Aug. 29, 1961 J. J. CHAMBERLAIN 2,998,588

TWO-PART ELECTRICAL CONNECTORS

Filed Aug. 10, 1959 2 Sheets-Sheet 1

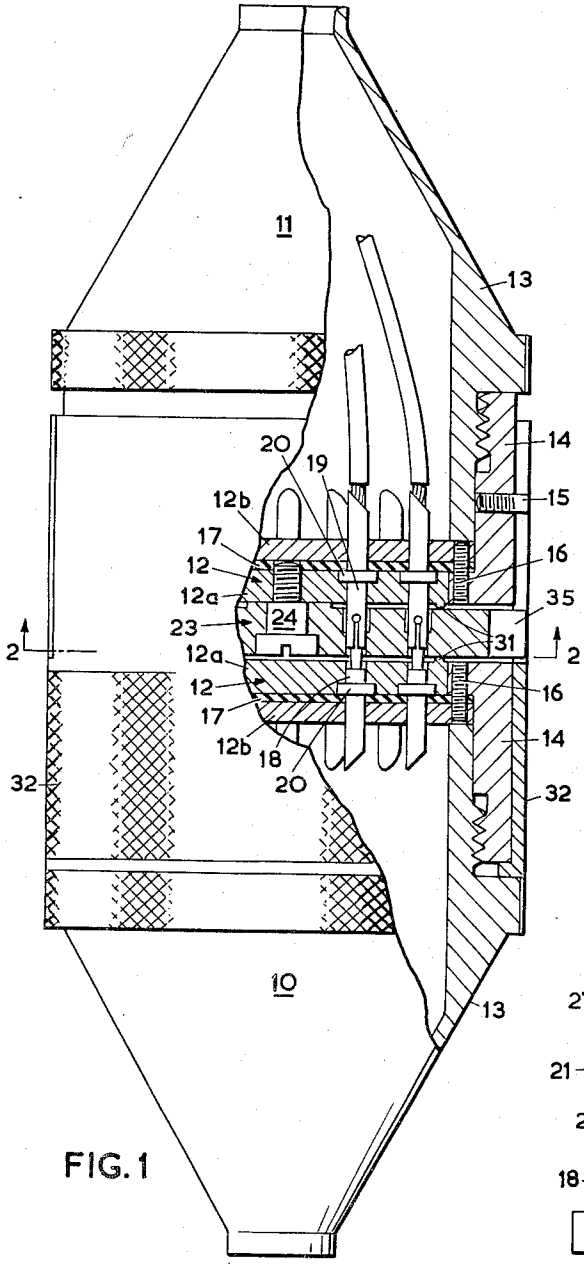

FIG. 1

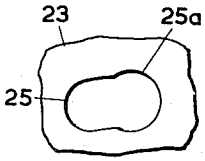

FIG. 3a

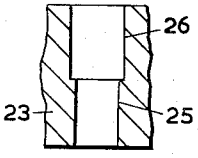

FIG. 3b

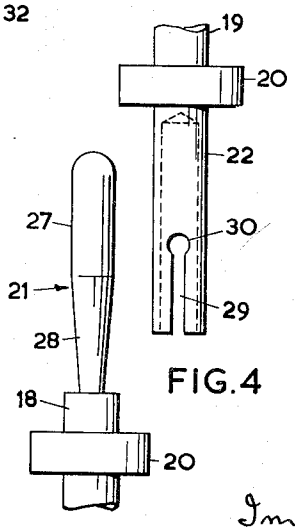

FIG. 4

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Aug. 29, 1961 J. J. CHAMBERLAIN 2,998,588

