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(54) **RECEPTACLE CONTACT POSITION COMPLIANCE FEATURE**

STECKHÜLSENKONTAKT MIT POSITIONIERUNGSMERKMAL

CARACTERISTIQUE D'ADAPTABILITE DE LA POSITION DE CONTACT D'UNE PRISE DE COURANT

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Description

[0001] This invention relates to electrical connectors and in particular high density electrical connectors for mating with a complementary pin field where there is the possibility of misalignment between mating pins and receptacles.

[0002] There are many electrical connectors used for applications having a large number of interconnections where the interconnections are of a high density. In these high density interconnections, some in the vicinity of a 2 mm pitch, the pin and the receptacle contact have been fully optimized for mechanical and electrical characteristics. Unfortunately, due to the nature of the optimization, sometimes conventional manufacturing tolerances are such that when the mating components are on opposite sides of their tolerance range it is possible to approach the integrity limit of the interconnection.

[0003] In order to accommodate this possibility, it is known to form the receptacle contact with opposing contact arms such that in nominal cases the pin would be engaged by both arms with the desired normal force and as the misalignment increases, the pin would be engaged by the near contact arm with a larger normal force than the away contact arm. In essence, the two contact arms are providing a redundancy such that the integrity of the electrical connection would be assured with a sufficiently large normal force only provided between one of the resilient receptacle arms and the pin. A connector of this type is disclosed in EP 0 422 785 where a board-to-board connector system is shown having receptacle contacts of opposing resilient contact arms closely received in terminal receiving cavities of a housing.

[0004] In some instances, it would be desirable to improve upon the aforegoing and provide some compliance to the system such that the pin and receptacle will float to align in order to accommodate minor misalignment. In WO 95/20252 a connector is disclosed for mating with a complementary pin field. The connector includes an insulating housing having terminal receiving channels therein. Disposed in each channel is a contact that includes a receptacle portion and a conductor engaging portion with a position compliance spring therebetween. The position compliance spring enables some float of the receptacle portion relative to the conductor engaging portion. However, due to the high density involved, the terminal receiving channel is typically closely disposed to the contact such that it is difficult for much float to be realized through the position spring. In cases like this, while the float will provide sufficient compliance to allow engagement of the mating pin by one arm of the receptacle portion it is desirable to improve upon the interface such that each arm would be capable of providing a desired minimum normal force. This, however, is difficult for the reasons set out above and especially the high density of contacts in the system that result in close positioning and optimized mechanical features.

[0005] The problem is solved by an electrical connector comprising a housing with a contact therein, the housing including a contact receiving passageway defined by opposing sidewalls, the contact having a connecting portion for engaging a mating terminal, said connecting portion is connected to a conductor engaging portion by a compliant positioning member that provides relative movement between the connection portion and the conductor engaging portion to accommodate misalignment with the mating terminal, where the contact is positioned in the contact receiving passageway with the connecting portion disposed between the opposing sidewalls and the connecting portion includes a contact section extending from a base that is coupled to the compliant positioning member, the connector being characterized in that the base extends across the channel between the sidewalls a distance greater than that which the contact section extends, such that upon mating with a sufficiently misaligned mating terminal, the contact section is displaced relative the conductor engaging portion such that the base comes into supporting contact with one of the sidewalls to provide a fulcrum point about which rotation of the contact section occurs upon further insertion of the sufficiently misaligned mating terminal.

[0006] It is an advantage of this invention that an additional compliance beyond that realized with only a compliant position member between the connecting portion and the conductor engaging portion can be realized. It is an additional advantage that this additional compliance can be provided in a high density application with highly optimized components. It is yet another advantage that this invention is especially advantageous when used with a contact section having opposing resilient arms where the additional rotational compliance results in an increased normal force of the away arm by bringing the arm against the pin. It is important to note that while the invention is especially advantageous in this type of system it is not meant to be limiting and would be applicable to other contact structures. It is also advantageous that the invention reduces insertion force and associated wear between the mating contacts.

[0007] The invention will now be described by way of example with reference to the drawings wherein:

Figure 1 is a receptacle connector having a high density of contacts for mating with a complementary pin field;

Figure 2 is a top view of the connector of figure 1;

Figure 3 is a side view of a contact of a contact module incorporating the present invention;

Figure 4 is a detail view of a portion of a contact incorporating the present invention of the module of figure 3;

Figure 5 is a sectional view of the connector of figures 1 and 2 taken along the line 5-5 of figure 2;

Figure 6 is a detail view of a portion of the section of figure 5;

Figure 7 is an upper sectional representation of a

contact according to the present invention positioned to receive a nominally aligned mating terminal;

Figure 8 corresponds to figure 7 showing initial insertion of the mating terminal;

Figure 9 corresponds to figure 8 showing full insertion of the mating terminal;

Figure 10 is an upper sectional representation of a contact according to the present invention showing a slightly misaligned mating terminal positioned to be received therein;

Figure 11 corresponds to figure 10 and shows initial insertion of the slightly misaligned mating terminal;

Figure 12 corresponds to figure 11 showing full insertion of the slightly misaligned mating terminal;

Figure 13 is an upper sectional representation of a contact according to the present invention showing a substantially misaligned mating terminal positioned for insertion therein;

Figure 14 corresponds to figure 13 and shows initial insertion of the substantially misaligned mating terminal;

Figure 15 corresponds to figure 14 showing full insertion of the substantially misaligned mating terminal; and

Figure 16 is a graphical representation showing insertion force versus misalignment for the cases of figures 7-15.

