

PATENT SPECIFICATION

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(54) ELECTRICAL CONNECTORS WITH LOCKING STRUCTURE

(71) We, FORD MOTOR COMPANY LIMITED, of Eagle Way, Brentwood, Essex CM13 3BW, a British Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is directed to the field of matable electrical connectors for establishing electric circuits between pairs of connectors. More specifically, the present invention is directed to that portion of the above-noted field which is concerned with the mechanism by which matable connectors are maintained in assembled relationship. More particularly still, the present invention is directed to that portion of the above-noted field which is concerned with mechanisms by which matable pairs of connector blocks are held in assembled relationship by an overcenter locking type mechanism which may be easily intentionally separated while maintaining a positively locked relationship when separation is not intended.

Electrical connectors of the general type described above are disclosed in U.S. patent 3,933,406. The above-noted patent contains an excellent discussion of the requirements associated with mating of electrical connectors, particularly those electrical connectors which are utilized in automotive vehicles. This patent also contains a description of the prior art and shows a particular system for overcoming the disadvantages noted in the prior art. This patent also contains a full discussion of the requirements for securing proper mating of electrical connections and the desirability of providing an electrical connector which gives all the desired mating characteristics but also permits easy unmating of such connectors when separation of the connectors is desired.

It is the principal object of this invention to provide a pair of matable connectors having an easily releasable overcenter locking structure which is simple and efficient in operation, which provides the necessary struc-

ture to achieve proper mating of the connectors, but which provides for release of such mated connectors by simply pulling on the same and without utilizing specially designed tools.

In accordance with the teachings of this invention, a pair of matable electrical connectors has an easily releasable overcenter locking structure which includes a double ramp member formed on one of the matable connectors, said double ramp member having a first inclined ramp surface of substantially constant width leading from a front face of the one connector upwardly to an apex and a second inclined ramp surface leading downwardly from the apex in a direction away from the first inclined ramp surface to a surface of the one connector; the second ramp surface having a wedge shape when viewed directly downwardly at the apex of the double ramp member, the wide portion of the wedge shape being at the apex and the narrow portion of the wedge shape being at the point of intersection of the second ramp surface and the surface of the connector; and a pair of cantilever beams formed on the other of the matable connectors, a supporting portion of each of the cantilever beams extending upwardly from a rear portion of a surface of the other connector with the cantilever beams projecting forwardly therefrom in a parallel, spaced relationship towards a front face of the other connector; the spacing between the cantilever beams being slightly greater than the substantially constant width of the first inclined surface of the double ramp member; each of the cantilever beams having at its free end an enlarged portion which projects into the space between the cantilever beams towards but not into engagement with the enlarged portion on the other one of the cantilever beams whereby a space exists between the enlarged portions; each of the enlarged portions having a cam releasing surface which, when viewed from directly above the cantilever beams, is inclined inwardly from the small space between the enlarged portion towards a rear portion of the canti-

5 lever beam with which said enlarged portion is associated. Each of the enlarged portions also having a cam locking surface which, when viewed from the front face of the other connector, extends downwardly and rearwardly from a top surface of each of the cantilever beams.

10 When the structure above described is used for mating and unmating electrical connectors, the following actions are achieved. During movement of the pair of matable connectors towards a mated position, the cantilever beams are deflected upwardly by engagement of the cam locking surfaces and the first inclined ramp surface of the double ramp member. The cantilever beams and their enlarged portions surround the double ramp member after movement over the apex to lock the matable connectors in a mated position. The cam releasing surfaces of the enlarged portions of the cantilever beams are drawn along the wedge shape of the second ramp surface of the double ramp member to spread the cantilever beams apart to permit easy unmating of the mated connectors.

25 The invention will now be described with reference to the accompanying drawings, in which:—

30 FIGURE 1 is a plan view of the matable electrical connectors of this invention; FIGURE 2 is a side elevational view of the electrical connectors moving to a mated position; FIGURE 3 is a side elevation view of the electric connectors in the mated position; FIGURE 4 is a plan view of the electrical connectors in a mated position; FIGURE 5 is a plan view of the mated connectors moving towards an unmated condition; and FIGURES 6 and 7 show a drawer slide structure used for guiding the electrical connectors to and away from mated positions.

