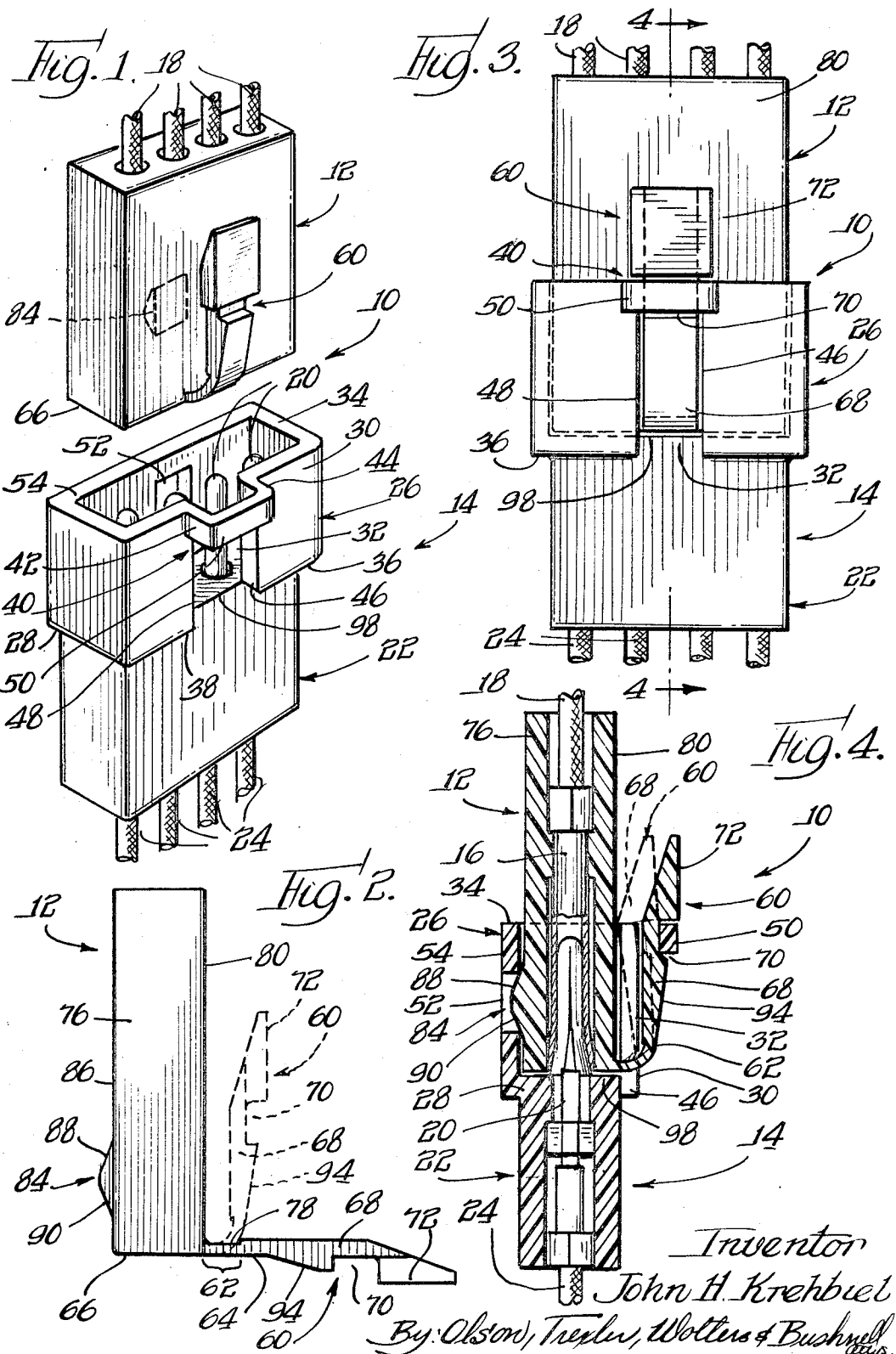


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ELECTRICAL CONNECTOR HAVING RESILIENT ARCUATELY
BENDABLE LOCKING MEANS
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**ELECTRICAL CONNECTOR HAVING RESILIENT
ARCUATELY BENDABLE LOCKING MEANS**
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ABSTRACT OF THE DISCLOSURE

