April 14, 1959 L. A. ARCHER ET AL 2,882,509

INTERFITTING ELECTRICAL CONNECTOR

Filed June 30, 1954 2 Sheets-Sheet 1

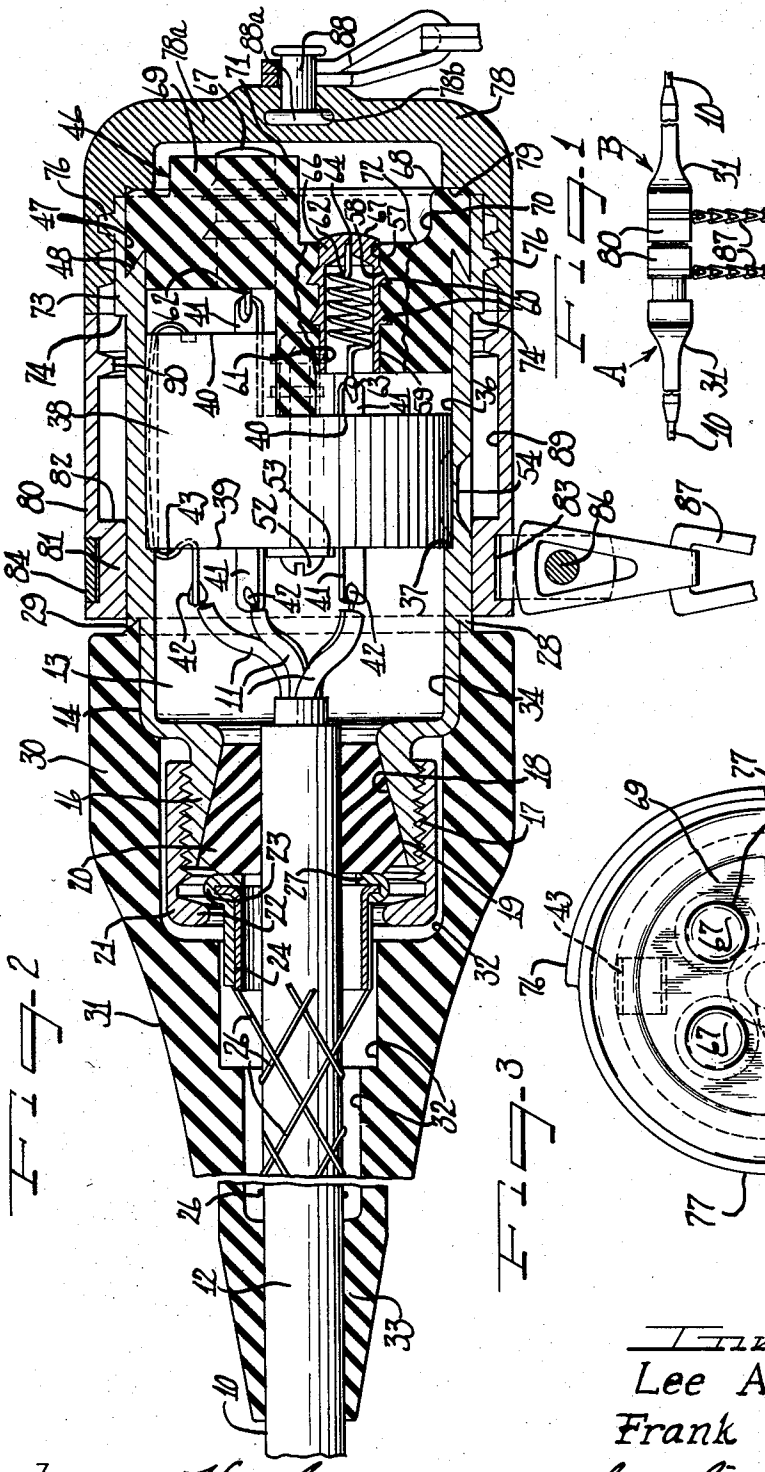

