



US010326236B1

(12) **United States Patent**  
**Harmelink et al.**

(10) **Patent No.:** **US 10,326,236 B1**  
(45) **Date of Patent:** **Jun. 18, 2019**

(54) **ELECTRICAL CONNECTOR WITH  
AUTOMATIC LATCHING**

(56) **References Cited**

U.S. PATENT DOCUMENTS

- (71) Applicant: **Deere & Company**, Moline, IL (US)
- (72) Inventors: **Gregory K. Harmelink**, Moorhead, MN (US); **Jon T. Jacobson**, Fargo, ND (US); **Michael A. Hajicek**, West Fargo, ND (US)
- (73) Assignee: **DEERE & COMPANY**, Moline, IL (US)
- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

2,496,208	A *	1/1950	Hasselbaum .....	H01R 13/5219	439/144
4,312,553	A *	1/1982	Lyckesjo .....	B60D 1/64	439/281
5,302,141	A *	4/1994	O'Reilly .....	B60D 1/64	439/144
5,595,492	A *	1/1997	Taguchi .....	H01R 13/62955	439/157
5,709,561	A *	1/1998	Cadoret .....	H01R 13/62933	439/144
5,785,532	A *	7/1998	Maue .....	B60R 16/0238	439/34
5,873,744	A *	2/1999	Ramos, Jr. ....	H01R 13/6275	439/144

(Continued)

(21) Appl. No.: **15/900,435**

FOREIGN PATENT DOCUMENTS

(22) Filed: **Feb. 20, 2018**

EP	0568030	A1	11/1993
EP	1686658	A2	8/2006
WO	2013119276	A1	8/2013

- (51) **Int. Cl.**  
**H01R 13/62** (2006.01)  
**H01R 13/627** (2006.01)  
**H01R 13/447** (2006.01)  
**H01R 13/633** (2006.01)  
**H01R 12/71** (2011.01)  
**H01R 13/52** (2006.01)  
**H01R 13/506** (2006.01)

*Primary Examiner* — Alexander Gilman

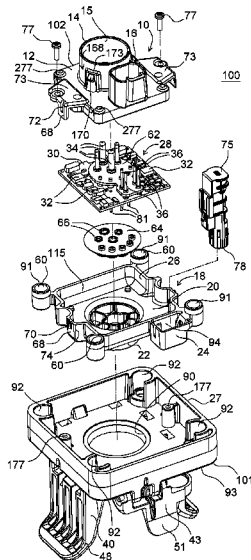
- (52) **U.S. Cl.**  
CPC ..... **H01R 13/6273** (2013.01); **H01R 12/716** (2013.01); **H01R 13/447** (2013.01); **H01R 13/506** (2013.01); **H01R 13/5219** (2013.01); **H01R 13/633** (2013.01)

(57) **ABSTRACT**

- (58) **Field of Classification Search**  
CPC ..... H01R 13/5273; H01R 12/716; H01R 13/447; H01R 13/506; H01R 13/5219; H01R 13/633  
USPC ..... 439/78  
See application file for complete search history.

An electrical connector comprises a first housing member that engages a second housing member engages to form an enclosure. In the enclosure, a substrate supports a central set of conductive members in a second tubular portion a peripheral set of conductive members within the first hollow support. A first arm is pivotably attached to the second housing member. The first arm is resiliently biased inwardly toward the second base portion. A second arm is pivotably attached to the second housing member and spaced apart from the first arm. The second arm is resiliently biased inwardly toward the second base portion. In accordance with one aspect, the arms support automatic latching of the connector portion to a mating connector.

**21 Claims, 7 Drawing Sheets**



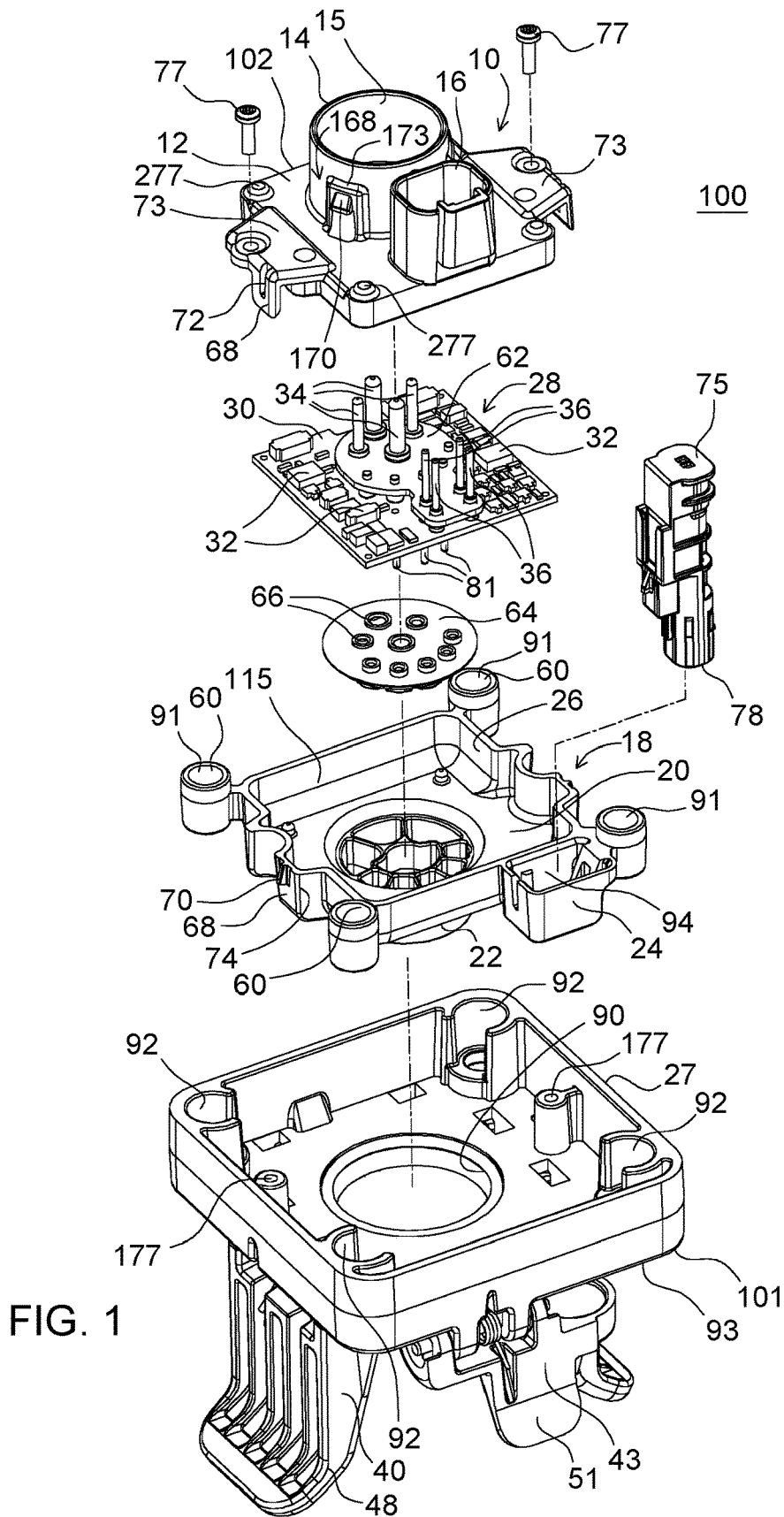
(56)

