

Aug. 4, 1970

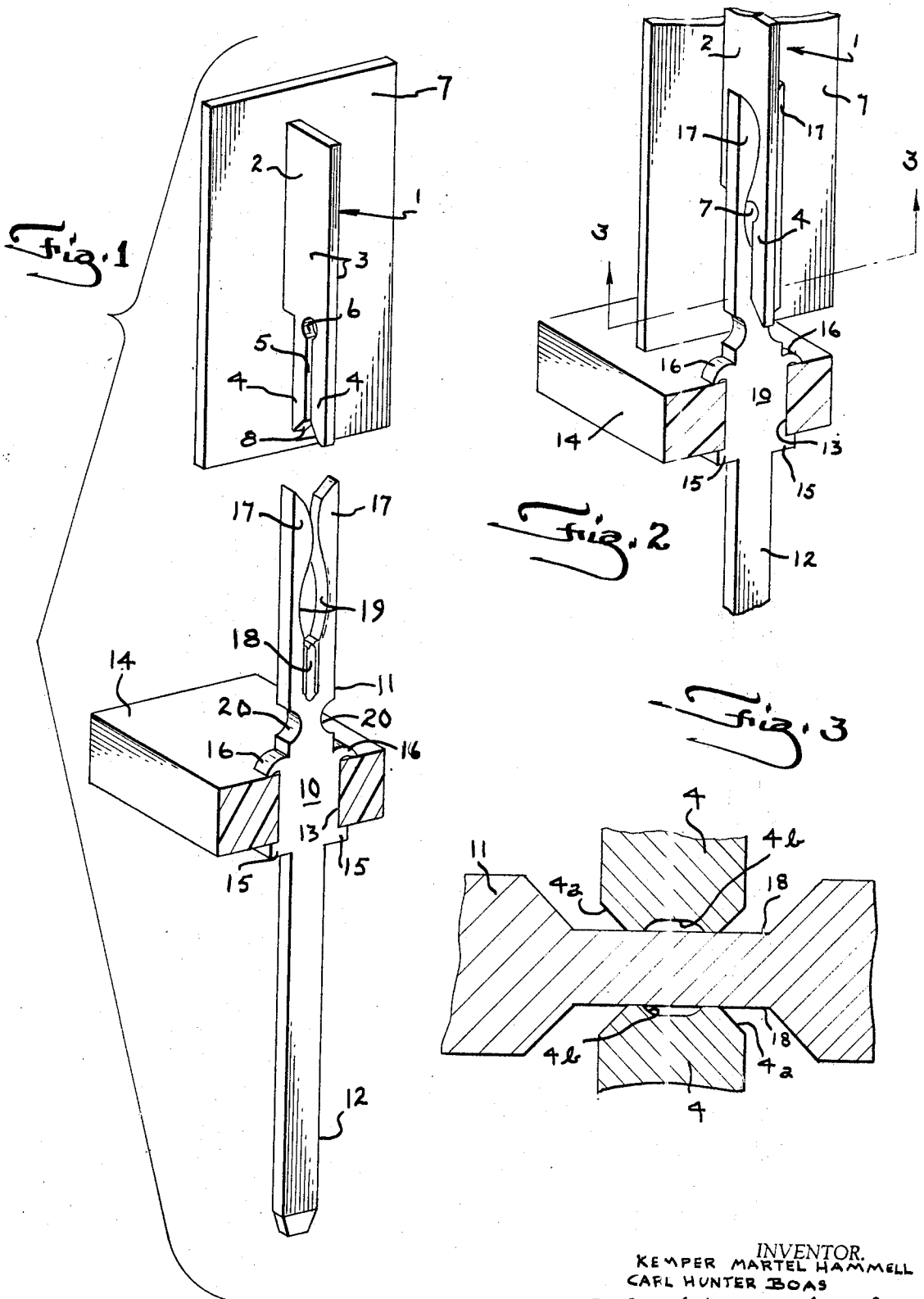
K. M. HAMMELL ET AL

3,523,273

ELECTRICAL CONNECTORS

Original Filed March 16, 1966