[0008] With reference now to figure 1, an electrical connector according to the present invention is shown generally at 2. The electrical connector 2 includes a matrix of a plurality of pin receiving openings 4 arranged in five (5) horizontal rows 6 and twenty-two (22) vertical columns 8 that contain openings 4 in each of the rows 6. Each opening 4 includes funnel-shaped guide surfaces 10 that defines a mouth 12 wherein contact arms 14 are accessible. A centrally located portion 16 is provided for mechanical features such as coding and locking. With reference now to figure 2, the electrical connector 2 is shown from above and includes a forward housing portion 18 wherein the rows 6 in column 8 of openings 4 are disposed. A plurality of modules 20 are fitted to a rear surface 21 of the housing 18.

[0009] The modules 20 are best seen in figure 3. The module 20 includes five contacts 22 according to the present invention that have been stamped and formed using a lead frame construction technique and overmoulded within an insulative body 24. This structure is fully described in EP-A-0 422 785 incorporated herein by reference for all purposes. The contacts 22 of a particular module 20 make up the contacts corresponding to a given column 8 of the connector 2 of figure 1. Each contact 22 includes a connecting portion 26 and a conductor engaging portion 28 that are joined together by a compliant positioning member 30. In the case of the contacts 32 illustrated in this embodiment they are configured for through-hole mounting on a printed circuit board (not shown), however other configurations may be desirable such as insulation displacement contact (IDC) for termination of an insulated wire. The connecting portion 26 is configured as a receptacle connector and includes the contacting arms 14 that extend outward from a base 32. The contact arms 14 make up a contact section 33 (Figure 4). The contact arms 14 have been twisted 90° relative the base 32 through twist sections 34 as is known. The contact arms 14 extend from the base 32 and converge towards one another to define an engaging section 36 therebetween where a mating terminal or pin would be received. The arms 14 then diverge outwardly to free ends 38 such that a guide funnel 40 is defined by the diverging surfaces 42. The base 32 is connected to the compliant positioning member 30 such that the compliant positioning member 30 and the connecting portion 26 take on a tuning fork-like shape.

[0010] With reference now to figure 4, the contacting portion 26 and compliant positioning member 30 is shown in enlarged form. The base 32 of the contacting portion 26 is defined by an outer surface 44 that gives the base 32 a bulbous configuration having a span of dimension A. The contact section 33 is defined by the contact arms 14 and has a span B, where the span A is greater than span B. The compliant positioning member 30 is a necked down section of the lead frame that connects the base 32 to the conductor engaging portion 28. The compliant positioning member 30 is sufficiently necked down such that as a mating pin is inserted into the mouth 40 and is slightly misaligned such that the pin comes in contact with the diverging surfaces 42, the connecting portion 26 will swing in respective directions C relative to the conductor engaging portion 28 thereby improving alignment. The compliant positioning member 30 might also provide compliance in a plane perpendicular to that of the drawing, however with reference once again to figure 1, this plane would correspond to that of one of the rows 6 and as a result of the twist of the contact arms 14 at the twisted section 34 the contact arms 14 span the entire opening 12 such that a pin received anywhere along this axis would be reliably engaged. Without space limitations, the compliance provided by the compliant positioning member 30 might be sufficient to ensure reliable engagement of the mating terminal. However, the connecting portions 26 are closely received within the housing 18.

[0011] With reference now to figure 5, a sectional view of connector 2 is shown having the module 20 affixed thereto with the contacts 22 positioned in the housing 18. The housing 18 includes contact receiving passageways 46 that are in communication with the openings 12 that make up the matrix. Each contact receiving passageway 46 is defined by opposing sidewalls 48,50 that are spanned on both sides by partition walls 52 such that the channel 46 is defined in a manner that electrically isolates the contacts 22 located in adjacent passageways 46 of either the rows 6 or the columns 8. The mating terminal is received through the opening 12 into

the passageway 46 and engaged therein by the contact arms 14. As can be seen, the base 32 of the contact section 33 is closely disposed to the sidewalls 48,50 while the contact section 33 has some space therebetween.

[0012] With reference to figure 6, a section of the cavity 46 is shown in greater detail. The space between the opposing sidewalls 48,50 is defined as D. In the particular embodiment illustrated, D would nominally equal 1.65 mm. The span A of the outer surface 44 of the base 32 would have a nominal span of 1.63 mm. Additionally, the contacting region 46 defines a gap size E having a nominal size of 0.18 mm. The opening 12 into each of the cavities 46 has a nominal size of F equal to 0.70 mm. The mating terminal is a pin of nominal size 0.38 mm.

[0013] With reference now to figures 7-15 the operation of the present invention will be described. With reference first to figures 7-9, the insertion of a nominally aligned mating terminal (pin) 54 is shown to be received between the contact arms 14 of the contact section 33 of the conductor engaging portion 26. In this case, the compliant positioning member 30 does not function to provide compliance and the contacting arms 14 simply open normally about the pin 54 until it is fully inserted, as best seen in figures 8 and 9.

