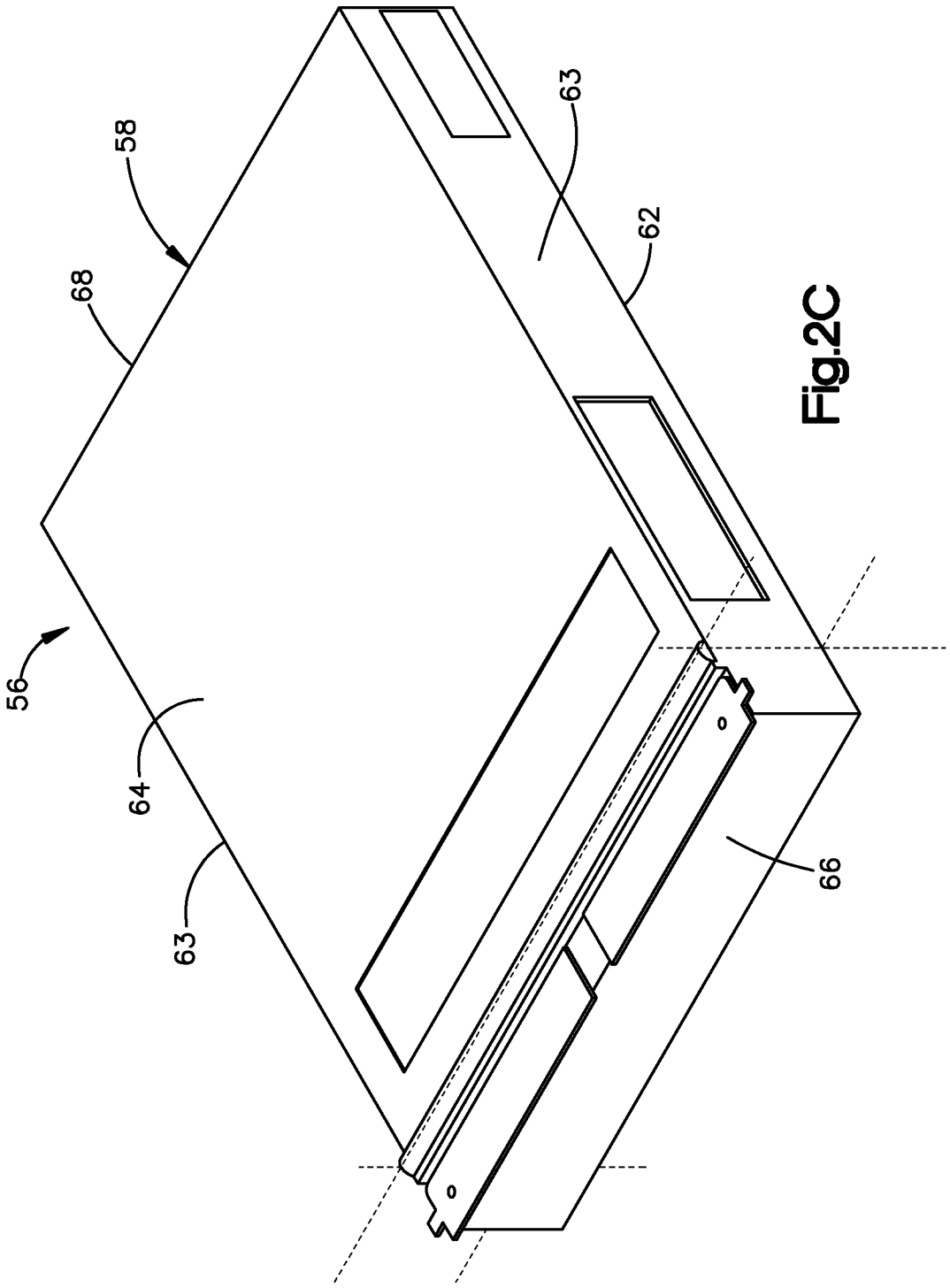

Fig.2C

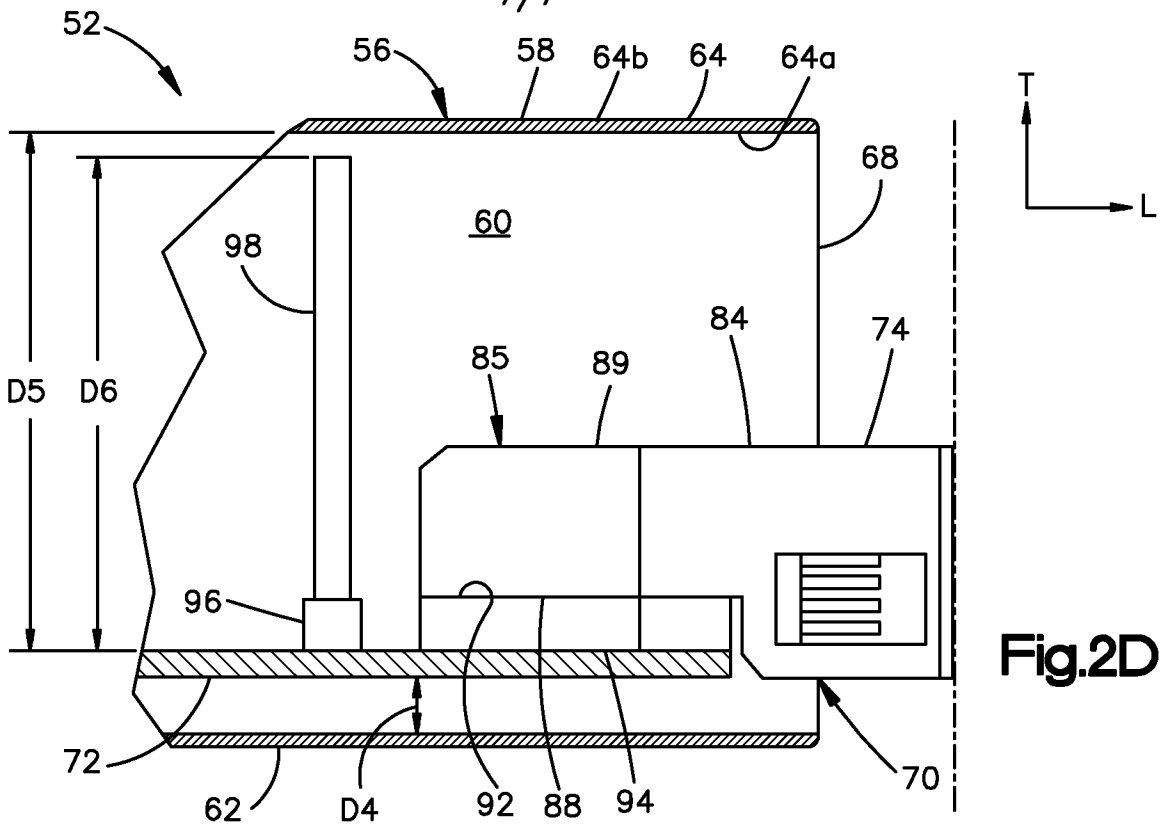

Fig.2D

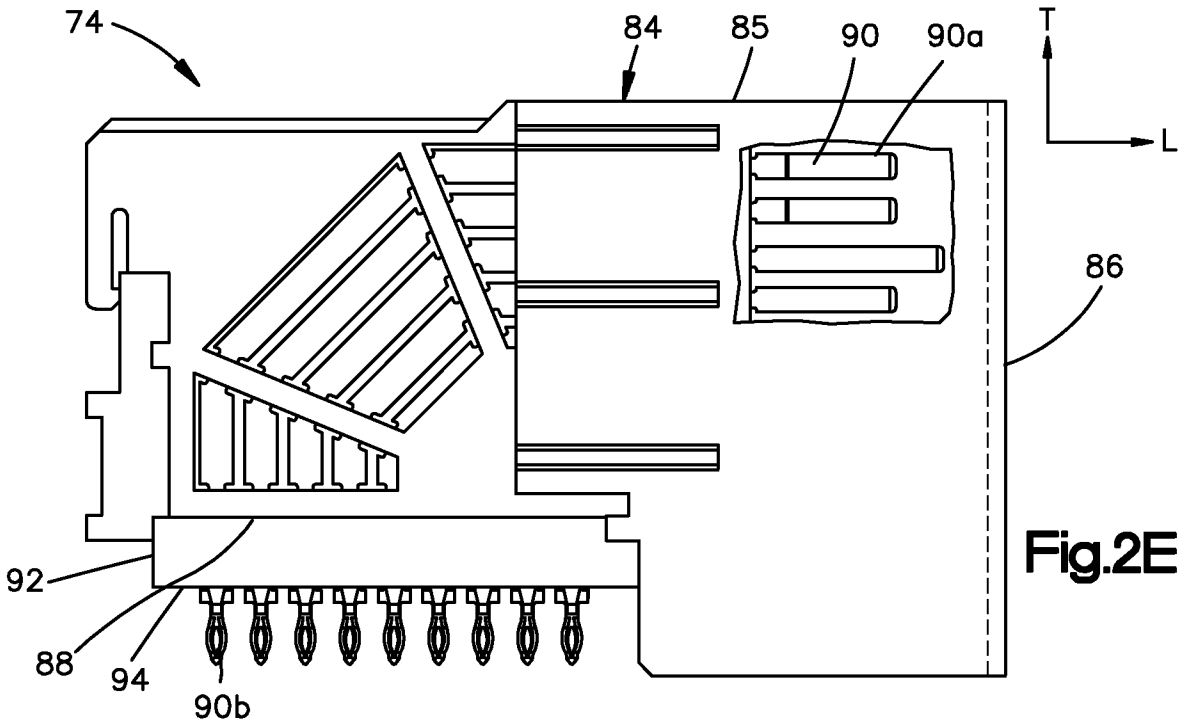

Fig.2E

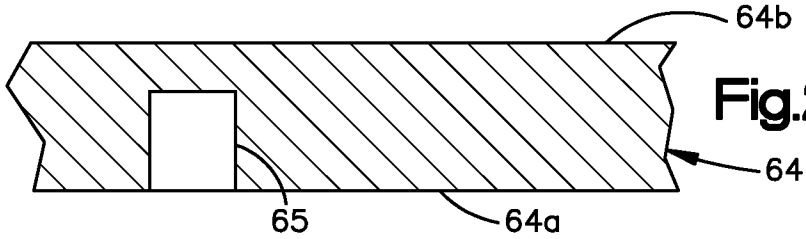

Fig.2F

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/063950

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/514(2006.01)i, H01R 12/71(2011.01)i

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 13/514; H01R 13/66; H01R 11/00; H01R 13/658; H01R 12/16; H01R 12/00; H01R 12/71

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: compatible, DIMM, right angle electrical connector, height, spacer, manufacturing cost

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6142830 A (STEFFEN LOEFFLER) 07 November 2000 See abstract, column 1, lines 48-59 and figure 1.	1-11
