(51) International Patent Classification 7:
F16L 37/32, B67D 3/00

(21) International Application Number: PCT/NL00/00303

(22) International Filing Date: 10 May 2000 (10.05.00)

(30) Priority Data:
1012020 10 May 1999 (10.05.99) NL

(71)(72) Applicant and Inventor: VLASBLOM, Casparus [NL/NL]; Blauw-roodiam 98, NL-2718 SJ Zoetermeer (NL).

(74) Agent: JORRITSMAN, Ruurd; Nederlandsch Octrooibureau, Scheveningsweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).

(31) Data Entry: The Hague (NL).


(54) Title: CONNECTOR ASSEMBLY AND METHOD OF MANUFACTURE

(57) Abstract

A connector assembly for optionally allowing a free-flowing medium to pass through comprises: a hollow female element (1) with a transverse closure wall (9) and passage openings (11) which are formed in the side wall, a male element (3) which can be inserted into the female element (1) and can be coupled thereto, an adapter socket (5), inside which the female element (1) can be displaced in the axial direction between a position in which it closes off the flow of medium and in which the passage openings (11) are closed off by the adapter socket (5), and a position in which it allows medium to flow through and in which the passage openings (11) are not closed off by the adapter socket (5). The female element (1) is provided, at a distance from the transverse closure wall (9), with connecting means (17) which can form a connection with connecting means (55) arranged on the male element (3) and/or the coupling piece (7) which is coupled thereto. As a result of actuating the male element (3) and/or the coupling piece (7) which is coupled thereto, the female element (1) can be displaced between the abovementioned position in which it closes off the flow of medium and the abovementioned position in which it allows medium to flow through, in which latter position the connecting means (17, 55) of the female element (1) are accommodated in a relatively narrow cavity (28) in the adapter socket (5), so as to form a connection to the male element (3) and/or the coupling piece (7) which is coupled thereto, while in the abovementioned position in which the flow of medium is closed off, the said connecting means (17, 55) are accommodated in a relatively wide cavity (32) in the adapter socket (5), with the result that the connection between the female element (1) and the male element (3) and/or the coupling piece (7) which is coupled thereto can be broken. While the coupling between the female element (1) and the male element (3) and/or the coupling piece (7) which is coupled thereto is being brought about, the said connecting means (17, 55) are situated in the said wide cavity (32) in the adapter socket (5), in a clear space therein.

![Diagram of connector assembly](image)
## FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

