United States Patent [19]

Johnson

[11] **3,808,580**

[45] **Apr. 30, 1974**

[54] **SELF-LOCKING COUPLING NUT FOR ELECTRICAL CONNECTORS**

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[73] Assignee: **Matrix Science Corporation,** Torrance, Calif.

[22] Filed: **Dec. 18, 1972**

[21] Appl. No.: **315,948**

[52] **U.S. Cl.** ..... **339/89 R,** 339/91 R

[51] **Int. Cl.** **H01r 13/54**

[58] **Field of Search** 339/89–91

[56] **References Cited**

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3,462,727	8/1969	Blight et al.	339/89 M
3,601,764	8/1971	Cameron	339/89 M
3,393,927	7/1968	Kelly et al.	339/90 R
3,552,777	1/1971	Heinrich et al.	339/89 R
3,594,700	7/1971	Nava et al.	339/89 R
3,669,472	6/1972	Nodsady	339/89 R

FOREIGN PATENTS OR APPLICATIONS

2,002,273	2/1969	France	339/90 R

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[57] **ABSTRACT**

An electrical connector adapted to be secured to a mating electrical connector. A first member extends outwardly from the connector shell with indentations formed on a radially extending surface of the first member. A coupling nut is axially aligned with the connector and surrounds a portion of the connector outer shell. A pair of longitudinally extending slots are formed on the outer surface of the coupling nut. A second member is longitudinally movable in the slot and rotatable with the coupling nut. Protrusions on the second member surface interact with the first member indentations for varying the tightness between the electrical connector and the mating electrical connector. A spring member is positioned adjacent the second member for urging the second member protrusions to interact with the first member indentations. Indicator means are provided on the outer surface of the coupling nut. The second member extends to the outer surface of the coupling nut, and alignment of the second member with the indicator means provides a visual and tactile indication of the desired degree of tightness between the mated connectors.

4 Claims, 6 Drawing Figures

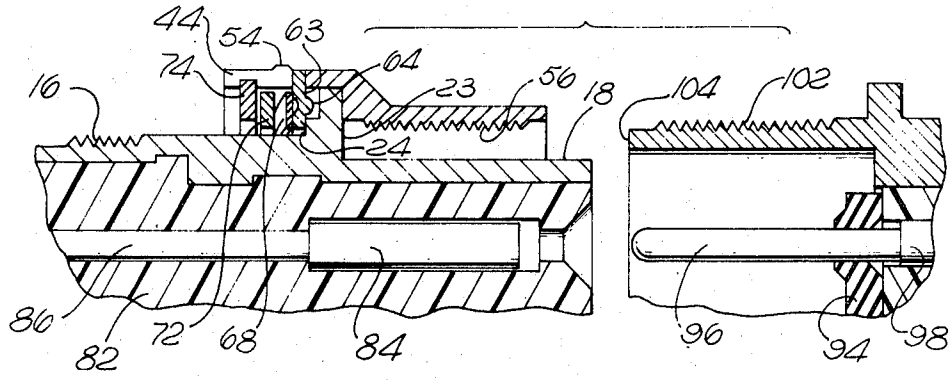


Fig. 1.

