Aug. 12, 1969 B. E. SHLESINGER, JR 3,461,258

POSITIVE PRESSURE CAM TYPE CONNECTOR ASSEMBLY AND HOUSINGS THEREFOR

Filed Feb. 16, 1967 2 Sheets-Sheet 1

Fig. 1

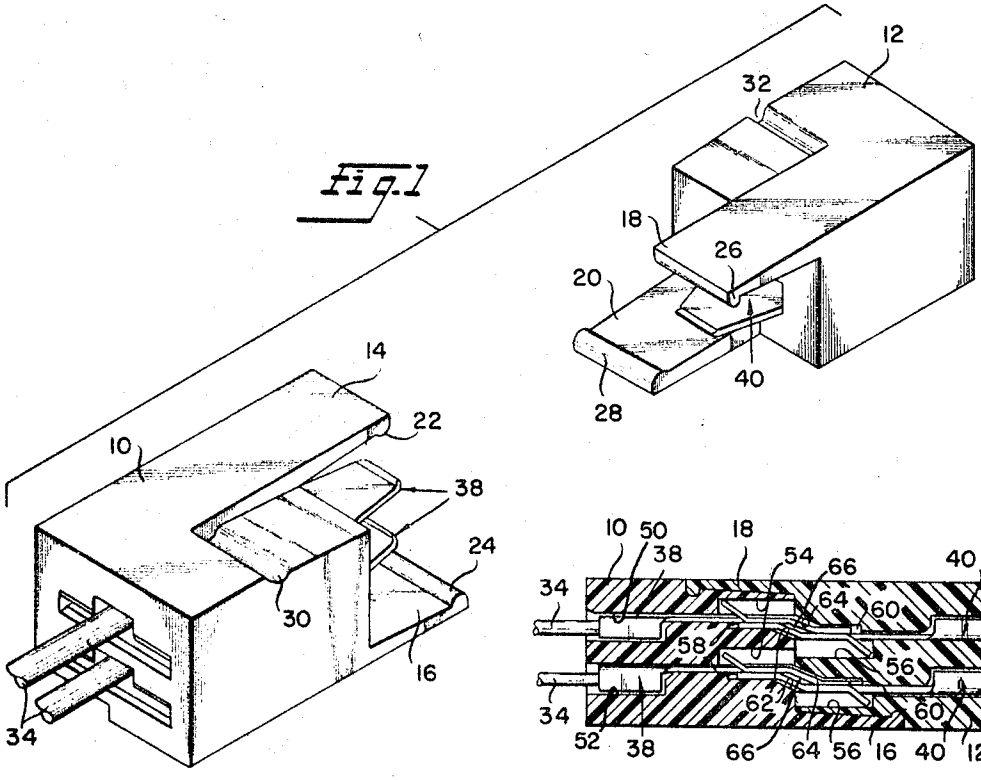
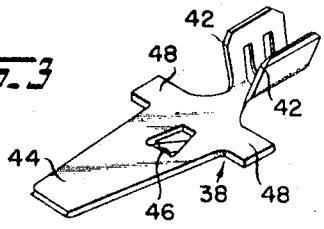


Fig. 2

Fig. 3



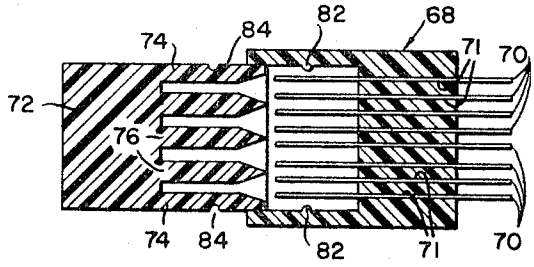


Fig. 4

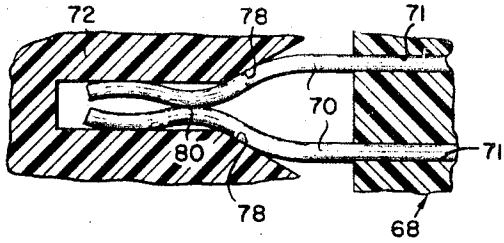


Fig. 5

INVENTOR

Bernard Edward Shlesinger Jr.

