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3,101,986

SELF-LOCKING PLUG AND JACK TYPE ELECTRICAL CONNECTOR

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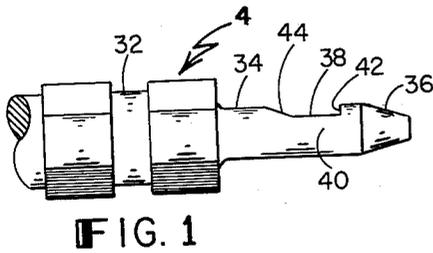


FIG. 1

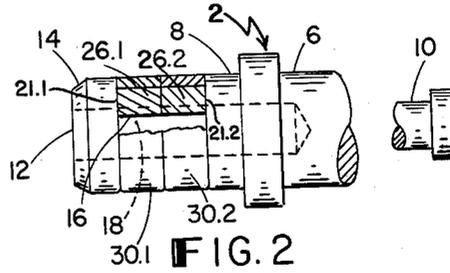


FIG. 2

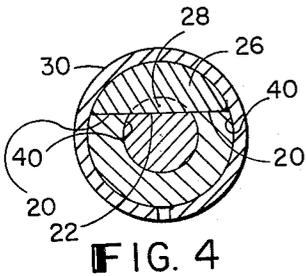


FIG. 4

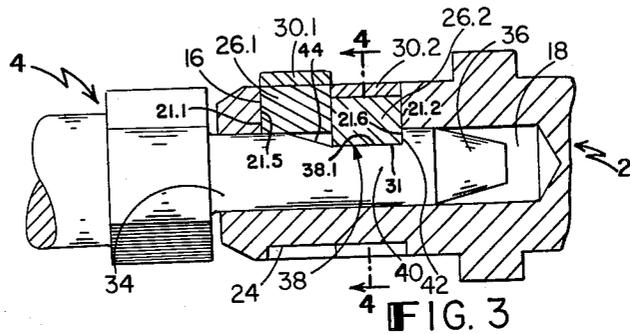


FIG. 3

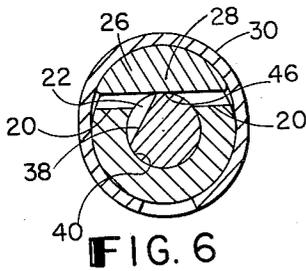


FIG. 6

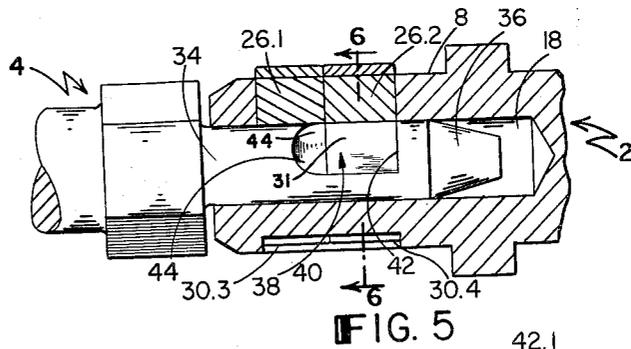


FIG. 5

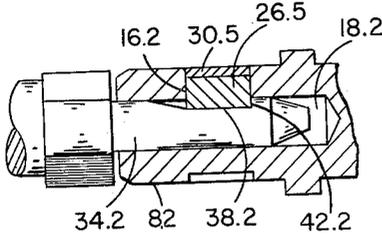


FIG. 8

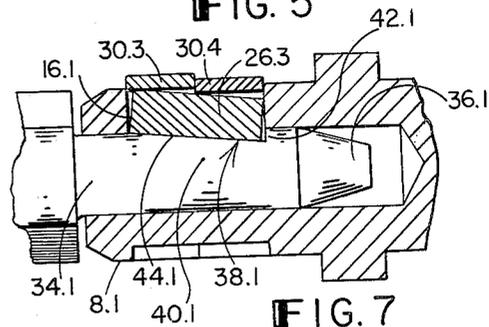


FIG. 7

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**SELF-LOCKING PLUG AND JACK TYPE
ELECTRICAL CONNECTOR**

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The field of this invention is that of electrical connectors, more particularly that of electrical connectors of the plug and jack type.