3 Sheets-Sheet 1



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Aug. 4, 1970

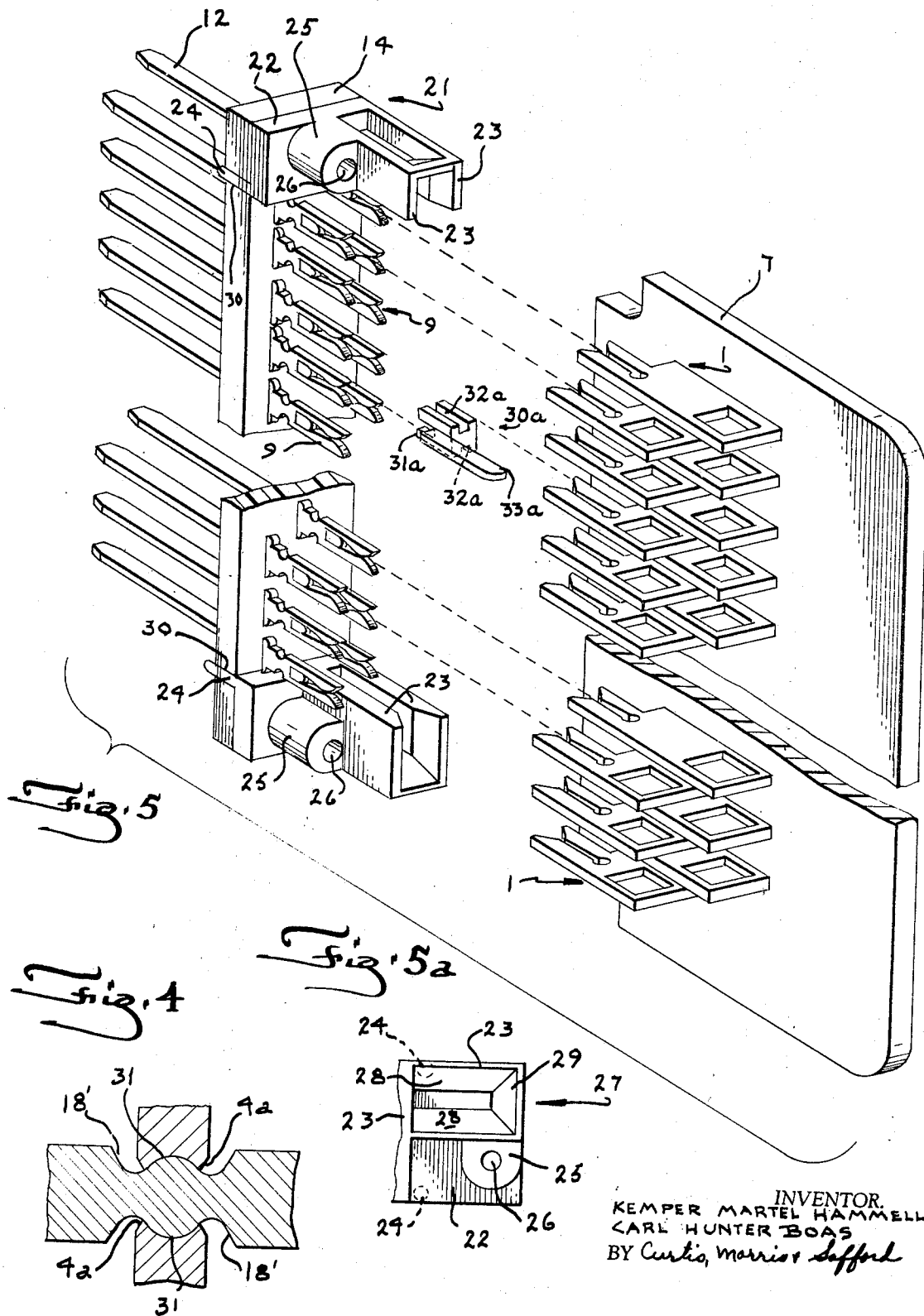