Fig. 2



Fig. 1

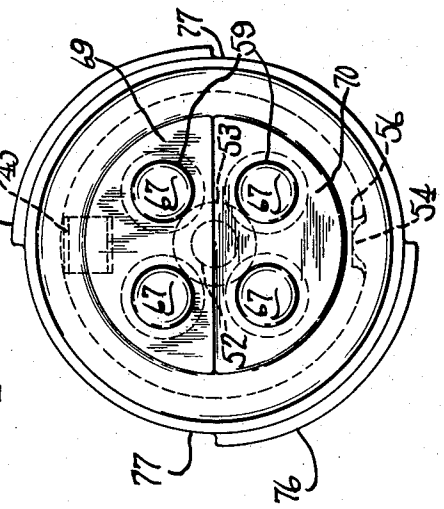

Fig. 3

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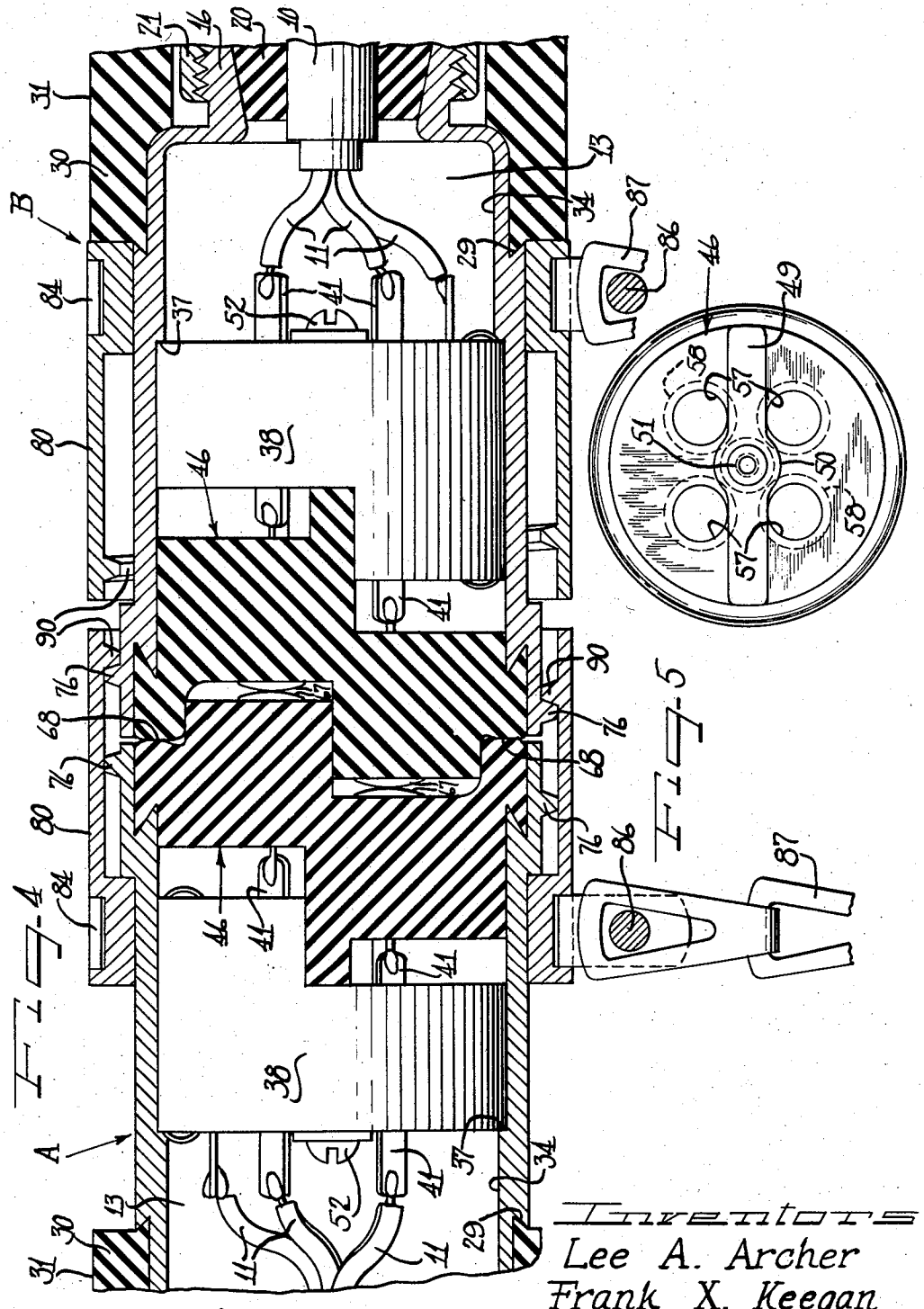