[0014] With reference now to figures 10-12, a slightly misaligned mating terminal 54 is shown. The mating terminal 54 is aligned with a near contact arm 14' such that it will abut the diverging surface 42 of that arm before entering the mating region 36. As a result of the compliant positioning member 30, the connecting portion 26 pivots slightly during the insertion process such that the away arm 14'' also engages the mating pin 54. As best seen in the partial and full insertion illustrations of figures 11 and 12.

[0015] With reference now to figures 13-15, a substantially misaligned terminal 54 is illustrated where the pin 54 is all the way over against one of the sides of the opening 12 and aligned to stub against the near arm 14'. In this configuration, it is conceivable that the near arm 14' will perform all the work of engaging the mating pin 54 with a large normal force where the away arm 14'' would only marginally engage the pin 54. Upon initial insertion, the pin 54 causes the compliant positioning member 30 to act such that the outer surface 44 of the base 32 comes into supporting contact with a sidewall 50 thereby establishing a fulcrum point 52 as illustrated in figure 14. Further insertion of the mating pin 54 results in a rotation about the fulcrum point 52 in the direction of arrow G. This brings the away contact arm 14'' into further engagement with the mating terminal 54 such that the normal force generated by the away arm 14'' is increased. In the embodiment described, it is believed possible to assure that at least 30cN of force is generated by each of the arms.

[0016] With reference to the graph of figure 16, the net force exerted on a mating pin by the contact arms is plotted for the various misalignment (displacement) conditions possible between receptacle and pin. The net force equals zero where "perfect" alignment occurs (i.e. figures 7-9). The mating pin will realize some net force when the misalignment is in the range of figure 10-12 and up to the point of the base contacting the sidewall to establish the fulcrum 52,52' (shown as figure 14). Finally, beyond establishment of the fulcrum 52,52', the force curve becomes steeper as a result of pivoting about the fulcrum 52,52'. The measurements having been taken in a conventional load cell with the transducer coupled to the mating pin, showing that after establishment of the fulcrum a significant increase in realized force occurs.

[0017] As stated above, while the present invention has been described with the receptacle contact, it may be applicable to other contact configurations. better positioning and, in the case of a receptacle contact, increased normal force of the away arm.

[0018] An additional advantage is that as the compliant positioning member allows for float between the connecting portion and the conductor engaging portion when compared to a contact that would rely entirely on simple deflection to accommodate misalignment, the bulbous portion provides a pre-alignment in the channel due to the closer proximity to the sidewalls resulting from the larger span A.

Claims

1. An electrical connector (2) comprising a housing (18) with a contact (22) therein, the housing (18) including a contact receiving passageway (46) defined by opposing sidewalls (48, 50), the contact (22) having a connecting portion (26) for engaging a mating terminal 54, said connecting portion (26) is connected to a conductor engaging portion (28) by a compliant position member (30) that provides relative movement between the connection portion (26) and the conductor engaging portion (28) to accommodate any misalignment with the mating terminal (54), where the contact (22) is positioned in the contact receiving passageway (46) with the connecting portion (26) disposed between the opposing sidewalls (48, 50) and the connecting portion (26) includes a contact section (33) extending from a base (32) that is coupled to the compliance member (30), the connector (2) being characterized in that the base (32) extends across the channel (46) between the sidewalls (48, 50) a distance (A) greater than that which the contact section (33) extends, such that upon mating with a sufficiently misaligned mating terminal (54), the contact section (33) is displaced relative the conductor engaging portion (28) such that the base (32) comes into supporting contact with one of the sidewalls (48, 50) to provide a fulcrum point (52) about which rotation of the contact section (33) occurs upon further insertion of the

sufficiently misaligned mating terminal (54).

2. The electrical connector of claim 1 further characterized in that the base (32) is formed having a bulbous profile (44) of curved surfaces.

3. The electrical connector of claim 1 or claim 2 further characterized in that the connector includes multiple contacts (22) arranged in multiple rows (6) and columns (8).

Patentansprüche

1. Elektrischer Verbinder (2), der ein Gehäuse (18) mit einem Kontakt (22) darin aufweist, wobei das Gehäuse (18) einen Kontaktaufnahmedurchgang (46) umfaßt, der durch gegenüberliegende Seitenwände (48, 50) definiert wird, wobei der Kontakt (22) einen Verbindungsabschnitt (26) für einen Eingriff mit einer passenden Anschlußklemme (54) aufweist, wobei der Verbindungsabschnitt (26) mit einem Leitereingriffsabschnitt (28) durch ein nachgiebiges Positionierungselement (30) verbunden ist, das eine relative Bewegung zwischen dem Verbindungsabschnitt (26) und dem Leitereingriffsabschnitt (28) bewirkt, um jegliche Versetzung mit der passenden Anschlußklemme (54) aufzunehmen, wo der Kontakt (22) im Kontaktaufnahmedurchgang (46) angeordnet ist, wobei der Verbindungsabschnitt (26) zwischen den gegenüberliegenden Seitenwänden (48, 50) angeordnet ist und der Verbindungsabschnitt (26) einen Kontaktabschnitt (33) umfaßt, der sich von einer Basis (32) aus erstreckt, die mit dem nachgiebigen Element (30) gekoppelt ist, wobei der Verbinder (2) dadurch gekennzeichnet ist, daß sich die Basis (32) über den Kanal (46) zwischen den Seitenwänden (48, 50) über einen Abstand (A) erstreckt, der größer ist als der, über den sich der Kontaktabschnitt (33) erstreckt, so daß beim Eingriff mit einer ausreichend versetzten passenden Anschlußklemme (54) der Kontaktabschnitt (33) relativ zum Leitereingriffsabschnitt (28) so verschoben wird, daß die Basis (32) mit einer der Seitenwände (48, 50) in einen tragenden Kontakt kommt, um einen Drehpunkt (52) bereitzustellen, um den eine Drehung des Kontaktabschnittes (33) beim weiteren Einsetzen der ausreichend versetzten passenden Anschlußklemme (54) erfolgt.