Objects of this invention are to provide an electrical connector of the above type in which the plug unit and the jack unit can be interconnected or disconnected with great convenience; to provide such a connector in which the plug and jack units can be conveniently and securely locked in conducting relation and can be conveniently unlocked preparatory to separating them; to provide such a connector in which excellent electrical contact can be maintained between the plug and jack units thereof; to provide such a connector which is convenient and inexpensive to manufacture, assemble, and install, and easy to use because independent of tools for locking and unlocking, and to provide such a connector which is especially adapted to be made in very small sizes for use in electronic equipment.

The substance of the invention in its principal aspects can be briefly summarized as follows.

The self-locking plug electrical connector according to this invention has a jack unit with a sleeve portion which is open at least at one end. This jack unit is provided, preferably at the end opposite the sleeve portion, with terminal means of conventional type by which the jack unit can be mounted on a board or otherwise connected in an electrical circuit. The sleeve portion of the jack unit has a peripheral notch, preferably of chordal configuration, and this notch is spaced from the open end of the sleeve and extends into the hollow inner space of the sleeve. Key means preferably of segmental configuration corresponding to the chordal notch of the jack sleeve, are fitted within that notch, extending within the hollow inner space of the jack sleeve. Pressure means, for example one or more split-rings are fitted around the jack sleeve and the key means, for holding and biasing the key means normally within the hollow inner space of the jack sleeve. The plug unit has a cylindrical pin portion made to fit closely within the jack sleeve and is provided with terminal means of conventional type, preferably at the end of the plug unit opposite the cylindrical pin portion, for connecting the plug in an electrical circuit. The cylindrical pin portion of the plug has a tapered end and a peripheral transverse notch which is spaced from the tapered end, and smoothly intersects the peripheral surface of the cylindrical pin portion at either side.

The cylindrical pin of the plug unit can be inserted into the sleeve of the jack unit such that the tapered end of the pin will wedge the key means from within the hollow inner space of the sleeve against the bias of the pressure means. The notch in the pin can then be aligned with the sleeve notch so that the biased key means will reenter the hollow inner space of the sleeve to fit within the pin notch, thereby locking the plug and jack units together. The key means are adapted not only to fit within the pin notch for locking the plug and jack units together, but, being biased, also to bear heavily against the pin portion of the plug unit for pressing the side of the pin opposite the notch into firm electrical contact with the corresponding inner surface of the jack sleeve.

When separation of the plug and jack units is desired

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to break the electrical connection therebetween, the plug is rotated relative to the jack which rotates the pin within the jack sleeve, such that the peripheral surface of the pin at the transverse side of the plug notch will wedge the key means from within the hollow inner space of the jack sleeve and from within the pin notch, thus permitting withdrawal of the plug pin from the jack.

In an important aspect of the invention, a pair of keys are arranged to fit side-by-side within the notch in the jack sleeve, each key extending within the hollow inner space of the sleeve. A pair of split-rings are fitted around the sleeve and around respective keys. However the pin of the mating plug can receive only one of the keys which serves to lock the plug and jack units, whereas the other key bears heavily against the pin periphery for holding the plug and jack units in particularly firm electrical contact.

In another practically important aspect of the invention, a single key is fitted within the notch in the jack sleeve and biased by a pair of split-rings. The pin notch in this embodiment is along the pin axis tapered from a depth sufficient to accommodate the key up to the peripheral surface of the pin. When the notches in the pin and jack sleeve are aligned, the key is tilted into the pin notch for locking the plug and jack units in interconnected relation. However, the portion of the key which bears against the pin notch at a point where the notch is relatively shallow is strongly biased by the split-ring fitted over the key at that point so that the pin portion of the plug is held firmly in electrical contact with the jack sleeve.

These and other objects and aspects of the invention will appear from the following description of several practical embodiments illustrating its novel characteristics.