FIG. 4



FIG. 5



FIG. 7

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# INTERFITTING ELECTRICAL CONNECTOR

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7 Claims. (Cl. 339—48)

This invention relates generally to electrical connectors and more particularly relates to an improved form of interfitting connector which embodies an inductive type coil in the connector housing to offset the capacitance of the conductor wires and which utilizes interfitting parts which are quickly and conveniently coupled together to facilitate proper mating between current continuing contact members.

It is an object of the present invention to provide a separable connector including inductive compensating means for offsetting capacitive influences.

Another object of the present invention is to provide improved coupling means for a separable connector having interfitting parts.

Another object of the present invention is to provide an improved electrical separable connector having a reduced number of simplified elements which may be economically fabricated and which will be rugged in service.

Yet another object of the present invention is to provide a connector structure which will employ symmetrical parts of identical configuration so as to reduce the necessity of stock piling multiple parts.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a connector employing the principles of the present invention is shown by way of illustrative example.

Figure 1 is a reduced scale partially broken elevational view showing a separable connector in accordance with the principles of the present invention;

Figure 2 is an enlarged cross-sectional view with parts shown in elevation and partly broken showing one part or one unit of the connector shown in Figure 1 with the closure cap over the end of the fitting;

Figure 3 is an end elevational view of the parts shown in Figure 2 but with the closure cap removed to illustrate additional details of construction;

Figure 4 is an enlarged cross-sectional view showing two adjoining coaxially disposed parts connected as illustrated in Figure 1; and

Figure 5 is a rear elevational view with parts removed showing additional details of construction of the contact carrying member provided in accordance with the principles of the present invention.

As shown on the drawings:

In the elevational view of Figure 1, two cable ends are shown interconnected by a separable connector including two separate units A and B, which units are constructed identically so as to be interchangeable with one another. Accordingly, only one unit need be described in detail and identical reference numerals will be applied to all common structural units wherever possible.

Making particular reference to Figure 2, it will be noted that a cable **10** has a plurality of electrical conductors **11** and is covered by a sheath **12** made of rubber or some other good electrically non-conductive protective material.



At the end of the cable **10** the conductor wires **11** are bared and are introduced into a wiring chamber **13** of a rigid cylindrical housing **14** through a reduced neck **16** formed on the housing **14**.

The neck **16** is exteriorly threaded as at **17** and the bore extending through the neck **16** is axially tapered as at **18** to form a wedging contact surface with a similarly tapered peripheral surface **19** formed on a rubber locking sleeve **20** interposed between the cable **10** and the reduced neck **16**.

A nut member **21** is threaded on the reduced neck **16** and includes a radially inwardly extending abutment shoulder **22** which is of smaller diameter than the end of the reduced neck **16** and which engages the radially outwardly projecting shoulder **23** formed on a bushing construction indicated generally at **24** and having connected thereto woven meshed wires **26** which grip the cable **10** on the outside of the housing **14**.

The shoulder **23** on the bushing construction **24** has an inwardly turned radially extending flange **27** which abuts against the end face of the rubber lock ring **20** so that axial advance of the nut **21** on the reduced neck **16** will wedge the locking ring **20** securely into full contact engagement with the rubber sheath **12** on the cable **10**.