An electrical connector including a mating receptacle and plug. The receptacle includes, in one wall thereof, a slot having a bar extending transversely across the slot, and the plug includes, on a corresponding wall, a latch lever which is integrally formed with the plug. The lever is normally in a relaxed position, extending outwardly from the wall at an offset angle thereto and, prior to insertion of the plug into the receptacle, is bent about its attached end to a tensioned position wherein it extends substantially parallel to the wall of the plug. When the plug is inserted into the receptacle, the lever is released and, still being under tension, is forced against the latch bar with which it mates to retain the plug and receptacle interlocked. In a preferred embodiment, a cam lug is provided on the plug on the wall opposite from the lever. The cam lug fits into a recess in a corresponding wall of the receptacle upon being joined with the plug. The cam lug is forced into and held in the recess by the force provided by the tensioned lever to further secure the plug and receptacle in an interlocked position.

This invention relates generally to an electrical connector and more particularly to an electrical connector having a releasable latch means for interconnecting a plug and a receptacle portion of a connector.

Electrical connectors are commonly utilized for interconnecting two groups of wires rather than separately joining together individual pairs of wires. The prior art electrical connectors commonly include a plug having a terminal connected to a first group of wires and a receptacle having terminals connected to a second group of wires. The two groups of wires are electrically interconnected by inserting the plug portion of the connector into the receptacle portion of the connector. A latch means is usually provided for preventing the plug from being accidentally pulled out of the receptacle.

The prior art electrical connector latches usually include a latch lug projecting from the plug into a recess in the receptacle. The latch is generally released by placing the lug, manually or with a tool, out of engagement with the recess. Once the plug has been forced out of engagement, the plug and receptacle portion of the connector can be separated. When the plug is reinserted in the receptacle, the lug will again engage the recess to securely latch the two connector components together.

The generally satisfactory service provided by these prior art electrical connector latches is shown by the widespread industrial usage of the latches. However, the prior art connector latches have proven to be somewhat unsatisfactory, due to the difficulty in disengaging the latch lug from the associated latching recess. This difficulty is multiplied when one of the connector elements is mounted in front of or behind a control panel where access to the latch lug is limited.

Therefore, it is an object of this invention to provide an improved electrical connector structure having a readily engageable and disengageable latch structure for securely interconnecting the mating parts of the connector.

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Another object of this invention is to provide an electrical connector having a latch structure which can be released by depressing a readily accessible lever mounted on the connector.

Another object of this invention is to provide an improved electrical connector of two-piece construction which is simple in design and structure, economical to manufacture, highly practicable in use, and which is readily connected and disconnected for rapid assembly and disassembly of electrical components.

Another object of this invention is to provide an electrical connector structure which is easily molded with an integrally formed resilient latch structure.

These and other objects and features of the invention will become more apparent upon a reading of the following detailed description taken in connection with the accompanying drawing, wherein:

FIG. 1 is a perspective view of a connector for interconnecting two groups of wires shown with a plug element separated from a receptacle element for purposes of clarity of illustration;

FIG. 2 is an elevational view of the plug element with a latch lever illustrated in solid lines as originally formed and illustrating the latch lever in dashed lines in a locking position;

FIG. 3 is an elevational view illustrating the latch lever in locked position to prevent the plug element from being removed from the receptacle element; and

FIG. 4 is a sectional view, along the line 4—4 of FIG. 3, illustrating the latch lever in solid lines in a locking position and illustrating the latch lever in dashed lines in an unlocked position.

Referring now to the drawing in greater detail, there is shown in FIG. 1 a connector assembly 10 which is molded of a suitable polymeric material such as nylon. The connector assembly 10 includes a plug 12 and a receptacle 14. A plurality of female metallic terminals 16 are mounted in the plug 12 and are connected to a first group of wires 18. As is best seen in FIG. 4, a plurality of metallic male type terminals 20 are mounted in a base portion 22 of the receptacle 14 and connected to a second group of wires 24. The terminals 20 are positioned in mating engagement with the terminals 16 when the plug 12 is inserted in a socket section 26 of the receptacle 14 to provide an electrical connection between the wires 18 and 24. The terminals 16 and 20 are constructed and mounted as illustrated in my prior United States Patent No. 3,178,673, and reference may be had thereto for further details concerning the terminals.