40 In FIGURE 1 there is seen a pair of matable electrical connectors generally identified by the numeral 10. The connectors include a male connector 12 and a female connector 14. An electrical lead 16 carries wiring structure (not shown) to blade receiving electrical connectors 18 of known construction housed within the male connector 12. Similarly, female connector 14 has an electrical lead 20 associated therewith which is connected by wiring structure (not shown) to a pair of blade connectors 22. The type and shape of the electrical connectors housed within the male connector 12 and the female connector 14 is a matter of choice to the designer. Any of the many hundreds of different types of terminals and connectors may be utilized along with the structure of this particular invention which provides an easily releasable overcenter locking structure.

65 The overcenter locking structure for a pair of matable electrical connectors as taught in this invention may be best understood by viewing FIGURES 1 through 5 while the

structure is described. The structure shown in the drawings includes upper and lower locking structures. The description in this portion of the specification will describe only the upper structure, but the lower structure operates in the same manner. It is best to utilize upper and lower structures if there are four or more electrical connections to be made between the matable connectors. If there are three or less connections to be made, a single releasable overcenter locking structure may be sufficient. This releasable overcenter locking structure can also be used with another cantilever locking device which are already known in the art. With this brief introduction, reference is now made to the drawings for a description of the releasable overcenter locking structure.

85 A double ramp member 24 is formed on the top surface 26 of the female connector 14. This double ramp member 24 has a first inclined ramp surface 28 of a substantially constant width leading from a front face 30 of the female connector 14 upwardly to an apex 32 of the double ramp member 24.

90 A second inclined ramp surface 34 leads downwardly from the apex 32 of the double ramp member 24 in a direction away from the first inclined ramp surface 28 to a final position at the top surface 26 of the female connector 14. The apex 32 of the double ramp member 24 is intermediate the locations at which the first inclined ramp surface 28 and the second inclined ramp surface 34 intersect the top surface 26 of the female connector 14. As is best seen in FIGURES 1, 4 and 5, the second inclined ramp surface 34 has a generally wedge shape when viewed looking directly downwardly at the apex 32 of the double ramp member 24. The wide portion of the wedge shape is at the apex 32 and the narrow portion of the wedge shape is at the point of intersection of the second ramp surface 34 and the top surface 26 of the female connector 14.

110 The male connector 12 is provided with an upper pair of cantilever beams 36. Supporting portions 38 of the cantilever beams 36 extend upwardly from a rear portion of a top surface 40 of the male connector 12 and support the cantilever beams 36 so that they project forwardly therefrom in a parallel, spaced relationship towards the front face 30 of the female connector 14. The spacing between the cantilever beams 36—36 is slightly greater than the width of the first inclined ramp surface 28 of the double ramp member 24.

125 Each of the cantilever beams 36—36 has at its free end an enlarged portion 42 which projects into the space between the cantilever beams towards but not into engagement with the enlarged portion 42 on the other one of the cantilever beams 36 whereby a space exists between the opposed enlarged portions

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42—42. Each of the enlarged portions 42 has a cam releasing surface 44 thereon which can best be seen in FIGURES 1, 4 and 5. When the cam releasing surface 44 is viewed from directly above the cantilever beams 36—36, this cam releasing surface 44 is inclined inwardly from the small space between the enlarged portions 42 of the cantilever beams 36—36 towards a rear portion of the cantilever beam 36 with which the enlarged portion 42 is associated.

Each of the enlarged portions 42 of the cantilever beams 36 has a cam locking surface 46 best seen in FIGURES 2 and 3. This cam locking surface, when viewed from the front face of the connector, extends downwardly and rearwardly from a top surface of each of the cantilever beams 36—36.