Aug. 12, 1969 B. E. SHLESINGER, JR 3,461,258

POSITIVE PRESSURE CAM TYPE CONNECTOR ASSEMBLY AND HOUSINGS THEREFOR

Filed Feb. 16, 1967 2 Sheets-Sheet 2

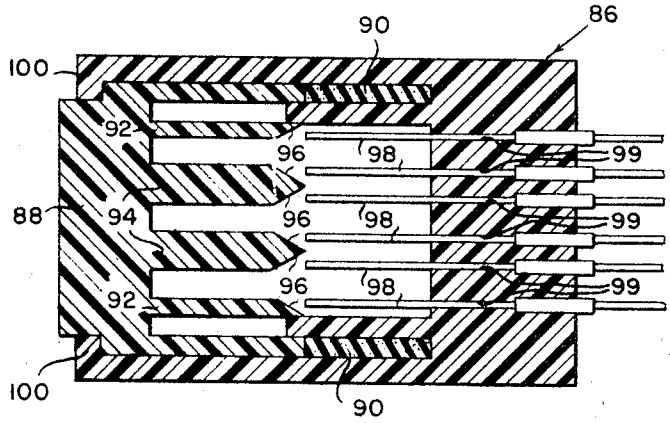


Fig. 6

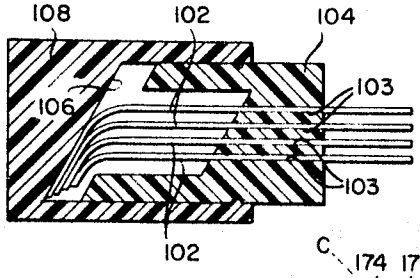


Fig. 7

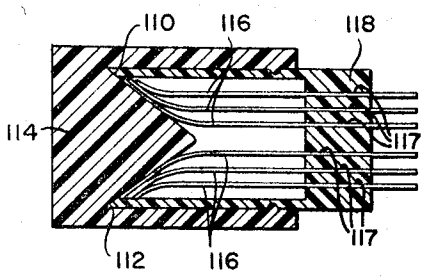


Fig. 8

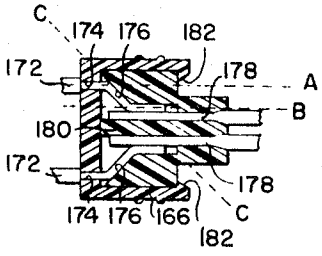


Fig. 12

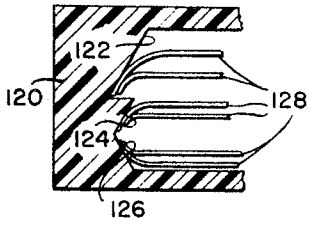


Fig. 9

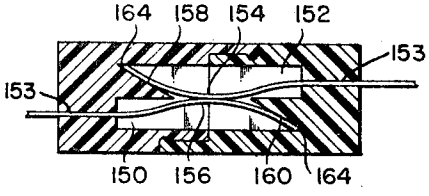


Fig. 11

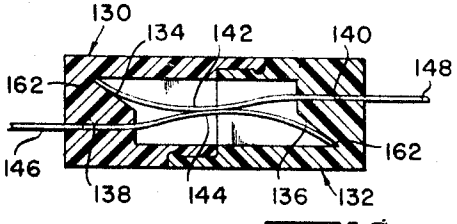


Fig. 10

INVENTOR

Bernard Edward Shlesinger Jr.

United States Patent Office

3,461,258

Patented Aug. 12, 1969

3,461,258

POSITIVE PRESSURE CAM TYPE CONNECTOR ASSEMBLY AND HOUSINGS THEREFOR

Bernard Edward Shlesinger, Jr., Annandale, Va., assignor to AMP Incorporated, Harrisburg, Pa.