The socket section 26 of the receptacle 14 is formed by a rectangular housing which is connected to the base section 22 at an outwardly projecting shoulder 28 (see FIG. 1). The socket section 26 includes a front side wall 30 in which a longitudinally extending latch slot or aperture 32 is formed. The latch slot or aperture 32 extends from an outermost end surface 34 of the receptacle 14 to an innermost end surface 38 (see FIG. 3) of the shoulder 28. The slot 32 is positioned in the center of the side wall 30 and extends longitudinally for the entire length of the side wall. This construction facilitates forming of the slot 32 when the receptacle 14 is being molded as a unitary structure.

A retaining or latch bar means 40 is integrally formed with the side wall 30 of the socket section 26. The latch bar means 40 includes a pair of transversely outwardly extending connector bars 42 and 44 (see FIG. 1) which are positioned with an inner surface coplanar with opposite side surfaces 46 and 48 of the latch slot 32. An outermost surface of the latch bar means 40 is positioned in a coplanar relationship with the outermost end wall 34 of the receptacle 14. The two parallel connector bars

42 and 44 are interconnected by a latch bar 50 which extends transversely across the latch slot or aperture 32.

Referring now to FIG. 1, taken in conjunction with FIG. 4, it will be seen that a rectangular aperture or recess 52 is formed in a rear side wall 54 of the socket section 26. The recess 52 is positioned centrally of the rear wall 54 directly opposite the longitudinally extending latch slot 32. As is perhaps best seen in FIG. 4, the recess 52 is positioned intermediate the outermost end wall 34 of the socket section 26 and the shoulder 28 which interconnects the socket and base section. From a comparison of FIGS. 1 and 4, it will be apparent that the aperture or recess 52 and the latch slot or aperture 32 both extend completely through the side walls of the socket section 26 and are positioned with their longitudinal axes in the same transversely extending plane as is the central longitudinal axis of the receptacle element 14.

Referring now to FIG. 2 taken in conjunction with FIG. 1, it can be seen that the plug element 12 includes an integrally formed latch lever 60. The latch lever 60 includes a resiliently deformable end section 62 which is initially molded with an outermost surface 64 in a coplanar relationship with an outer end surface 66 of the receptacle 12, as indicated in solid lines in FIG. 2. The latch lever 60 includes a longitudinally extending body section 68 in which a transversely extending locking recess or notch 70 is formed. An actuator or latch release section 72 is integrally formed with an outer end portion of the body 68 to enable the latch lever 60 to be readily engaged for pivoting movement relative to a body or base 76 of the plug 12. A transversely extending notch or recess 78 is molded in an inner side of the resiliently deformable end section 62 of the latch lever to facilitate the pivoting of the latch lever from an initial outwardly extending position shown in solid lines in FIG. 2 to a second position extending generally parallel to a side wall 80 of the base 76 of the plug element 12, as illustrated in dashed lines in FIG. 2. Since the end section 62 of the latch lever 60 is notched at 78 to have a reduced cross-sectional area, an arcuate bend is formed in the end section 62 when the latch lever is pivoted from the initial position projecting outwardly from the plug element 12 to the second position, illustrated in dashed lines, extending generally parallel to the plug element.

A cam lug 84 is integrally formed with a rear wall 86 of the plug element 12. The cam lug 84 includes first and second oppositely sloping cam surfaces 88 and 90 which engage opposite ends of the rectangular recess 52 when the plug element 12 is positioned in the receptacle element 14, as illustrated in FIG. 4. The oppositely sloping cam surfaces 88 and 90 tend to center the cam lug 84 relative to the recess 52 while interlocking the plug 12 and receptacle 14.

Referring now to FIG. 3, taken in conjunction with FIG. 2, it can be seen that when the plug element 12 is inserted in the receptacle element 14, the latch lever 60 engages the latch bar means 40 to securely interlock the plug and receptacle elements. This engagement of the latch lever 60 and latch bar means 40 prevents the plug from being inadvertently pulled out and removed from the receptacle and interrupting the electrical connection between the first group of wires 18 and the second group of wires 24. The outer end portion of the plug element 12 is inserted in the socket section 26 of the receptacle 14 with the latch lever in the position indicated in dashed lines in FIG. 2. When the latch lever is in this position, that is extending generally parallel to the wall 80 of the plug 12, an outwardly sloping longitudinally extending cam surface 94 of the latch lever 60 engages the latch bar means 40 and pivots the latch lever inwardly about the end portion 62 as the plug element 12 is inserted into the receptacle element 14. The latch lever 60 is retained in this position by locking engagement of the recess or notch 70 with the transversely extending latch bar 50. The end portion 62 of the latch lever 60 is adjacent to

an outer end surface 98 of the base section 22 of the receptacle 14.