As is best seen in FIGURES 6 and 7, a drawer slide type of structure is provided for the matable electrical connectors 10 to align the same during a mating operation. The drawer slide structure consists of a raised portion 48 formed in the female connector 14 and a grooved recess 50 formed in the male connector 12. When the connectors 12 and 14 are being brought to a mated condition, the grooved recess 50 is guided by the raised portion 48 to assure accurate alignment of the cantilever beams 36—36 and the double ramp member 24.

Operation

The easily releasable overcenter locking structure of this invention operates in the manner to be described herein below. The male connector 12 and the female connector 14 are brought together so that the raised portion 48 of the female connector is located in the grooved recess 50 of the male connector 12. The connectors are then moved towards each other, this action causing the cantilever beams 36—36 to be deflected upwardly from the top surface 40 of the male connector 12 because the cam locking surface 46 of the enlarged portions 42 of the cantilever beams 36 engages and moves upwardly along the first inclined ramp surface 28 of the double ramp member 24 mounted on the female connector 14. This deflecting action is best shown in FIGURE 2. The purpose of this deflecting action is to build up a force developed by pushing the cantilever beams up the ramps. When the cantilever beams pass over the apex 32 of the double ramp member 24, the male connector and female connector are driven together with sufficient force to insure that the blade connectors 22 are properly united with the blade receiving connectors 18, thereby assuring proper electrical connection.

FIGURES 3 and 4 illustrate the electrical connectors in a locked condition. In this condition, the cantilever beams 36—36 and the enlarged portions 42 thereof surround the

double ramp member 24 to retain the connectors in their mated position.

When one desires to unmate the mated connectors, they simply pull on the electric wired lead 16 of the male connector and the cam releasing surfaces 44 formed on the enlarged portions 42 of the cantilever beams 36—36 are drawn along the wedge shape of the second inclined ramp 34 of the double ramp member 24 to thereby spread the cantilever beams 36—36 apart to permit easy unmating of the matable connectors. In this unmating operation, the cantilever beams 36—36 are not deflected upwardly from the top surface 40 of the male connector 12 whereby no substantial forces resisting unmating of the connectors are developed.

WHAT WE CLAIM IS:—

1. A pair of matable electrical connectors, including easily releasable overcenter locking structure comprising:

a double ramp member formed on one of the matable connectors, said double ramp member having a first inclined ramp surface of substantially constant width leading from a front face of the one connector upwardly to an apex and a second inclined ramp surface leading downwardly from said apex in a direction away from said first inclined ramp surface to a surface of the one connector;

said second ramp surface having a wedge shape when viewed looking directly downwardly at said apex of said double ramp member, the wide portion of said wedge shape being at said apex and the narrow portion of said wedge shape being at the point of intersection of said second ramp surface and the surface of the connector; and

a pair of cantilever beams formed on the other of the matable connectors, a supporting portion of each of said cantilever beams extending upwardly from a rear portion of a surface of the other connector with said cantilever beams projecting forwardly therefrom in a parallel, spaced relationship towards a front face of the other connector; the spacing between said cantilever beams being slightly greater than said substantially constant width of said first inclined ramp surface of said double ramp member; each of said cantilever beams having at its free end an enlarged portion which projects into the space between said cantilever beams towards but not into engagement with said enlarged portion on said other one of said cantilever beams whereby a space exists between said enlarged portions; each of said enlarged portions having a cam releasing surface which, when viewed from directly above said cantilever beams, is inclined inwardly from said small space between said enlarged portions towards a rear portion of said cantilever beam with which said enlarged portion is associated, each of said enlarged portions also having a cam

locking surface which, when viewed from said front face of the other connector, extends downwardly and rearwardly from a top surface of each of said cantilever beams;

5 whereby said cantilever beams are deflected upwardly by engagement of said cam locking surfaces and said first inclined ramp surface of said double ramp member during movement of said pair of matable connectors towards a mated position, whereby said cantilever beams and said enlarged portions thereof surround said double ramp member to lock said matable connectors in a mated position, and whereby said cam releasing surfaces of said enlarged portions of said cantilever beams are drawn along said wedge shape of said second ramp surface of said double ramp member to spread said cantilever beams apart to permit easy unmating of said matable connectors.