Filed Feb. 16, 1967, Ser. No. 616,616

Int. Cl. H01h 3/00; H01r 13/54

U.S. Cl. 200—153 29 Claims

ABSTRACT OF THE DISCLOSURE

An electrical conductor assembly which includes a pair of mating members which have an open first position and a closed second position; a pair of passageways in the assembly; a pair of cam surfaces in the assembly and a chamber adjacent the cam surfaces when the members are in the second position; a flexible conductor mounted in each of the passageways and extending a distance beyond the end of its passageway greater than the length of the cam surface; the flexible conductors when the mating members are in closed position extending into the chamber and having a primary and a secondary axis; the cam surfaces being in line with the primary axis of the conductors when the mating members are in the first and second positions; and said conductors being in engagement with each other when the mating members are in the second position; and the end of each conductor when the mating members are in the second position having their secondary axis different from their primary axis and parallel to and spaced from the primary axis.

This invention relates to electrical connectors and more particularly to electrical connectors of the hermaphroditic and cam type having positive pressure connector means therein.

PRIOR ART DEVELOPMENTS

There have been a number of types of hermaphroditic connectors and cam connectors utilizing a positive pressure for good electrical contact. Earlier prior art devices such as Barre, United States Patent 3,217,285 of Nov. 9, 1965 and British Patent 930,509 of July 3, 1963 illustrate the broad principles set out. The difficulties with these connectors, is that they do not provide a good positive wipe upon insertion and require a very complex type of blade which is expensive and difficult to manufacture.

OBJECTS AND SUMMARY

It is therefore, an object of this invention to provide a hermaphroditic connector which is inexpensive and simple to manufacture and utilizes flat blades for conductors.

Another object of this invention is to provide a connector which uses a double wipe and double contact connection.

Still a further object of this invention is to provide a connector assembly which applies positive pressure at all times to the conductors when the assembly is in connected position. Still another object of this invention is to provide a connector which will have a low contact withdrawal resistance.

A further object of this invention is to provide a connector assembly which has improved vibration and shock reliability.

Still another object of this invention is to provide an electrical assembly in which the parts which mate are identical requiring therefore only one master die to produce both mating parts.

Yet a further object of this invention is to provide an electrical assembly which can be used to simultaneously cause connection of a number of pairs of conductors.

Another object of this invention is to provide an assembly having a reciprocating member which permits ready connection and disconnection.

Still a further object of this invention is to provide a connector assembly having cam surfaces which individually cause connection between two or more conductors.

To summarize, it is therefore an object of this invention to provide an electrical connector which requires a minimum of space and a maximum of contact connection and in which there is a positive pressure at all times on the connector and where if necessary a double wipe and a double connection can be utilized.

These and other objects of this invention and advantages and capabilities will be apparent from the following description and appended claims and accompanying drawings in which:

FIGURE 1 is an enlarged exploded view showing the assembly in position for connection;

FIGURE 2 is a cross sectional view of the connector assembly in mating position;

FIGURE 3 is a perspective view of a conductor blade used in the assembly;

FIGURE 4 is a cross sectional view illustrating another modification of this invention utilizing the cam principle;

FIGURE 5 is an enlarged fragmentary view in cross section showing two conductors in contact relation;

FIGURE 6 is a further modification of the invention in cross section which includes a spring return mechanism;

FIGURES 7, 8 and 9 illustrate additional modifications of this invention in cross section showing various cam surface assemblies;

FIGURES 10 and 11 illustrate in cross section still further modifications of the invention showing hermaphroditic assemblies.

FIGURE 12 is a sectional view illustrating another modification of this invention.