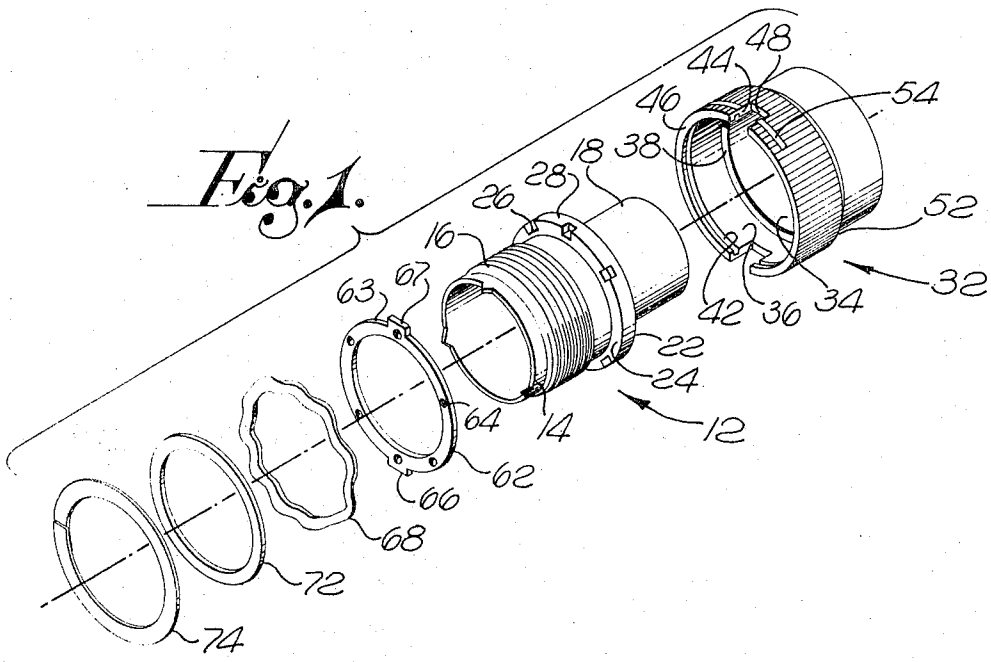
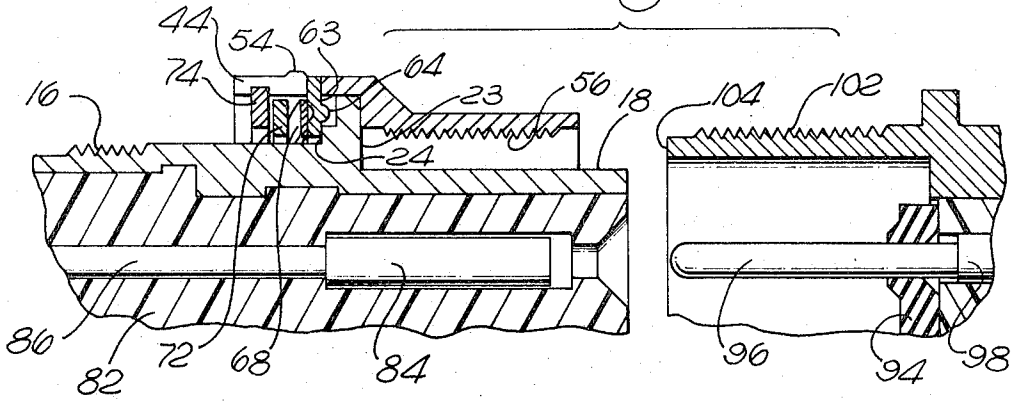


Fig. 2.



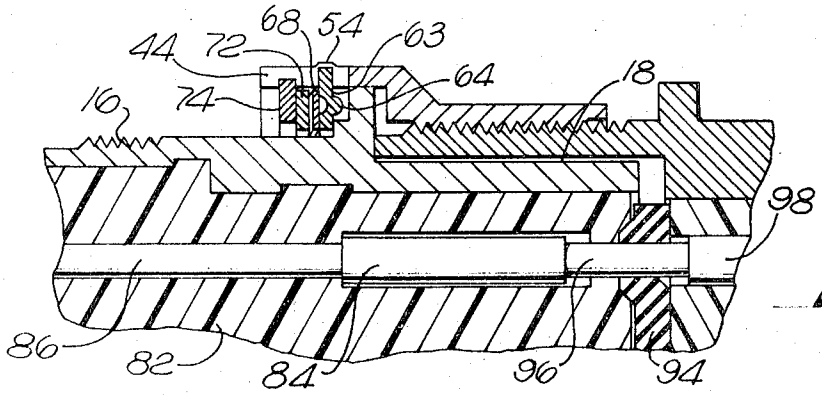


Fig. 3.

Fig. 4.