**References Cited**

U.S. PATENT DOCUMENTS

5,951,309 A *	9/1999	Hopper	.....	H01R 13/447	8,376,758 B2 *	2/2013	Sell	.....	B60D 1/64
				439/136					439/34
6,054,779 A *	4/2000	Zubko	.....	B60Q 1/305	8,535,071 B1 *	9/2013	Mueller	.....	B60D 1/64
				307/10.8					439/144
6,450,833 B1 *	9/2002	Brown, Jr.	.....	B60D 1/64	8,939,785 B2 *	1/2015	Chiu	.....	H01R 13/621
				439/518					439/333
6,554,626 B2 *	4/2003	Ramos, Jr.	.....	H01R 13/405	9,415,730 B2 *	8/2016	Scheele	.....	B60R 16/0239
				439/144	9,496,639 B2 *	11/2016	Harmon	.....	H01R 13/5202
6,827,594 B1 *	12/2004	Davis	.....	H01R 13/62933	9,543,719 B2	1/2017	Bartholomew et al.		
				439/157	9,806,478 B2	10/2017	Bartholomew et al.		
6,840,782 B1	1/2005	Borden et al.			9,825,404 B2 *	11/2017	Yoshigi	.....	H01R 12/58
7,491,065 B2 *	2/2009	Wagner	.....	H01R 13/5213	2003/0054688 A1 *	3/2003	Howard	.....	H01R 13/447
				439/35					439/559
7,967,617 B2 *	6/2011	Vonnegut	.....	H01R 13/6658	2007/0072461 A1 *	3/2007	Williams	.....	H01R 13/5219
				439/142					439/144
8,167,639 B2 *	5/2012	Weidner	.....	H01R 13/62	2009/0195971 A1 *	8/2009	Phillips	.....	H02G 3/16
				439/352					361/643
8,192,216 B1 *	6/2012	Puluc	.....	H01R 13/64	2011/0056723 A1 *	3/2011	Slippy	.....	H01R 13/5808
				439/271					174/73.1
8,251,732 B2 *	8/2012	Armacost	.....	H01R 13/745	2012/0202377 A1 *	8/2012	Puluc	.....	H01R 13/5219
				439/347					439/559
					2013/0130525 A1 *	5/2013	Hachadorian	.....	H01R 13/5213
									439/142
					2014/0377970 A1 *	12/2014	Crovetti	.....	H01R 13/5213
									439/131