FIGURES 1 THROUGH 3

The assembly as generally shown in FIGURE 1 is comprised of a pair of hermaphroditic housings **10** and **12** which as illustrated in FIGURE 1 are generally rectangular in configuration. The housings are made of some nonconductive material which may be molded or cast or otherwise formed as illustrated. Coupling members **14, 16, 18** and **20** project forwardly of the housing and have locking ribs or beads **22, 24, 26** and **28**. The coupling members **14** and **16** and **18** and **20** are laterally spaced relative to each other as best illustrated in FIGURE 1. The locking ribs **22, 24, 26** and **28** engage in slots such as **30** and **32**. Leads **34** and leads **36** are crimped to conductors **38** and **40**.

As best illustrated in FIGURE 3, a conductor **38** which is identical with conductors **40** shown in FIGURE 2 is provided with clamping members **42** which are crimped or otherwise formed around the leads **34** and **36** to insure positive electrical connection. The leads **34** and **36** would be stripped if necessary. The method of connecting the leads to the conductor **38** does not form a part of this invention as this may be done by any means such as crimping, soldering, and the like.

The conductor **38** includes a smooth flat blade **44** which is quite flexible so that the blade may be bent or flexed in various planes. The blade **44** has struck from it a tine **46** for purposes of locking the conductor in the housing **10** or the housing **12** as the case may be. The conductor **38** is also provided with centering arms **48** for positioning the conductor in the passageways **50** and **52** of the blocks or housings **10** and **12** respectively. The passageways **50** and **52** are relieved as at **54** and **56** to provide clearance means for the locking tine **46**. The passageways are further relieved by clearance spaces **58** and **60** which receive the ends of the blades **44**. The housings **10** and **12** are provided with cam surfaces **62** and **64** respectively.

It will be noticed in FIGURE 2 that the flexible conductors extend a distance beyond the end of their respective passageways greater than the length of the cam surfaces **62** and **64**. It should be further noticed that the flexible conductors when in mated position have primary and secondary axes. The main body of the conductor lies along the primary axis and the end of the conductor lies along the secondary axis. The two axes are parallel and spaced from each other in the configuration illustrated in FIGURE 2. The intermediate portions of the conductors in the areas of a cam surfaces **62** and **64** show gaps **66**. It will be obvious that the action in the closing of the two housings **10** and **12** causes a double wiping action of the conductors by the ends of the conductors resulting in a two point contact connection. One point of contact for a pair of conductors is in one housing and the other point of contact for the same pair of conductors is in the other housing. Due to the action of the cams **62** and **64**, a bowing occurs in the conductors towards each other as will be obvious from a study of FIGURE 2. This bowing action is possible due to the flexing of the blades of the conductors **38** and **40**. In the device illustrated in FIGURES 1 through 3, the relieved portions or clearance spaces **58** and **60** are slightly larger than the thickness of the blade **44** of the conductors **38** and **40**. This insures a good firm contact between the conductors. When the housings **10** and **12** are spaced from each other for initial assembly, the blades **44** of the conductors **38** and **40** are non-configured and lie flat. As aforementioned, the blades when the housings **10** and **12** are in mating position assume an S-shaped configuration.

FIGURES 4, 5 AND 6

In FIGURE 4, the housing **68** is provided with a plurality of parallel conductors **70** mounted in passageways **71** therein in spaced relation. A mating housing **72** is provided with a series of outer tines **74** and inner tines **76**. All of the tines are provided with cam surfaces **78**. A spaced pair of conductors **70** which are aligned with two face to face cams **78** will come together as best shown in FIGURE 5 when the housing **68** is mated with the mated housing **72**. A pressure contact **80** is made by the two conductors being cammed together when the housings are mated. The conductors may be mounted in the housing **68** in any conventional fashion. The spacing between the tines should be sufficient to permit a contacting pair of conductors **70** to slide thereinto without difficulty. Locking snaps **82** are provided to engage recesses **84** for maintaining the housings **68** and **72** in mating position.