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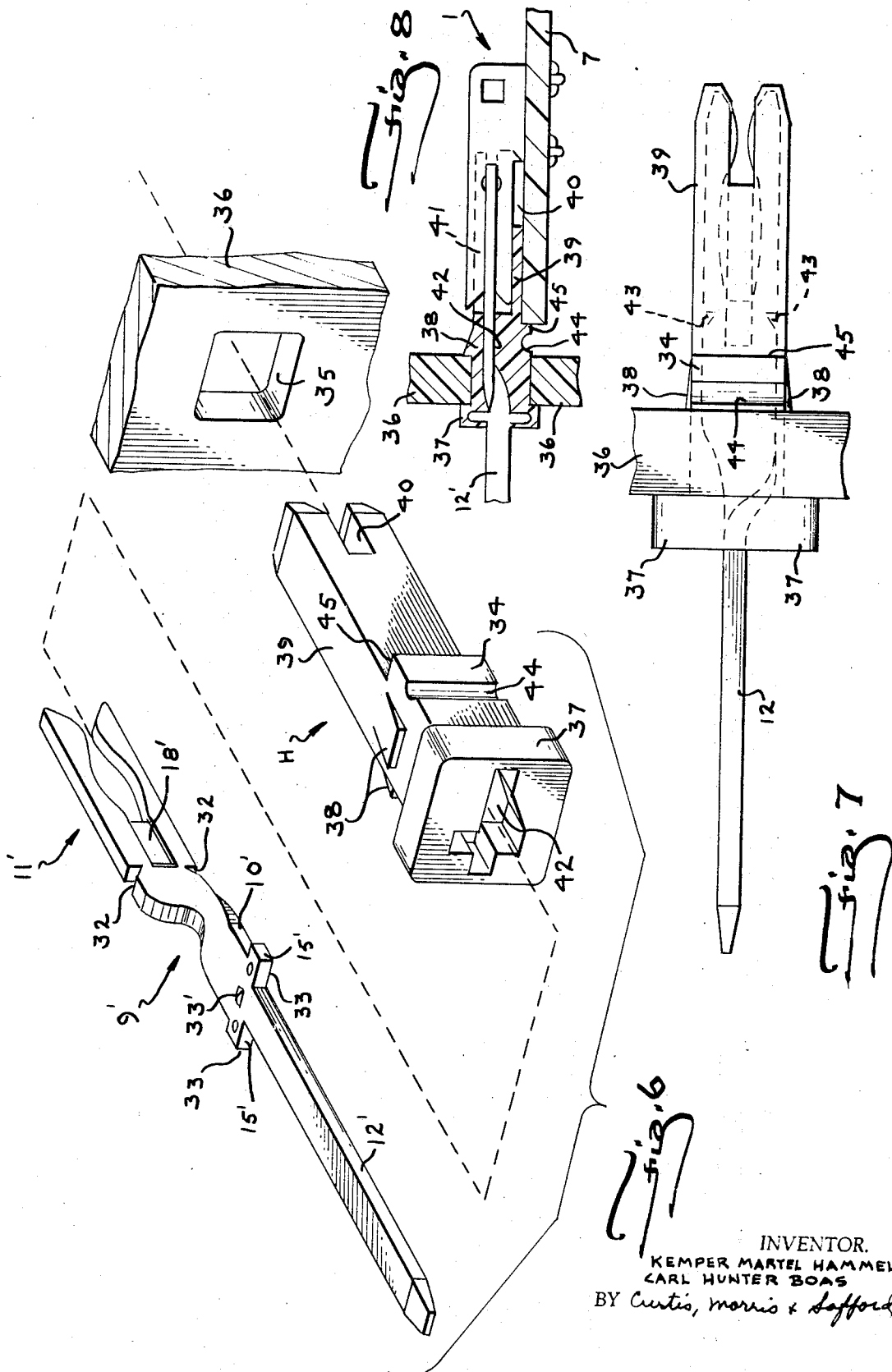
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ELECTRICAL CONNECTORS