\* cited by examiner



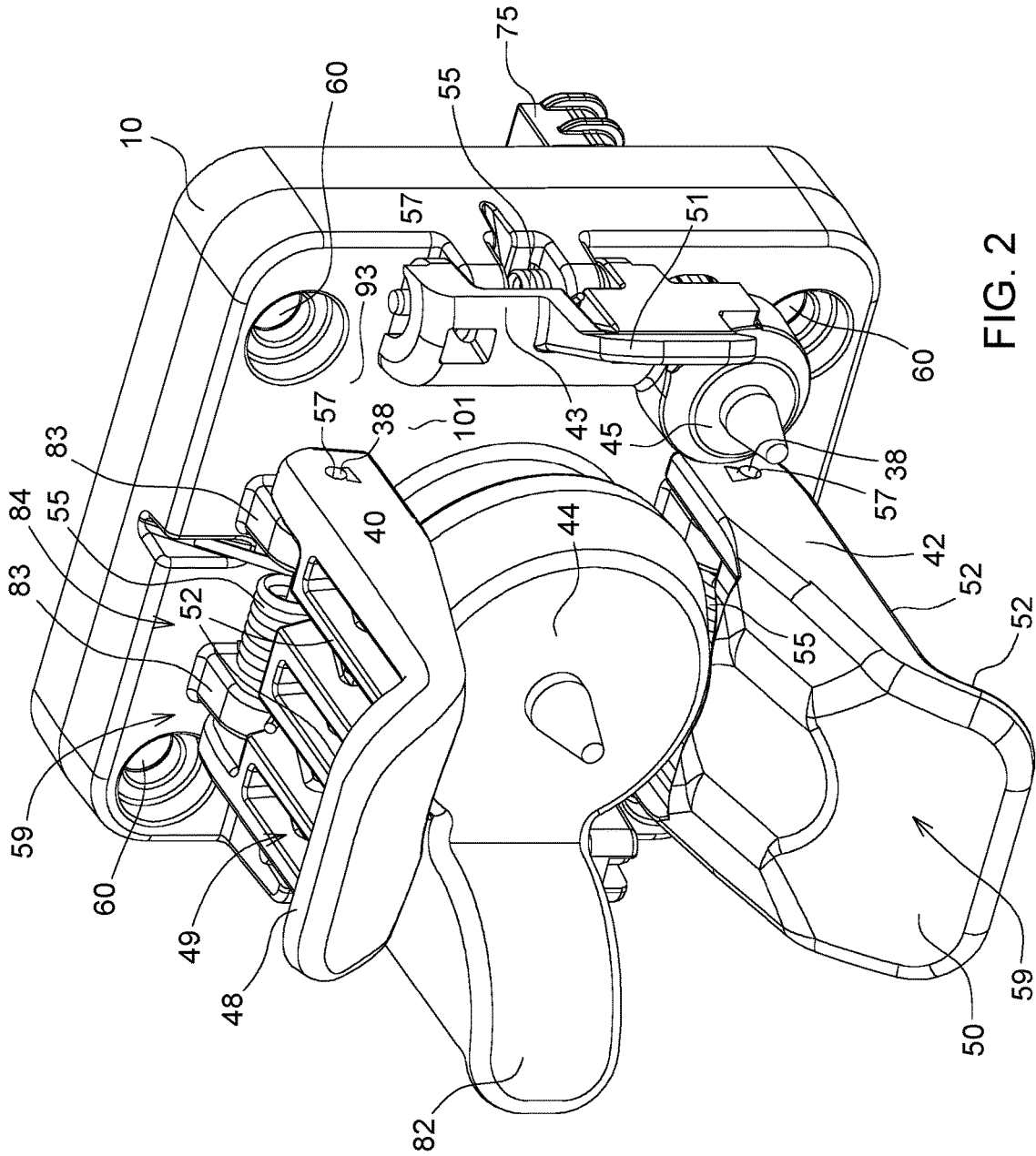


FIG. 2

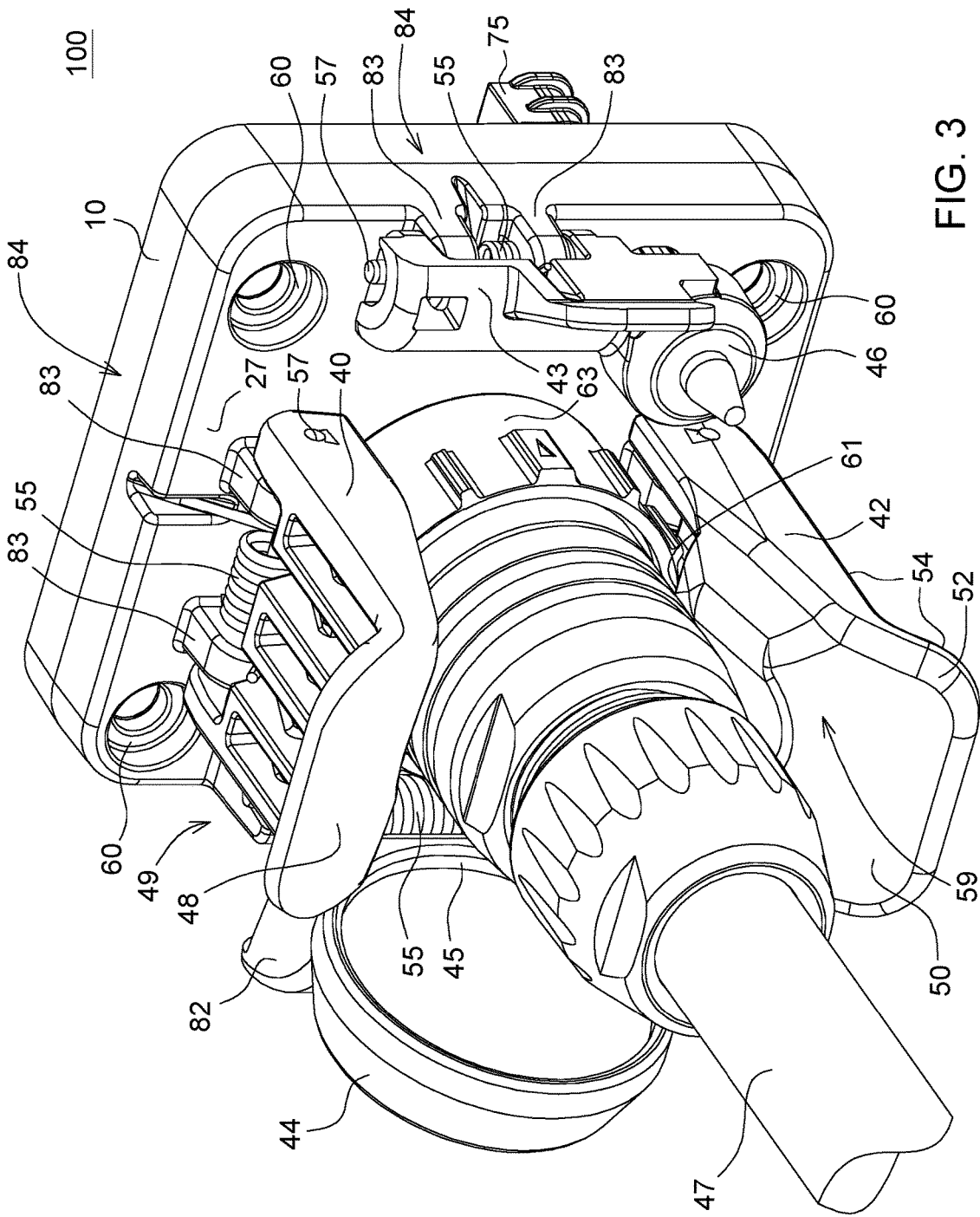


FIG. 3

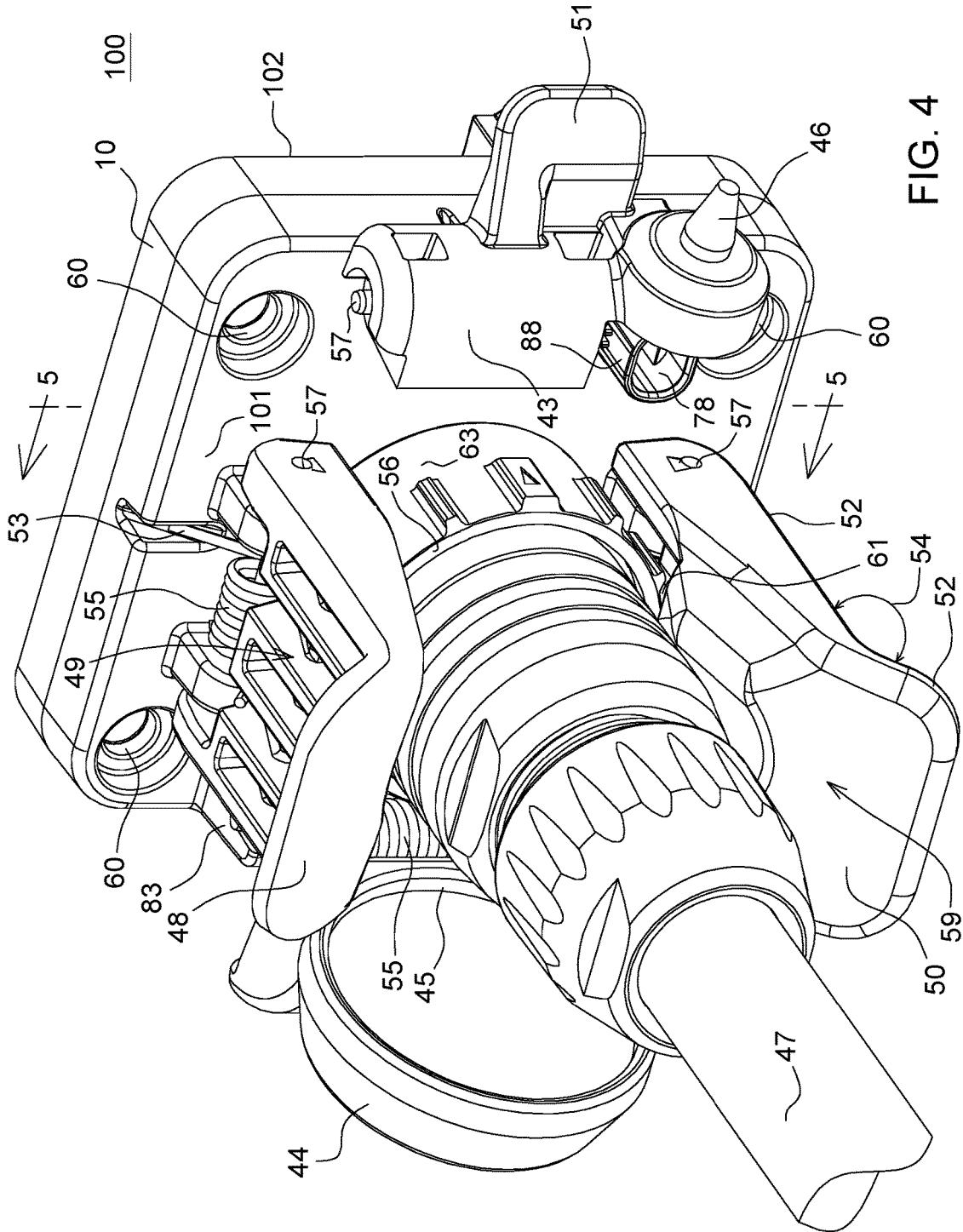


FIG. 4

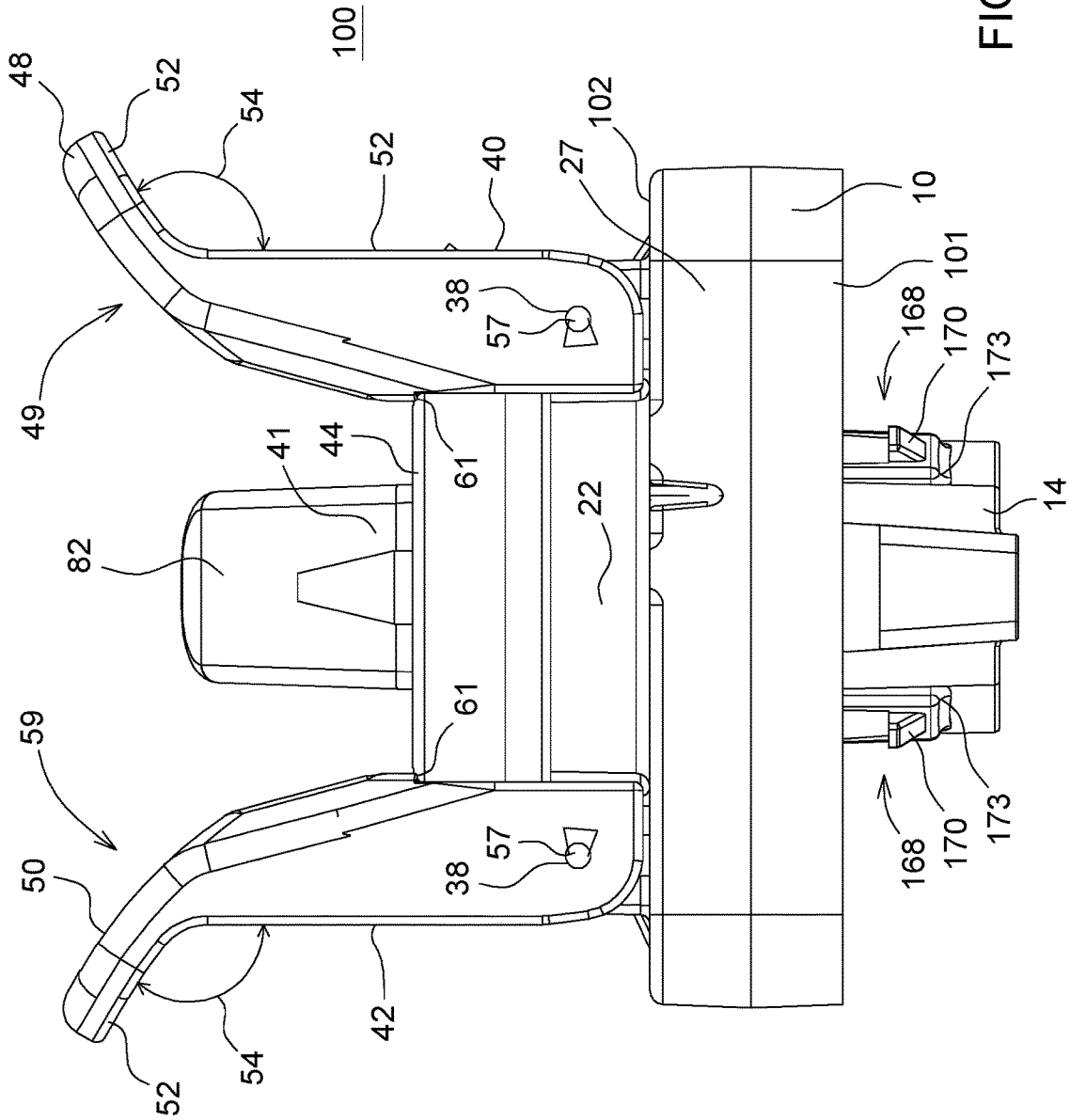


FIG. 5

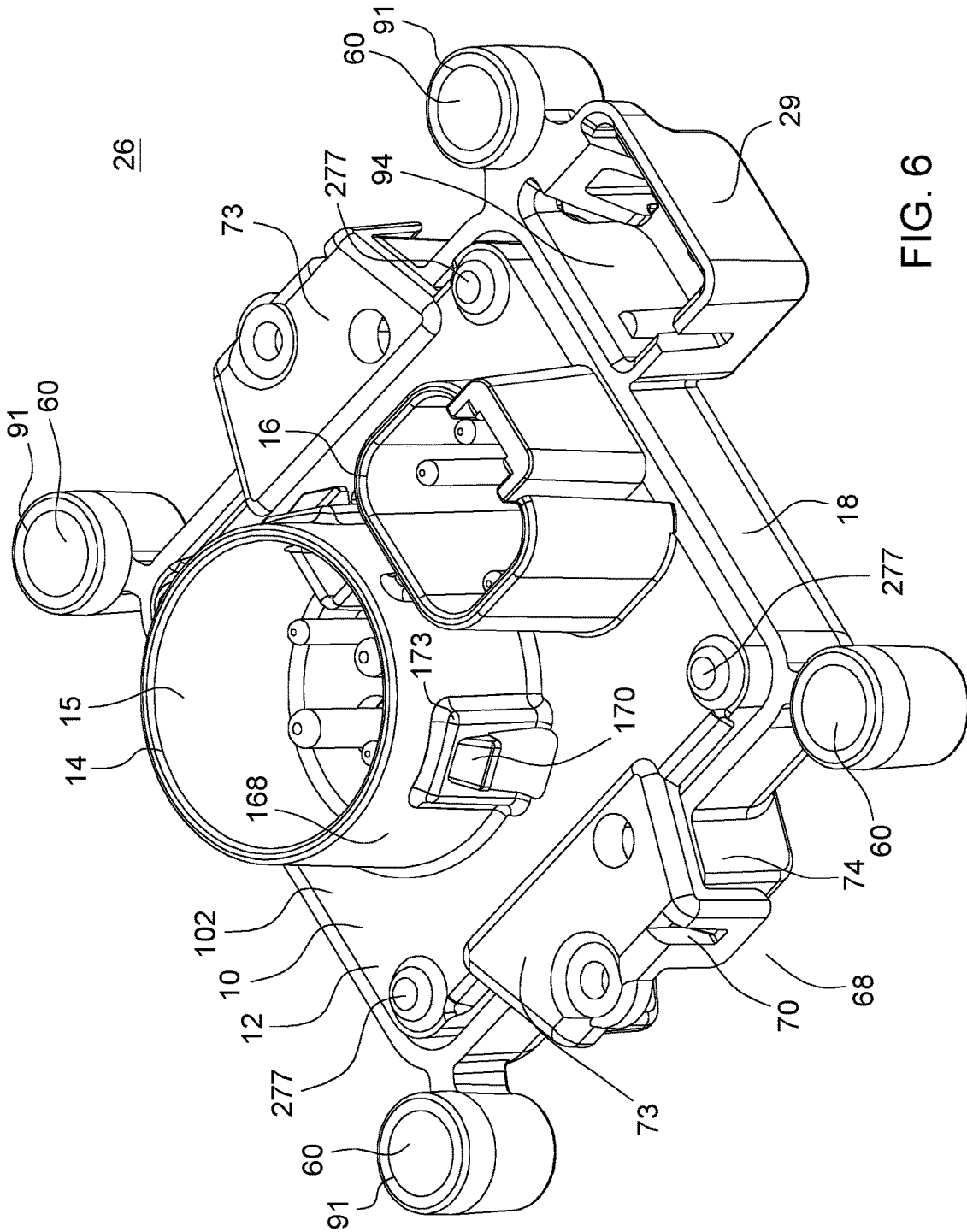


FIG. 6



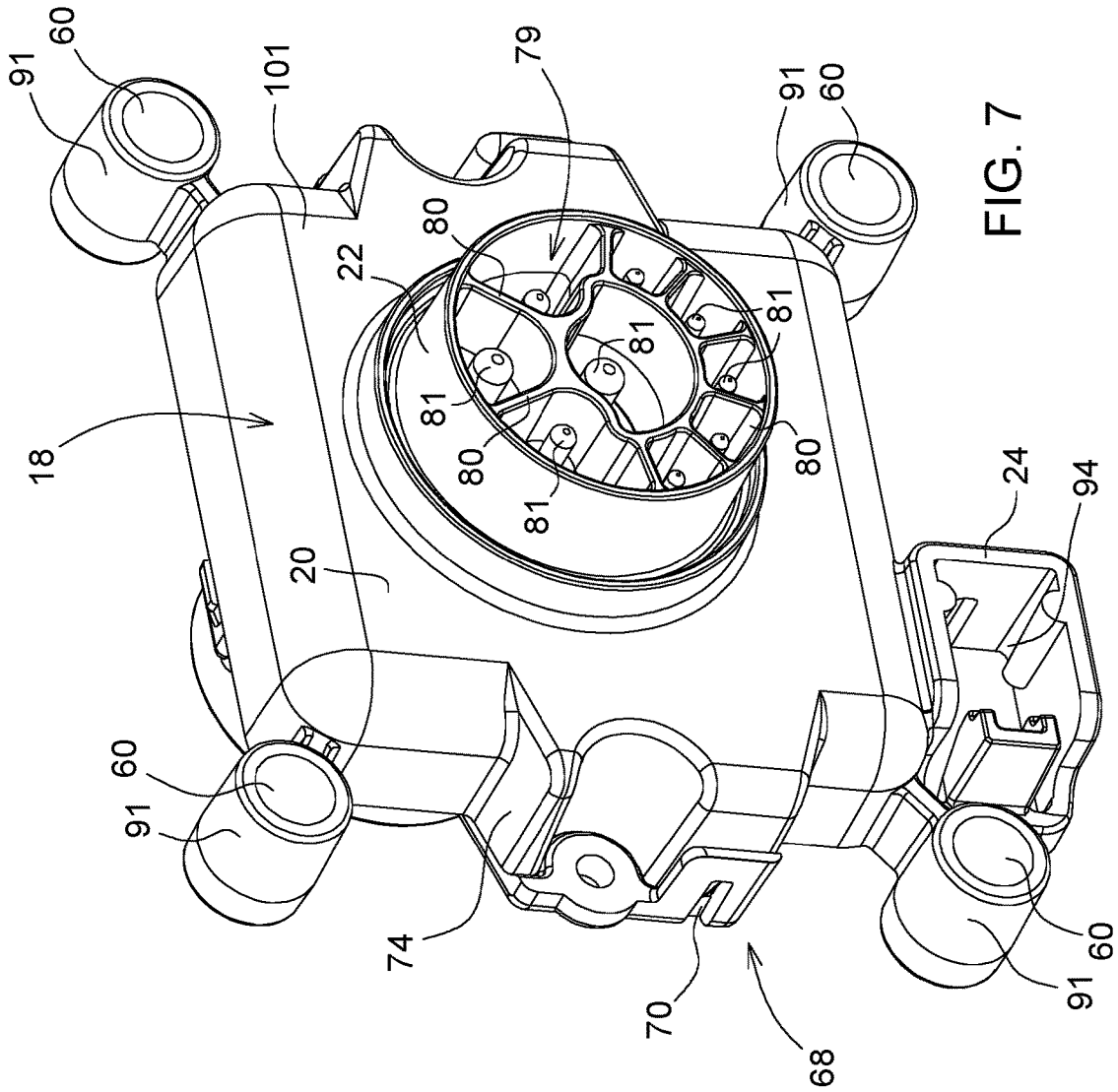


FIG. 7

1

## ELECTRICAL CONNECTOR WITH AUTOMATIC LATCHING

### FIELD

This disclosure relates to an electrical connector, for a vehicle, with automatic latching.

### BACKGROUND

In the prior art, an implement bus breakaway connector (IBBC) is used for off-road equipment. For example, the IBBC can support electrical connections for between a tractor and an implement via an implement cable that terminates in a mating member (e.g., socket). The electrical connector is typically mounted on the tractor or other propulsion unit via a standard mounting configuration, such as the ISO 11783-2 (ISOBUS standard). If the operator forgets to unplug the mating member from the electrical connector while separating the tractor and the implement, the break-away feature allows the controlled disconnection between the mating member and the electrical connector without damaging the cable. The conventional IBBC supports a controller area network (CAN) data bus with several conductors. However, the conventional IBBC may not support automatic latching or locking of the mating member to the connector.

### SUMMARY

In accordance with one embodiment, an electrical connector comprises a first housing member that has a first base portion, a first tubular portion extending outward from the first base portion and a first hollow support extending outward from the first base portion. A second housing member has a second base portion, a second tubular portion extending outward from the second base portion and a second hollow support extending outward from the second base portion. The second housing member engages the first housing member (e.g., via snap-fit connectors) to form an enclosure. In the enclosure a substrate supports a central set of conductive members within the second tubular portion and