2. Elektrischer Verbinder nach Anspruch 1, außerdem dadurch gekennzeichnet, daß die Basis (32) so ausgebildet ist, daß sie ein kolbenartiges Profil (44) aus gewölbten Flächen aufweist.

3. Elektrischer Verbinder nach Anspruch 1 oder Anspruch 2, außerdem dadurch gekennzeichnet, daß der Verbinder mehrere Kontakte (22) umfaßt, die in mehreren Reihen (6) und Spalten (8) angeordnet sind.

Revendications

1. Connecteur électrique (2) comprenant un boîtier (18) contenant un contact (22), le boîtier (18) englobant un passage de réception du contact (46) défini par des parois latérales opposées (48, 50), le contact (22) comportant une partie de connexion (26) destinée à s'engager dans une borne d'accouplement (54), ladite partie de connexion (26) étant connectée à une partie d'engagement de conducteur (28) par un élément de positionnement adaptable (30) permettant un déplacement relatif entre la partie de connexion (26) et la partie d'engagement du conducteur (28) pour assurer l'adaptation à un quelconque désalignement par rapport à la borne d'accouplement (54), le contact (22) étant positionné dans le passage de réception du contact (46), la partie de connexion (26) étant agencée entre les parois latérales opposées (48, 50) et la partie de connexion (26) englobant une section de contact (33), s'étendant à partir d'une base (32) accouplée à l'élément adaptable (30), le connecteur (2) étant caractérisé en ce que la base (32) s'étend à travers le canal (46) entre les parois latérales (48, 50) sur une distance (A) supérieure à la distance d'extension de la section de contact (33), de sorte que lors de l'accouplement avec une borne d'accouplement suffisamment désalignée (54), la section de contact (33) est déplacée par rapport à la partie d'engagement du conducteur (28), un contact de support étant ainsi établi entre la base (32) et une des parois latérales (48, 50), pour établir un point de pivotement (52) autour duquel la section de contact (33) tourne lors de l'insertion ultérieure de la borne d'accouplement suffisamment désalignée.

2. Connecteur électrique selon la revendication 1, caractérisé en outre en ce que la base (32) est formée de sorte à avoir un profil bulbeux (44) de surfaces courbées.

3. Connecteur électrique selon les revendications 1 ou 2, caractérisé en outre en ce que le connecteur englobe de multiples contacts (22) agencés dans de multiples rangées (6) et colonnes (8).