Between the grip exerted on the cable **10** by the meshed wires **26** and the locking ring **20**, it will be appreciated that relative axial displacement of the cable with respect to the housing **14** is effectively precluded.

The housing **14** is provided with an annular radially outwardly projecting shoulder **28** characterized by the provision of a lip formed at a reentrant angle and receiving a complementary-shaped lip **29** formed on the enlarged end **30** of a flexible tapered sheath **31** which extends rearwardly from the housing **14** and engages the cable **10** at a point longitudinally and axially spaced away from the housing **14**. The flexible sheath **31** preferably embodies sufficient rigidity to minimize action of the cable in the area adjacent the housing **14**.

The sheath **31** is particularly characterized by the formation of a plurality of counterbored recesses identified generally by the reference numeral **32**, which recesses **32** terminate in a reduced neck **33** snugly engaging the cable **10**. By virtue of such provision, the sheath **31** is effectively retained in proper position relative to the housing **14**, however, if it becomes necessary to operate the nut **21** the provision of the recesses **32** in the relatively short contact areas provided by the reduced neck **33** facilitates retraction of the sheath **31** on the cable **10**.

The housing **14** is provided with a cylindrical bore **34** which is adjacent a counterbore indicated at **36**, an annular shoulder **37** being formed in the housing **14** between the bore **34** and counterbore **36**.

Received in the counterbore **36** and abutting against the shoulder **37** is a coil member **38** which more particularly constitutes a generally cylindrical insulator made of electrically non-conductive material and having integrally molded therein a toroidal coil which is an inductive type of coil designed to offset the capacitance of the conductor wires of the connector. For the purposes of the present invention, it may be noted that the coil member **38** has a radially extending back wall **39** and a radially extending stepped front wall **40**. Projecting axially or longitudinally from the walls **39** and **40** are wire terminals **41** and it will be understood that such terminals **41** are in proper circuit relationship with the inductor-type coil embedded within the coil member **38**. Thus, the terminals **41** projecting from the wall **39** are conveniently connected to the bared conductor wires **11** by means of soldered joints indicated at **42**. It will be noted further that a grounding clip **43** is carried at the periphery

of the coil member 38 and engages the walls of the housing 14.

A contact-carrying member indicated generally by the reference numeral 46 extends transversely across the open end of the housing 14 and is preferably made of an electrically non-conductive resilient material such as synthetic rubber or the like.

According to the present invention, a positive seal is provided between the member 46 and the housing 14 by pinching the contact carrying member 46 at those portions disposed between a saw tooth shoulder 48 and a front seal at 68 on the member 46. No separate retainers need be threaded into the housing or otherwise employed and a smaller overall connector diameter may be economically utilized.

An annular counterbore 47 is provided in the end of the housing 14 and terminates in a keyway 48 providing an interlocking dovetail connection with a complementary shaped portion on the contact-carrying member 46. In other words a saw tooth shoulder is formed which is pinched whenever the connector is in use or when the connector is capped.

As is specifically shown in Figure 5, the contact-carrying member 46 has a rib 49 which projects axially or longitudinally off the back face thereof and which is centrally enlarged as at 50 to receive a threaded insert 51 molded integrally in the enlarged portion 50 of the rib 49. Thus, the rib 49 provides a diametrically extending abutment surface which engages against the front wall 40 of the coil member 38, the threaded insert 51 lying in register with an axially extending opening formed in the coil member 38 to pass a fastening screw 52. In other words, the screw 52 is passed through a washer 53 and through the coil member 38 for threaded engagement with the threaded insert 51 whereupon the contact-carrying member 41 and the coil member 38 will be axially drawn together. Since the coil member 38 abuts against the shoulder 37 and the contact-carrying member 46 is keyed and locked by the keyway 48, it will be appreciated that both parts are securely locked in firm assembly with the housing 14.

An inwardly projecting embossment 54 is formed in the housing 14 and projects into a slot 56 formed in the coil member 38, thereby to prevent relative rotation between the coil member 38 and the housing 14. The detent and recess relationship effected by the embossment 54 and the slot 56 is clearly illustrated in Figure 3.