<table>
<thead>
<tr>
<th>AL</th>
<th>Albania</th>
<th>ES</th>
<th>Spain</th>
<th>LS</th>
<th>Lesotho</th>
<th>SI</th>
<th>Slovenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>Armenia</td>
<td>FI</td>
<td>Finland</td>
<td>LT</td>
<td>Lithuania</td>
<td>SK</td>
<td>Slovakia</td>
</tr>
<tr>
<td>AT</td>
<td>Austria</td>
<td>FR</td>
<td>France</td>
<td>LU</td>
<td>Luxembourg</td>
<td>SN</td>
<td>Senegal</td>
</tr>
<tr>
<td>AU</td>
<td>Australia</td>
<td>GA</td>
<td>Gabon</td>
<td>LV</td>
<td>Latvia</td>
<td>SZ</td>
<td>Swaziland</td>
</tr>
<tr>
<td>AZ</td>
<td>Azerbaijan</td>
<td>GB</td>
<td>United Kingdom</td>
<td>MC</td>
<td>Monaco</td>
<td>TD</td>
<td>Chad</td>
</tr>
<tr>
<td>BA</td>
<td>Bosnia and Herzegovina</td>
<td>GE</td>
<td>Georgia</td>
<td>MD</td>
<td>Republic of Moldova</td>
<td>TG</td>
<td>Togo</td>
</tr>
<tr>
<td>BB</td>
<td>Barbados</td>
<td>GH</td>
<td>Ghana</td>
<td>MG</td>
<td>Madagascar</td>
<td>TJ</td>
<td>Tajikistan</td>
</tr>
<tr>
<td>BE</td>
<td>Belgium</td>
<td>GN</td>
<td>Guinea</td>
<td>MK</td>
<td>The former Yugoslav Republic of Macedonia</td>
<td>TM</td>
<td>Turkmenistan</td>
</tr>
<tr>
<td>BF</td>
<td>Burkina Faso</td>
<td>GR</td>
<td>Greece</td>
<td>ML</td>
<td>Mali</td>
<td>TR</td>
<td>Turkey</td>
</tr>
<tr>
<td>BG</td>
<td>Bulgaria</td>
<td>HU</td>
<td>Hungary</td>
<td>MN</td>
<td>Mongolia</td>
<td>TT</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>BJ</td>
<td>Benin</td>
<td>IE</td>
<td>Ireland</td>
<td>MR</td>
<td>Mauritania</td>
<td>UA</td>
<td>Ukraine</td>
</tr>
<tr>
<td>BR</td>
<td>Brazil</td>
<td>IL</td>
<td>Israel</td>
<td>MW</td>
<td>Malawi</td>
<td>UG</td>
<td>Uganda</td>
</tr>
<tr>
<td>BY</td>
<td>Belarus</td>
<td>IS</td>
<td>Iceland</td>
<td>MX</td>
<td>Mexico</td>
<td>US</td>
<td>United States of America</td>
</tr>
<tr>
<td>CA</td>
<td>Canada</td>
<td>IT</td>
<td>Italy</td>
<td>NE</td>
<td>Niger</td>
<td>UZ</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>CF</td>
<td>Central African Republic</td>
<td>JP</td>
<td>Japan</td>
<td>NL</td>
<td>Netherlands</td>
<td>VN</td>
<td>Viet Nam</td>
</tr>
<tr>
<td>CG</td>
<td>Congo</td>
<td>KE</td>
<td>Kenya</td>
<td>NO</td>
<td>Norway</td>
<td>YU</td>
<td>Yugoslavia</td>
</tr>
<tr>
<td>CH</td>
<td>Switzerland</td>
<td>KG</td>
<td>Kyrgyzstan</td>
<td>NZ</td>
<td>New Zealand</td>
<td>ZW</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td>CI</td>
<td>Côte d’Ivoire</td>
<td>KP</td>
<td>Democratic People’s Republic of Korea</td>
<td>PL</td>
<td>Poland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CM</td>
<td>Cameroon</td>
<td>KR</td>
<td>Republic of Korea</td>
<td>PT</td>
<td>Portugal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN</td>
<td>China</td>
<td>KZ</td>
<td>Kazakhstan</td>
<td>RO</td>
<td>Romania</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CU</td>
<td>Cuba</td>
<td>LC</td>
<td>Saint Lucia</td>
<td>RU</td>
<td>Russian Federation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>Czech Republic</td>
<td>LI</td>
<td>Liechtenstein</td>
<td>SD</td>
<td>Sudan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE</td>
<td>Germany</td>
<td>LK</td>
<td>Sri Lanka</td>
<td>SE</td>
<td>Sweden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DK</td>
<td>Denmark</td>
<td>LR</td>
<td>Liberia</td>
<td>SG</td>
<td>Singapore</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The invention relates to a connector assembly for optionally allowing a free-flowing
medium to pass through or blocking this flow, comprising a hollow female element with a
transverse closure wall and passage openings which are formed in the side wall, a male
element which is optionally of hollow design, in which case it is provided with passage
openings in the vicinity of its insert end and can be fitted axially into the female element so
as to form a seal, and an adapter socket, inside which the female element can be displaced
axially in a sealed manner. At a distance from the said transverse closure wall, the female
element is provided with projecting connecting means which can form a connection with
connecting means on the male element or a coupling piece which is connected thereto.
When the male element is fitted axially into the female element, the female element can be
pushed at least sufficiently far out of the adapter socket for the said passage openings to lie
outside the adapter socket, allowing medium to pass through. In this position, in which
medium is allowed to flow through, the connection between the male and female elements
is also enclosed between the adapter socket and the male element in such a manner that it
cannot be broken. From this through-flow position, the female element, which is coupled to
the male element by means of the said projecting parts, can be retracted from this through-
flow position by means of the male element, into and beyond a position in which the inner
surface of the adapter socket widens and the said coupling between the male and female
elements is broken.

A connector assembly of this nature is known from American patent 4,445,551.
However, the drawback of the assembly described in this patent is that the elastic properties
of the material of the assembly are crucial for it to function. In this connector assembly, the
coupling between the male and female elements is brought about by the fact that outwardly
projecting coupling means are moved radially inwards, by means of a stop on the adapter
socket, when the female element is pushed out of the adapter socket. Consequently, the
connecting means are in a deformed state when the male and female elements are coupled
to one another. During uncoupling, the coupling means have to spring back outwards as a
result of the memory effect of the material in order to release the male element again. It will
be obvious that after a certain time the memory effect of the material in question tails off
and the action of the assembly is no longer ensured. This problem is exacerbated by the fact
that the coupling means, in the position in which medium is allowed to flow through, are
clamped in between the male and female elements. Consequently, these coupling means
may be in the deformed state for a prolonged period, which has an adverse effect on the
memory effect of the material. Another drawback of this is that the coupling means cannot
be of circular symmetrical design.

The object of the present invention is to eliminate these drawbacks by providing a
connector assembly in which the connecting means which connect the male and female
parts are in a substantially undeformed state both in the through-flow position and in the closed position. This ensures that the material from which the assembly is made is subjected to considerably lower loads. Moreover, the elastic properties of the material are of less importance for an assembly according to the present invention, which is of benefit to the service life.