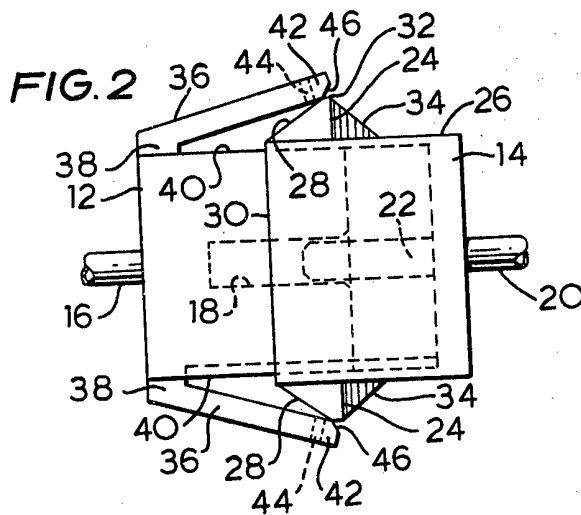
20 2. A pair of matable electrical connectors as defined in Claim 1 wherein: drawer slide

means are provided in part on one of the connectors and in part on the other of the connectors, said drawer slide means for guiding the matable electrical connectors towards their mated position in a manner such that said pair of cantilever beams are accurately aligned with said double ramp member during movement of the matable connectors to their mated position. 25 30

3. A pair of matable connectors as defined in Claim 2 wherein: the one matable connector has at least a pair of double ramp members formed thereon and the other connector has as many pairs of cantilever beams formed thereon as there are double ramp members on the one connector. 35

4. A pair of matable electrical connectors substantially as hereinbefore described with reference to and as shown in the accompanying drawings. 40

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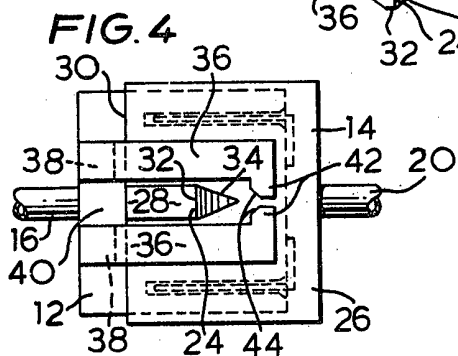
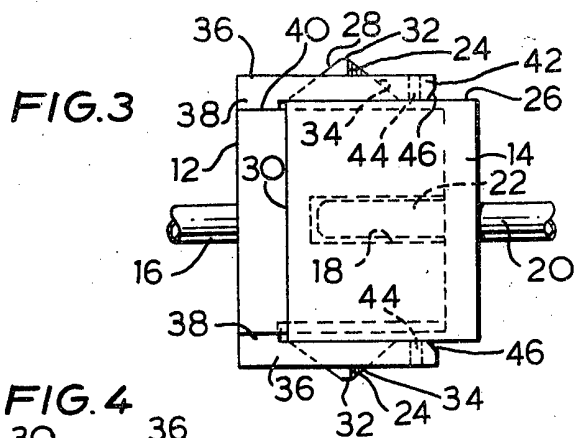


FIG. 5

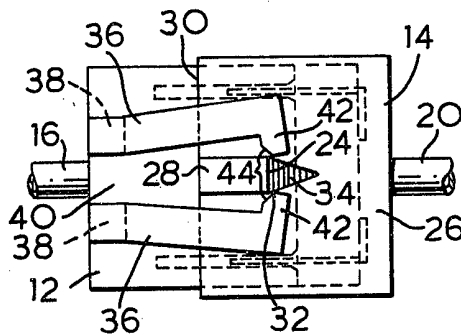


FIG. 6

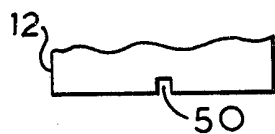


FIG. 7