The description refers to a drawing in which:

FIG. 1 is a fragmentary side elevation of the plug unit according to the invention;

FIG. 2 is a fragmentary side elevation of the jack unit according to the invention;

FIG. 3 is a fragmentary side elevation, partially in section, along the longitudinal axis of the connector, showing the plug and jack units in locked relation;

FIG. 4 is a section view along line 4-4 of FIG. 3;

FIG. 5 is a fragmentary side elevation similar to FIG. 3, showing the plug and jack units in unlocked relation;

FIG. 6 is a section view along line 6-6 of FIG. 5;

FIG. 7 is a fragmentary side elevation, similar to FIG. 3, showing an alternative embodiment of the connector according to the invention; and

FIG. 8 is a fragmentary side elevation similar to FIG. 3, showing another alternative embodiment of the connector.

In FIGS. 1-6, numeral 2 indicates the jack unit and 4 indicates the plug unit of an electrical connector according to the invention.

The jack unit of the connector has a body portion 6, a sleeve portion 8, and terminal means 10 preferably located opposite the jack sleeve. This terminal means is here shown to comprise a solder tip, but any suitable terminal means by which the jack unit can be mounted on a terminal board or wire or otherwise connected in an electrical circuit is within the scope of this invention. It will be evident that a plug unit or second jack unit of similar or conventional construction can replace the terminal means.

The jack sleeve is open at 12 and this open end of the sleeve is preferably chamfered as at 14. The sleeve is notched by a cutout, as at 16, at a location spaced from the open end of the sleeve, the notch extending into the hollow inner space 18 of the sleeve. Preferably, as shown in FIGS. 2 and 4, the notch comprises a chordal segment cut out from the sleeve to provide the

longitudinal flat surfaces 20, 20 on the sleeve at either side of the notch extending into the hollow inner space of the sleeve, and terminating at both ends in essentially flat transverse surfaces 21.1, 21.2 as at 22. The diameter of the sleeve is reduced, as at 24, at the location of the sleeve notch for purposes to be described below.

A pair of keys 26.1, 26.2 of chordally segmental configuration corresponding to the sleeve notch are fitted side-by-side within the sleeve notch or cutout so that these keys rest with their flat inner faces on the flat surfaces 20 of the notch and so that the central portion 28 of each key extends into the hollow inner space of the sleeve. The flat transverse end faces which essentially fit the transverse surfaces 21.1, 21.2 of the sleeve are indicated at 21.5, 21.6.

A pair of split-rings 30.1, 30.2 of resilient material are fitted around the reduced diameter portion of the sleeve and around respective keys 26.1, 26.2 for biasing the keys normally to rest within the inner space of the sleeve. As shown in FIG. 3, since the rings are fitted around the reduced diameter portion of the sleeve, there will be no tendency of the rings to be displaced from the keys.

The plug unit 4 of this connector has a body portion 32 and a cylindrical pin portion 34, and is provided with terminal means (not shown), preferably at a location opposite the pin portion of the plug. The plug terminal means can be of any conventional type for connecting the plug unit in an electrical circuit. They can, but need not be, of the same type as is provided on the jack unit, or they can be jack or pin means of similar or conventional construction.

The pin portion of the plug has a conically tapered end 36 and a peripheral notch 38 with a chordally segmental flat surface 38.1 and is adapted to fit closely within the jack sleeve. The pin notch 38 is spaced from the tapered end of the pin, and smoothly intersects the peripheral surface of the pin at either transverse side 40—40 of the notch. The side of the pin notch nearest the tapered end of the pin provides a shoulder 42 which is substantially perpendicular to the cylindrical axis of the pin whereas the opposite side of the pin notch can be tapered, as at 44, to provide clearance for purposes to be described below. It will be apparent that the flat inner surface 31.4 of the key 26.2 is adapted to fit the flat side surfaces 20 of the sleeve cutout and the flat surface 38.1 of the pin notch.