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Continuation of application Ser. No. 534,744, Mar. 16, 1966. This application July 3, 1968, Ser. No. 751,655

Int. Cl. H01r 11/22, 9/14

U.S. Cl. 339—64

19 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector comprises a support portion for securable disposition on a mounting member, a contact section and a conductor-engaging section. The contact section is provided with bifurcated contact arms connected together by a bridge section. Each contact arm is provided with an inner surface of substantially sinusoidal configuration with an outer section of the inner surface defining a contact-engaging area of large radius and an inner section having an arcuate configuration thereby providing a varying cross section less than the radius of contact-engaging area and approximating a beam of constant strength to provide spring characteristics to the contact arms so as to maintain the contact-engaging areas in close proximity with respect to each other.

This is a continuation of application Ser. No. 534,744 filed Mar. 16, 1966 now abandoned.

This invention relates to electrical connectors and more particularly to electrical connectors having a forked or bifurcated contact area.

Connectors having forked or bifurcated contacts are being used in electrical and electronic technology to terminate conductive members. The terminations, in most cases, are effected by the forked or bifurcated contact areas of complimentary connectors.

One of the objects of this invention is to provide a pair of self-mating bifurcated or forked electrical connectors which are matable along their axial centerlines with the face of one connector at right angles to the face of the other and the contact surfaces of at least one connector extending beyond the bifurcated section of the other and making electrical contacts on both sides of the base portion of the other contact.

Another object of this invention is to provide a bifurcated electrical connector provided with tynes or fork members that have sufficient length so that the base portion of the tyne approximates a beam of constant strength providing a strong section at its maximum moment and an unusually high degree of flexure without weakness.

A further object of this invention is to provide for good mechanical and electrical compatibility with dissimilar forked connectors, which have short and stiff tynes; the connectors of this invention have long resilient tynes and are provided with a grooved-bridging section between the tynes at their base sections to engage properly with the tynes of the short stiff fork and flat surfaces on each side of the short stiff fork beyond the base ends of the tynes so as to engage properly with the tynes of the connector of this invention.

Still another object of this invention is to provide a fork-type connector which mates compatibly with either an identical fork-type connector, a dissimilar fork-type

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connector or a flat tab connector having sufficient lead-in engaging sections to provide for the normal degree of mismatching found in multiple circuit connectors, having a sufficient resiliency and strength in the fork member to withstand the forces due to mis-matching without set being established in the connector and having contact surfaces with sufficient radius and width to reduce the contact pressures to values not exceeding the galling pressures of the contact plating material.

An additional object of this invention is to provide bifurcated connectors of the type mentioned above with a reduced section near its base, the flexural strength of the reduced section from the centers of the contact areas of the tynes to the center of the reduced section being substantially less than the flexural strength of either tyne from the center of its contact area to its base, so that even when the fork is angularly displaced from its normal axial centerline due to normal mis-matching with its mating connector, the contact surfaces of both tynes bear against their mating contact surfaces with substantial contact force.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

The foregoing objects are achieved by an electrical connector comprising a body portion, a contact portion extending outwardly from the body portion and including a bifurcated-contact section provided with substantially parallel arms and oppositely opposed recesses inwardly from innermost ends of the arms, opposed surfaces on the arms each having a rounded extension toward the outer end and a radiused section disposed between the recesses and the rounded extension, and a connection portion extending outwardly from another end of the body portion.

In the drawings:

FIG. 1 is a perspective exploded view of an electrical connector according to the present invention and a conventional electrical connector;

FIG. 2 is a perspective view of the electrical connectors of FIG. 1 in a connected condition;

FIG. 3 is a view taken along lines 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 3 but illustrating an alternative embodiment of the invention;

FIG. 5 is an exploded perspective view of connectors of the present invention in stacked relationship matable with conventional connectors in a similarly mounted relationship;

FIG. 5a is a front view of one of the mounting member guides;

FIG. 6 is an exploded perspective view of another embodiment of the invention;

FIG. 7 is a view of FIG. 6 in an assembled position; and

FIG. 8 is a cross-sectional view of FIG. 7 with the electrical connector mated with a conventional connector member.

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Turning now to FIGS. 1 through 3, an electrical connector member 1 includes a body section 2 and a bifurcated contact section 3 including parallel contact arms 4 which are spaced from each other by means of a slot 5 terminating inwardly at the innermost ends of the contact arms at a circular opening 6. Electrical connector member 1 is a conventional electrical connector and is of the type disclosed in U.S. Pat. No. 2,828,474. Electrical connector member 1 is mounted on a mounting member 7 which may be a printed circuit board or some other mounting member having electrical circuitry thereon. Electrical connector 1 is mounted on mounting member 7 in connection with the electrical circuitry thereon in any suitable manner such as by clinching, soldering etc. The outer ends of contact arms 4 have angular engaging surfaces 8 inwardly to slot 6 in order to facilitate engagement of the electrical connector member with electrical connectors of similar configuration, and beveled surfaces 4a along the inward edges of the contact arms.