a peripheral set of conductive members within the first hollow support. A first arm is pivotably attached to the enclosure or an outer enclosure. The first arm is resiliently biased inwardly toward the second base portion. A second arm is pivotably attached to the enclosure and spaced apart from the first arm. The second arm is resiliently biased inwardly toward the second base portion. In accordance with one aspect, the arms support automatic latching of the connector portion to a mating connector portion.

### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an exploded perspective view of the electrical connector.

FIG. 2 shows a perspective view of an outer side or implement side of the assembled electrical connector of FIG. 1 with a first lid covering the socket or connector portion.

FIG. 3 shows a perspective view of an outer side of the assembled electrical connector of FIG. 1 with a mating connector engaged with the socket or connector portion.

FIG. 4 shows a perspective view of an outer side of the assembled electrical connector of FIG. 1 with the second lid open to expose a data port.

FIG. 5 is a cross section shown along reference line 5-5 of FIG. 4.

2

FIG. 6 shows a perspective view of an inner side of the electrical connector of FIG. 1, which shows the first housing member connected to the second housing member without the outer enclosure.

FIG. 7 shows a perspective view of an outer side of the electrical connector similar to FIG. 6.

### DETAILED DESCRIPTION

In accordance with one embodiment, in FIG. 1 an electrical connector 100 comprises a first housing member 10 that has a first base portion 12, a first tubular portion 14 (e.g., first tubular support) extending outward from the first base portion 12 and a first hollow support 16 extending outward from the first base portion 12. A second housing member 18 has a second base portion 20, a second tubular portion 22 (e.g., second tubular support) extending outward from the second base portion 20 and a second hollow support 24 (with recess 94, possibly with mating features on interior walls to retain a first data port