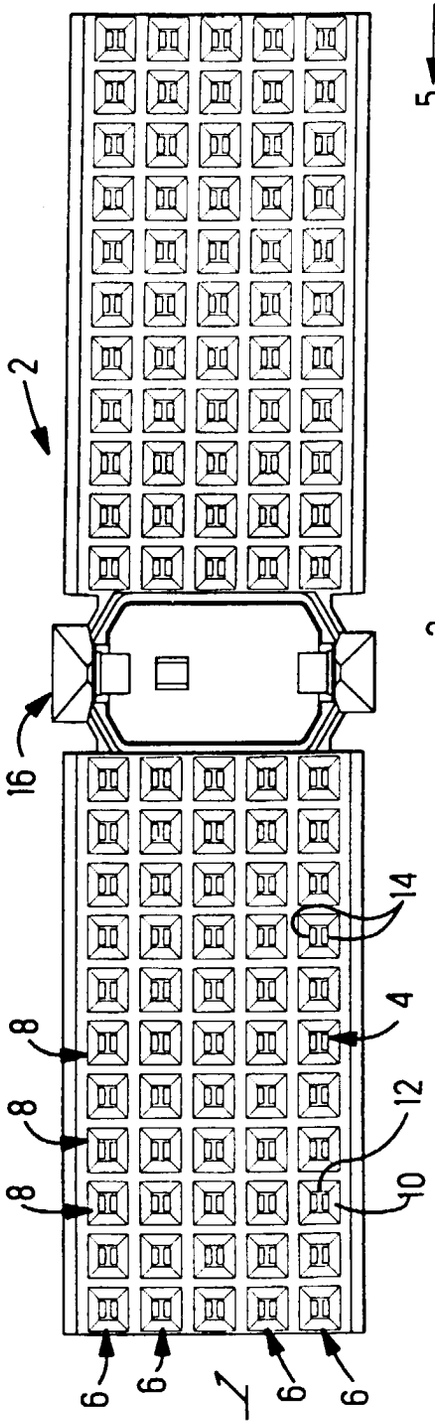

Fig. 1

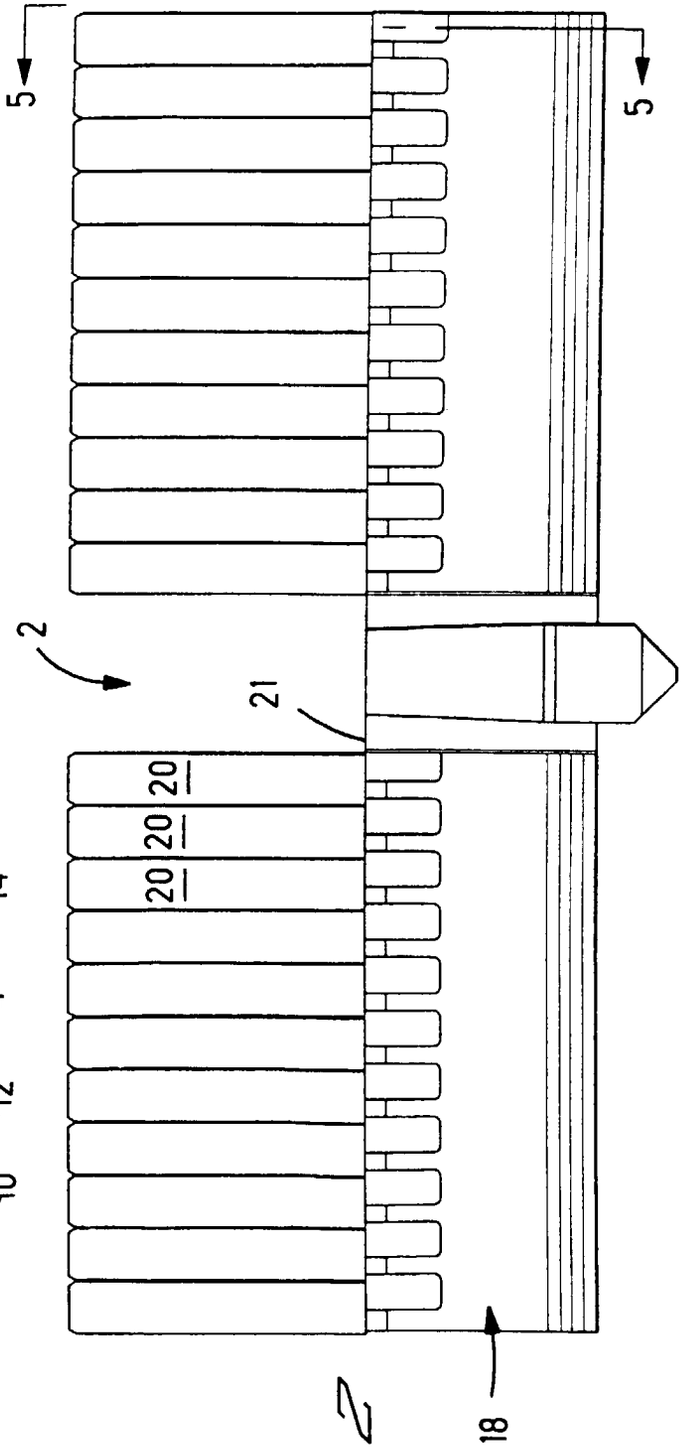

Fig. 2