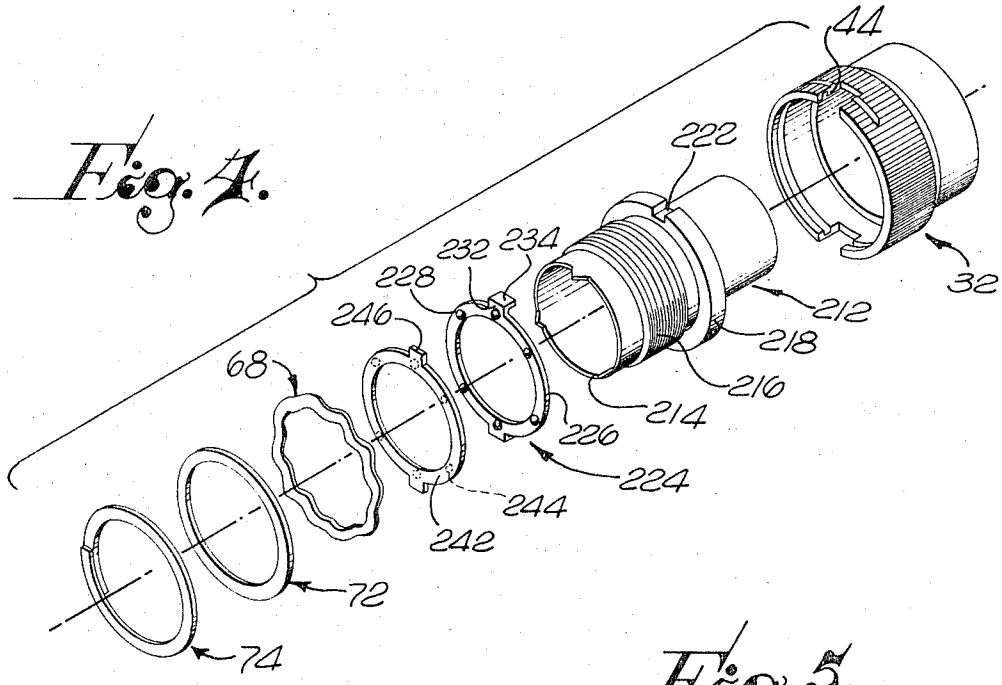


Fig. 5.

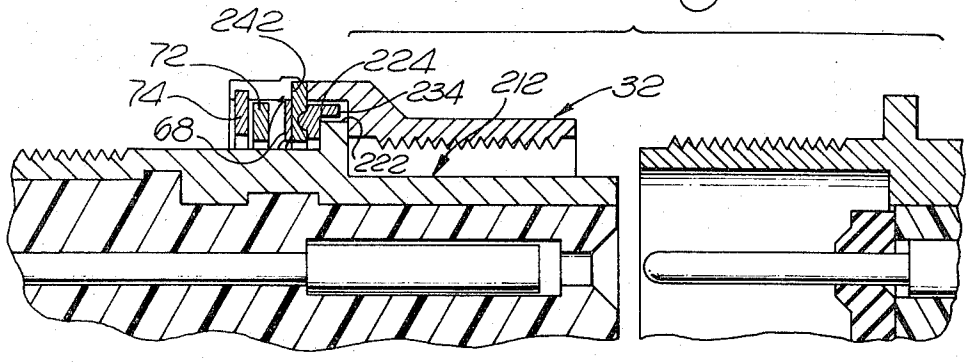
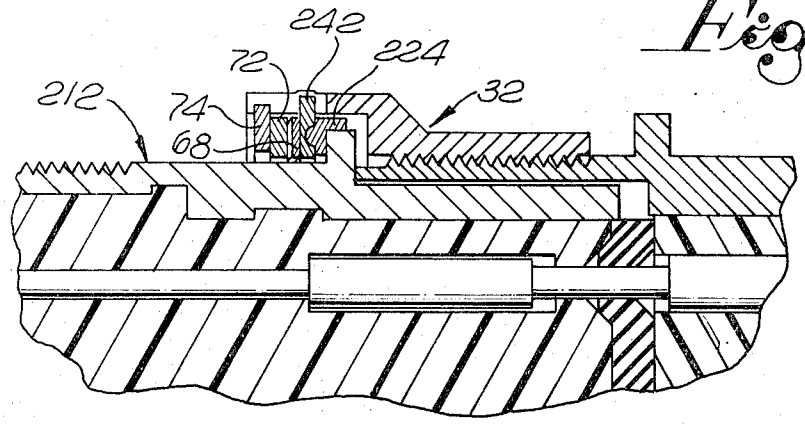


Fig. 6.