TWO-PART ELECTRICAL CONNECTORS

Filed Aug. 10, 1959 2 Sheets-Sheet 2

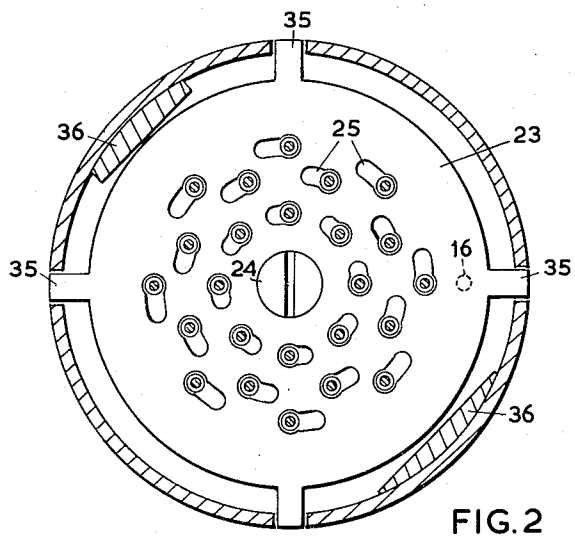

FIG. 2

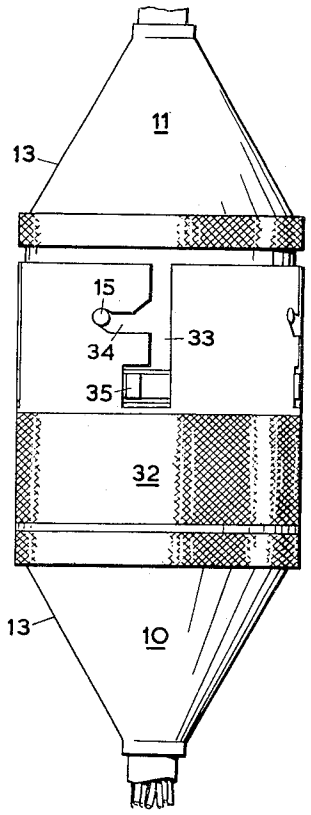

FIG. 5

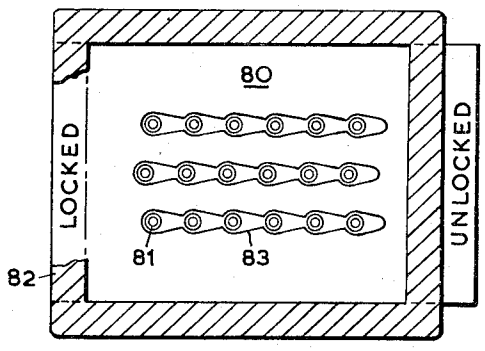

FIG. 6.

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TWO-PART ELECTRICAL CONNECTORS

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6 Claims. (Cl. 339—75)

This invention relates to two-part electrical connectors.

The invention essentially consists in a two-part electrical connector having at least one contact pin and co-operating resilient contact sleeve, and provided with a clamping member through an aperture in which the contact sleeve passes at least when the two parts of the connector are in engagement, the walls of the aperture acting on movement of the clamping member from a "released" to a "clamped" position to deform the contact sleeve to cause it to grip the contact pin.

Although the invention may be applied to connectors having only a single pin and sleeve contact pair, it is more particularly applicable to multi-point connectors, such as may be used for the interconnection of electronic or communication apparatus, in which it is desired to combine consistently good electrical contact between the pins and the sleeves with ease of separation and engagement of the two parts of the connector. In such a construction the clamping member will of course be common to all the contact pairs, each contact sleeve passing through a separate aperture in the clamping member.

Other features of the invention will be evident in the following description of various forms of electrical connectors embodying preferred forms of the invention. The description refers to the accompanying drawings, in which:

FIG. 1 is a side elevation, partly sectioned, of a multi-point two-part connector;

FIG. 2 is a transverse cross-section of the connector shown in FIG. 1 on the line marked 2—2 in that figure;

FIGS. 3*a* and 3*b* show respectively a plan and a cross-section of part of a clamping member included in the construction of FIG. 1;

FIG. 4 shows details of the mating contact parts of the connector;

FIG. 5 is an external view of the complete connector; and

FIG. 6 shows a cross-section through the mating contact parts of a further form of connector.