and second data port) extending outward from the second base portion 20. The second housing member 18 engages the first housing member 10 (e.g., via snap-fit connectors 68) to form an enclosure 26. A substrate 28 is disposed within the enclosure 26, where the substrate 28 supports a central set of conductive members (34, 36) within the first tubular portion 14 and the second tubular portion 22. An interior 15 of the first tubular portion 14 contains a central set of conductive members 34, or metallic pins. The substrate 28 supports a peripheral set of conductive members (34, 36) within the first hollow support 16.

In one embodiment, an outer enclosure 27 is connected to the enclosure 26. For example, the enclosure 26 or the second housing member 18 may comprise a set of sleeves 91 located about a periphery of the enclosure 27 or the second housing member 18. The sleeves 90 can be inserted into corresponding pockets 92 in the outer enclosure 27 to connect the outer enclosure 27 to the enclosure 26.

In one embodiment, a first arm 40 is pivotably attached to the outer enclosure 27 via a protruding hinge portion 83, which extends outward from the outer enclosure 27. In an alternate embodiment, the first arm 40 is pivotably attached to the enclosure 26 or the second housing member 18. The first arm 40 is resiliently biased inwardly toward the exterior 93 of the outer enclosure 27, or toward second base portion 20, via one or more springs 55 or other resilient members associated with a protruding hinge portion 83.

In one embodiment, a second arm 42 is pivotably attached to the outer enclosure 27 via a protruding hinge portion 83, which extends outward from the outer enclosure 27. In an alternate embodiment, the second arm 42 is pivotably attached to the enclosure 26 or the second housing member 18. The second arm 42 is spaced apart from the first arm 40. The second arm 42 is resiliently biased inwardly toward the exterior 93 of the outer enclosure 27, or toward the second base portion 20, via one or more springs 55 or other resilient members associated with the protruding hinge portion 83.