In connection with the contact-carrying member 46, it may be noted that this member can be conveniently fabricated by a molding operation and the member is preferably provided with a plurality of axially extending through holes, each adapted to receive a contact member. Thus, there is shown at 57 (Figure 2) a recess 57 particularly characterized by the formation of a pair of axially spaced annular recesses 58 along the length thereof. A current-continuing contact member 59 takes the form of a cylindrically-shaped part having a pair of axially spaced outwardly projecting ribs 60 and having an internal recess 61. The ribs 60 are received in the recesses 58 and the recess 61 receives a coiled current-continuing wire 62 which is soldered as at 63 to the terminal 41 projecting from the wall 40 of the coil member 38 and which is connected as at 64 to the head portion 66 of the contact member 59, thereby to provide a solid current path between the terminal 41 and a convexly-shaped axially or longitudinally projecting contact surface 67 formed on the contact member 59.

The wire 62 is coiled to provide a spring type pig-tail lead which affords axial movement tolerance of the contacts while insuring a positive electrical connection. Moreover, the pigtail itself can be conveniently extended for convenient soldering without danger of shorting due to pig-tail slack.

The contact-carrying member is particularly characterized by the provision thereon of an annular abutment shoulder 68 which projects axially or longitudinally beyond the end of the housing 14, thereby to provide a resilient abutment surface at the end of the connector unit.

The contact-carrying member 46 is further characterized by the provision of hermaphroditic parts including a male part 69 and a female part 70. Beacuse the contact-carrying member 46 is essentially cylindrical, the male and female parts 69 and 70 take the form of adjacent semi-circular segments as is clearly depicted in Figure 3.

As will be noted upon referring to Figure 3 in connection with Figure 2, the contact members 59 are circumferentially and radially spaced in regard to the hermaphroditic parts 69 and 70 so as to provide complete symmetry. It will be further noted that the male part 69 provides a radially extending wall surface 71 and the female part 70 provides a radially extending wall surface 72. Both wall surfaces 71 and 72 are broken only by the convexly-shaped contact surfaces 67 of the contact members 59, thereby insuring a good wiping contact surface when two adjoining contact surfaces 67 are brought together in mating relationship.

The housing 14 is provided with an enlarged annular boss 73 which provides a radially extending abutment wall 74. On the boss 73 there is formed a pair of radially outwardly projecting circumferentially spaced helical ribs 76. Although the ribs 76 have appreciable circumferential extent, the ribs 76 are so spaced as to provide alternately spaced ribs 76 and recesses 77, the purpose of which will become manifest presently. The contact carrying members 46 key the connector components together. Additionally it will be noted upon referring to Figure 4 that each member 46 has a non-symmetrical cross-section in longitudinally transverse plane or section so that the relative location with respect to the front seal provides unequal side to center contact movement when the seal is moved in by the compressive action of the coupling. Although the inward movement of the seal does not deflect the sunken contacts, it does deflect the raised contacts, thereby assisting in providing a desirable wiping action on the contact surfaces.

It may be further noted that the resilient mounting of the button-type contacts in the elastic inner body members and the lack of perfect alignment between confronting contact members which resutls from the usual manufacturing tolerances, or an intentional misalignment for the purpose of promoting wiping contact will insure that the projecting portions of the button-type contacts which project longitudinally beyond the respective inner body members engage one another and partake of a sufficient lateral movement so a true wiping action will occur between the engaging surfaces and an efficient electrical contact will be promoted.

To protect the connector when not in use, an end cap 78 is provided which is a generally cup-shaped member having an inner boss providing a radially extending abutment wall 79 which engages the resilient shoulder 68. The side walls of the end cap 78 have internal threads formed thereon so as to facilitate threaded assembly of the end cap 78 on the housing 14, thereby placing the abutment surfaces 68 and 79 in sealing relationship. The cap 78 comprises a glass reinforced molded article made of phenolic resin or a similar plastic material.