In FIGURE 6, the housing **86** holds a button or plunger **88**. A spring member **90** is provided for maintaining the button or plunger in extended position within the housing **86**. The spring member **90** may be of resilient material such as plastic or may be a coil spring or the like. Outer tines **92** and inner tines **94** are provided on the button **88** and have cam surfaces **96** which operate on the conductors **98** in a manner similar to that illustrated in FIGURE 4. The conductors **98** are mounted in passageways **99** in housing **86**. The button or plunger **88** may be positioned in the housing **86** by snapping the button therein around the shoulders **100** of the housing **86**. Any other conventional arrangement for insertion of the plunger **88** in the housing **86** may be provided. It will be noted that the pairs of conductors **98** will have primary and secondary axes similar to the structure shown in FIGURE 2 when in mating position.

When the plunger **88** is pushed downwardly into the housing **86**, the pairs of blades **98** are cammed together in the manner similar to that shown in FIGURE 5. The spring members **90** force the plunger **88** to return to normal position when pressure is released thereon. As in the previous described modifications, the ends of the connectors **70** in FIGURE 4 and **98** in FIGURE 6 are in line with the cam surfaces **78** and **96** respectively. It should be further noted that the camming of the ends of the conductors in FIGURES 4, 5 and 6, when in mating position, have a different axis which is substantially parallel to the primary axis in the manner set out. It will be noted that bowing occurs in the areas of the cams **78** and **98** also.

FIGURES 7, 8 AND 9

FIGURE 7 is a slightly different modification of the invention in which the conductors **102** are mounted in passageways **103** in the housing **104** and are cammed in the same direction by a cam surface **106** in the mating housing **108**. The conductors **102** have their ends in overlapping relationship as illustrated in FIGURE 7. The cam surface **106** is in line with the primary axis of the conductors **102**. When the housings **104** and **108** are mated, the ends of the conductors **102** will be bent into another direction so that the primary axes of the conductors intersects the secondary axis of the conductors in mated position. Between the primary and secondary axes of the conductors in the mating position, will be bowing. A positive contact will therefore be made at all time due to the spring pressure involved.

FIGURE 8 shows a slightly different modification of the invention illustrated in FIGURE 7 and includes two cam surfaces **110** and **112** in the mating housing **114** which abut each other and run in opposite directions. Certain of the conductors **116** will run in one direction whereas others will run in the opposite direction as noted in FIGURE 8.

In FIGURE 9, the mating housing **120** is shown with three cam surfaces **122**, **124** and **126**. Cam surfaces **122** and **124** run in the same direction whereas cam surface **126** runs in the reverse direction. It is noted that cam surfaces **124** and **126** form a depression rather than an apex as in FIGURE 8. The conductors **128** overlap each other in a manner similar to that described with regard to FIGURE 7.

In all instances, the conductors **102**, **116**, and **128**, have a primary and secondary axes when the housings are mated. The secondary axis in FIGURES 7 through 9 of the conductors is at a diagonal with the primary axes. In order to function properly, the conductors must be quite flexible, relatively thin, smooth and unconfigured when in non-mating position. This provides the best possible pressure contact action when the housings are mated.

FIGURES 10 and 11

In FIGURE 10, the hermaphroditic housings **130** and **132** are provided with cam surfaces **134** and **136**. The cam surfaces, run rearwardly from the passageways **138** and **140**. It is to be noted that the bows **142** and **144** of the conductors **146** and **148** respectively extend back only to the forward edge of the mounting passageway cam surface. FIGURE 11 is substantially similar to FIGURE 10 but includes recessed areas **150** and **152** which permit the bow of the conductors **154** and **156**, mounted in passageways **153**, to extend back into the mounting passageway beyond the forward edge of the passageway cam surfaces **158** and **160**. In the structure shown in FIGURES 10 and 11 stops **162** in FIGURE 10 and **164** in FIGURE 11 are provided to prevent further forward travel of the conductors when the housings are mated. In FIGURES 10 and 11, the conductors **142**, **144** and **154** and **156** extend beyond the end of their respective housings a distance farther than the greatest depth of the passageways in the opposite conductor in the areas of their cam surfaces. This causes buckling of the conductors toward each other as illustrated in FIGURES 10 and 11, in order to provide a good pressure contact between conductors. It will be obvious, from a review of the material, that multiple pairs of conductors can be used in housings provided with multiple passageways operating in a manner similar to the structures shown in FIGURES 10 and 11.