In accordance with one aspect, the arms (40, 42) support automatic latching of the connector portion 79 (in FIG. 7) to a mating connector portion 63, where the latched state is illustrated in FIG. 3. In one embodiment as illustrated in FIG. 2, the first arm 40 terminates in a first tab 48; the second arm 42 terminates in a second tab 50; and a third arm 43 terminates a third tab 51. The first arm 40 and first tab 48 are collectively referred to as the first pawl 49; the second arm 42 and the second tab 50 are collectively referred to as the

second pawl 59; the third arm 43 the third tab are collectively referred to as the third pawl 58.

In one configuration, the first housing member 10, the second housing member 18 and the outer enclosure 27 can be made or formed by injection molding of plastic, a polymer, fiber-filled plastic, a fiber-filled polymer, a plastic matrix that binds of filler, or a polymer matrix that binds a filler. The filler or fiber may comprise glass fiber, carbon fiber, ceramic fiber, glass filler, or other filler.

As illustrated in FIG. 1, FIG. 6 and FIG. 7, collectively, the second housing member 18 engages with and connects to the first housing member 10 via one or more snap-fit connectors 68. For example, the first housing member 10 has a plurality of first snap-fit connector portions (70 or 72) and wherein the second housing member 18 has a plurality of second snap-fit connector portions (70 or 72) to interlock with corresponding ones of each other to join and secure the first housing member 10 and the second housing member 18. As illustrated, each snap-fit connector 68 comprises a connector protrusion 70 that interlocks or engages with connector slot 72 to form a snap-fit connection between the first housing member 10 and the second housing member 18 (e.g., near wings 73 and respective mating wall portion 74).

In an alternate embodiment, the snap-fit connectors 68 may be replaced or supplemented by fasteners 277 that engage corresponding bores or anchors in the second housing member 18.

In one embodiment, the central conductive members 34 are sealed with respect to the second housing member 18 or the second base portion 20 via an elastomeric seal 64 with openings 66 to receive the central conductive members 34. The elastomeric seal 64 can be compressed between the substrate 28 and an annular portion or step in an interior 115 of the second housing member 18. The elastomeric seal 64 may be composed of silicone rubber, synthetic rubber or natural rubber, for example. The elastomeric seal 64 may be used alone or with additional sealant, plastic resin, polymer resin, filler, or potting compound to provide a hermetic, weather-resistant seal that is resistant to salt and fog, for instance.

After the first housing member 10 and the second housing member 18 are connected to form an enclosure 26, an optional outer enclosure 27 may be mounted on the outer surface of the enclosure 26 via interlocking of the sleeves and respective sockets 92. However, in an alternate embodiment the outer enclosure 27 may be mounted on the outer surface of the enclosure 26 via one or more fasteners 77 (e.g., that engage corresponding receptacles 177 associated with the enclosure 26). The outer enclosure 27 is associated with protruding supports or protruding hinges 83 that extend outward from the outer enclosure 27. If the outer enclosure 27 is not used, then the protruding supports or protruding hinges 83 may extend from the second housing member 18. The integral protruding hinge 83 or protruding supports along with corresponding shafts 57 form pivot points 84 upon which the first arm 40, the second arm 42, and third arm 43 can rotate. The integral protruding hinge 83 or protruding supports have openings for receiving corresponding shafts 57. One or more coil springs 55 are coaxially mounted about or on respective shafts 57 to bias the first lid 44 and the second lid 46 toward or in respective closed position. In one embodiment, one or more coil springs 55 or other resilient members bias the first arm 40, the second arm 42, and the third arm 43 toward an exterior 93 of the outer enclosure 27 or second housing member 18. In other words, one or more coil springs 55 are coaxially mounted about or on respective shafts 57 to bias the first pawl 49, the second

pawl 59, and third pawl 58 toward an exterior 93 of the outer enclosure 27. In one configuration, one end of the spring 55 is retained by a retention slot 53 in an exterior of the outer enclosure 27, whereas an opposite end of the spring is retained by a corresponding retention slot in the first pawl 49 or second pawl 59.

In one embodiment, the first lid 44 is associated with an arm portion 41 that terminates in a tab portion 82. The arm portion 41 of the first lid 44 has an opening for receiving a respective shaft 57 associated with one or more springs 55 coaxially mounted about the shaft 57. The second lid 46 is associated with a third arm 43 that has an opening for receiving a respective shaft 57 associated with one or more springs 55 mounted about the shaft 57.

The first arm 40 has an opening or bore 38 for receiving a respective shaft 57 associated with one or more springs 55 coaxially mounted about the shaft 57. The second arm 42 has an opening or bore 38 for receiving a respective shaft 57 associated with one or more springs 55 coaxially mounted about the shaft 57.

In one embodiment, the first lid 44 has an arm portion 41 with an opening or bore 38 for receiving a shaft 57 or hinge pin. Opposite the arm portion 41, the first lid 44 terminates in a tab portion 82 that serves as a handle that can be manipulated by a user's hand or one or more fingers. The first lid 44 comprises a cap or cover that is mounted to the second housing member 18, outer enclosure 27 or base using a shaft 57 or hinge pin (e.g., composed of metal or an alloy). In one embodiment, the ends of the shaft 57 are retained by push nuts or retention rings that mate with a respective groove in the shaft 57. In one embodiment, a spring 55 or double torsion coil spring is used to bias the first lid 44 in a closed position over the end of the second tubular portion 22 (e.g., as shown in FIG. 5). The first lid 44 holds a seal 45 (e.g., in FIG. 4 an elastomeric substantially annular face seal 45) in a compressed state to keep dirt, debris and moisture out of the unmated connector. The first lid 44 can swing open or handle by a tab 82 or handle portion. The arm portion 41 of the first lid 44 at an end opposite of the hinged end supported by a protruding hinges 83. The opened first lid 44 exposes the connector portion 79 for use or connection with a mating connector portion 63. Here, the connector portion 79 is illustrated as a socket that contains conductive pins 81 or substantially circular vehicle connector. The connector portion 79 may include optional dielectric compartments 80 or walls to separate respective conductive pins 18 from each other.

In one embodiment as illustrated in FIG. 5 during a closed state of a first lid 44, the first arm 40 has a first notch 61 or first seating portion that presses against an annular end of the first lid 44. Similarly, during a closed state of the first lid 44, the second arm 42 has a seating portion or second notch 61 that presses against an annular end of the first lid 44.

The connected data refers to a state when the mating connector portion 63 is plugged in or connected to the connector portion 79 as illustrated in FIG. 3 and FIG. 4. For example, in the connected state the mating connector portion 63 is engaged with a socket, port or connector portion 79 in the end of the second tubular portion 22. During the connected state, the first arm 40 or first pawl 49 has a first notch 61 (or first seating surface) that engages or presses against an annular step 56 or shelf of the mating connector portion 63 to latch or lock removably the connection in place between the mating connector portion 63 and the connector portion 79. Meanwhile, during the connected state, the second arm 42 or second pawl 59 has a second notch 61 (or second seating surface) that presses against the annular step

56 or shelf of the mating connector portion 63 to latch or lock removably the connection in place between the mating connector portion 63 and the connector portion 79. For example, the notches 61 (e.g., first seating portion and the second seating portion) are positioned on oppositely (e.g., 180 degrees apart) with respect to a substantially annular end of the second tubular portion 22.