Electrical connector 9 is the electrical connector that is the object of the present invention. This electrical connector includes a body portion 10, a contact portion 11 and a connection portion 12. The connector is susceptible to mass production by automatic machinery and is conveniently formed by shaping a sheet metal blank or strip of a suitable electrically conductive material such as brass, bronze or the like in successive forming steps. The metal is sufficiently hard and resilient to impart to the contact portion a spring-like character to accomplish the intended purpose. Body portion 10 is mounted in an opening 13 of a dielectric mounting member 14. Body portion 10 includes lugs 15 to abut against one surface of mounting member 14 and clinched portions 16 are sheared from body portion 10 against the other surface of body member 14 in accordance with conventional clinching techniques in order to secure electrical connector 9 in position on the mounting member. Of course, the electrical connector can be secured on the mounting member or in a housing member in any suitable manner, but, in any case, electrical connector 9 is rigidly mounted in its mounting member to accommodate automatic wiring techniques.

Contact portion 11 extends outwardly from body portion 10 and is a bifurcated contact portion including contact arms or tyne 17 which extend parallel with respect to each other. Bevelled recesses or grooves 18 are disposed in opposite surfaces of contact portion 11 at the innermost ends of contact arms 17 and these recesses communicate with the slot between the contact arms. The contact arms include opposed surfaces 19 each of which include an inner portion having a large outward radius and an outer portion defining an extension also having a large inward contact radius. The extensions define outer contact surfaces and recesses 18 define inner contact surfaces. The opposed surfaces have an undulatory shape defining a sinusoidal configuration. The outer ends of the opposed surfaces are tapered outwardly so as to facilitate the engagement of connector 9 with another connector 9, connector member 1, some other similar type of bifurcated electrical connector or a flat tab electrical connector.

As can be discerned, the large radiused inner sections of opposed surfaces 19 are long and reduced in cross section approximating beams of constant strength near their common base section which provide excellent spring characteristics to maintain the large radiused contact extensions in close proximity with respect to each other in order to provide excellent contact engagement characteristics. Contact arms 17 also have the innermost sections of surfaces 19 sufficiently long so as to provide long resilient beams providing excellent spring characteristics thereto. The base portion of each contact arm approximating a beam of constant strength also provides a strong section at its maximum moment and an extremely high degree of flexure without weakness.

Body portion 10 includes a necked-down section formed by oppositely opposed arcuate depressions 20. The necked-down portion is of much dimensions to allow connector 9

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when rigidly mounted on mounting member 14 in aligned and/or staggered rows, as illustrated in FIG. 5, to have freedom of movement in more than one axis so as to properly align itself with a matable electrical connector member 1, similarly mounted upon mounting member 7 but somewhat misaligned with respect to contact 9. In order to achieve adequate contact pressures at both outer contact surfaces of tyne 17 when contact 9 is misaligned with contact 1, it is necessary that the flexural strength of the contact about its reduced section at 20 be substantially less than the flexural strength of either tyne 17. This is essential and provides a contact having the advantages of a fixed base and connection portions, 3 and 12 with a self-aligning free-floating connector capable of adequately mating with a non-aligning connector. With the necked-down section providing freedom of movement of the contact portion, a permanent set of the contact arms is prevented. Thus, there is obtained orientation in normal planes when the electrical connectors of the present invention mate with the same connector, similar connectors or the like. The disposition of connectors 9 on a mounting member in aligned rows, staggered aligned rows or the like provides modular expandability, system interchangeability and grid system flexibility.

Mounting member guides 21 are disposed on each side of aligned electrical connectors 9 on mounting member 14. Each guide 21 is made from a suitable dielectric material in accordance with conventional molding techniques and includes a base 22 having parallel legs 23 extending outwardly from one surface thereof and parallel lugs 24 extending outwardly from the other surface of base 22. Inner leg 23 includes an arcuate projection 25 having an opening 26 extending therethrough. A wall 27 extends outwardly from base 22 connecting legs 23 to form a U-shaped cavity. The outer ends of legs 23 and wall 27 include bevelled surfaces 28 and 29. Guides 21 are mounted on mounting member 14 with the other surface of base 22 disposed against mounting member 14 and lugs 24 are disposed in respective openings 30 (only one being shown) in mounting member 14, and a securing means (not shown) such as a screw are passed through holes in mounting member 14 in communication with openings 26. With guides 21 secured in position on the mounting member, the spaces between legs 23 properly guide mounting member 7 toward mounting member 14 so that connector members 1 properly mate with respective connectors 9. Walls 27 limit sidewise movement of mounting member 7. Lugs 24 in openings 30 stabilize the guides on the mounting member.