Referring now to FIG. 4, the plug element 12 is shown inserted in the receptacle element 14 with the latch lever 60 in locking engagement with the latch bar 50 to interlock the plug and receptacle. It should be noted that the body section 68 of the latch lever 60 is positioned outside of the latch slot 32 with an inner surface of the body section extending generally parallel to an outer surface of the wall 30 of the socket 26. The latch lever is depressed inwardly, by manually engaging the latch release section 72 and pressing the latch lever inwardly, as indicated by dashed lines in FIG. 4. When the latch lever has been pivoted to the position indicated by the dashed lines in FIG. 4, the body section 68 of the latch lever will be intermediate the two opposite side walls 46 and 48 of the latch slot and in abutting engagement with the outer surface 80 of the base section 76 of the plug. When the latch lever is in this position, the notch or recess 70 will be disengaged from the latch bar 50 to enable the plug element 12 to be withdrawn from the receptacle element 14.

After the latch lever 60 has been pivoted to the unlocked position, indicated by dashed lines in FIG. 4, the plug element 12 can be withdrawn from the socket 26 of the receptacle 14 by pulling the plug element longitudinally outwardly relative to the receptacle 14. As the plug element is moved longitudinally outwardly, the first cam surface 88 flexes the rear wall 54 of the socket 26 outwardly to disengage the cam lug 84 from the rectangular recess 52. In a similar manner, when the plug 12 is inserted in the receptacle 14, the cam surface 90 of the cam lug 84 will flex the rear wall 54 of the socket section 26 outwardly to facilitate the reinsertion of the plug into the receptacle. Once the plug has been reinserted into the receptacle, and the latch lever 60 released to enable it to resiliently pivot into locking engagement with the latch bar 50, the latch lug 84 is in engagement with the recess 52 to further interlock the plug element and receptacle element. It should be noted that the inner cam surface 88, once the nose of the cam 84 has been cleared by the outwardly flexed side wall 54, tends to cam the plug 12 into position in the receptacle 14.

The operation of the electrical connector 10 will be apparent from the above description. However, for purposes of affording a more complete understanding of the invention, it is advantageous now to provide a functional description of the mode in which the component parts cooperate. The plug 12 initially is formed with the latch lever 60 extending perpendicularly transversely outwardly, as indicated in solid lines in FIG. 2. The latch lever is pivoted upwardly, to the position indicated in dashed lines in FIG. 2, to facilitate insertion of the plug 12 into the receptacle 14. As the plug is moved downwardly into the receptacle, the cam lug 84 will flex the rear wall 54 of the receptacle outwardly. As the downward movement continues, the inner cam surface 88 will tend to react with the rear wall 54 of the socket section 26 to cam the plug 12 downwardly into secure mating engagement with the receptacle 14. When the cam surface 88 has cleared the rear wall 54, the cam lug 84 will engage the cam recess 52.

Contemporaneously with the occurrence of this cam action, the latch lever 60 will pivot inwardly from the position indicated in solid lines in FIG. 2 to the position indicated in dashed lines in FIG. 4. The inward movement of the latch lever 60 will result from a sliding engagement of the cam surface 94, of the latch lever, with the latch bar 50. As the plug is inserted into the receptacle, the latch bar 50 will snap into the notch 70 to provide locking engagement between the notch and the latch bar 50, as indicated in solid lines in FIG. 4. When the receptacle 14 and plug 12 are positioned as shown in FIG. 4, there will be a secure electrical connection between the terminals 20 for the wires 24 and the terminals 16 for the wires 18.

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The latching lever 60 is retained in resilient engagement with the latch bar 50 by the inherent resilient tendency of the arcuately bent end section 62 of the latch lever to pivot the latch lever to its initial position shown in solid lines in FIG. 2. This inherent resiliency will cause the latch lever to pivot forwardly to provide a secure engagement between the latch bar 50 to prevent the notch 70 from being accidentally disengaged by vibration or other movement of the wires 18 or 24. This natural resiliency of the latch lever 60 will also tend to force the cam lug 84 into the recess 52. This rearward force which will be exerted by the latch lever 60 on the plug 12 will also cause the two cam surfaces 88 and 90 to tend to automatically position the plug element 12 relative to the receptacle element 14.