The general arrangement of the connector shown in FIGS. 1–5 of the drawings will be evident from a consideration of FIGS. 1 and 2. The two parts of the connector, which may be distinguished as the plug part **10** and the socket part **11**, each consist of a composite body member **12** carrying the contact members, an outer casing formed by a cable sleeve **13** for receiving the incoming cables to the connector, and a retaining ring **14** by means of which the body **12** is clamped against an end face of the cable sleeve **13**. The two parts of the connector are circular in cross-section, the retaining ring **14** being screwed on to the cable sleeve **13**. Threaded studs **15** pass through the retaining ring **14** and bear against the wall of the cable sleeve **13** to prevent relative rotation of these parts. Further threaded studs **16** prevent relative rotation of the body member **12** and the retaining ring **14**.

Each of the body members **12** comprises two discs **12***a* and **12***b* of moulded insulating material with a resilient sealing disc **17** compressed between them. A series of holes, with their centres disposed on three circles co-axial with the connector, are provided in these components for the plug contacts **18** or socket contacts **19**

of the connector. Each hole in the outer plate **12***a* of the body member is counterbored to provide a location for a shoulder **20** formed on the contact. With this construction, damaged contacts may be very easily replaced, while the seal **17** prevents the ingress of moisture to the interior of the connector part through the apertures in the body members.

The body members **12** may, of course, be moulded each from a single piece of insulating material, the contacts being permanently inserted within the body member during the moulding process.

The exposed parts of the plug contact members **18** form contact pins **21**, and those of the socket contact members **19** form sleeve contacts **22**; these parts will be described in more detail with reference to FIG. 4, it being sufficient here to mention that the contact pin **21** is a solid pin while the sleeve **22** is sufficiently thin to be resilient and readily deformable.

A generally circular clamping plate **23** is pivotally secured to the socket part **11** of the connector by means of a screw **24**, both the plate **23** and the screw **24** being moulded in insulating material. The clamping plate has formed in it a series of slots **25**, one for each co-operating contact pair of the connector. The slots **25** are arcuate in form, their side walls being formed by arcs of constant angular length having their centres on the axis of the connector; one end of each slot is closed by a semi-circular portion having the same diameter as the separation of the arcuate slot walls, while the other end of the slot is closed by a part-circular portion of rather greater diameter. This slot formation does not extend for the full depth of the clamping plate **23**, the slots **25** being widened as shown at **26** where they open on to the inner face of the clamping plate **23** to provide a clearance for the contacts. The formation of each of the slots **25** is shown in plan and in cross-section in FIGS. 3*a* and 3*b* respectively.

Since, as will be clear from FIG. 2, the formation of the slots **25** in the clamping plate repeats the formation of the connector contact members, movement of the clamping plate **23** about its central pivot through an angle of about 10 degrees will cause each contact sleeve **22** to move from one end to the other of the associated slot **25**. In the "released" position of the clamping plate **23**, each sleeve contact **22** lies in the enlarged end portion **25***a* of its associated slot, the diameter of this end portion being such as to allow a slight clearance around the contact sleeve and thus to permit the ready insertion or removal of the associated contact pin **21**. When the clamping plate **23** is moved to its "clamped" position, the arcuate side walls of the narrower portion of the slot, which are separated by a distance slightly less than the normal diameter of the contact sleeve **22**, deform the contact sleeve to cause it to grip the contact pin. Since the contact sleeves lie at the extreme end of the narrower portion of the slot **25**, between parallel parts of the slot walls, when the clamping plate **23** has completed its movement to its clamped position, there is no tendency for the clamping plate to return of its own accord to its released position.

The locking action of the clamping plate **23** is assisted by the formation of the contact pins **21** and sleeves **22**. An enlarged view of these components is shown in FIG. 4 of the drawings on a larger scale. The contact members are here shown side by side but in the same relative position as in their normal engaged position.