In one configuration, the first arm 40 and the second arm 42 have notches 61 for automatically latching to (and pressing against) a first lid 44 that is hinged to the connector in a closed state and for automatically latching to (and pressing against a step in) a mating connector portion 63 in a releasable connected state. For example, the notches 61 comprise seating surfaces and the notches 61 press against the first lid 44 in the closed state to form a hermetic seal 45 via an annular ring in an interior 115 of the first lid 44 that presses against an end of the second tubular portion 22. In one embodiment, the notches 61 press against an end (e.g., annular end) or a step (e.g., annular step or rectangular step) in the mating connector portion 63 in a connected state to secure removably the mating connector portion 63 to the connector portion 79, where the mating connector portion 63 will automatically release from the connector portion 79 if an outward pulling force on the mating connector portion 63 exceeds a threshold level.

A first lid 44 covers an end of the second tubular portion 22. The first lid 44 is hinged to the second housing member 18 and biased toward the end of second tubular portion 22. A second lid 46 covers a corresponding container 88 that is associated with a data port 76, where the data port 76 may comprise a first port 75, a second port 78, or both. The second lid 46 is hinged to the outer enclosure 27, or second housing member 18, and biased toward the container 88. The second lid 46 is attached to a third arm 43 that terminates in a third tab 51. The third arm 43 has a notch 61 for retaining a mating data port connector portion in a removably connected state when the mating connector data port connector portion is connected to the corresponding data port 76.

In one embodiment, as shown in FIG. 4, the second lid 46 is opened to expose conductors of a data port, such as an Ethernet port, a Universal Serial Bus (USB) port, an ADSL (Asymmetric Digital Subscriber Line) port, or Very High Bitrate Digital Subscriber Line (VDSL) within the container 88. Under a first example, the conductors of the data port 76 comprise two pins associated with two-wire Ethernet, two-wire ADSL or two-wire VDSL. Under a second example, the conductors of the data port 76 comprise four pins associated with four wire Ethernet or four-wire shielded USB port.

In one embodiment, the substrate 28 comprises a circuit board 30 with electrical and electronic components 32 to support communications of Controller Area Network (CAN) data messages over particular conductive members 34 of the central set and the particular conductive members 36 of the peripheral set.

In one embodiment, as illustrated in FIG. 5, the first arm 40 terminates in a first tab 48 and the second arm 42 terminates a second tab 50, wherein the first tab 48 and the second tab 50 comprise handles to support release, by a human hand, of a mating connector portion 63 from engagement with the connector 79, or the second tubular support 22. In one example, the outer surfaces 52 of the first arm 40 and the first tab 48 form an angle 54 that is greater than a substantially orthogonal angle 54 to form a handle that can be pressed against readily to open a closed state or connected state of the electrical connector 100. Similarly, the outer surfaces 52 of the second arm 42 and the second tab 50 form an angle 54 that is greater than a substantially orthogonal

angle 54 to form a handle that can be pressed against readily to open a closed state or connected state of the electrical connector 100.

In one embodiment, the outer side 101 or implement side of the electrical connector 100, opposite the inner side 102 or tractor side, provides connector portion 79 (e.g., an integrated circular connector feature or port) with conductive members 81 for mating with mating connector portion 63 or socket with conductors that makes electrical and mechanical contact with the conductive members 81. The outer side 101 or implement side of the electrical connector 100 provides a plurality of integral hinges 83 that project outward from the outer side 101 to provide pivot points 84 for a first lid 44, first arm 40, a second arm 42, and a second lid 46 (or third arm 43 associated with the second lid 46). The first arm 40, the second arm 42 and the third arm 43 may terminate in respective tabs (48, 50, 82) that can provide handles for a user to operate to connect and disconnect a mating connector portion 63 (e.g., mating plug or socket) to the connector portion 79 of the electrical connector 100. Collectively, an arm (40, 42, 43) and corresponding tab (48, 50) are referred to as pawl (49, 59). The arms or pawls (49, 59) are supported by a shaft 57 or hinge pin that is mounted between protruding hinges 83 that extend outward from the surface of the second housing member 18 or outer enclosure 27, where the torsion spring 55 biases the arms or pawls (49, 59) toward the second housing member 18 or outer enclosure 27. In one illustrative configuration, the electrical connector may have standard footprint to match the ISO 11783-2 (ISOBUS) four bolt mounting footprint of openings 60 on a vehicle.

In one embodiment, the pawls (49, 59) are arranged with the hook portions, seating portions, or notches 61 facing inward towards the second tubular portion 22 or connector portion 79 (e.g., substantially circular vehicle connector). The pawls (49, 59) are spring-loaded (e.g., by springs 55) or resiliently biased to latch or close towards the end of the second tubular portion 22 or connector portion 79 (e.g., implement connector portion). Both pawls (49, 59) can rotate or swing respective handle portions in a pawl arc in a pawl plane that is generally perpendicular to a lid arc or lid plane of the first lid 44. The travel of each pawl (49, 59) in the inward pawl arc is limited by a stop or limit of the pawl (49, 59) or its arm at or near the respective hinge 83, such as a bottom edge of the pawl (49, 59) or its respective arm (40, 42) that rests against an exterior 93 of the outer enclosure 27. Accordingly, both pawls (49, 59) are always separated by at least a minimum distance (e.g., minimum lateral distance proportional to the dimensions or width of the mating connector portion 63) between hook portions, seating portions or notches 61, such that the mating connector portion 63 can be readily, removably connected or disconnected.

Normally Closed and Sealed State

In one embodiment, the electrical connector 100 has several states, such as a normally closed and sealed state for the first lid 44, the second lid 46, or both. The normally closed and sealed state refers to a state in which the mating connector portion 63 is disconnected from the connector portion 79 (e.g., substantially circular vehicle connector). If the mating connector portion 63 is disconnected or if the connector portion 79 is not in use, then the first lid 44 will be closed covering and sealing hermetically the connector opening of the connector portion 79. Similarly, if the mating connector is disconnected from the data port 76, such as an Ethernet port or USB port, then the second lid 46 will be closed covering and sealing hermetically the connector

opening or container **88** to prevent the ingress of moisture, dirt, debris and contaminants.

The first lid **44** is a cap or cover for protecting the connector **79** from the ingress of dirt, debris, contaminants, salt, corrosive chemicals, or moisture that might otherwise damage (e.g., corrode) the conductor members **81** or interfere with a reliable electrical connection associated with the electrical connector **100** and a corresponding mating connector portion **63**. If the first lid **44** is closed, then the first pawl **49** or first arm **40** and the second pawl **59** or second arm **42** latch or resiliently bias the first lid **44** in the closed position, against an annular step **56** (in FIG. 4), by the notches **61**, seating portions or hook features. If the second lid **46** is closed, then the third arm **43** or third pawl latch or resiliently bias the second lid **46** in the closed position, against the container **88**, by a notch **61**, seating portion or hook feature.

#### Manual Release and Opening of First Lid

If the user presses (e.g., strikes) the tabs (**48**, **50**) or handles of the arms (**40**, **42**) with the palm of his or her hand and if the user simultaneously grasps the handle, then the arms (**40**, **42**) will move outward and unlatch allowing the first lid **44** to be opened. If the first lid **44** is opened sufficiently, then the user can manually insert of the mating connector portion **63** portion of the electrical connector **100** into the connector portion **79** to form a reliable electrical and mechanical connection between the vehicle and an external cable **47** and connector portion **79** (e.g., associated with an implement, such as a towed implement). In one illustrative example, the mating connector portion **63** comprises an implement harness connector.

#### Manual Insertion of the Mating Implement Harness Connector

If the user holds the first lid **44** or cover open with one hand and grasps the mating connector portion **63** (e.g., implement harness connector) with the other hand while pushing the mating connector portion **63** end through the opening formed by the pawls (**49**, **59**), then the pawls (**49**, **59**) will open to receive the mating connector portion **63**. If the mating connector portion **63** (e.g., implement harness connector) pushes past the pawls (**49**, **59**) to a fully seated condition, then both pawls (**49**, **59**) will return to a rest position which that positively retains or latches the mating connector portion **63** to the electrical connector **100** in the mated and sealed position, which can also be referred to as a connected state.