According to the invention, to this end the connector assembly is characterized in that while the coupling between the female element and the male element and/or the coupling piece which is coupled thereto is being brought about, the said connecting means are situated in the said wide cavity in the adapter socket, in a clear space therein.

In a preferred embodiment, the female element is designed in such a way that it is substantially undeformed when it is at least partially accommodated in the adapter socket. This applies to any position of the female element in the adapter socket, in particular including when the female element and the male element are coupled to one another.

Furthermore, it is preferable for the female element to be provided with means which limit the movement of the female element inside the adapter socket, and for these means, and also the connecting means, to be situated on the side of the passage openings which is remote from the end wall. Consequently, the movement which the female element has to make in order to open the passage openings can be relatively small. This has the advantage that the space which is required in the packaging in order to open the passage openings remains limited. Another advantage is that the female element can be of compact design, so that it is possible to save on material.

It is also preferable for the connector assembly to be designed in such a way that, when the said connection between the female element and the male element is being formed, the position of the female element and the adapter socket with respect to one another does not change in the axial direction. This has the advantage that less force is required for coupling: it is only necessary to bring about the coupling between the male element and the female element, while the friction caused by the sealing of the passage openings does not have to be overcome.

In the basic embodiment, the connecting means of the female element are at least inwardly projecting means which can engage on a stop face on the male element. This embodiment will be explained in more detail during the description of the figures.

A further drawback of the connector assembly as described in the abovementioned American patent is that it is possible for medium to flow through the passage openings in the male element when the male element has been completely uncoupled from the female element. This may be highly undesirable. Therefore, a further object of the present invention is to provide a connector assembly in which flow through the male element is impossible when the male element is not in the through-flow position.
This object is achieved by the fact that, in a particular embodiment, the male element is accommodated, optionally moveably, in a coupling piece, and that the coupling piece, in a starting position, seals off the passage openings in the male element, whereas when the connector assembly is in the position in which medium is allowed to flow through, this is not the case.

In one embodiment, the coupling piece and the female element are provided with means which can be made to interact with one another in order to fix them with respect to one another, the coupling piece and the male element also being provided with means which can be made to interact with one another in order to enable the male element and the coupling piece to be fixed in a first position with respect to one another.

Appropriate selection of the type and strength of the connection between the male element, female element and the coupling piece ensures that, when the assembly is being coupled and uncoupled, the coupling piece firstly provides the connection between the female element and the male element and secondly ensures that flow through the male element is only possible in the position in which medium is allowed to flow through. This functionality is achieved by means of the measures described in Claims 9 to 14.

An embodiment of a connector assembly of this nature, and also the way in which it functions, are described in detail in the description of the figures.

One particular function of an embodiment with the coupling piece may be that when the said openings in the female element are moved into the closed position by simply pulling on the coupling piece, the connection between the male element and the female element remains enclosed between the adapter socket and the male element and is only released when the male element is pulled out of the female element.

Another embodiment is characterized in that the male element executes a free travel with respect to the female element, between the position in which medium is allowed to flow through and the position in which the flow of medium is closed off, without the said coupling between the female element and the male element and/or the coupling piece which is coupled thereto being broken. If the passage openings in the male and/or female element are also provided with non-return valves, a pump function is given to the connector assembly.

The invention also relates to a method for producing a combination of the female element and the adapter socket of the connector assembly according to the invention by injection moulding.

It is intended that it should be possible to produce the female element and the adapter socket in a joint operation by injection moulding. In this case, the method is characterized in that the female element and the adapter socket are produced simultaneously in line with one another in one mould cavity. In this case, the mould cavity is formed by a number of mould parts and is divided in such a way that, after a number of mould parts have been
moved, the female element is pulled into the adapter socket by a mould part which, during the injection moulding, is releasably connected to the female element. An appropriate selection of the mould parts allows the female element to function as an injection-moulding shield for the adapter socket. This ensures that the female element and the adapter socket are moulded symmetrically, which is advantageous since it is possible to counteract undesirable deformation of the product caused by non-uniform shrinkage. Furthermore, partial seams are prevented from forming on the sealing surfaces, so that the corresponding seals have a better action and can therefore withstand higher pressures.

The combination of the male element and coupling piece could also be produced in a similar way in a joint operation.

The invention will now be explained with reference to the figures, which show two exemplary embodiments of connector assemblies according to the present invention. The figures also show an example of the injection mould for production of a female element and an adapter socket.

Figure 1 shows a longitudinal section through the four separate components of the connector assembly according to the invention, with the male element provided with a coupling piece.