A		12-57
Y	US 5310354 A (JOSEPH A. OSWALD, JR.) 10 May 1994 See abstract, column 3, lines 42-43, column 4, lines 6-8 and figure 1.	1-11
A	US 2003-0096516 A1 (YAKOV BELOPOSKY et al.) 22 May 2003 See abstract, paragraphs [0020]-[0035], claim 1 and figures 1, 3.	1-57
A	US 2006-0034061 A1 (KEVIN P. GRUNDY et al.) 16 February 2006 See abstract, paragraphs [0083]-[0085] and figures 13-15.	1-57
A	US 2003-0068920 A1 (CHE-YU LI et al.) 10 April 2003 See abstract, paragraphs [0056]-[0057], claims 1-24 and figures 2-3.	1-57

☐ 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
21 March 2016 (21.03.2016)	**23 March 2016 (23.03.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/063950

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6142830 A	07/11/2000	CN 1147792 C	28/04/2004
		CN 1229212 A	22/09/1999
		EP 0940850 A1	08/09/1999
		EP 0940850 B1	13/08/2003
		JP 11-317489 A	16/11/1999
		KR 10-0538916 B1	27/12/2005
		TW 415069 A	11/12/2000
US 5310354 A	10/05/1994	None	
US 2003-0096516 A1	22/05/2003	CA 2410742 A1	20/05/2003
		CN 1421959 A	04/06/2003
		EP 1315245 A1	28/05/2003
		JP 2003-197299 A	11/07/2003
		KR 10-2003-0041797 A	27/05/2003
		TW 200303633 A	01/09/2003
		TW I221683 B	01/10/2004
		US 6666693 B2	23/12/2003
US 2006-0034061 A1	16/02/2006	US 2007-0236901 A1	11/10/2007
		US 7227759 B2	05/06/2007
		US 7613011 B2	03/11/2009
		WO 2006-107306 A1	12/10/2006
US 2003-0068920 A1	10/04/2003	US 6480014 B1	12/11/2002
		WO 01-45479 A1	21/06/2001