A sleeve member 80 is loosely fitted on the outside of the housing member 14 and is relatively movable with respect thereto. The sleeve 80 has an enlarged portion 81 providing a radial wall 82 engaging the shoulder 74 to limit the extent of relative axial movement of the sleeve member 80 and the housing 14. The end of the sleeve member 80 is also recessed as at 83 to receive a retainer ring 84 attached by a pin 86 to a flexible connecting means such as a chain 87. The other end of the chain 87 is attached by means of a rivet or some other suitable fastening means 88 to the end wall of the end

cap 78. Notice that the cap 78 has an unbroken end wall 78*a* characterized by a recess 78*b* formed upon molding an enlarged end portion 88*a* of the rivet 88 integrally therein. A potential source of leakage is thus eliminated.

The sleeve member 80 is provided with a cylindrical recess 89 which is of sufficient diameter to freely telescope over the ribs 76. The sleeve 80 is particularly characterized, however, by the provision of a plurality of radially inwardly projecting helical ribs 90. The ribs 90 are circumferentially spaced from one another to provide suitable recesses therebetween and, accordingly, the alternately spaced ribs 90 and recesses correspond in number and location to the ribs 76 and recesses 77 on the body member 14. The inner diameter of the ribs 90 is less than the outer diameter of the ribs 76. By relatively rotating the sleeve 80 and the body member 14, the ribs 90 and the recesses 77 may be adjusted into axial register, thereby permitting axial adjustment of the sleeve 80 so that the ribs 90 will move past the ribs 76 and beyond the end of the housing 14, whereupon the ribs 90 may be moved past the ribs 76 on an adjoining connector to effect a coupling relationship.

In other words, making specific reference to Figure 4, there is shown two units, according to the present invention, namely, the units A and B of Figure 1, each constructed in accordance ith the details thus far described. The sleeve 80 on the unit B remains in its retracted position, however, the sleeve 80 on the unit A has been moved so that the ribs 90 are threaded behind the ribs 76 on the unit B thereby coupling the units A and B in firm assembly with one another.

Moreover, because of the pitch angle of the helical threads provided by the ribs 76 and 90, the units A and B will be axially advanced so as to resiliently clamp the contact-carrying members 46 together with one another at the resilient abutment surface 68, 68.

Although the present invention contemplates the provision of contact-carrying members 46 having hermaphroditic parts and being of resilient construction to afford a resilient interengagement at the surfaces 68 so as to produce a firm clamping engagement and a good wiping contact at the contact surfaces 67, it may be noted that particularly good results are obtained by using for the contact-carrying members 46 a 40—50 durometer rubber which affords a good natural wiping fit for the contact surfaces 67.

The resilient construction provides pressure to the button type contacts by shear action in the resilient material, thereby minimizes loss of contact pressure due to compression set of the resilient material.

In Figure 1, it will be noted that the end caps 78 are retained when not in use by the chains 87, a feature which permits the individual fittings to be immediately protected when disconnected merely by fastening the end caps onto the housings 14.

Although various minor structural modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. A two part separable connector having complementally identical interfitting parts each including a generally cylindrical outer body member, a resilient inner body member extending across the end of said outer body member and supported at its periphery only, said inner body member having a peripheral shoulder extending longitudinally beyond the end of the outer body member, said inner body member having interiorly of said peripheral shoulder a male part extending longitudinally beyond said shoulder and a female part recessed to receive the male part of an identical mating connector part, an electrically conductive contact member carried by said inner body member at each of said male and female parts and extending through said inner body part for connection to conductor wires inside of said outer body member, and locking means on said outer body member whereup both interfitting parts may be longitudinally aligned and interlocked with said peripheral shoulders in engagement, said contact members having button-type transversely curved engagement surfaces projecting longitudinally beyond said inner body member to engagingly contact the corresponding transversely curved surfaces of similar contact members in a mating connector part, said contact surfaces having wiping contact with one another when said inner body member provides unequal side to center contact movement in response to the compressive action of the locking means.