The contact pin **21** is a solid copper pin of circular cross-section, having a tip portion **27** of constant diameter and a reverse-tapered portion **28** between the tip **27** and the pin root. The sleeve contact **22** is a thin-walled copper sleeve having a pair of diametrically opposed slots

29 running longitudinally from its open end and terminating each in a circular hole 30. As will be seen from FIG. 4, the bottom of each cut 29, formed by the hole 30, is situated when the contact pin and sleeve are in normal engagement at a point well down the constant diameter tip portion 27 of the contact pin. Comparison with FIG. 1 shows that the action of the clamping plate 23 in deforming the contact sleeve 22 consists in bending the upper part of the contact sleeve over the shoulder formed in the contact pin 21 by the conjunction of its constant diameter tip portion 27 and its reverse-tapered portion 28. A positive locking effect is thus achieved.

It will be evident that in addition to its locking function the clamping plate 23 also provides protection for the contact members against inadvertent damage, and particularly protects the thin-walled sleeve contacts 22 against damage when the two parts of the connector are separated. Seals to prevent the ingress of moisture into the space between the body members 12 and the clamping member 23 when the parts of the connector are engaged, are formed by walls 31 of part-circular cross-section, projecting from the face of each body member 12 and completely surrounding the contact area; these walls bear against the adjacent face of the clamping plate 23 to provide a seal. It will be noted that, except for its central boss, which receives the securing screw 24, the face of the clamping plate 23 adjacent to the socket part of the connector is relieved to provide a clearance.

In many applications, it is necessary to provide a mechanical retaining device between the two halves of the connector in addition to that provided by the contact clamping means; for example safety regulations for a particular application may specify that a mechanical retaining device between the halves of the connector should be completely independent of the electrical connections. The connector shown in the drawings is therefore provided with a bayonet-union type retaining device, shown in the general view which forms FIG. 5. A bayonet locking sleeve 32 can revolve about the plug part 10 of the connector, to which it is secured, its skirt projecting beyond the plug part 10 to receive the socket part 11. Four axial slots 33, and corresponding circumferential slots 34, leading out of them, co-operate with the heads of the studs 15 (which lock the body retaining ring 14 of the socket part 11 to its cable sleeve 13) to lock the two parts of the connector together. The axis slots 33 in the locking sleeve extend beyond the corresponding circumferential slots 34 for approximately half the length of the sleeve to receive four corresponding studs 35 projecting radially from the circumference of the clamping plate 23, of which they form integral parts.

The angular motion of the locking sleeve 32 necessary to cause the co-operating studs 15 to pass from the axial slots 33 to their engaged positions at the end of the circumferential slots 34 thus also moves the clamping plate 23 from its "released" to its "clamped" position. A single movement of the locking sleeve 32 thus mechanically locks the two parts of the connector together by virtue of the bayonet-union type retaining device it embodies, and also effects the individual clamping of each co-operating contact pair of the connector through the medium of the clamping plate 23. The simultaneous release of the contacts and of the bayonet union is effected in the same way.

On engagement of the two parts of the connector, the bayonet locking sleeve 32, which is free to rotate on the plug part 10 of the connector, is placed over the socket part 11 with the clamping plate studs 35 passing up its axial slots 33; the engagement of these slots with the co-operating studs 15 on further engagement of the parts ensures that the clamping plate 23 is in its "released" position before engagement of the contact pins and sleeves occurs. It will be seen from FIG. 2 that a completely symmetrical disposition of the contacts is employed, correct location of the two body members 12

of the connector prior to engagement of the contact pins and sleeves being ensured by a pair of locating tabs 36, of different sizes, extending from one connector part to enter corresponding recesses formed in the other part. Engagement of the contact pins and sleeves presents no difficulty, since the clearance afforded by the enlarged ends 25*a* of the locking slots in the clamping plate 23 permits slight movement of the contact sleeves to accommodate the pins.

In a modified version of this connector, the composite construction of the two parts of the connector, involving the assembly of a number of component parts and also involving the use of such devices as moisture seals and cable anchorages, is abandoned in favour of a one piece moulded construction for each part of the connector; each connector part then comprising a solid block of moulded insulating material in which the plug or socket contact members are embedded together with the conductors connected to them. In a construction similar to that shown in the drawings, for example, the clamping plate 23 and the bayonet locking sleeve 32 would be the only removable parts of the connector.