#### Manual Release of Implement Harness Connector

If the user grasps or pulls on the mating connector portion **63** (e.g., mated implement harness connector) and if the user presses (e.g., bumps) simultaneously into the pawls (**49**, **59**) with the hand (e.g., knuckles of his or her hand) in a connected state or latched state, then the pawls (**49**, **59**) will move outward and unlatch allowing or handle portion the mating connector portion **63** to disconnect from the electrical connector **100** or second tubular portion **22**. If or once the mating connector portion **63** (e.g., implement harness connector) is manually released and removed, then the electrical connector **100** will automatically latch onto the cover **44** in a closed state.

#### Automatic Positive Latching

If the mating connector portion **63** (e.g., implement harness connector) is unmated and removed from the vehicle electrical connector, then the first lid **44** or cover will automatically push past the pawls (**49**, **59**) to close over top of the end of the second tubular portion **22** or the vehicle connector opening of connector portion **79**. If the first lid **44** is closed completely, then both pawls (**49**, **59**) will return to

a rest position which positively retains or latches the first lid **44** in the closed and sealed position.

#### Break Away Release of Implement Harness Connector

If the mating connector portion **63** portion (e.g., the mated implement harness) is pulled away from the vehicle electrical connector **100** with sufficient force, then the pawls (**49**, **59**) will open releasing the mating connector portion **63** (e.g., implement harness connector) without damage to the electrical connector or the mating connector portion **63**, or the mated implement cable **47** or wire harness.

Whenever the Break Away Release Occurs, then Automatic Latching Will Occur.

The electrical connector **100** of the disclosure features a robust spring-loaded hinge pin design (e.g., shaft **57** and torsion springs **55**) for connector's moving parts to foster reliability and longevity. The electrical connector **100** is well suited for providing automatic latching of one or more lids and automatic latching between the electrical connector and mating connector portion (e.g., **63**), such as an implement harness connector or data port connector. Accordingly, the automatic latching of lids protects the conductive members from damage, corrosion and the ingress of dirt and debris that might otherwise interfere with a reliable electrical connection between the electrical connector and mating connector portion. The electrical connector provides additional space that supports a high speed data connection, such as Ethernet, two-wire Ethernet, four-wire Ethernet or USB.

Having described the preferred embodiment, it will become apparent that various modifications can be made without departing from the scope of the invention as defined in the accompanying claims.

The invention claimed is:

1. An electrical connector comprising:

a first housing member having a first base portion, a first tubular portion extending outward from the first base portion and a first hollow support extending outward from the first base portion;

a second housing member having a second base portion, a second tubular portion extending outward from the second base portion and a second hollow support extending outward from the second base portion; the second housing member engaging the first housing member to form an enclosure;

in the enclosure, a substrate supporting a central set of conductive members within the second tubular portion, the substrate supporting a peripheral set of conductive members within the first hollow support;

an outer enclosure in contact with the enclosure;

a first arm pivotably attached to the enclosure or the outer enclosure of the electrical connector, the first arm resiliently biased inwardly toward the second base portion; and

a second arm pivotably attached to the enclosure or the outer enclosure and spaced apart from the first arm, the second arm resiliently biased inwardly toward the second base portion.

2. The electrical connector according to claim 1 wherein the first arm and the second arm have respective notches for automatically latching to a first lid that is hinged to the connector in a closed state and for automatically latching to a mating connector portion in a releasable connected state.

3. The electrical connector according to claim 2 wherein the notches press against the first lid in the closed state to form a hermetic seal via an annular ring in an interior of the first lid that presses against an end of the second tubular portion.

4. The electrical connector according to claim 2 wherein the notches press against a step in the mating connector in a connected state to secure removably the mating connector portion to the connector, where the mating connector portion will automatically release from the connector if an outward pulling force on the mating connector portion exceeds a threshold level.

5. The electrical connector according to claim 1 wherein the second housing member engages with and connects to the first housing member via a snap-fit connector.

6. The electrical connector according to claim 1 wherein the first housing member has a plurality of first snap-fit connector portions and wherein the second housing member has a plurality of second snap-fit connector portions to interlock with corresponding ones of each other to join and secure the first housing member and the second housing member.

7. The electrical connector according to claim 1 wherein the central conductive members are sealed with respect to the second housing member via an elastomeric seal with openings to receive the central conductive members.

8. The electrical connector according to claim 7 wherein the elastomeric seal is compressed between the substrate and an annular portion in an interior of the second housing member.

9. The electrical connector according to claim 1 further comprising:

a first lid for covering an end of the second tubular portion, the first lid hinged to the second housing member and biased toward the end of second tubular portion.

10. The electrical connector according to claim 1 further comprising:

a second lid for covering a corresponding container, the second lid hinged to the second housing member and biased toward the second hollow support, the second lid attached to a third arm that terminates in a tab.

11. The electrical connector according to claim 10 wherein the third arm has a notch for retaining a mating connector portion in a removably connected state when the mating connector portion is connected to the connector portion.

12. The electrical connector according to claim 10 wherein the second lid is opened to expose conductors of a data port within the container.

13. The electrical connector according to claim 11 wherein the conductors comprise two pins associated with two-wire Ethernet.

14. The electrical connector according to claim 11 wherein the conductors comprise four pins associated with four wire Ethernet.

15. The electrical connector according to claim 1 wherein the substrate comprises a circuit board with electrical and electronic components to support communications of Controller Area Network (CAN) data messages over particular

conductive members of the central set and the particular conductive members of the peripheral set.

16. The electrical connector according to claim 1 wherein the first arm terminates in a first tab and the second arm terminates a second tab, wherein the first tab and the second tab support release, by a human hand, of a mating connector portion from engagement with the first tubular portion or a connector portion.

17. The electrical connector according to claim 16 wherein outer surfaces of the first arm and the first tab form an angle that is greater than a substantially orthogonal angle and wherein outer surfaces of the second arm and the second tab form an angle that is greater than a substantially orthogonal angle.

18. The electrical connector according to claim 1 wherein the first arm has a first seating portion that presses against an annular end of the second tubular portion when a mating connector portion is engaged with a connector portion in the end of the second tubular portion and wherein the second arm has a second seating portion that presses against the annular end of the second tubular portion when the connector mating portion is engaged a connector portion in an end of the second tubular portion.

19. The electrical connector according to claim 18 wherein the first seating portion and the second seating portion are positioned on oppositely on the annular end of the second tubular portion.

20. An electrical connector comprising:

a first housing member having a first base portion, a first tubular portion extending outward from the first base portion and a first hollow support extending outward from the first base portion;

a second housing member having a second base portion, a second tubular portion extending outward from the second base portion and a second hollow support extending outward from the second base portion; the second housing member engaging the first housing member to form an enclosure with a set of pockets;

in the enclosure, a substrate supporting a central set of conductive members within the second tubular portion, the substrate supporting a peripheral set of conductive members within the first hollow support;

an outer enclosure connected to the enclosure;

a first arm pivotably attached to the outer enclosure, the first arm resiliently biased inwardly toward the second base portion; and

a second arm pivotably attached to the outer enclosure and spaced apart from the first arm, the second arm resiliently biased inwardly toward the second base portion.

21. The electrical connector according to claim 20 wherein the enclosure comprises a set of pockets around its periphery, and wherein the outer enclosure has sleeves that interlock with the corresponding pockets.

\* \* \* \* \*