A dielectric keying member 30a has a U-shaped body 31a provided with channels 32a in the outer surfaces of the legs. Each channel 32a is matable with respective aligned connectors 9 and each of these channels has a projection (not shown) matable with opposing arcuate depressions in these aligned connectors. The U-shaped body allows the keying member to be readily inserted on the adjacent aligned connectors within channels 32a, and the resiliency of the dielectric material maintains the projections in depressions 20. An extension 33a extends outwardly from body 31a and is disposed between a connector member 1, that is in the row of connector members furthest from mounting member 7, and mounting member 7. Keying member 30a always assures that a correct type of circuitry on mounting member 7 is connected to the proper bank of connectors 9.

Connection portion 12 can take the form as illustrated in the drawing whereby a connection can be made thereto by means of a connector disclosed in U.S. Pat. No. 3,239,918 by connecting a wire thereto by means of conventional wire wrapping techniques, by welding a wire thereto or by soldering a wire thereto. Connection portion 12 can take any other suitable form to terminate a conductive member thereto as desired.

When electrical connector member 1 is disposed in a mated electrical position with electrical connector 9, as

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illustrated in FIGS. 2 and 3, the opposed outer ends of contact arms 4 are disposed within respective recesses 18 of connector 9 to allow sufficient side-wise play therein. The outer opposed contact surfaces of contact arms 17 engage contact section 3 inwardly from circular opening 6 and they are movable therealong. The inner ends of recesses 18 are bevelled and serve to act as stop means to limit the inner movement of the ends of contact arms 4 of connector member 1 along the inner contact surfaces of connector 9. The large radius of the outer contact surfaces allows a ratio of at least several times the usual contact area of contact 1 to be obtained on contact sections 3 of connector member 1. This eliminates the normal heel and toe effect on the flat contact surfaces when misalignment occurs.

When electrical connector member 1 is made, opposed edges 4a are bevelled by swaging. Working of the metal during the formation of the opposed bevelled surfaces causes arcuate channels 4b to be formed in the opposing contact surfaces. FIG. 4 illustrates an alternative embodiment of the present invention wherein recesses 18' are formed with arcuate projections 31 to mate with arcuate channels 4b. The opposed arcuate channels of connector member 1 engage respective arcuate projections 31 in recesses 18' thereby providing stabilization between the mated connectors.

FIGS. 6 through 8 illustrate another embodiment of the invention. In this embodiment, electrical connector 9' is similar to electrical connector 9 of FIGS. 1 through 3 except that body portion 10' has a 90 degree twist therein which places contact portion 11' in a plane at right angles to the plane containing connection portion 12'. Contact portion 11' is also disposed in a plane parallel to an edge of connection portion 12' as illustrated in FIG. 8. Contact portion 11' has notches 32 disposed in the edges thereof adjacent recesses 18'. Lugs 15' have projections 33 extending outwardly from one surface thereof and a similar projection 33' extends outwardly from the same surface of body portion 10' intermediate the projections on lugs 15'.

Dielectric housing H is molded from any suitable dielectric material. Housing H includes a rectangular body section 34 fitable into rectangular opening 35 in metallic mounting member 36. A flange 37 is located at one end of body section 34 for engagement with one surface of mounting member 36. Projections 38 are located on three sides of body section 34 and these engage the other surface of mounting member 36 in order to lock housing H in position thereon. As can be discerned, projections 38 are bevelled in a direction away from flange 37 to facilitate the insertion of housing H in opening 35. A rectangular section 39 of smaller cross section than section 34 extends outwardly from body section 34. Short slot 40 and long slot 41 are located in opposed sides of section 39 and these slots communicate with an opening 42 extending through housing H to receive connector 9' therein. Opening 42 contains projections 43 which engage respective notches 32 when connector 9' is disposed within opening 42 to secure the connector in position within housing H. The entrance to opening 42 is located in flange 37 and this entrance has a cross-shaped configuration to permit contact portion 11', a body portion 10' and lugs 15' to be received within housing H while connection portion 12' extends outwardly therefrom. Projections 33 and 33' on lugs 15' and body portion 10' engage corresponding cavities within the inner surface of the entrance of opening 42 in order to aid in securing connector 9' in position within the housing.