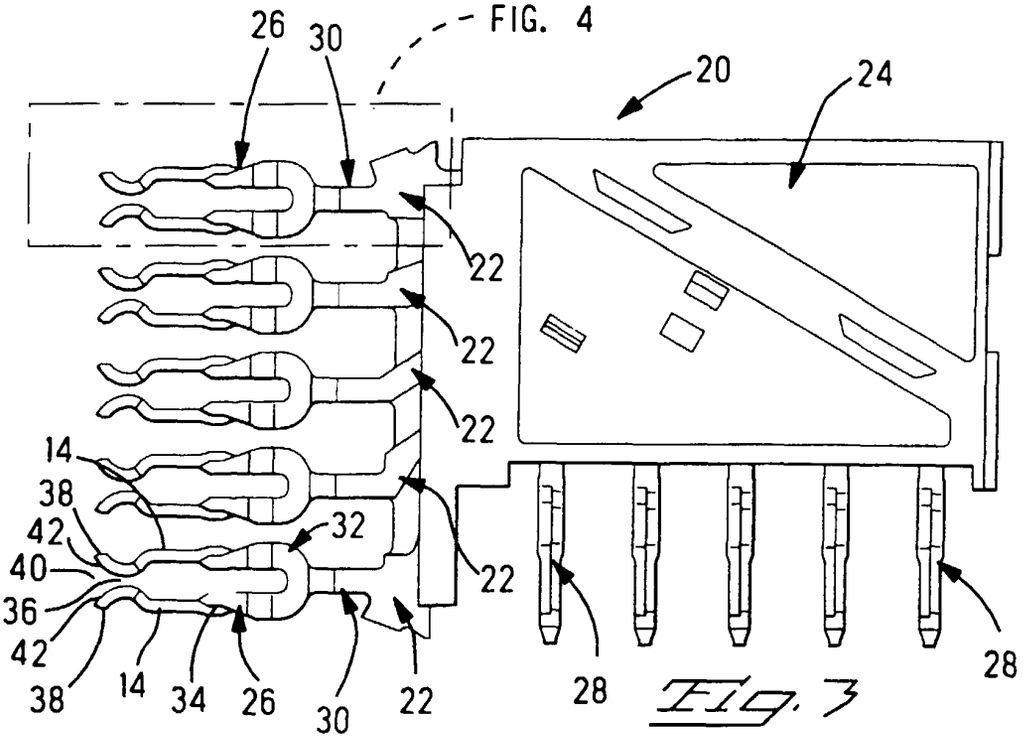

Fig. 3

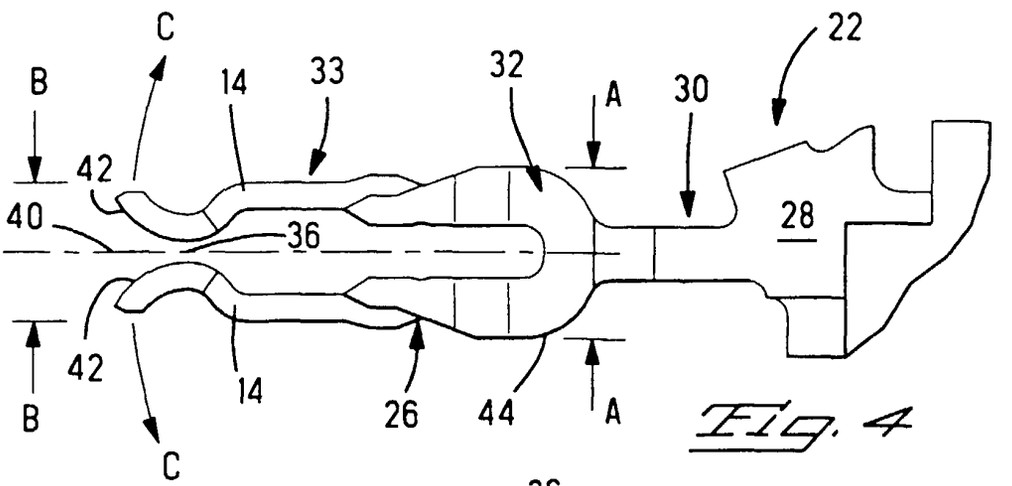

Fig. 4

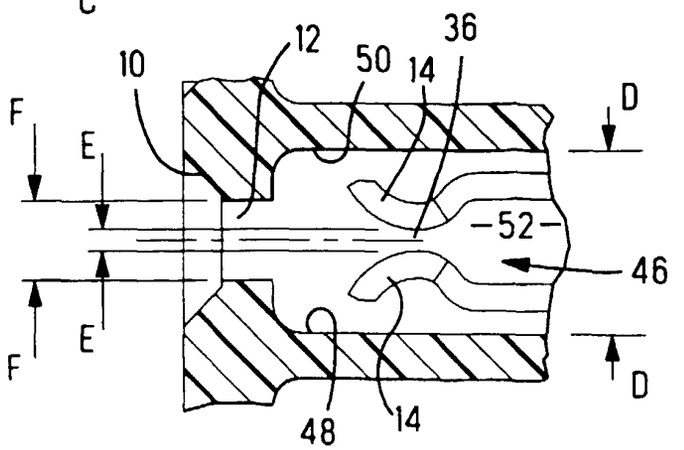