Figures 2 to 6 show the connector assembly from Figure 1 during its movement from the position in which it closes off the flow of medium into the position in which it allows medium to flow through.

Figures 7 to 9 show the connector assembly from Figure 1 when it is moving from the position in which medium is allowed to flow through into the position in which the flow of medium is closed off.

Figures 10 to 13 show a cross section through part of an injection mould in various positions during the simultaneous production of the female element and the adapter socket. Figure 14 shows a perspective, cross-sectional view of the components of another embodiment according to the present invention.

Figures 15 to 17 show the positions of the components of the connector assembly according to the present invention during coupling.

The connector assembly comprises a closure assembly 2 and an opening assembly 4, cf. Figure 2. The closure assembly 2 comprises a female element 1, in the form of a cap, and an adapter socket 5 in which the said female element 1 is slideably accommodated. The opening assembly 4 comprises a tubular male element 3 and a coupling piece 7 in which the said male element 3 is slideably positioned. In Figure 1, the four components of the assembly are shown separately and the various details are denoted by reference numerals.
Figure 2 shows how elements are positioned with respect to one another in the starting situation. The female element 1 is accommodated in the adapter socket 5 in order to form the closure assembly 2. The male element 3 together with the coupling piece 7 forms the opening assembly 4.

The female element 1 comprises an end wall 9 and four openings 11 which are arranged cylindrically near the said end wall 9. Furthermore, the female element is provided with a stop face 13, a locking protrusion 15, a stop rib 17, a stop face 19, an end stop face 21 and a conical entry surface 23.

The adapter socket 5 is provided with a part 25 which can be attached to a packaging or belongs to a packaging, a conical surface 27 and a stop face 29 with a bevelled end face 30. The adapter socket 5 further comprises a narrow socket-like section 28 which is delimited by an inner wall 26.

In the starting situation, as shown in Figure 2, the female element 1 is positioned in the adapter socket 5, so that the conical face 27 of the adapter socket 5 bears against the face 13 of the female element 1. The locking protrusion 15 bears against the bevelled end face 30 and, together with the stop 13 and the conical surface 27, forms a connection 13, 15, 27, 30 which ensures that the female element 1 is situated in the desired, fixed starting position with respect to the adapter socket 5, cf. Figure 2. In this situation, the cylindrical holes 11 in the female element 1 are sealed by the socket wall 24 of the adapter 5.

The male element 3 comprises an end wall 31, openings 33 formed in the cylindrical wall 34, a first recess 35 in the outside of the cylindrical wall 34 and a second recess 39 in the cylindrical wall 34.

The coupling piece 7 comprises a stop face 43, a conical widening surface 45, a run-on surface 53, an enclosing stop 57, an inner wall 59, a first locking protrusion 51 and a second connecting protrusion 55.

In the starting situation shown in Figure 2, the male element 3 is partially accommodated in the coupling piece 7. They are held in position with respect to one another by the fact that the first locking protrusion 51 on the coupling piece 7 fits into the first recess 35 in the male element 3 to form a connection 35, 51. In the starting situation, the openings 33 are closed off by the inner wall 59 of the coupling piece 7. In this situation, it is impossible for medium to flow either through the closing assembly 2 or the opening assembly 4.

When the closing assembly and the opening assembly are coupled, the opening assembly is fitted into the closing assembly 2, as denoted overall by the arrow A, cf. Figures 2 and 3. In the process, a force is exerted on the adapter socket 2 on the one hand and on the male element 3 or the coupling piece 7 on the other hand. The steps which are involved in the coupling operation are shown in Figures 2 to 6.
During coupling, the run-on surface 53 of the coupling piece 7 will centre itself around the conical surface 23 of the female element 1, as shown in Figure 3. When the opening assembly 4 is pushed further into the closing assembly 2, the second connecting protrusion 55 will latch over the stop rib 17 of the female element 1, forming a connection 17, 55. This is shown in Figure 4. Since the connection 17, 55 exerts a force which is directed in the direction of insertion on the coupling piece 7, the stop face 43 and the end face 21 are pulled together. Consequently, as the openings 33 slide along the seam, it is impossible for any free-flowing medium to leak out of the male element 3 into the passage 32 in the adapter socket 5.

To form the connection 17, 55 in this way, it is necessary for the connection 35, 51 between the male element 3 and the coupling piece 7 to be able to absorb a greater force than that which is required to form the connection 17, 55. If this were not the case, the male element 3 would slide inside the female element 1 before the connection 17, 55 has been formed and therefore without the closing and opening assemblies having been coupled to one another.