SELF-LOCKING COUPLING NUT FOR ELECTRICAL CONNECTORS

BACKGROUND OF THE INVENTION

1. Field of the invention

The field of art to which the invention pertains includes the field of electrical connectors, particularly with respect to a self-locking coupling nut for use with an electrical connector which provides a visual and tactile indication when a desired degree of tightness has been attained between mating electrical connectors.

2. Description of the prior art

The best known prior art is found in U.S. Pat. No. 3,552,777.

Self-locking electrical connectors have been utilized in the aircraft industry to replace the practice of locking threaded electrical connectors with safety wire. In one form of a self-locking electrical connector, a plurality of balls are mounted in the flange of a connector shell. A sleeve is positioned around the connector shell and rotation of the sleeve urges the balls toward a flange having a plurality of ball receiving indentations. As the sleeve is rotated to tighten the connection, the indentations engage and disengage the balls which move axially under the influence of a spring. As the threaded connection becomes tighter, it becomes more difficult to move the indentations past the balls. A visual indication of the properly mated condition is provided through an opening in the sleeve wherein a plate member may be viewed in the correct position when the locked condition of the connectors has occurred.

The above-mentioned structure is relatively complex to assemble in view of the use of the balls in the sleeve. In addition, such a structure is relatively expensive since the parts must be accurately machined for use with the balls. Moreover, where the electrical connector is to be secured to a mated electrical connector in an inaccessible position, it has been found that the visual indication of the locked condition cannot be determined by the operator.

SUMMARY OF THE INVENTION

An electrical connector adapted to be secured to be a mating electrical connector. A first member extends outwardly from the electrical connector shell and has discontinuities formed on a radially extending surface of the first member. A coupling nut is axially aligned with the connector member and surrounds a portion of the connector outer shell. A longitudinally extending slot is formed on the outer surface of the coupling nut. A second member is movable in the slot and has discontinuities on the surface thereof which interact with the first member discontinuities for the varying degree of tightness between the electrical connector and a mating electrical connector when the connectors are secured together.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of an electrical connector shell and a self-locking coupling nut made in accordance with the invention;

FIG. 2 is a side view, in section, of a pair of mating electrical connectors, one of which contains the self-locking nut of FIG. 1;

FIG. 3 is a side view, in section, of the electrical connectors of FIG. 2 in a fully mated condition;

FIG. 4 is an exploded perspective view of an alternative arrangement of an electrical connector shell and self-locking coupling nut made in accordance with the invention;

FIG. 5 is a side view, in section, of a pair of mating connectors, one of which contains the self-locking coupling nut of FIG. 4; and

FIG. 6 is a side view, in section, of the electrical connectors of FIG. 5 in a fully mated condition.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, there is shown in FIG. 1, an exploded perspective view of a connector shell and a self-locking coupling nut made in accordance with principles of the invention. The connector shell **12** comprises a rear cylindrical portion **14** which typically may be threaded on a portion of its outer surface **16** so as to mount the shell on a bulkhead or other terminal structure. The connector shell further comprises a front cylindrical portion **18.** A radially extending flange **22** is formed integral with the cylindrical shell at the junction of the front cylindrical portion **18** and the rear cylindrical portion **14.** The flange contains a front surface **23** and a rear surface **24.** A plurality of radially formed indentations **26** extend inwardly from the rear surface **24** and radially to the flange outer surface **28.**