FIGURE 12

In FIGURE 12, the housing **166** receives the housing **168**. A chamber **170** is formed by the housings when in closed position. Blades **172** are mounted in passageway **174** and are shown flexed inwardly by cam surfaces **176** against blades **178** which at all times lie in a single plane and have only one axis in open or closed position as compared to the blades **172** which in open position have a single axis but in closed position have two spaced and parallel axis A and B with a diagonal axis C. A separator **180** separates conductors or blades **178**. Latches **182** maintain the housings in mating position.

While the invention has been described in connection with different embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as may be applied to the essential features hereinbefore set forth and fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim is:

1. A hermaphroditic electrical assembly comprising:
(a) a pair of mating housings,
(b) a passageway in one housing cooperating with a passageway in the other housing,
(c) each housing having a flexible conductor mounted in its passageway and when assembled extending into the passageway of the other housing and having a primary and an offset secondary axis,
(d) each housing having a cam surface on its passageway in line with the primary axis of the conductor mounted in the other housing and deflecting the end of the conductor mounted in the other housing in a direction toward and into engagement with its own conductor, and
(e) the end of each conductor when in assembled position having a secondary axis different from said primary axis so as to provide a two point contact connection between said conductors.

2. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) said flexible conductors are relatively thin blades.

3. A hermaphroditic electrical assembly as in claim **2** and wherein:
(a) said blades are substantially flat and straight in non-assembled relation and S-shaped in assembled relation.

4. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) the end of the conductor of one housing projects a distance beyond the cam surface of the other housing.

5. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) the secondary axes of said conductors are parallel to each other.

6. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) the secondary axes of said conductors are parallel to each other and to said primary axes.

7. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) said conductors when in contact connection form an opening between said two point contact connection.

8. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) the ends only of said conductors are in contact connection.

9. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) said passageway of each housing adjacent its cam surface is relieved from its conductor, a distance slightly greater than the thickness of the end of the other conductor.

10. A hermaphroditic electrical assembly as in claim **1** and wherein:
(a) said housings each include a plurality of said cooperating passageways and a plurality of said flexible conductors.

11. A hermaphroditic electrical assembly as in claim **10** and wherein:
(a) said passageways in each housing are parallel to each other, and
(b) lock means for holding said housings in assembled relation.

12. A housing for an electrical assembly comprising:
(a) a passageway,
(b) a substantially flat unitary, non-configured blade conductor mounted in said passageway and flexible throughout its contact length,
(c) said passageway including a cam surface adjacent the end of said passageway, and
(d) said conductor extending beyond the end of said passageway a distance greater than the length of said cam surface.

13. A housing for an electrical assembly as in claim **12** and wherein:
(a) said passageway adjacent said cam surface is relieved from said conductor a distance slightly greater than the thickness of said conductor end.

14. A housing for an electrical assembly as in claim **12** and including:
(a) a plurality of said passageways each having one of said conductors.

15. A housing for an electrical assembly as in claim **12** and wherein:
(a) said cam surface extends rearwardly in said housing relative to said passageway.

16. A housing for an electrical assembly as in claim **12** and wherein:
(a) said cam surface extends forwardly in said housing relative to said passageway.

17. A housing for an electrical assembly as in claim **15** and wherein:
(a) said passage includes an enlarged area which includes said cam surface.

18. A hermaphroditic electrical assembly comprising:
(a) a pair of mating housings,
(b) a passageway in one housing cooperating with a passageway in the other housing,
(c) each housing having a flexible conductor mounted in its passageway and when assembled extending into the passageway of the other housing,
(d) each housing having a cam surface on its passageway in line with the primary axis of the conductor mounted in the other housing, and
(e) each passageway having a stop for deflecting the conductor mounted in the other housing in a direction toward and into engagement with its own conductor.