Since the stop face 43 of the coupling piece 7 then bears against the female element 1, the force exerted on the male element 3 is transmitted directly to the female element 1. Since the connection 13, 15, 27, 30 can absorb a greater force than the connection 35, 51, the latter will be broken. Consequently, the male element 3 slides into the female element 1 until its end wall 31 bears against the inside of the end wall 9 of the female element 1, cf. Figure 5. However, before the male element 3 reaches this limit position, the first locking protrusion 51 on the coupling piece 7 is moved into the second recess 39 in the male element 3, with the result that a new connection 39, 51 is formed between the male element 3 and the coupling piece 7. To achieve this, it is necessary for the connection 13, 15, 27, 30 to be able to apply a force which is great enough to produce the connection 39, 51. When the male element 3 is in its position in which it has penetrated as far inwards as possible, openings 33 in the male element 3 and the openings 11 in the female element 1 are aligned with one another.

As a result of the male element 3 then being moved further into the female element 1, the connection 13, 15, 27, 30 between the female element 1 and the adapter socket 5 will be broken. This is the only connection which is subjected to load, since the end face 31 of the male element 3 is supported against the end wall of the female element 1, as can be seen in Figure 6. As a result, the female element 1, with the male element 3 which has been pushed into it, will slide out of the adapter socket 5 until the stop 19 bears against the stop face 29 and the aligned holes 11 and 33 open out freely into the packaging of which part 25 forms part (cf. Figure 6). It is now possible for medium to flow out of the male element 3, through the openings 33 which are formed therein, through the aligned openings 11 in the female element, into the packaging, and also in the reverse direction. The friction between the
enclosing stop 57 of the coupling piece 7 and the inner surface 26 of the adapter socket 5 ensures that the female element 1 does not slide back into the adapter socket 5. To increase this frictional force, an additional snap-action connection may be fitted.

During uncoupling, the opening assembly 4 is pulled out of the closing assembly 2, in the direction of arrow B, by on the one hand pulling on the male element 3 and on the other hand holding the adapter socket in place, cf. Figure 6. In the process, the same steps as for coupling are passed through, but in the reverse order. These steps are shown in Figures 6 to 9.

Since connection 17, 55, in the position in which it has been introduced to the greatest depth, is clamped in between the outer surface 34 of the male element 3 and the inner wall 26 of the narrow socket-like section 28 of the adapter socket 5, this connection 17, 55 cannot be broken. This is shown in Figure 6. This connection 17, 55 can only be broken when the enclosing stop 57 on the coupling piece 7 is pulled past the narrow socket-like section 28. To enable the female element 1 to be pulled back into the adapter socket 5 before the male element 3 is pulled out of the female element 1, the force which the connection 39, 51 is able to absorb must be greater than the force which is required to produce the connection 13, 15, 27, 30. This state is shown in Figure 7.

Since it is not possible to pull the female element 1 further into the adapter socket 5, either connection 17, 55 or connection 39, 51 will be broken. Making connection 17, 55 stronger than connection 39, 51 ensures that the male element 3 is pulled back into the coupling piece 7 first, as shown in Figure 8. Moreover, connection 17, 55 is strong enough to bring about connection 35, 51. To break connection 35, 51 again, more force is required than that needed to break connection 17, 55, and consequently the latter will then be broken and the closing-opening element will be fully uncoupled. This is shown in Figure 9.

In one embodiment, it is ensured that, during uncoupling, if it is not the male element 3, but rather the coupling piece 7, which is pulled, the aligned openings 11, 33 are pulled back into the adapter socket 5. Since, in this embodiment, the connection 17, 55 remains clamped between the outer surface 34 of the male element 3 and the inner wall 26 of the adapter socket 5, the closing assembly 2 and the opening assembly 4 will remain coupled to one another via the coupling piece 7. Only when the male element 3 is pulled out of the female element 1 is the connection 17, 55 no longer enclosed and the two members can be uncoupled.

By allowing the connector assembly, after the male element and the female element have been coupled, to execute a free movement between the position in which the flow of medium is closed off and the position in which medium is allowed to flow through, and providing the openings 11 in the female element 1 with non-return valves, it is possible to obtain a pumping action. In this way, the liquid, for example, in the packaging can be pressurized by pulling the male element 3 back and forth. This may be useful in order to
remove a liquid from a packaging. By providing the male element 3 with non-return valves it is possible, for example, to place the packaging under a slight vacuum.

Figures 10 to 12 diagrammatically illustrate how the closing assembly 2 can be produced in an advantageous way. As stated previously, the female element 1 is used as an injection-moulding screen for the adapter socket 5, cf. Figure 10. The female element 1 is injected via the gate 60, and via an integral hinge 61 the material can also reach the adapter socket 5. Since both components of the closing assembly 2 are now produced in a single mould cavity, it is possible, by appropriately selecting the mould parts, to assemble the closure piece as soon as it is removed from the mould. To this end, the mould is split, as shown in Figure 10. A further advantage of this mould splitting is that there is no partial seam formed on the closure surface 12 of the female element 1. By selecting that part of the sealing surface 12 which is formed in mould part I to be as large as possible, it is possible to make the seal between the female element 1 and the adapter socket 5 more reliable.

