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**U1S** S2316

(56) Documents Cited
**GB 2264201 A** **EP 0251655 A** **EP 0124987 A**
**EP 0048601 A** **US5171158 A**

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(54) Abstract Title
**Electrical connector**

(57) The female part 3 of an underwater electrical connector 1 has inner and outer chambers 17,19 containing non-conductive fluid. Each chamber 17,19 has an opening sealed by a respective spring loaded ball 53 in the unmated condition of the connector 1 and by a contact pin 7 of the male part in the mated condition of the connector 1. The balls 53 are displaced transversely to the direction of movement of the contact pin 7 to engage the contact socket 5 and automatically re-seal the openings when the contact pin 7 is withdrawn.

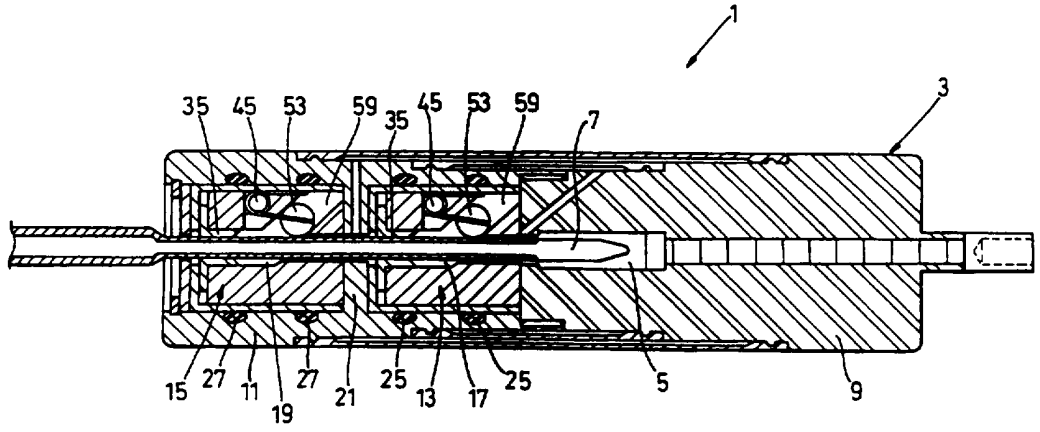


*Fig. 1*

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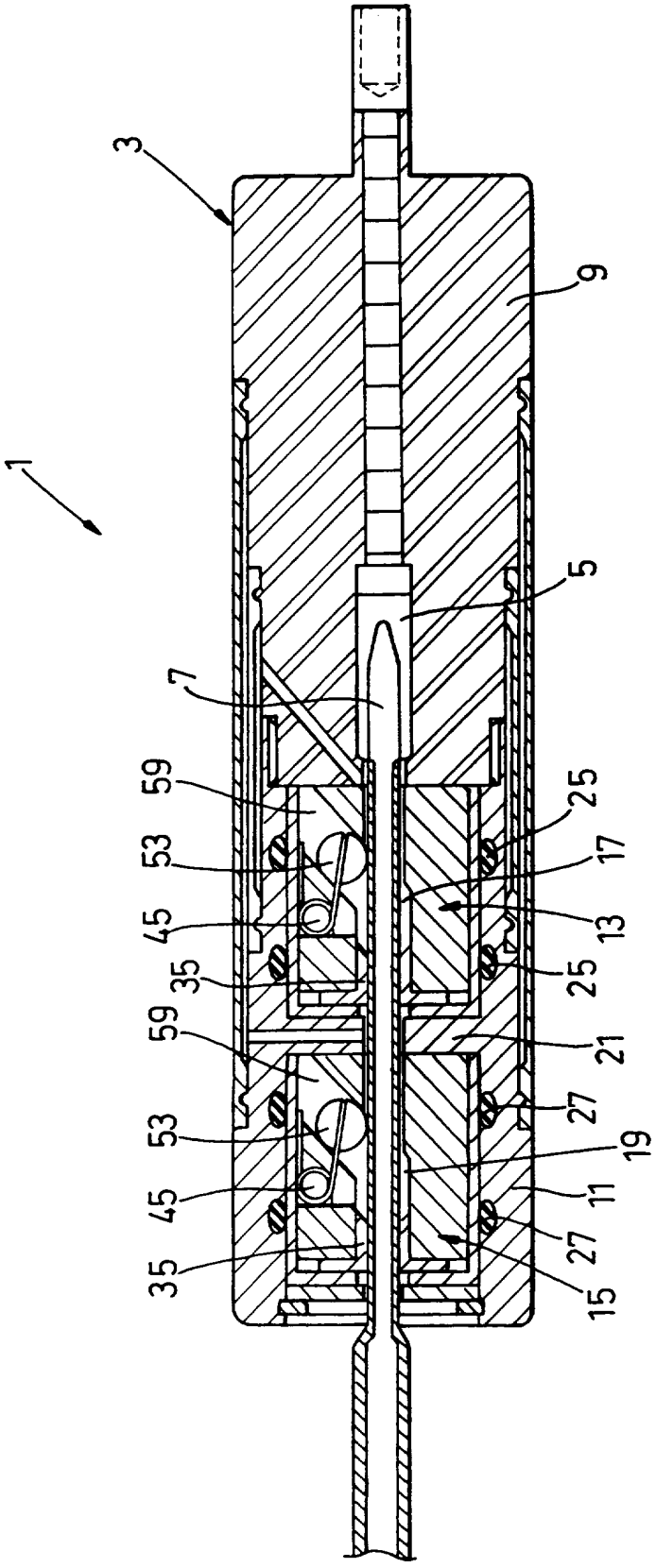