A coupling nut **32** is adapted to be positioned over the connector shell **12** from the front end thereof and comprises a reduced diameter front bore portion **34** and an enlarged diameter rear bore portion **36.** The junction of the front bore portion **34** and the rear bore portion **36** defines a rearwardly facing shoulder **38.** An annular groove **42** is formed at the rear end of the rear bore portion **36.** A pair of notches **44** are formed in the rear bore portion **36** of the coupling nut and extend from the rear surface **46** of the coupling nut to a rearwardly facing shoulder **48.** The notches **44** are normally formed 180° apart on the connector shell. The outer surface **52** of the rear bore portion is knurled to facilitate rotation of the coupling nut **32.** In addition, circumferentially extending raised indicator members **54** are positioned on the outer surface **52** and extend on either side of the notches **44.** The front bore portion **34** of the coupling nut **32** contains threads **56.**

A clutch plate **62** is formed of a cylindrical disc whose front surface **63** contains a plurality of protrusions **64** which extend in a forward direction. As shown in FIG. **2,** the disc is mounted on the outer surface of the rear cylindrical portion **14** of the shell with the front surface **63** abutting the surface **24.** The clutch plate also contains a pair of outwardly extending flanges **66** which are positioned in the notches **44** and abut the shoulder **48.** The outer surface **67** of the flanges is flush with the knurled outer surface **52.** A wave spring **68,** having a disc shape, is positioned behind the clutch plate **62.** Positioned behind the wave spring **68** is a washer **72.** The washer **72** is secured in the rear bore portion **36** by means of a retaining ring **74** which is positioned in the annular groove **42.**

Referring again to FIG. **2,** the connector shell **12** is shown assembled with the coupling nut **32,** the clutch plate **62,** the wave spring **68,** the washer **72** and the retaining ring **74** positioned thereon. Mounted within the interior of the connector shell **12** is an insulator **82** having a socket contact **84** positioned in the front end

thereof. The front end of the socket contact extends forward from the front surface of the insulator **82.** A conductor **86,** which normally is soldered or crimped to the socket **84,** extends rearwardly in the insulator **82.** While only one socket contact **84** and one conductor **86** are shown, it should be understood of course, that a plurality of sockets and associated conductors are normally mounted in the insulator **82.**

A receptacle shell **92** is adapted to be mated with the shell **12** and contains an insulator **94** therein. The insulator **94** contains a pin contact **96** at the front end with a forwardly extending portion adapted to be mated with the socket contact **84.** A conductor **98,** which may be soldered or crimped to the pin contact **96,** is positioned in the rear of the insulator **94.** The front outer surface of the receptacle shell **92** contains threads **102** which are adapted to be mated with the threads **56** formed in the front bore portion **34** of the coupling nut **32.**

When the connectors of FIG. **2** are mated, the pin contact **96** is inserted in the socket contact **84.** In addition, the receptacle shell **92** is positioned between the outer surface of the connector portion **18** and the threaded bore portion **34.** The coupling nut **32** is rotated so that the threads **56** engage the threads **102** on the outer surface of the receptacle shell **92.** When the front end **104** of the shell **92** abuts the front surface **23** of the flange **22,** the connector members are in an initial mated condition. Then the coupling nut **32** moves forward with respect to the shell **12** upon further rotation thereof. As can be seen in FIG. **3,** while the coupling nut **32** moves forward, the rear surface **24** of the flange **22** abuts the front surface **63** of the clutch plate **62** preventing the clutch plate **62** from moving forward. Simultaneously, the clutch plate **62** rides rearwardly along the longitudinal axis of the notch **44.** Since the clutch plate **62** has its flanges **66** positioned in the notches **44,** the rotation of the coupling nut with respect to the connector shell causes the protrusions **64** in the clutch plate to ride in and out of the indentations **26** formed in the flange **22.**

As the coupling nut **32** rotates, the spring **68** is compressed so that as the washer **72** and the retaining ring **74** move closer toward the clutch plate **62.** Thus, the protrusions **64** have greater difficulty moving in and out of the indentations **26** in the flange **22** with further rotation of the coupling nut **32.** When the flanges **66** are aligned with the ridges **54** on the outer surface of the coupling nut, the electrical connectors are in a locked condition. In addition, it should be noted that should visual alignment of the ridges **54** with the flanges **66** be not possible, the operator can feel the ridges and the flange and determine that the connectors are in the locked condition.