19. A hermaphroditic electrical assembly as in claim **18** and wherein:
(a) said conductors when said housings are assembled have contacting bows.

20. A hermaphroditic electrical assembly as in claim **18** and wherein:
(a) the bow of a conductor extends back into its mounting passageway beyond the forward edge of said passageway cam surface.

21. An electrical conductor assembly comprising:
(a) a pair of mating members having an open first position and a closed second position,
(b) a plurality of passageways in said assembly,
(c) a cam surface means in said assembly and a chamber adjacent said cam surface means,

(d) a flexible substantially flat, unitary, non-configured blade conductor mounted in each of said passageways and extending a distance beyond the end of said passageway,

(e) said flexible conductors when said mating members are in said closed position extending into said chamber and having a primary and a secondary axis,

(f) said cam surface means being in line with the axis of said conductors when said mating members are in said first and second positions, and

(g) said conductors being in conductive engagement with each other when said mating members are in said second position.

22. An electrical conductor assembly as in claim **21** and wherein:

(a) said cam surface means is a single cam surface.

23. An electrical conductor assembly as in claim **22** and wherein:

(a) said conductors are lapped when said mating members are in the second position.

24. An electrical conductor assembly as in claim **22** and wherein:

(a) said cam surface means includes at least two adjacent cam surfaces.

25. An electrical conductor assembly as in claim **24** and wherein:

(a) at least two of said cam surfaces run transversely to each other.

26. An electrical conductor assembly as in claim **25** and wherein:

(a) at least two of said cam surfaces run in the same general direction.

27. An electrical conductor assembly comprising:

(a) a pair of mating members forming a housing having an open first position and a closed second position,

(b) a pair of passageways in said assembly,

(c) a pair of cam surfaces on one of said mating members of said assembly and a chamber adjacent said cam surface,

(d) a flexible conductor mounted in each of said passageways and extending a distance beyond the end of said passageway greater than the length of said cam surface,

(e) said flexible conductors when said mating members are in said closed position extending into said chamber and having a primary and an offset secondary axis,

(f) said cam surfaces being in line with the primary axis of the conductors when said mating members are in said first and second positions,

(g) said conductors being in engagement with each other when said mating members are in said second position,

(h) the end of each conductor when said mating members are in said second position having their offset secondary axis different from their primary axis and parallel to and spaced from said primary axis, and

(i) spring means for urging said mating members apart.

28. An electrical conductor assembly comprising:

(a) a pair of mating members having an open first position and a closed second position,

(b) a plurality of passageways in said assembly,

(c) a cam surface means in said assembly and a chamber formed adjacent said cam surface means,

(d) a flexible substantially flat, unitary, non-configured blade conductor mounted in each of said passageways and extending a distance beyond the end of said passageways,

(e) at least one of said flexible conductors when said mating members are in said closed position extending into said chamber and having a primary axis and an offset secondary axis,

(f) said cam surface means being in line with the axis of at least one of said flexible conductors when said mating members are in said first and second positions,

(g) said conductors being in conductive engagement with each other when said mating members are in said second position, and

(h) at least another of said conductors having a primary axis only when said mating members are in said first and second positions.

29. A hermaphroditic electrical assembly comprising:

(a) a pair of mating housings,

(b) a pair of passageways in one housing cooperating with a pair of passageways in the other housing,

(c) each housing having a flexible conductor mounted in its passageways and when assembled extending into the passageways of the other housing,

(d) each housing having a cam surface on one of its passageways in line with the primary axis of the conductor mounted in the other housing, and

(e) each passageway having a stop for deflecting the end of the conductor mounted in the other housing in a direction toward and into engagement with its own conductor, and

(f) said cam surface on said one passageway of said pair extending rearwardly in said housing relative to said other passageway of said pair.

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ROBERT K. SCHAEFER, Primary Examiner

H. BURKS, Assistant Examiner

U.S. Cl. X.R.

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