*Fig. 1*

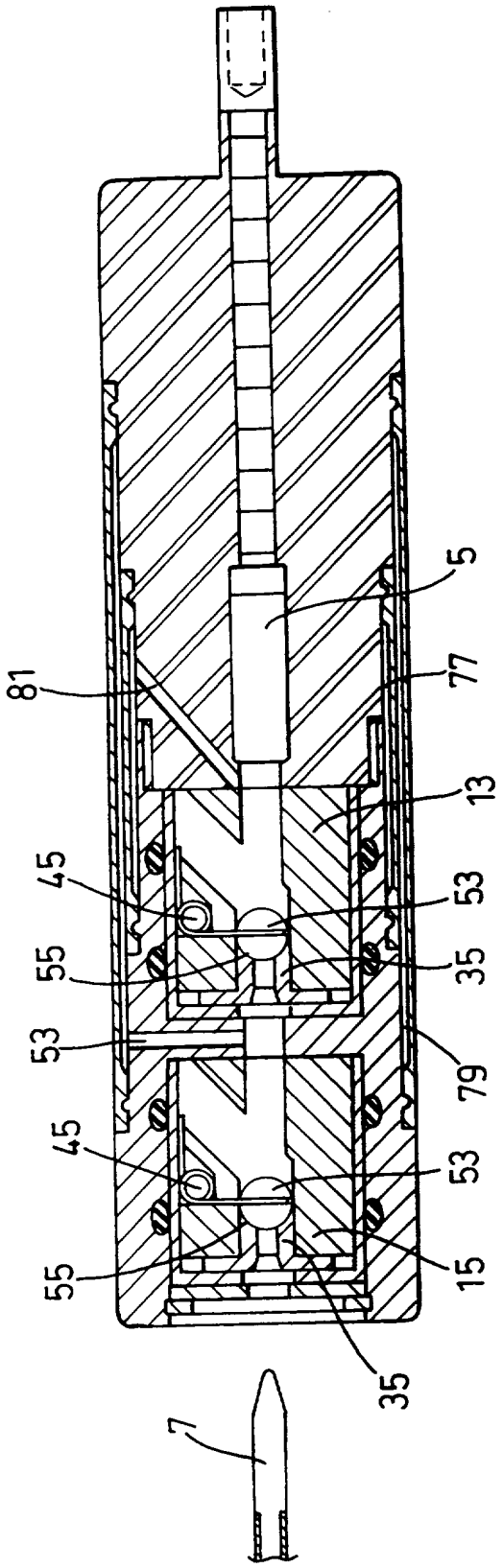


*Fig. 2*

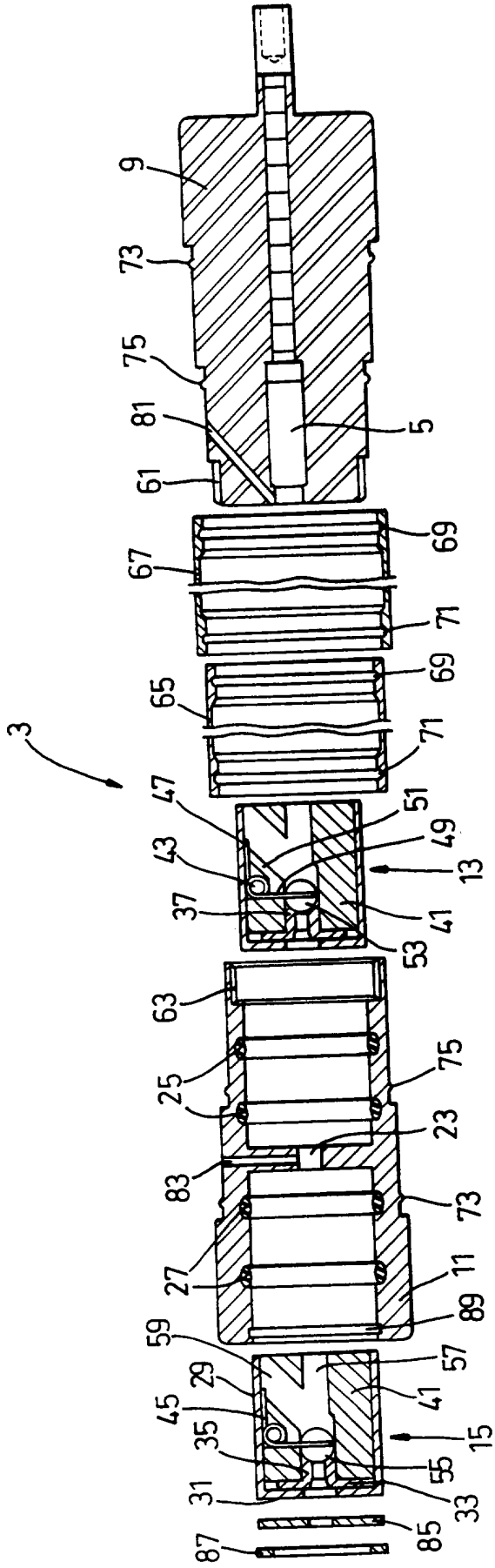
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*Fig. 3*

# ELECTRICAL CONNECTORS

This invention relates to electrical connectors and in particular, though not exclusively, to underwater electrical connectors designed for releasable mating engagement.

Known underwater electrical connectors commonly comprise a male part having at least one contact pin and a female part having at least one contact socket for reception of the contact pin when the male and female parts are brought together.

Usually, the engagement of the contacts is effected in a non-conductive fluid such as oil which isolates the contacts from the surrounding water. Typically, the contact socket is arranged in a chamber containing the fluid and the contact pin extends through and seals an opening into the chamber to prevent escape of the fluid from the chamber and/or penetration of the surrounding water into the chamber in the mated condition of the connector.

In one arrangement, the opening is self-closing to seal the chamber in the unmated condition of the connector. A relatively low force is sufficient to insert the contact pin and engage the contact socket with the result that there is no tendency for the connector to de-mate. However, insertion of the contact pin distorts the opening with the result that sealing efficiency may be reduced on removal of the contact pin. Sealing efficiency may also be adversely affected with temperature, pressure changes in the surrounding water.

In another arrangement, the opening is closed to seal the chamber in the unmated condition of the connector by a slidable, spring loaded piston that is pushed back when the contact pin is inserted to engage the contact

socket. A relatively high force is required to overcome the biasing of the shuttle pin when the contact pin is inserted to engage the contact socket with the result that there is a tendency for the connector to de-mate. Furthermore, although there is less distortion of the opening, wear and abrasion from sliding movement of the shuttle pin can result in a reduction in sealing efficiency.

The present invention is intended to provide an electrical connector of simple construction in which the problems and disadvantages aforementioned are mitigated.

According to the present invention we provide an electrical connector comprising first and second parts, a contact of the first part extending through an opening in the second part when the first and second parts are brought together to engage a contact of the second part in a mated condition of the connector, the opening being closed in an unmated condition of the connector by a resiliently biased member arranged so that, when the first and second parts are brought together, the member is engaged by the contact of the first part during insertion thereof through the opening and is displaced transversely with respect to the direction of movement of the first part to engage the contact of the second part, and non-conductive fluid within the second part.

By this invention, the resilient biasing of the member acts transverse to the direction of movement of the contact pin in the mated condition of the connector. As a result, there is no tendency for the connector to de-mate.

Preferably, the member comprises a ball engageable with a part-spherical seating to close the opening in the unmated condition of the connector. In

this way, the opening is not subject to wear and abrasion from displacement of the ball towards and away from the seating.

Advantageously, the ball is biased to close the opening by a spring, preferably a torsion spring. As a result, the ball automatically closes the opening when the contact pin is withdrawn in the unmated condition of the connector.

In a preferred arrangement, the opening is provided in a chamber containing the non-conductive fluid and is closed in the mated condition of the connector by the contact pin to prevent escape of the fluid.

Preferably, two chambers are provided each containing non-conductive fluid and having axially aligned openings closed by respective resiliently biased members that are displaced transversely by the contact pin when the first and second parts are brought together.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, wherein:-

FIGURE 1 is a longitudinal section showing an electrical connector embodying the invention in the mated condition;

FIGURE 2 is a longitudinal section showing the electrical connector of Figure 1 in the unmated condition; and

FIGURE 3 is an exploded longitudinal section showing the component parts of the female part of the connector shown in Figures 1 and 2.

The electrical connector 1 comprises a female part 3 having a contact socket 5 for reception of a contact pin 7 of a male part (not shown) in the mated condition of the connector 1 shown in Figure 1.

The connector 1 may have more than one pair of mating contacts 5,7 with any suitable means (not shown) for ensuring each pair of mating contacts 5,7 is correctly aligned when the two parts of the connector 1 are brought together.

The contact socket 5 is provided in a rear section 9 of the female part 3 and a front section 11 houses a pair of seal units 13,15 for retaining a dielectric medium within inner and outer chambers 17,19 in the unmated condition of the connector 1 shown in Figure 2.

The seal units 13,15 are slidably received within the front section 11 on opposite sides of a partition wall 21 having a central opening 23 connecting the seal units 13,15 and are sealed within the front section 11 by respective pairs of O-rings 25,27.

Each seal unit 13,15 includes an outer sleeve 29 with an internal flange 31 at one end providing an abutment for an external collar 33 of a bush 35 received in the entry end 37 of a through bore 39 in an insert 41 slidably received in the outer sleeve 29.

Each seal unit 13,15 further includes a torsion spring 43 located in a recess 45 in the outer surface of the insert 41. The spring 43 has a leg 47 at one end secured between the insert 41 and the outer sleeve 29 to prevent rotation of the spring 43 in the recess 45.

A leg 49 at the other end of the spring 43 extends through a slot 51 in the insert 41 and carries a ball 53 of metal or plastics. The ball 53 is biased by the spring 43 to engage a part-spherical seating 55 at the end of the bush 35 in the unmated condition of the connector 1 shown in Figure 2. The ball 53 may be biased by any other suitable means.

An exit end 57 of the through bore 39 is of reduced cross-section smaller than the diameter of the ball 53 and the insert 41 has a transverse bore 59 of similar cross-section to the entry end 37 of the through bore 39. The ball 55 is displaced into the transverse bore 59 by the contact pin 7 in the mated condition of the connector 1 shown in Figure 1.

The front end of the rear section 9 of the female part 3 is a push fit in the rear end of the front section 11 with engagement of respective axial formations 61,63 to prevent relative rotation therebetween.

The two sections 9,11 are axially secured together so that the contact socket 5 is axially aligned with the through bores 39 in the seal units 13,15 and with the opening 23 in the partition wall 21.

Two sleeves 65,67 with internal grooves 69,71 at opposite ends are engageable with external annular ribs 73,75 on the front and rear sections of the female part 3 to form concentric annular pressure balancing chambers 77,79.

The annular chamber 77 communicates with the inner chamber 13 via an angled bore 81 in the rear section 9 of the female part 3 and the annular chamber 79 communicates with the outer chamber 15 via a radial bore 83 in the front section 11.

The seal unit 13 of the inner chamber 17 is located and retained in the front section 9 when the front and rear sections 9,11 are connected together. The seal unit 15 of the outer chamber 19 is located and retained in the front section 9 by a washer 85 secured by a circlip 87 received in an internal annular groove 89.

In the unmated condition of the connector 1 shown in Figure 2, the ball 53 of each seal unit 13,15 co-operates with the seating 55 of the bush 35 under the biasing of the torsion spring 43 to seal the chambers 17,19.

In the mated condition of the connector 1 shown in Figure 1, the ball 53 of each seal unit 13,15 is displaced by the contact pin 7 against the biasing of the torsion spring 43 into the transverse bore 59 and the contact pin 7 extends through the bush 35 of each seal unit 13,15 to seal the chambers 17,19.

In this way, dielectric medium is prevented from escaping and water is prevented from entering the chambers 17,19 in both the mated and unmated conditions of the connector 1.

When the male and female parts of the connector 1 are brought together to make an electrical connection, the contact pin 7 penetrates and seals the outer chamber 19 followed by the inner chamber 17 before engaging the contact socket 5.

The reverse sequence occurs when the male and female parts of the connector 1 are taken apart with each chamber 17,19 being automatically re-sealed by engagement of the ball 53 with the seating 55 of the bush 35 under the biasing of the spring 43 when the contact pin 7 is withdrawn through the bush 35.

As will be appreciated, by displacing the ball 53 of each seal unit 13,15 transversely with respect to the direction of movement of the contact pin 7, there is no axial spring force acting on the contact pin 7 in the mated condition. As a result, insertion of the contact pin 7 is facilitated and there is no tendency for the connector to de-mate.

Furthermore, such transverse displacement avoids the problems of wear and abrasion caused by axial displacement of a shuttle pin in the prior art connectors and enables the overall length of the connector to be reduced.

In the above described connector 1, engagement of the contact pin 7 with the contact socket 5 is protected by a pair of seal units. It will be appreciated however that the number of seal units may be increased or decreased to suit any particular requirements.

Claims:

1. An electrical connector comprises first and second parts, a contact of the first part extending through an opening in the second part when the first and second parts are brought together to engage a contact of the second part in a mated condition of the connector, the opening being closed in an unmated condition of the connector by a resiliently biased member arranged so that, when the first and second parts are brought together, the member is engaged by the contact of the first part during insertion thereof through the opening and is displaced transversely with respect to the direction of movement of the first part to engage the contact of the second part, and non-conductive fluid within the second part.

2. An electrical connector according to Claim 1 wherein the member comprises a ball resiliently biased to close the opening in the unmated condition of the connector.

3. An electrical connector according to Claim 2 wherein the ball is biased to close the opening by a spring.

4. An electrical connector according to Claim 3 wherein the spring is a torsion spring.

5. An electrical connector according to any one of Claims 2 to 4 wherein the opening is provided with a part-spherical seating engaged by the ball in the unmated condition of the connector.

6. An electrical connector according to any one of Claims 2 to 5 wherein the contact of the first part comprises a pin and the contact of the second part comprises a socket.

7. An electrical connector according to Claim 6 wherein the ball is displaced by insertion of the pin through the opening to engage the socket in the mated condition of the connector.

8. An electrical connector according to Claim 7 wherein a plurality of axially aligned openings are provided for insertion of the pin with each opening being closed by a respective ball in the unmated condition of the connector.

9. An electrical connector according to Claim 8 wherein the socket is arranged inwardly of the innermost opening.

10. An electrical connector substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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**Claims searched:** 1-10

**Examiner:** A J Rudge
**Date of search:** 21 July 1998

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H2E(EFBD)

Int Cl (Ed.6): H01R

Other: ONLINE - WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| Z | GB 2 264 201 A | (Swift) - eg claim 1 | 1 at least |
| Y | EP 0 251 655 A1 | (Tronic) - see abstract | " |
| Y | EP 0 124 987 A2 | (Cairns) - see abstract | " |
| Y | EP 0 048 601 A2 | (Cairns) - eg page 4, lines 25 et seq | " |
| X | US 5,171,158 | (Cairns) - eg col.2, ll49-58 | " |

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|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
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