As can be best seen in FIG. 3, the plug pin can be inserted within the sleeve of the jack unit through the open end of the sleeve, whereby the tapered end 36 of the pin will successively engage each key 26 and will wedge each key from within the inner space 18 of the jack sleeve to the extent necessary to permit the plug pin to pass beneath the two keys. When the pin has been inserted in the sleeve a sufficient distance so that the pin notch is aligned with the sleeve notch, the split-rings 30—30 will successively bias the keys to return within the hollow inner space of the sleeve and into the pin notch. The outermost key first engaged by the tapered end 36 of the pin can be designed to span the pin notch so that, as the pin notch passes beneath said key, the key will not enter the pin notch, or, as shown, the outermost key can be adapted to enter the pin notch. In this instance, the pin notch should be tapered, as at 44, so that this key will be wedged from within the notch by the taper 44 as the pin notch passes beneath the key. The shoulder 42 of the pin notch will engage the innermost key 26 and will thereby lock the plug and jack unit together preventing withdrawal of the plug from the jack sleeve. The outermost key having been wedged from within the pin notch will be biased against the peripheral surface of the plug pin 34 and will hold the side of the pin opposite the pin notch firmly in electrical contact with the corresponding inner surface of the jack sleeve.

When separation of the plug and jack units of the connector is desired for breaking the electrical connection therebetween, the plug is rotated relative to the jack unit around the cylindrical axis of the plug pin as shown in FIG. 4. Since the pin notch smoothly intersects the peripheral surface of the pin at either transverse side 40 of the notch, the peripheral surface of the pin at the side of the pin notch will wedge the locking key 26.2 from within the inner space of the jack sleeve and from within the pin notch to the extent necessary to permit withdrawal of the plug pin from within the jack sleeve. Thus it can be seen that the plug and jack units of the connector provided by this invention are automatically locked together when the plug is inserted within the jack unit and can be conveniently unlocked to permit separation of the plug and jack unit by rotating the plug a quarter turn relative to the jack unit.

In FIG. 7, an alternative embodiment of this invention is illustrated. The jack unit is shown to comprise a sleeve portion 8.1 notched as at 16.1 in the manner described above. A single key 26.3 of chordal segmental configuration corresponding to the sleeve notch is fitted within the sleeve notch and is biased to extend within the hollow inner space of the jack sleeve by a pair of split-rings 30.3—30.4.

The plug unit of this embodiment has a cylindrical pin portion 34.1 which is provided with a peripheral notch 38.1. The side of the pin notch nearest the tapered end 36.1 of the pin provides a shoulder 42.1 which is substantially perpendicular to the cylindrical axis of the pin, and the notch has a tapered bottom 44.1 which extends along the pin axis smoothly to intersect the peripheral surface of the pin. The notch otherwise extends transversely of the pin axis as described above with respect to the embodiment of this invention as illustrated in FIGS. 1-6 and smoothly intersects the peripheral surface of the pin at either transverse side 40.1—40.1 of the notch.

When this plug pin is inserted within the jack sleeve, the key 26.3 is first wedged from within the jack sleeve as described above and then, when the pin and sleeve notches are aligned, is biased to enter the pin notch. The key is tilted within the pin notch, one of the split rings, 30.4, holding one portion of the key against the tapered surface 44.1 of the pin notch adjacent the notch shoulder 42.1 for locking the plug and jack units together, and the other split ring 30.3 holding the other portion of the key firmly against the remaining tapered surface 44.1 of the notch for holding the plug and jack units firmly in electrical contact. Otherwise, this embodiment of the invention is the same as that shown in FIGS. 1-6.

FIG. 8 shows a third embodiment of the connector according to this invention. The jack unit is shown to comprise a sleeve portion 8.2 notched as at 16.2 in the manner described above. A single key 26.5 of chordal segmental configuration corresponding to the sleeve notch is fitted within the sleeve notch and is biased to extend within the hollow inner space 18.2 of the jack sleeve by a split-ring 30.5.

The plug unit of this embodiment of the invention has a cylindrical pin portion 34.2 which is provided with a peripheral notch 38.2 and which corresponds to the plug unit shown in FIG. 1. When the plug is inserted within the jack sleeve, the key 26.5 is first wedged from within the jack sleeve, as described above with reference to FIGS. 1-6, and then, when the pin and sleeve notches are aligned, it is biased to enter the pin notch. The key engages the pin notch shoulder 42.2 and locks the plug and jack units together thus preventing axial withdrawal of the plug pin from the jack sleeve, and it also bears heavily against the bottom of the pin notch 38.2 for holding the plug and jack units firmly in electrical contact.