The plug 12 may be disengaged from the receptacle 14 by pressing the latch lever 60 inwardly relative to the plug 12 against the natural resiliency or spring force exerted by the arcuately bent end portion 62 of the latch lever 60. When the latch lever 60 has been pivotably moved inwardly, the body section 68 of the latch lever will be intermediate the two opposite side surfaces 46 and 48 of the latch slot 32 and an inner surface of the latch lever 60 will be in abutting engagement with the side surface 80 of the plug 12, as indicated by the dashed lines in FIG. 4. The notch 70 will then be positioned inwardly and disengaged from the latch bar 50.

Once the latch lever has been resiliently pivoted inwardly, the plug can be disconnected from the receptacle by pulling the plug outwardly relative to the receptacle. As the plug is pulled outwardly relative to the receptacle, the cam surface 94 of the latch lever 60 will slide along the inner surface of the latch bar 50 and the cam surface 88 of the cam lug 84 will flex the rear wall 54 outwardly. After the nose of the cam lug 84 has cleared the outer edge of the recess 52, the resilient outward force exerted by the latch lever 60, as it tends to pivot to its initial position, indicated by dotted lines in FIG. 2, will tend to continue the outward movement of the plug 12 relative to the receptacle 14. Thus, once the cam lug 84 has been disengaged from the recess 52, the latch lever 60 will automatically tend to resiliently pull the plug element away from the receptacle as the latch lever 60 resiliently pivots to its initial outwardly extending position.

It will be understood that the member 12 described herein, for purposes of this specification and claims, as a plug member, is also known in the electrical components industry as a "receptacle." The designation of the member 12 as a "receptacle" by the electrical components industry results from the fact that the female type terminals 16 are mounted in the member 12. It will also be understood that the member 14 described herein for purposes of this specification and claims as a receptacle member is also known in the electrical component industry as a "plug." The member 14 is known in the electrical components industry as a "plug" because the male type terminals 20 are mounted therein. However, since this disclosure is drawn primarily to the connector members 12 and 14, without substantial regard to the relationship of the terminals 16 and 20, and because the member 12 is inserted into the member 14, the member 14 has been designated as a receptacle into which the member 12, designated as a plug, is inserted.

It is contemplated that, if desired, a plurality of latch levers 60 could be utilized for interlocking the plug and receptacle elements 12 and 14. It is also contemplated that the cam lug 84 could, if desired, be replaced with a latch lever and latch bar means, similar to the latch lever 60 and latch bar means 40 if it is desired to provide a latch assembly on opposite sides of a connector. While the latch slot 32 extends longitudinally for the entire length of the side wall 30 of the socket section 26 in the preferred embodiment of the invention, to facilitate molding of the receptacle element 14 and insertion of the plug element 12, it is contemplated that the latch slot could, if desired, be terminated short of the innermost end of

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the side wall 30 and the latch lever 60 moved for a corresponding distance inwardly of the plug 12. Therefore, while particular embodiments of the invention have been shown, it should be understood, of course, that the invention is not limited thereto, since it is contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An electrical connector comprising: a receptacle element adapted to encase terminal ends of a first group of wires, said receptacle element including a base section connected to a socket section, latch slot means formed in a side wall of said socket section, latch bar means connected to said side wall and extending transversely across said latch slot means, said latch bar means including first and second connector bars projecting outwardly from said first side wall adjacent opposite sides of said latch slot means, said first and second connector bars being interconnected at their outermost ends by a lock bar which extends transversely across said latch slot means; and a plug element adapted to encase terminal ends of a second group of wires, said plug element having an end portion adapted to be inserted in the socket section of said receptacle element, said plug element including latch lever means integrally formed with a wall means of said plug element for interlocking said receptacle element and said plug element, said latch lever means being resiliently bendable from a normal, relaxed position extending not substantially less than a right angle outwardly from said wall means, to a tensioned position extending in a generally parallel relationship with said wall means, said latch lever means including a body section connected to said wall means by a resiliently, arcuately bendable end portion, said end portion including a section of reduced cross-sectional area to facilitate moving said latch lever means from said normal to said tensioned position, said latch lever means further including notch means formed in said body section of said latch lever for engaging said latch bar means of said receptacle element, said latch lever means still further including a latch release section integrally formed with said body section, said latch release section being adapted for manual engagement to facilitate resilient movement of said latch lever means from a locked position wherein said notch means engages said lock bar of said latch bar means to an unlocked position wherein said notch means is disengaged from said latch bar means to facilitate removal of said plug element from said receptacle element.