Fig. 6

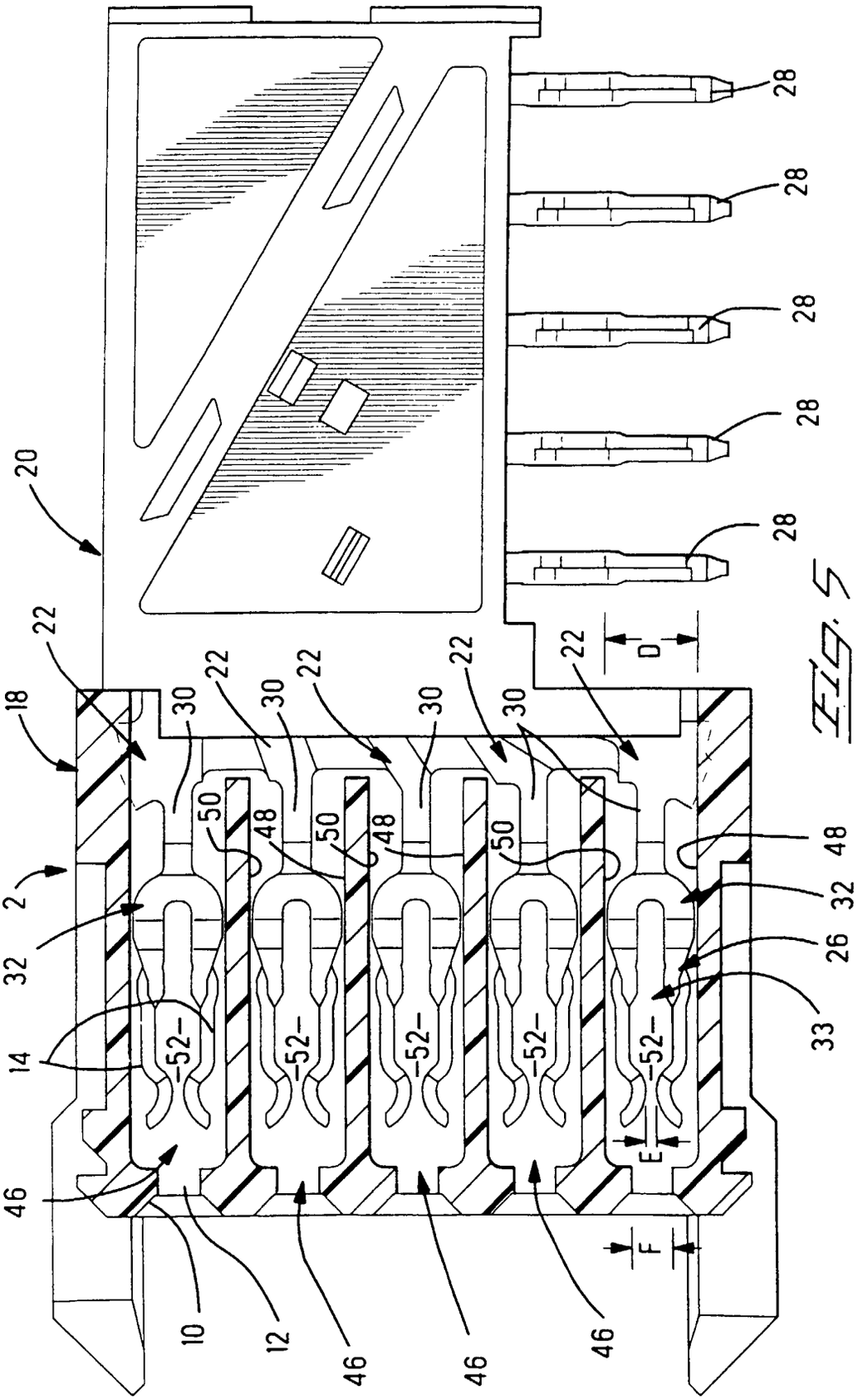
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Fig. 5