The clutch plate **62** has been illustrated with protrusions **64** which move in and out of indentations **26** formed on the flange **22.** It should be understood, of course, that the rear surface of the flange **24** could contain protrusions which would interact with indentations formed on the clutch plate **62.**

Referring now to FIG. **4,** there is shown an alternative arrangement for the self-locking coupling nut made in accordance with the invention. In FIG. **4,** the coupling nut **32** is similar to that used in the embodiment of FIG. **1.** The connector shell **212** comprises a rear cylindrical portion **214** which is threaded on its outer surface **216** in a similar manner as the connector shell of FIG. **1.** However, the radially extending flange **222** does not contain indentations. Instead, the radially extending flange **218** contains a pair of slots **222** on opposite sides of the shell. A clutch plate **224** is formed of a cylindrical disc **226** having a plurality of indentations **228** formed on its rear surface. In addition, the clutch plate contains a pair of outwardly extending flanges **232.** A pair of tabs **234** extends forwardly from the outer end of each of the flanges **232** in a direction parallel to the longitudinal axis of the connectors and forms an extension of the flanges. When the clutch plate is positioned on the connector shell, the tabs **234** fit into the slots **222** formed on the flange **218.**

Positioned adjacent and directly behind the clutch plate **224** is a lock ring **242** formed of a cylindrical disc. Formed on the front surface of the lock ring are a plurality of protrusions **244.** In addition, a pair of opposed outwardly extending flanges **246** extends from the outer surface of the lock ring. The flanges **246** are inserted in the notches **44** of the coupling nut **32.** Positioned behind the lock ring is the wave spring **68,** a washer **72,** as well as a retaining ring similar to that utilized in the arrangement of FIG. **1.**

It should be noted that the operation of the device of FIGS. **4–6** is similar to that of FIGS. **1–3.** However, the lock ring **242** of FIGS. **4–6** is fixably rotated with the coupling nut **32** rather than the clutch plate as in the arrangement of FIGS. **1–3.** It should be noted that the arrangement of FIGS. **4–6** enables the clutch plate and lock ring to be readily replaced should wear occur between the indentations and protrusions formed on the clutch plate and lock ring, respectively. In the embodiment of FIG. **1,** since the indentations are formed on a flange fixed directly to the connector shell, it has been found necessary to manufacture a special connector shell therefor. In the embodiments of FIGS. **4–6,** the conventional connector shell can be easily modified so that the slots **222** are formed therein for insertion of the tabs **234** formed on the clutch plate. Additionally, it should be noted that the position of the indentations and protrusions illustrated in the clutch plate and lock ring, respectively, could also be reversed.

I claim:

1. An electrical connector having an outer shell and adapted to be secured to a mating electrical connector comprising:

a first means extending outwardly from said shell and having spherical discontinuities unitarily formed on a radially extending surface;

a coupling nut axially aligned with said connector member and surrounding a portion of said connector outer shell;

a longitudinally extending slot formed on the outer surface of said coupling nut; and

a second means longitudinally movable in said slot and having discontinuities unitarily formed on the surface thereof and interacting with said first means discontinuities to vary the degree of tightness between said connector member and a mating connector member when said connector members are secured together; and

said discontinuities on one of said means extending along the axis of said connector shell to form depressions on a relatively smooth surface formed in a plane perpendicular to said connector shell axis, and said discontinuities on said other of said means extending along said axis of said connector shell to

form a plurality of protrusions extending from a relatively smooth surface formed in a plane perpendicular to said connector shell axis.

2. An electrical connector in accordance with claim 1 wherein said second means comprises a clutch plate which is rotatable with said coupling nut.

3. An electrical connector in accordance with claim 2 wherein said first means comprises a flange integrally formed with said connector shell and wherein a spring member is positioned adjacent said clutch plate for urging said clutch plate discontinuities to interact with said flange discontinuities.

4. An electrical connector in accordance with claim 3 wherein said flange discontinuities are formed of indentations formed on said flange surface and said clutch discontinuities are formed of protrusions formed on a surface of said clutch plate which is in a plane parallel to the flange surface.

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