2. A connector assembly as set forth in claim 1 wherein: said latch lever means includes a cam surface means, said cam surface resiliently engaging said latch bar means when said plug element is being withdrawn from said receptacle element to automatically tend to force said plug element outwardly relative to said receptacle element.

3. An electrical connector comprising: a receptacle element adapted to engage terminal ends of a first group of wires, said receptacle element including a base section connected to a socket section by a shoulder means projecting outwardly from said base section, latch slot means formed in a first side wall of said socket section, said latch slot means extending through the first side wall of said socket section and longitudinally of said socket section from said shoulder means to an outermost end surface of said socket section, latch bar means connected to said first side wall and extending transversely across said latch slot means, said latch bar means including first and second connector bars projecting outwardly from said first side wall adjacent opposite sides of said latch slot means, said first and second connector bars being interconnected at their outermost end portions by a lock bar which extends transversely across said latch slot means, recess means formed in a second side wall of said socket section opposite said first side wall thereof and intermediate said outermost end surface of said socket section

and said shoulder means, and a plug element adapted to encase terminal ends of a second group of wires, said plug element having an end portion adapted to be inserted in the socket section of said receptacle element intermediate said first and second side wall, said plug element including latch lever means integrally formed with a first wall means of said plug element for interlocking said receptacle element with said plug element, said latch lever means being resiliently bendable from a normal relaxed position extending outwardly from said first wall means at an offset angle thereto to a tensioned position extending in a generally parallel relationship with said first wall means, said latch lever means including a body section connected to said first wall means by a resiliently, arcuately bendable end portion, said end portion including a section of reduced cross-sectional area to facilitate moving said latch lever means from said initial position to said second position, said latch lever means further including notch means formed in said body section for engaging said latch bar means of said receptacle element, said latch lever means still further including a latch release section formed integrally with said body section, said latch release section being adapted for manual engagement to facilitate resilient movement of said latch lever means from a locked position wherein said notch means engages said latch bar means to an unlocked position wherein said body section is intermediate opposite side surfaces of said latch slot means and said notch means is disengaged from said latch bar means to facilitate removal of said plug element from said receptacle element, and cam lug means integrally formed with a second wall means of said plug element opposite said first wall means for engaging the recess means in the second side wall of said socket section, said cam lug, due to the tension provided by said latch lever means in said second position being forced into and held in said recess means, to further interlock said plug element and said receptacle element, said cam lug means including first and second cam surfaces, said first cam surface resiliently flexing a side wall of said socket section outwardly when said plug element is inserted in said receptacle element, and said second cam surface resiliently flexing the second side wall of said socket section outwardly when said plug element is removed from said receptacle element.

4. An electrical connector as set forth in claim 3 wherein: the resiliently deformable end portion of said latch lever means includes a surface which is substantially coplanar with an outermost end surface of said plug element when said latch lever means is in said initial position.

5. An electrical connector as set forth in claim 3 where-

in: said first and second connector bars have inner surfaces located in a substantially coplanar relationship with the side surfaces of said latch slot means.

6. An electrical connector comprising: a receptacle element adapted to encase terminal ends of a first group of wires, said receptacle including a base section connected to a socket section, latch slot means formed in a side wall of said socket section, latch bar means connected to said side wall and extending transversely across said latch slot means; and a plug element adapted to encase terminal ends of a second group of wires, said plug element having an end portion adapted to be inserted in the socket section of said receptacle element, said plug element including latch lever means integrally formed with a wall means of said plug element for interlocking said receptacle element and said plug element, said latch lever means being resiliently bendable from a normal relaxed position extending not substantially less than a right angle outwardly from said wall means, to a tensioned position extending in a generally parallel relationship with said wall means, said latch lever means including a body section connected to said wall means by a resiliently, arcuately bendable end portion, said end portion including a section of reduced cross-sectional area and being of a predetermined length, significantly less than the over-all length of said body section, to facilitate moving said latch lever means from said normal to said tensioned position, said latch lever means further including notch means formed in said body section of said latch lever means for engaging said latch bar means of said receptacle element, said latch lever means still further including a latch release section integrally formed with said body section, said latch release section being adapted for manual engagement to facilitate resilient movement of said latch lever means from a locked position wherein said notch means engages said latch bar means to an unlocked position wherein said notch means is disengaged from said latch bar means to facilitate removal of said plug element from said receptacle element.

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