2. A two part separable connector as defined in claim 1, said outer body member having a reduced neck at the end opposite the end in which said inner body member is supported, and a cable extending through said reduced neck and providing the conductor wires connected to said contact members.

3. A connector as defined in claim 2, a resilient sleeve between said cable and said reduced neck, said neck and said sleeve having complementary tapered wedging surfaces, a retainer nut threaded on said neck and having an inwardly projecting abutment, a bushing engaged by said abutment and having woven meshed wires connected thereto gripping said cable outside of said housing, and a flexible tapered sheath carried by said outer body member and extending rearwardly therefrom to engage said cable away from said outer body member.

4. A connector as defined in claim 3, said sheath having an elongated recess formed therein and terminating in a reduced neck at the end thereof snugly engaging the cable.

5. A connector for the end of a cable having a plurality of conductor wires, comprising, a rigid cylindrical body member open at one end and forming an outer housing at the end of said cable, a flexible tapered sheath on said housing extending rearwardly therefrom and engaging said cable away from the end thereof, said sheath being of sufficient rigidity to reduce the action of said cable adjacent said connector, means connecting said housing in firm assembly with said cable, and a contact-carrying member in the open end of said housing made of an electrically non-conductive resilient material, said contact-carrying member formed to provide an annular abutment shoulder projecting longitudinally outwardly beyond the open end of said housing, and having contact members providing contact surfaces projecting longitudinally outwardly in transversely spaced relation with one another, said housing having connecting coupling means for mating and engaging with a similar axially aligned adjacent connector for driving and locking said connectors together with said abutment shoulders in engagement and said contact surfaces in contact, means forming a saw tooth interlocking dovetail coupling connection between the outer peripheral surface of said contact-carrying member and the inner peripheral surface of said housing to provide a positive seal between the contact-carrying member and the housing and to develop a locking action placing said contact-carrying member in firm assembly with said housing.

6. A two part separable connector having complementally identical interfitting parts each including a generally cylindrical outer body member, a resilient inner body member extending across the end of said outer body member, said inner body member having a peripheral shoulder extending longitudinally beyond the end of the outer body member, said inner body member having interiorly of said peripheral shouler a male part extending longitudinally beyond said shoulder and a female part recessed to receive the male part of an identical mating connector part, an electrically conductive con-

tact member carried by said inner body member at each of said male and female parts and extending through said inner body part for connection to conductor wires inside of said outer body member, an outwardly projecting helical rib and an annular shoulder provided on the peripheral surface of said outer body member in axially spaced apart relation, and a sleeve loosely carried by said outer body member and providing an annular shoulder abutting said body member shoulder and an inwardly projecting helical rib for engaging an adjoining helical rib on the other part, whereupon both of said interfitting parts will be axially interlocked and coupled, means axially inwardly of said peripheral shoulder locking said inner body member to said outer body member to deflect said resilient peripheral shoulders in compression, said contact members having button-type engagement surfaces and deflecting said inner body member in shear, thereby minimizing loss of contact pressure due to compression set of the resilient material.

7. In a connector, a generally cylindrical outer body member having a plurality of circumferentially alternating radially outwardly projecting helical ribs and recesses formed on the peripheral surface thereof, a movable sleeve on said outer body member and having a plurality of circumferentially alternating inwardly projecting ribs and recesses corresponding in number to said recesses and ribs, respectively, abutment means between said sleeve and said outer body member limiting relative axial movment therebetween, said sleeve and outer body member being relatively rotatable to move said ribs and recesses into and out of axial register with one another and being movable axially when opposed ribs and recesses are in register to move said inwardly projecting sleeve ribs beyond the end of said outer body member for threadedly engaging the body ribs on a mating connector, an elastic inner body member, said inner body member having a peripheral shoulder extending longitudinally beyond the end of said outer body member, said inner body member having interiorly of said peripheral shoulder a male part extending longitudinally beyond said shoulder and a female part recessed to receive the male part of an identical mating connector part, and button-type contact members carried by said inner body member projecting beyond said inner body member to engage the contact members of the mating connector.

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