It should be understood that, although specific embodiments of the connector provided by this invention have

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been shown for the purposes of illustration, this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A self-locking plug and jack assembly comprising:
 - a jack unit having a sleeve at an end, said sleeve having a portion of smaller outer diameter spaced from the open end thereof, and said sleeve having a chordal segmental notch in said smaller diameter portion which extends within the hollow inner space of the sleeve; a pair of keys of chordal segmental configuration disposed in said sleeve notch in side-by-side relation, said keys being adapted to extend within the hollow inner space of said sleeve; a cylindrical plug adapted to fit within the sleeve, said plug having a chordally segmental notch which is spaced from the end of the plug and which is adapted to receive one of said keys, said notch extending transversely of the plug axis and smoothly intersecting the peripheral surface of the plug at either side of the notch; and a pair of split-rings fitted around the smaller diameter portion of the sleeve and around respective keys for biasing said keys normally to extend within the hollow inner space of said sleeve; whereby, when the plug is inserted within the sleeve with the notches aligned, said one key will be biased into the plug notch for locking the plug and jack unit together and the other key will be biased against the plug for holding the plug and sleeve in electrical contact and whereby, when the plug is rotated in the sleeve, the peripheral surface of the plug at the side of said notch will wedge said one key from within the hollow inner space of the sleeve for permitting separation of the plug and jack unit.
 2. A self-locking plug and jack assembly comprising:
 - a jack unit having a sleeve portion open at one end, said sleeve portion being provided with a chordally segmental cutout having flat longitudinal side surfaces, extending into the hollow inner space of the sleeve portion, and terminating at both ends in essentially flat transverse surfaces;
 - a key fitted within said sleeve portion at said cutout, having inner flat face means adapted to fit said side surfaces of the sleeve portion, and terminating in essentially flat transverse end faces adapted to fit said transverse surfaces of the sleeve portion;
 - a plug adapted to fit within said sleeve portion and having a notch with a chordally segmental flat surface adapted to fit said inner face means of said key and slightly tapered in axial direction, said notch terminating towards the end of the plug with a transverse shoulder adapted to fit the corresponding transverse end face of the key; and
 - a pair of circumferential spring rings for biasing said key for normal confinement within said cutout of the sleeve portion;

whereby, when the plug is inserted in the sleeve portion with the plug notch and the sleeve cutout in alignment, one spring ring will tilt the key into the

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- plug notch for locking the plug and the jack unit together in electrical contact and the other spring ring will bias the key against the plug notch for electrical contact and whereby, when the plug is rotated within the sleeve portion, an edge of the flat surface of the plug will wedge the key from within the hollow inner space of the sleeve portion against the bias of the spring rings for permitting separation of the plug from the jack unit.
3. A self-locking plug and jack assembly comprising:
 - a jack unit having a sleeve portion open at one end, said sleeve portion being provided with a chordally segmental cutout having flat longitudinal side surfaces, extending into the hollow inner space of the sleeve portion, and terminating at both ends in essentially flat transverse surfaces;
 - two keys fitted within said sleeve portion at said cutout, having inner flat face means adapted to fit said side surfaces of the sleeve portion, the keys contacting each other and terminating in essentially flat transverse end faces adapted to fit said transverse surfaces of the sleeve portion;
 - a plug adapted to fit within said sleeve portion and having a notch with a chordally segmental flat surface adapted to fit said inner face means of the key near the plug tip and adapted to lie essentially in the plane defined by side surfaces of the sleeve portion, said notch terminating towards the tip of the plug with a transverse shoulder adapted to fit the corresponding transverse face of said tip key and extending into an outwardly tapered surface; and
 - two circumferential spring means for biasing said keys for normal confinement within said cutout of the sleeve portion;
- whereby, when the plug is inserted in the sleeve portion with the plug notch and the sleeve cutout in alignment, the tip key will be biased into the plug notch for locking the plug and the jack units together in electrical contact and the other key will be biased for holding the plug and the sleeve in electrical contact and whereby, when the plug is rotated within the sleeve portion, an edge of the flat surface of the plug will wedge the tip key from within the hollow inner space of the sleeve portion against the bias of the pressure means for permitting separation of the plug from the jack unit.

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