Although the connector shown in the drawings is employed for connecting together the free ends of a pair of multi-core cables, it is evidently equally suitable for connecting such a cable to a piece of apparatus, one part of the connector being then provided with a flange for receiving it to the apparatus.

FIG. 6 of the drawings shows a cross-section through the mating contact pairs of a further form of connector, in which a contact clamping plate 80 is again arranged for limited movement in a direction normal to the axes of the co-operating contact pins and sleeves 81 to effect its clamping and unclamping action. In this version of the connector, however, the clamping plate 80 is arranged for limited rectilinear movement, being a rectangular plate slidably mounted within a rectangular body member 82 of one part of the connector. The pins and sleeves 81 are arranged in three similar rows and the corresponding tapered slots 83 formed in the plate 80 for each contact pair communicate with each other to form three irregular slots running along the length of the plate 80. The plate is slightly longer than the corresponding dimension of the body member 82, so that in either operative position it projects at one side of the body member.

As in the versions previously described, the clamping plate 80 may be arranged to co-operate with, or to form part of, a mechanical locking means for the two parts of the connector.

What I claim as my invention and desire to secure by Letters Patent is:

1. An electrical connector comprising a first connector part having at least one contact pin having a tip portion and a second portion of reduced thickness compared with the tip portion, a second connector part having at least one corresponding hollow contact sleeve engaging over the contact pin and being slotted and inwardly-deformable at least over that portion engaging the reduced-thickness portion of the pin, a clamping member formed with at least one slot having an enlarged portion of a dimension greater than the free dimension of the slotted portion of said sleeve and a narrower portion of a dimension less than said free dimension, said clamping member being movable transversely of said pin and sleeve between a "released" position in which the inwardly-deformable portion of the sleeve co-operates with the enlarged portion of the slot and a "clamped" position in which the inwardly-deformable portion of the sleeve lies within the narrower portion of the slot thereby to be deformed inwardly to grip the reduced-thickness portion of the pin.

2. An electrical connector as claimed in claim 1 comprising pivotal mounting means whereby the clamping member is pivotally mounted on one connector part for

angular movement between its "released" and "clamped" positions.

3. An electrical connector as claimed in claim 2 comprising a slotted locking sleeve rotatably mounted on one connector part, projections on the other connector part co-operating with said locking sleeve, and an operative connection between the locking sleeve and the clamping member, at least when the connector parts are engaged, whereby rotation of the locking sleeve rotates the clamping member between its "released" and "clamped" positions.

4. An electrical connector comprising a first connector part having a plurality of aligned contact pins, each pin having a tip portion and a second portion of reduced thickness compared with the tip portion, a second connector part having a plurality of corresponding aligned hollow contact sleeves each sleeve engaging over a contact pin and each sleeve being slotted at least over that portion engaging the reduced-thickness portion of the pin, a clamping member formed with a plurality of slots, each slot having an enlarged portion of a dimension greater than the free dimension of the slotted portion of said sleeve and a narrower portion of a dimension less than said free dimension, said clamping member being movable transversely of said pins and sleeves between a "released" position in which the slotted portion of the sleeve co-operates with the enlarged portion of the slot and a "clamped" position in which the slotted portion

of the sleeve lies within the narrower portion of the slot thereby to be deformed inwardly to grip the reduced-thickness portion of the pin.

5. An electrical connector as claimed in claim 4 comprising pivotal mounting means whereby the clamping member is pivotally mounted on one connector part for angular movement between its "released" and "clamped" positions.

6. An electrical connector as claimed in claim 5 comprising a slotted locking sleeve rotatably mounted on one connector part, projections on the other connector part co-operating with said locking sleeve, and an operative connection between the locking sleeve and the clamping member, at least when the connector parts are engaged, whereby rotation of the locking sleeve rotates the clamping member between its "released" and "clamped" positions.

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