With slots 40 and 41 disposed in opposite sides of section 39, a bifurcated section is formed at the outer end of section 39 and long slot 41 exposes one of recesses 18'. The side containing short slot 40 provides insulation to one of the contact arms of connector member 1 when mated with connector 9' as illustrated in FIG. 8. The outer ends of the bifurcated section of section 39 are

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beveled to prevent the mounting member carrying connector members 1 from hanging upon the housing during the mating of connector members 1 with connectors 9'. The opposed inner surfaces of the ends of the bifurcated section of section 39 are also beveled to facilitate mating of connector members 1 with connectors 9'. A groove 44 is located in section 34 to provide a keying arrangement between adjacent housings on mounting member 36 and the mounting member carrying connector members 1. A stepped section 45 is located between sections 34 and 39 and the inner end of the mounting member carrying connector members 1 abuts thereagainst in order to limit the movement thereof.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

What is claimed is:

1. An electrical connector comprising a body portion, a contact portion extending outwardly from one end of said body portion and including a bifurcated-contact section provided with substantially parallel arms and oppositely-opposed recess extending inwardly from innermost ends of said arms to provide an inner contact area having a cross section along the length thereof of uniform thickness less than the thickness of said bifurcated-contact section, opposed surfaces on said arms each having a rounded-contact extension adjacent an outer end thereof and a section disposed between said recesses and said rounded-contact extension on said surfaces, said section having an arcuate configuration thereby providing a varying cross-section less than said rounded-contact extension and approximately a beam of constant strength to provide spring characteristics to said arms, and a connection portion extending outwardly from another end of said body portion.

2. An electrical connector according to claim 1 wherein said body portion includes a relief section to allow freedom of movement of said contact portion in normal axes when said electrical connector is mounted on a mounting member so as to prevent misalignment with another electrical connector.

3. An electrical connector according to claim 1 wherein said rounded extension has a large radius.

4. An electrical connector for engagement with an electrical connector member having a contact section including a bifurcated-contact area, said electrical connector comprising a body portion, means on said body portion to secure said body portion in an opening of a support member, a contact portion extending outwardly from one end of said body portion and including a bifurcated-contact section provided with substantially parallel arms, said contact portion having recesses in a bridge section at innermost ends of said arms to provide an inner contact area having a uniform cross section along the length thereof and a thickness less than the thickness of said bifurcated-contact section, opposed surfaces on said arms with each of said opposed surfaces having a rounded extension toward an outer end thereof and a radiused section of large radius disposed between said recesses and said rounded extension, said bifurcated-contact section being matable at right angles with said bifurcated-contact area of said electrical connector member with outermost ends of said bifurcated-contact area being disposable within respective ones of said recesses and said rounded extensions engageable on said contact section inwardly from the innermost ends of said bifurcated-contact area, and a connection portion extending outwardly from another end of said body portion and connectable with a conductive member.

5. An electrical connector according to claim 4 wherein said body portion includes a relief area to permit said bifurcated-contact section to be properly aligned with

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said bifurcated-contact area of said electrical connector member.

6. An electrical connector comprising one piece of conductive material having a body portion, a contact portion at one end of said body portion and having arm members extending substantially parallel to each other and defining a bifurcated-contact section, opposing surfaces of said arm members defining a substantially sinusoidal configuration thereby providing an undulatory slot with outer sections of said opposing surfaces being disposed close to each other to define an outer contact-engaging section and inner sections of said opposing surfaces being further apart than said outer sections, said outer sections and inner sections having a large radius, said inner sections providing spring characteristics to said arm members to maintain the outer sections close to each other, recesses disposed in each side of said contact portion at the inner ends of said arm members and in communication with the undulatory slot between said opposed surfaces to provide an inner contact area having a uniform cross section along the length thereof and a thickness less than the thickness of said bifurcated-contact section, and a connecting portion at the other end of said body portion for connecting to a conductive means.

7. An electrical connector according to claim 6 wherein said body portion includes means to mount said electrical connector on a mounting member.

8. An electrical connector according to claim 7 wherein said body portion includes a necked-down portion to allow said contact portion to properly mate with a similar misaligned electrical connector, said necked-down portion having a flexural strength substantially less than the flexural strength of either of said arm members.