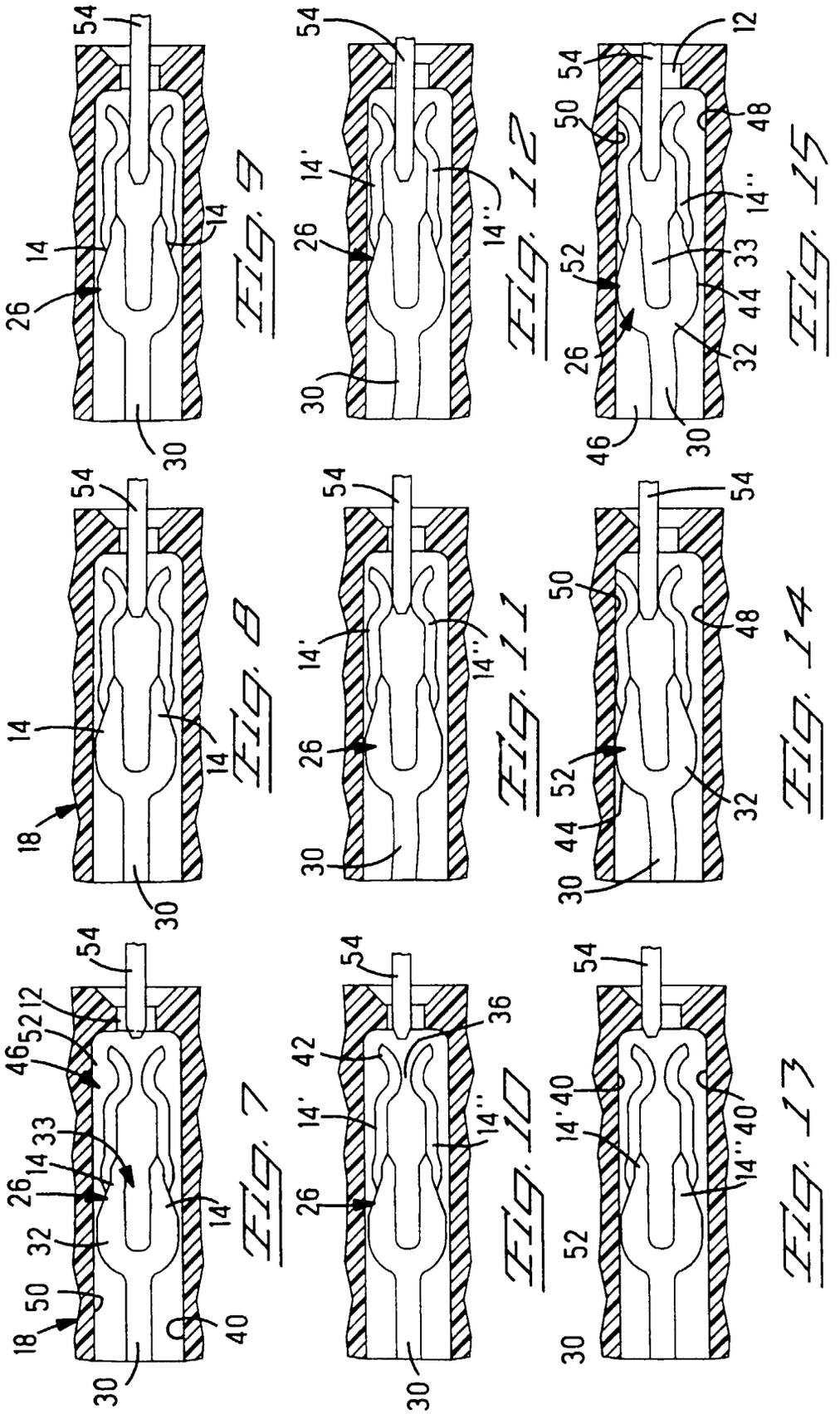

Fig. 9 Fig. 12 Fig. 15

Fig. 8 Fig. 11 Fig. 14

Fig. 7 Fig. 10 Fig. 13

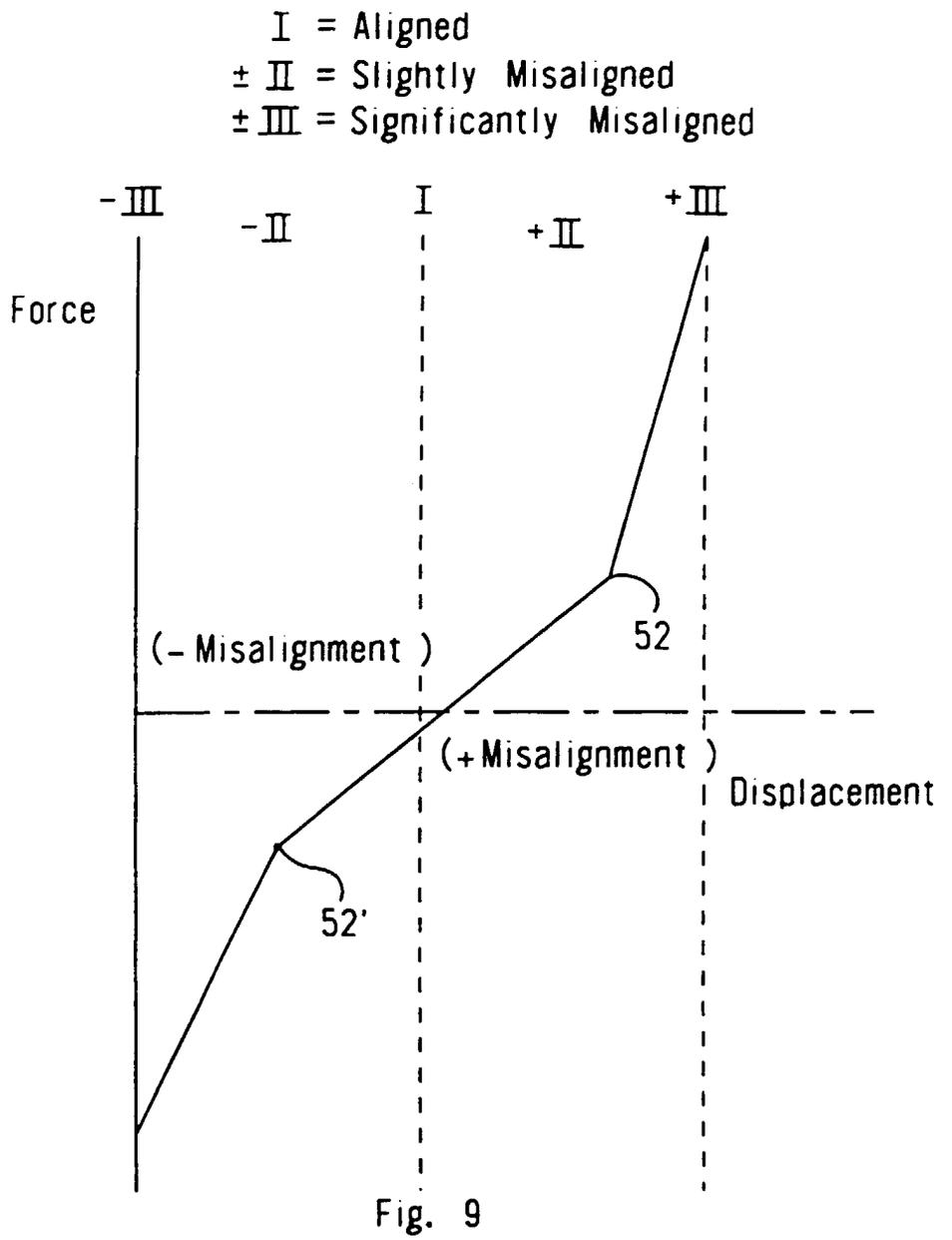
I = Aligned
± II = Slightly Misaligned
± III = Significantly Misaligned
-III
-II
I
+II
+III
Force
(- Misalignment)
52
(+ Misalignment)
Displacement
52'

Fig. 9

Fig. 16