After injection-moulding and solidification, first mould parts I, II and III are moved away, as shown in Figure 11. By then moving mould part V away from the mould cavity, the female element 1 is pulled into the adapter socket 5, and the membrane 61 between the female element 1 and the adapter socket 5 is broken. This is shown in Figure 12. Since the female element then cannot be pulled along any further, since it does not fit through the opening in the adapter socket 5, the mould part V is pulled off and the closure assembly 2 has been assembled and can be removed from the mould, as shown in Figure 13.

Another embodiment of the connector assembly, without coupling piece 7, is shown in Figures 14 to 17. In Figure 14, the three components of this embodiment are shown: the female element 1, the male element 3 and the adapter socket 5.

The female element 1 is a cap-like housing with an end wall 9 on one side. In the vicinity of this end wall 9 there is a sealing surface 12 which is provided with passage openings 11 and is delimited on one side by a stop face 13. On the other side, the female element 1 is provided with a connecting protrusion 17 and an enclosing stop 19.

The adapter socket 5 is a socket-like housing in which the female element 1 can be accommodated. The inner wall of the housing is provided with a section of small diameter 26, a stop protrusion 29 and a conical surface 27.

The male element 3 is a tubular housing with an insertion end 72 and a stop face 73 which, on one side, is delimited by a connecting surface 55. In the vicinity of the insertion end 72, the male element 3 is provided with passage openings 33.

The starting situation is shown in Figure 15. In this situation, the female element 1 rests in the adapter socket 5, together forming the closing assembly 2, while the male element, which forms the opener 4, is completely uncoupled. In this situation, the surfaces 13 and 27 of the female element 1 and the adapter socket 5, respectively, bear against one
another and the passage openings 11 in the female element 1 are sealed shut by the socket-like wall 24.

As a result of the male element 3 being fitted into the female element 1, the connecting protrusion 17 on the female element 1 engages behind the connecting surface 55 on the male element 3, resulting in a connection (17, 55), cf. Figure 16. In this situation, the passage openings 11, 33 in the female element 1 and male element 3 are aligned, but through-flow is not yet possible. The sealing surface 12 of the female element 1 and the socket-like wall 24 of the adapter socket 5 form a seal. This seal can be improved further by additional sealing means, for example a snap-action connection.

When the male element 3 is then pushed further into the adapter socket 5, the female element 1, together with the male element 3, will move out of the adapter socket 5, and the passage openings 11, 33 are exposed, cf. Figure 17. The stop protrusion 29 and enclosing stop 19 prevent the female element 1 from being able to move completely out of the adapter socket 5. It is essential for the overlap between the inner wall of the socket-like section 24 of the adapter socket 5 and the sealing surface 12 of the female element 1 to ensure a sufficient seal, so that it is impossible for any medium to flow through between the female element 1 and the adapter socket 5.

When the male element 3 is pulled back out of the adapter socket 5, the connection 17, 55 between the female element 1 and the male element 3 cannot be broken, since the locking protrusion 17 cannot bend outwards, because the enclosing stop 57 is resting against the inner wall of the section of the adapter socket 5 with the small diameter 26. This ensures that the connection 17, 55 can only be broken when the enclosing protrusion 19 has moved past the section with the small diameter 26 and therefore the female element 1 has returned completely to the starting position, cf. Figure 16.

By pulling on the male element 3 in the situation shown in Figure 16, it is possible to break the connection 17, 55 and the male element 3 can be uncoupled. In this way, the starting situation shown in Figure 15 is reached once again.
1. Connector assembly for optionally allowing a free-flowing medium to pass through, comprising:
   a hollow female element (1) with a transverse closure wall (9) and passage openings (11) which are formed in the side wall,
   a male element (3) which can be inserted into the female element (1) and can be coupled thereto,
   an adapter socket (5), inside which the female element (1) can be displaced in the axial direction between a position in which it closes off the flow of medium and in which the passage openings (11) are closed off by the adapter socket (5), and a position in which it allows medium to flow through and in which the passage openings (11) are not closed off by the adapter socket (5), in which assembly the female element (1) is provided, at a distance from the transverse closure wall (9), with connecting means (17) which can form a connection with connecting means (55) arranged on the male element (3) and/or a coupling piece (7) which is coupled thereto, and in which assembly, as a result of actuation of the male element (3) and/or the coupling piece (7) which is coupled thereto, the female element (1) can be displaced between the abovementioned position in which it closes off the flow of medium and the abovementioned position in which it allows medium to flow through, in which latter position the connecting means (17, 55) of the female element (1) are accommodated in a relatively narrow cavity (28) in the adapter socket (5), so as to form a connection to the male element (3) and/or the coupling piece (7) which is coupled thereto, while in the abovementioned position in which the flow of medium is closed off, the said connecting means (17, 55) are accommodated in a relatively wide cavity (32) in the adapter socket (5), with the result that the connection between the female element (1) and the male element (3) and/or the coupling piece (7) which is coupled thereto can be broken, characterized in that, while the coupling between the female element (1) and the male element (3) and/or the coupling piece (7) which is coupled thereto is being brought about, the said connecting means (17, 55) are situated in the said wide cavity (32) in the adapter socket (5), in a clear space therein.

2. Connector assembly according to Claim 1, characterized in that, in a position in which medium is allowed to flow through, the said connecting means (17, 55) in the relatively narrow cavity (28) in the adapter socket (5) are substantially not elastically deformed.

3. Connector assembly according to Claim 1 or 2, characterized in that the female element (1) is provided with means (13, 19) which limit the movement of the female element (1) inside the adapter socket (5), and in that these means (13, 19), and also the
connecting means (17), are situated on the side of the passage openings (11) which is remote from the end wall (9).

4. Connector assembly according to Claim 1, 2 or 3, characterized in that, when the said connection between the female element (1) and the male element (3) and/or the coupling piece (7) which is coupled thereto is being formed, the position of the female element (1) with respect to the adapter socket (5) does not change in the axial direction, under the influence of blocking means (15, 30).

5. Connector assembly according to Claim 1, 2, 3 or 4, characterized in that the connecting means (17) of the female element (1) are at least inwardly projecting means which can engage on a stop face (55, 73) on the male element (3).

6. Connector assembly according to Claim 1, 2, 3, 4 or 5, characterized in that the male element (3) is of hollow design and is provided with a flow passage (1) with at least one passage opening (33).

7. Connector assembly according to Claim 1, 2, 3, 4, 5 or 6, characterized in that the male element (3) is accommodated, optionally moveably, in a coupling piece (7), and in that the coupling piece (7), in a starting position, seals off the passage openings (33) in the male element (3), whereas when the connector assembly is in the position in which medium is allowed to flow through, this is not the case.

8. Connector assembly according to Claim 7, characterized in that the coupling piece (7) and the female element (1) are provided with means (17, 55) which can be made to interact with one another so as to fix the coupling piece (7) and the female element (1), and in that the coupling piece (7) and the male element (3) are provided with means (35, 51) which can be made to interact with one another in order to enable the male element (3) and the coupling piece (7) to be fixed in a first position with respect to one another.

9. Connector assembly according to Claim 8, characterized in that, when the connector assembly is being moved into the open position, the connection formed by the means (35, 51) for fixing the male element (3) and the coupling piece (7) can absorb a greater axial load than that which is required to bring about the connection formed by the means (17, 55) for fixing the coupling piece (7) and the female element (1) with respect to one another.

10. Connector assembly according to Claim 9, characterized in that, when the connector assembly is being moved into the open position, the connection formed by the means (13, 15, 27, 30) for fixing the female element (1) and the adapter socket (5) can absorb a greater axial load than the first connection, which is formed by interacting means (35, 51), between the male element (3) and the coupling piece (7).

11. Connector assembly according to Claim 10, characterized in that the connection, which is formed by means (13, 15, 27, 30), between the female element (1) and the adapter
socket (5) can absorb a greater axial load than that required to bring about a second connection (39, 51) between the coupling piece (7) and the male element (3).

12. Connector assembly according to Claim 11, characterized in that the connection formed by the means (17, 55) for fixing the coupling piece (7) and the female element (1), in the position in which medium is allowed to flow through, the openings (11, 33) allowing free-flowing medium to pass through, cannot be broken since this connection is clamped in between the outer surface (34) of the male element (3) and the inner wall (26) of a section of a relatively narrow cavity (28) in the adapter socket (5).

13. Connector assembly according to Claim 12, characterized in that, when the connector assembly is being moved into the position in which the flow of medium is closed off and when it is being uncoupled from this position, the outer surface (57) of the coupling piece (7) is moved outside the said section of the relatively narrow cavity (28), the load which the connection between the means (39, 51) of the male element (3) and the coupling piece (7) is able to absorb being greater than the load required to produce the connection between the means (13, 15, 27, 30) for fixing the female element (1) with respect to the adapter socket.

14. Connector assembly according to Claim 13, characterized in that, during further uncoupling, the connection between the connecting means (17, 55) for fixing the coupling piece (7) and the female element (1) can absorb a greater axial load than the said second connection (39, 51) between the means for fixing the male element (3) with respect to the coupling piece (7), and in that the connection between the said first means (35, 51) between the male element (3) and the coupling piece (7) can be brought about without breaking the connection (17, 55) for fixing the coupling piece (7) and the female element (1).

15. Connector assembly according to one of Claims 7 to 14, characterized in that if, in the position in which medium is allowed to flow through, the said openings (33) in the male element (3) are moved into a closed position as a result of the male element being pulled into the coupling piece (7), the coupling of the female element (1) and the coupling piece (7) remains enclosed between the female element (1) and the adapter socket (5) and is only released when the openings (11) in the female element (1) have also been moved into a closed position.

16. Connector assembly according to one of more of the preceding claims, characterized in that the male element (3) executes a free travel with respect to the female element (1), between the position in which medium is allowed to flow through and the position in which the flow of medium is closed off, without, in the process, releasing the coupling between the female element (1) and the male element (3) and/or the coupling piece which is coupled thereto.

17. Connector assembly according to one or more of the preceding claims, characterized in that the passage openings (11, 33) in the female element (1) or the male
element (3) are provided with non-return valves, thus imparting a pump function to the assembly.

18. Method for producing a combination of the female element (1) and the adapter socket (5) or the male element (3) and the coupling piece (7) of the connector assembly according to one or more of the preceding claims by injection moulding, characterized in that the female element (1) and the adapter socket (5) are produced simultaneously, in line with one another, in a single mould cavity, which is formed by a number of interacting mould parts (I to V), in such a manner that, after a number of mould parts (I, II, III) have been removed, the female element (1) can be pulled into the adapter socket (5) by a mould part (V) which, during the injection moulding, is releasably connected to the female element.

19. Method for producing a combination of the female element (1) and the adapter socket (5) or the male element (3) and the coupling piece (7), or each element of the connector assembly separately, according to one or more of the preceding claims, by injection moulding, characterized in that those surfaces (12, 24, 34, 59) of the elements (1, 3, 5, 7) of the connector assembly which are to fulfil a sealing function are formed entirely by one mould part (I, V), in such a manner that the sealing surfaces do not include any partial seams.
Fig 10
A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16L37/32 B67D3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16L A61M F16K B67D B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 4 445 551 A (BOND CURTIS J ET AL)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1 May 1984 (1984-05-01) cited in the application figures</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>DE 30 03 398 A (SPERRY CORP)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7 August 1980 (1980-08-07) figures</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>WO 94 29215 A (PORTOLA PACKAGING INC)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>22 December 1994 (1994-12-22) figures</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>US 4 375 864 A (SAVAGE CHESTER)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8 March 1983 (1983-03-08) figures</td>
<td></td>
</tr>
</tbody>
</table>

** Further documents are listed in the continuation of box C. **

** Patent family members are listed in annex. **

* Special categories of cited documents:
  - "C" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier document but published on or after the international filing date
  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed
  - "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
  - "Z" document member of the same patent family

Date of the actual completion of the international search: 22 August 2000

Date of mailing of the international search report: 29/08/2000

Name and mailing address of the ISA:

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer:

Budtz-Olsen, A
## INTERNATIONAL SEARCH REPORT

### Information on patent family members

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU 552437 B</td>
<td></td>
<td></td>
<td>29-05-1986</td>
</tr>
<tr>
<td>AU 1015383 A</td>
<td></td>
<td>CA 1178988 A</td>
<td>04-12-1984</td>
</tr>
<tr>
<td>DE 3279678 D</td>
<td>15-06-1989</td>
<td>DK 315883 A,B</td>
<td>08-07-1983</td>
</tr>
<tr>
<td>EP 0093157 A</td>
<td>09-11-1983</td>
<td>NO 832506 A</td>
<td>08-07-1983</td>
</tr>
<tr>
<td>NZ 202381 A</td>
<td>14-03-1986</td>
<td>WO 8301605 A</td>
<td>11-05-1983</td>
</tr>
<tr>
<td>US 4421146 A</td>
<td>20-12-1983</td>
<td>ZA 8208197 A</td>
<td>26-10-1983</td>
</tr>
<tr>
<td>DE 3003398 A</td>
<td>07-08-1980</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>WO 9429215 A</td>
<td>22-12-1994</td>
<td>US 5370270 A</td>
<td>06-12-1994</td>
</tr>
<tr>
<td>AU 7201794 A</td>
<td></td>
<td></td>
<td>03-01-1995</td>
</tr>
<tr>
<td>US 4375864 A</td>
<td>08-03-1983</td>
<td>BE 889672 A</td>
<td>18-01-1982</td>
</tr>
<tr>
<td>FR 2491191 A</td>
<td>02-04-1982</td>
<td>JP 57055894 A</td>
<td>03-04-1982</td>
</tr>
<tr>
<td>US RE32354 E</td>
<td>17-02-1987</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>