9. An electrical connector according to claim 6 wherein said recesses include arcuate projections.

10. An electrical connector assembly comprising a support member; electrical connectors secured to said support member in alignment; each of said electrical connectors including a body portion, means securing said body portion to said support member, a bifurcated-contact portion at one end of said body portion and extending outwardly from one surface of said support member, said contact portion defining a bridge section and arm members extending parallel to each other with a slot therebetween, opposing surfaces of said arm members having an undulatory configuration with large inner-radiused outer sections defining an outer contact section and large outer-radiused inner sections approximating beams of constant strength near their common base section which provide spring characteristics to maintain the outer sections in close proximity to each other, said bridge section including recesses in each side in communication with said slot to provide an inner contact area having a cross section along the length thereof of uniform thickness less than the thickness of said bifurcated-contact portion, and a contacting portion at another end of said body portion extending outwardly from another surface of said support member for connection to a conductive member.

11. An electrical connector assembly according to claim 10 wherein said recesses have arcuate projections therein.

12. An electrical connector assembly according to claim 10 wherein said body portion includes a necked-down portion having a flexural strength less than the flexural strength of either of said arm members for aligning said connectors with similar connectors secured in another support member.

13. An electrical connector assembly according to claim 10 wherein said support member includes guide means to guide another support member having similar connectors secured thereon into matable connection with the electrical connectors secured on said first-mentioned support member.

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14. An electrical connector assembly according to claim 12 wherein a keying means includes means securable between the arm members of the connectors on said first-mentioned support member and further means disposable between a connector thereon located on said other support member.

15. An electrical connector assembly according to claim 10 wherein said securing means includes a dielectric housing member having a passageway extending therethrough in which said connector is disposed, flange means and spaced projections securing said housing member in an aperture in said support member, and short and long slots in opposing surfaces in said housing member inwardly toward said spaced projections and in communication with said slot of said connector.

16. An electrical connector comprising one piece of conductive material having a body portion, a contact portion at one end of said body portion and having a bridge section and arm members extending substantially parallel to each other by defining a bifurcated-contact section, opposing surfaces of said arm members defining a substantially sinusoidal configuration thereby providing an undulatory slot with outer sections of said opposing surfaces being disposed close to each other to define an outer contact-engaging section and inner sections of said opposing surfaces being further apart than said outer sections, said outer sections and inner sections having a large radius, said inner sections providing spring characteristics to said arm members to maintain the outer sections close to each other, said bridge section at the inner ends of said arm members and in communication with the undulatory slot between said opposed surfaces providing an inner contact area having a uniform cross section along the length thereof, a connecting portion at the other end of said body portion for connecting to a conductive means, and a necked-down portion provided in said body portion and having a flexural strength substantially less than the flexural strength of either of said arm members to allow said contact portion to properly mate with a complementary misaligned electrical connector.

17. An electrical connector according to claim 16 wherein said body portion includes means to mount said electrical connector on a mounting member.

18. An electrical connector assembly comprising a support member; electrical connector means secured to said support member and including a body portion, means for securing said body portion to said support member, a bifurcated-contact portion at one end of said body portion and extending outwardly from one surface of said support member, said contact portion defining a bridge section and arm members extending parallel to each other with a slot therebetween, opposing surfaces of said arm members having an undulatory configuration with large inner-radiused outer sections defining an outer contact section and large outer-radiused inner sections approximating beams of constant strength near their common base section which provide spring characteristics to maintain the outer sections in close proximity to each other, said bridge section including in communication with said slot an inner contact area having a cross section along the length thereof of uniform thickness, a connecting portion at another end of said body portion extending outwardly from another surface of said support member for connection to a conductive member, and a necked-down portion provided in said body portion and having a flexural strength less than the flexural strength of either of said arm members for aligning said connectors with complementary connectors secured in another support member.

19. An electrical connector according to claim 18 wherein said connecting portion is in the same plane as said body and contact portions.

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RICHARD E. MOORE, Primary Examiner

U.S. Cl. X.R.

339—47, 220, 258, 276

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,523,273 Dated August 4, 1970

Inventor(s) KEMPER MARTEL HAMMELL & CARL HUNTER BOAS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 57, delete contacting, insert
- - - connecting - - -.

Column 8, line 21, delete by, insert - - -
thereby - - -.

JOHN H.

SOLE

OCT 27 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents