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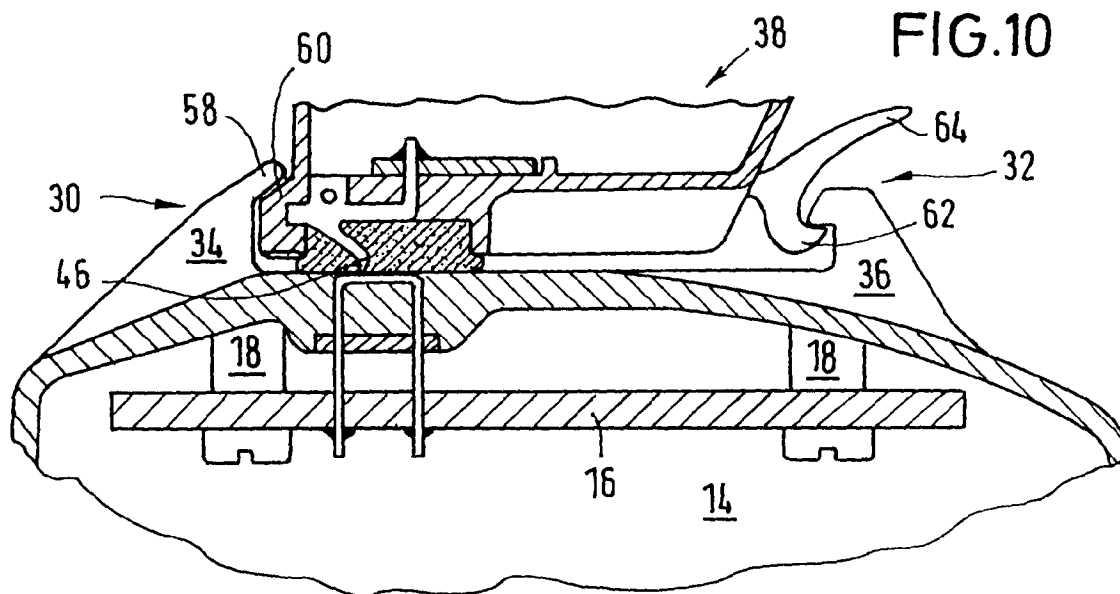
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50735 Köln (DE)(54) **Contact device**

(57) The invention relates to a contact device for connecting multi-wire lines in a moist or wet environment. The device comprises first and second housing portions (14,38), each portion including a plurality of contacts (20,42). It is the underlying objective to provide electrical connection between these contacts (20,42) without moisture or conducting fluid bridging over these

contacts. This object is obtained by the provision of a pad (48) at the second housing portion (38) which pad (48) encloses the contacts (42) of said second housing portion (38) and comprises an elastic, electrically insulating and water-imprevious material, and the contacts (42) extend into said pad (48) to such an extent that they pierce it when pressure is applied.

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Description

[0001] The invention concerns a contact device having one or more poles, comprising a first housing portion and a second housing portion which is movable with respect thereto and which is latchable thereto, and a plurality of contacts which are arranged in each housing portion in mutually spaced juxtaposed relationship and which are insulated from each other, wherein the contacts in the first and second housing portions are aligned with each other, the contacts in the first housing portion are exposed at a surface which is towards the second housing portion, and contact-making occurs in an environment which is moist and/or filled with a conducting fluid.

[0002] Contact devices for connecting multi-wire lines are known. Plug contacts in which a plug is fitted into a coupling are wide-spread. There are numerous other kinds of contact devices, depending on the use thereof involved. The present invention is concerned with a contact device intended to operate in an environment that is moist or that is even wetted or enriched with a fluid. Such a use occurs for example in the medical area. For the purposes of monitoring blood pressure and other data, patients are connected to sensors by way of a cannula and hoses. These hoses are filled for example with a natural salt solution. The salt solution is electrically conducting. It can happen that the salt solution issues from the hose at a connection, an interface or when there is a hole, and reaches the electrical contact devices. There the salt solution wets and bridges over the contacts of the one and/or other housing portion. That results in a measurement error or even a short-circuit. Another use of the contact device according to the invention is in the underwater sector. In this case also multi-wire lines are connected together or a multi-wire line is connected to a stationary connection. Water flows around the contacts. Measurement errors and short-circuits can occur.

[0003] Taking that situation as its basic starting point, the object of the present invention is so to design a multi-pole contact device that moisture or a conducting fluid cannot bridge over the contacts and thus measurement errors and short-circuits are avoided.

[0004] To attain that object, in a contact device of the kind set forth in the opening part of this specification, the invention provides that disposed at the second housing portion on the side thereof that is towards the first housing portion is a "pad" which encloses its contacts and which comprises an elastic, electrically insulating and water-imperious material and the contacts extend into said pad to such an extent that they pierce it when pressure is applied.

[0005] The pad or cushion encloses the contact surfaces of the contacts of the second housing portion. In that way it protects them from contact with moisture or a fluid. That prevents an undesirable flow of current between the contacts of the second housing portion. When

now the two housing portions are moved towards each other to make contact, the pad comes into contact with the surface of the first housing portion, that is towards the second housing portion. It gradually presses against that surface and in so doing pushes the moisture or fluid on that surface away. Likewise moisture or fluid which was previously to be found on the surface of the pad is displaced. In the closed position of the contact device, in which the two housing portions are at the minimum spacing from each other, the pad bears against the surface in a compressed condition and under such a pressure that a fluid can no longer be present between the surface and the pad or penetrate in between same. Thus the pad has displaced moisture and fluid and has prevented the moisture and fluid from reaching the contacts again. During the compression phase the contacts of the second housing portion have pierced the pad and contact the contacts of the first housing portion. That affords the desired electrical connection. The contacts and the region of the pad which is pierced by the contacts are sufficiently enclosed by non-pierced regions of the pad and are thus reliably protected from moisture and fluid.

[0006] Desirably the side of the pad, that is towards the first housing portion, is of a cambered or spherically curved configuration in a manner that will be described in greater detail hereinafter. The consequence of this is that, when it first makes contact with the surface of the first housing portion that contains the contacts, the pad is virtually only in punctiform contact therewith. When the pad is further pressed against the first housing portion, moisture and/or fluid are thus pressed away radially outwardly, starting from that location of punctiform contact. That prevents pockets containing moisture or fluid from being formed between the surface and the pad.

[0007] A further advantageous embodiment provides that in the open condition of the contact device the contacts of the second housing portion project into the pad approximately as far as half the thickness of the pad. That means that the pad can be compressed to approximately half its thickness, before contact is made. That ensures that, by the time contact is made, the pad has sufficiently pushed away and displaced moisture and fluid and the contacts are dry when contact occurs.

[0008] It is necessary to ensure that the contacts of the second housing portion pierce the pad and can thus come into contact with the contacts of the first housing portion. For that purpose the invention provides that the contacts of the second housing portion have points. Those points result in punctiform contact with the contact surfaces of the contacts of the first housing portion. The contacts of the first housing portion have flat surfaces, in which case the contacts bear against each other under pressure when contact is made and the points of the one contacts can become flattened off against the flat surfaces of the other contacts. Therefore the two housing portions are compressed to such an extent that the points of the one contacts come to bear under pressure against the flat surfaces of the other contacts and

in so doing are flattened off. That flattening effect increases the surface area of contact between the contacts of the respective housing portions, and thus enhances conductivity. The flattening effect further means that the contact device cannot be used just as often as may be desired. That is not a shortcoming. Only disposable articles are used in any case in the medical sector, for reasons of hygiene. Multiple usage of the contact device according to the invention is however possible in spite of the flattening effect on the contacts and the fact that the pad is pierced.

[0009] As mentioned above, for contact to occur the two housing portions must be moved towards each other to such an extent that the points of the one contacts pierce the pad and come into contact with the flat surfaces of the other contacts. The above-described principle of the invention is independent of the manner in which the two housing portions are guided, moved towards each other and held in the closed condition after contact has occurred. As one option in this respect the invention proposes that the two housing portions have mutually co-operating hinge portions on one side of their contacts and mutually co-operating lock portions on the other side of their contacts. The two housing portions form a hinge on the one side. The second housing portion is pivoted about same and in so doing is moved towards the first housing portion. When contact occurs or in the closed condition of the contact device, the lock portions provided at the other side come into operation. They lock the two housing portions in the closed condition.

[0010] In an embodiment the invention especially provides that on the first housing portion the hinge portions have at least one nose and a bar or strip portion which engages under the nose is arranged on the second housing portion. For the lock portions, in a first embodiment the invention provides that they have a nose on the first housing portion and a hook which engages under the nose, on the second housing portion, wherein the hook is of a flexible nature and has a handle. For the lock portions, in a second embodiment the invention provides that on the first housing portion they have at least two plates with openings, the plates being arranged at a mutual spacing, while provided on the second housing portion are hooks which can be elastically inserted into the openings. It is important in all embodiments that the hinge and lock portions can be operated with one hand.

[0011] Reference has already been made to the cambered or spherically curved shape of the pad. Cambered or spherically curved means rotationally symmetrical. A cambered or spherically curved and thus rotationally symmetrical pad satisfies the object in accordance with the invention. It was however explained that the second housing portion is pivoted and, during that pivotal movement, is moved towards the first housing portion. In other words, starting from its side which is towards the hinge portions, the pad firstly moves towards the sur-

face, which contains the contacts, of the first housing portion. From that side which is towards the hinge portions, the pad gradually and progressively presses against the surface which contains the contacts, until reaching its side that is towards the lock portions. The cambered configuration - to keep to that expression - should therefore not be rotationally symmetrical but should extend in the direction from the hinge portions to the lock portions and should impart its greatest thickness to the pad in the region of the points of the contacts. More specifically the invention provides that the pad is of an increasing thickness starting from its side which is towards the hinge portions, to the region in which the points of the contacts are disposed, and that thickness progressively decreases towards the side that is towards the lock portions.

[0012] The invention will now be further described by reference to the example of the embodiments illustrated in the drawing in which:

Figure 1 is a partly sectional side view of the second housing portion,

Figure 2 is a partly sectional side view of the first housing portion, with the second housing portion being shown in dash-dotted lines in a position prior to the two housing portions being fitted together,

Figure 3 is a view in cross-section taken along section line III-III in Figure 1,

Figure 4 is a view in cross-section taken along section line IV-IV in Figure 2,

Figure 5 is a partly sectional side view of part of the hinge portions and the adjacent regions of the two housing portions at the beginning of the pivotal movement of the second housing portion on to the first housing portion,

Figure 6 is a view in cross-section through the two housing portions in the plane of the contacts at the beginning of said pivotal movement,

Figure 7 is a side view similar to that shown in Figure 5 at the end of said pivotal movement,

Figure 8 is a view in cross-section similar to that shown in Figure 6 at the end of the pivotal movement,

Figure 9 is a side view on an enlarged scale of the point of a contact, as indicated by the circle at IX in Figure 7, after it has been flattened,

- Figure 10 is a partly sectional side view of the complete contact device with both housing portions in the closed condition and with a first embodiment of the lock portions,
- Figure 11 is a simplified side view of the two housing portions when the second housing portion pivots towards the first housing portion, with a second embodiment of the lock portions,
- Figure 12 is a front view in the direction of the arrow XII in Figure 11, and
- Figure 13 is a diagrammatic plan view on to the first housing portion in the direction indicated by the line XIII-XIII in Figure 11.

[0013] The contact device 12 is shown in its entirety in Figure 2. Figure 2 shows the first housing portion 14 with a printed circuit board 16 which is held by means of two screws 18. A plurality of contacts 20 are connected to the printed circuit board 16. They are disposed one behind the other or one beside the other, perpendicularly to the respective plane of the drawing. They are electrically connected to the printed circuit board 16 by way of solder connections 22. Figure 2 also shows an insulation 24. Figure 2 further shows the flat surface 26 which is in the upper region of the first housing portion 14. The contacts 20 terminate at or lie in that flat surface 26, with contact surfaces 28. When looking at Figure 2, the hinge portions 30 are to the left and the lock portions 32 are to the right. Both portions have noses. The noses of the hinge portion 30 are identified by reference numeral 34 and those of the lock portion 32 are denoted by reference 36. The second housing portion 38 is shown in dash-dotted lines in Figure 2. Figure 1 shows it in solid lines. The second housing portion 38 contains a printed circuit board 30 and a plurality of contacts 42. As in the case of the contacts 20 in the first housing portion 14, a plurality of contacts 42 are arranged one behind the other or one beside the other, perpendicularly to the respective plane of the drawing. They are electrically and mechanically connected to the printed circuit board 40 at solder connections 44. The contacts 42 have points 46.

[0014] Figures 1, 2 and 3 show the cushion or pad 48 which is essential for the invention, with its cambered underside 50. The pad 48 is disposed in a box-shaped projection on the underside of the second housing portion 38. It is held by a technology involving injection-moulding material therearound. The cambered underside 50 has its apex 52 in the plane of the points 46, which extends perpendicularly to the plane of the drawing, or along the section line III-III. When looking at Figure 1, the cambered underside 50 has a short surface 54 to the left of its apex 52 and a longer surface 56 to the right of its apex 52. When looking at Figure 1 the

thickness of the pad 48 increases along the surface 52 and gradually decreases again along the longer surface 56. Figures 1, 2 and 3 show the contact device 12 prior to closure of the housing or prior to contact being made between the contacts. In that condition the points 46 terminate approximately at half the height of the pad 48. Figures 3 and 4 clearly show how the respective four contacts 42 or 20 respectively are disposed in mutually juxtaposed relationship. Figure 3 shows by way of example four mutually juxtaposed contacts 42 of the second housing portion 38. Figure 4 correspondingly shows four mutually juxtaposed contacts 20 of the first housing portion 14. In the illustrated embodiment the contacts of both housing portions are fitted into printed circuit boards and soldered to the conductor tracks thereof.

[0015] Figure 2 shows the way in which the second housing portion 38 which is shown in dash-dotted lines is displaced in the direction of the arrow into a position beneath the nose 34 forming the hinge. That is the first stage in assembly of the two housing portions 14 and 38. Figures 5 and 6 show the second housing portion 38 in its condition of being pushed completely under the nose 34, when it is moved pivotally towards the first housing portion 14. A fluid is illustrated between the two housing portions 14 and 38. To make contact, the second housing portion 38 is pivoted in the direction of the illustrated arrow in the clockwise direction on to the first housing portion 14. When that occurs, the pad 48 is displaced and pressed on to the flat surface 26 containing the contacts 20. The apex 52 of the pad 48 first meets the surface 26. When that happens, the water is displaced in the direction of the two arrows illustrated in the drawing. It is pushed away towards the left and right, when looking at Figure 5. When looking at Figure 6, as Figure 6 is a view in cross-section, the water is pushed away towards the front and the rear. Figures 5 and 6 show the position prior to contact being made. Starting from the position shown in Figure 1, the points 46 have already somewhat pierced the pad 48. They are however still disposed completely in the pad 48 and are surrounded by it and are thus protected from the fluid. The points 46 are equally still at a spacing from the contact surfaces 28 of the contacts 20.

[0016] The pivotal movement of the second housing portion 38, which is shown in Figures 5 and 6, is continued until definitive contact is made. Figures 7, 8 and 9 show the final condition or the closed position of the contact device 12. The pad 48 is compressed. Its initially cambered underside 50 is now flat. The fluid which was initially to be found on the surface 26 has been completely pressed away. The points 46 of the contacts 42 bear against the contact surfaces 28 of the contacts 20 and in contact therewith. It is important for all contacts to be dry.

[0017] Figure 10 also shows the final condition with a particular illustration of the hinge portions 30 and the lock portions 32. They are of the shape already shown in Figures 1 and 2. The lock portion 32 which is fixed to

the second housing portion 38 has a hook 62 and a handle 64. The hook 62 engages under the nose 36. The lock portion is held and guided at the handle 64. The hook 62 and the handle 64 comprise an elastic material. That permits the hook 62 to be pushed past the nose 36 until the locked condition shown in Figure 10 is reached.

[0018] Figures 11 and 12 show another embodiment of the lock portions 32. On the first housing portion 14 they have two plates 66 with openings 68. Disposed on the second housing portion 38 are two hooks 70 with the handles 64. As in the embodiment illustrated in Figure 10, they comprise an elastic material. To close the contact device 12 the second housing portion 38 is pivoted in the clockwise direction about the hinge portion 30. That is indicated by the arrow in Figure 11. When that pivotal movement occurs, the hooks 70, by virtue of their elasticity, can be pushed on to the plates 66. The pivotal movement ends with the hooks 70 coming into latching engagement in the openings 68.

[0019] Figure 13 is a plan view of the two noses 58 of the first housing portion 14, the four mutually juxtaposed contact surfaces 28 and the two plates 66 with the openings 68. The two handles 64 are pressed together to open the contact device 12. The hooks 70 are released from the openings 68 and the second housing portion 38 can be pivoted in the counterclockwise direction about the hinge portion 30.

Claims

1. Multi-pole contact device comprising a first housing portion and a second housing portion which is movable with respect thereto and which is latchable thereto, and a plurality of contacts which are arranged in each housing portion in mutually spaced juxtaposed relationship and which are insulated from each other, wherein the contacts in the first and second housing portions are aligned with each other, the contacts in the first housing portion are exposed at a surface which is towards the second housing portion, and contact-making occurs in an environment which is moist and/or filled with a conducting fluid, characterised in that disposed at the second housing portion (38) on the side thereof that is towards the first housing portion (14) is a pad (48) which encloses its contacts (42) and which comprises an elastic, electrically insulating and water-impermeable material and the contacts (42) extend into said pad to such an extent that they pierce it when pressure is applied.
2. Contact device as set forth in claim 1, characterized in that the side of the pad (48), that is towards the first housing portion (14), is of a cambered configuration.
3. Contact device as set forth in claim 1, characterized

in that in the open condition of the contact device (12) the contacts (42) of the second housing portion (38) project into the pad (48) approximately as far as half the thickness thereof.

4. Contact device as set forth in one or more of claims 1 through 3, characterized in that the contacts (42) of the second housing portion (38) have points (46) and the contacts (20) of the first housing portion (14) have flat surfaces (26), the contacts (20, 42) bear against each other under pressure when contact is made and the points (46) of the one contacts (42) are flattened off against the flat surfaces (26) of the other contacts (20).
5. Contact device as set forth in one or more of claims 1 through 4, characterized in that the two housing portions (14, 38) have mutually co-operating hinge portions (30) on one side of their contacts and mutually co-operating lock portions (32) on the other side of their contacts (20, 42).
6. Contact device as set forth in claim 5, characterized in that on the first housing portion (14) the hinge portions (30) have at least one nose (58) and a bar portion (60) which engages under the nose is arranged on the second housing portion (38).
7. Contact device as set forth in claim 5, characterized in that the lock portions (32) have a nose (58) on the first housing portion (14) and a hook (62) which engages under the nose (58), on the second housing portion (38), wherein the hook (62) is of a flexible nature and has a handle (64).
8. Contact device as set forth in claim 5, characterized in that on the first housing portion (14) the lock portions have at least two plates (66) with openings (68), the plates being arranged at a mutual spacing, and on the second housing portion (38) are hooks (70) which can be elastically inserted into the openings.
9. Contact device as set forth in one or more of claims 1 through 8, characterized in that the pad (48) is of an increasing thickness starting from its side which is towards the hinge portions (30), to the region in which the points (46) of the contacts (42) are disposed, and that thickness progressively decreases towards the side that is towards the lock portions (32).

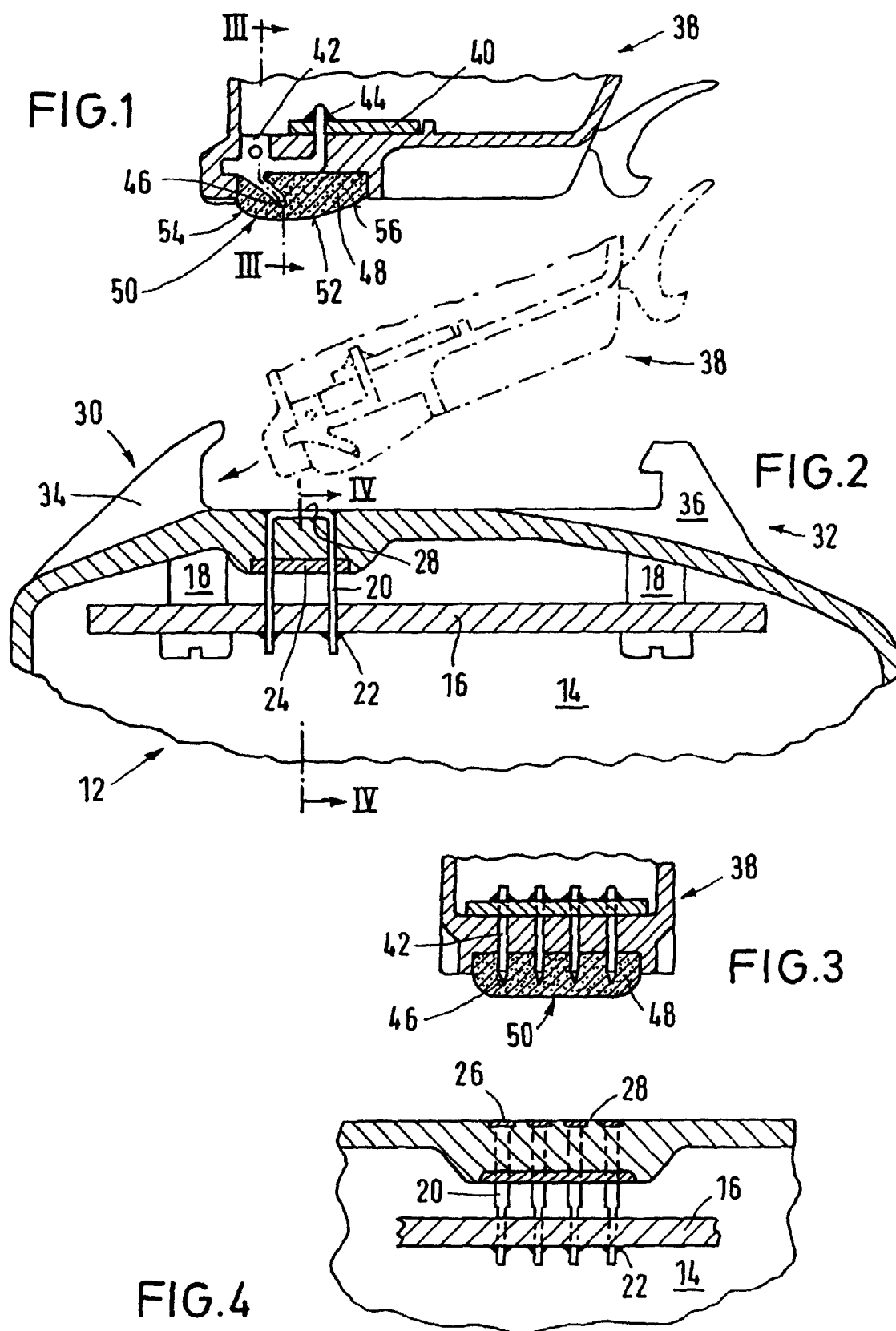


FIG.5

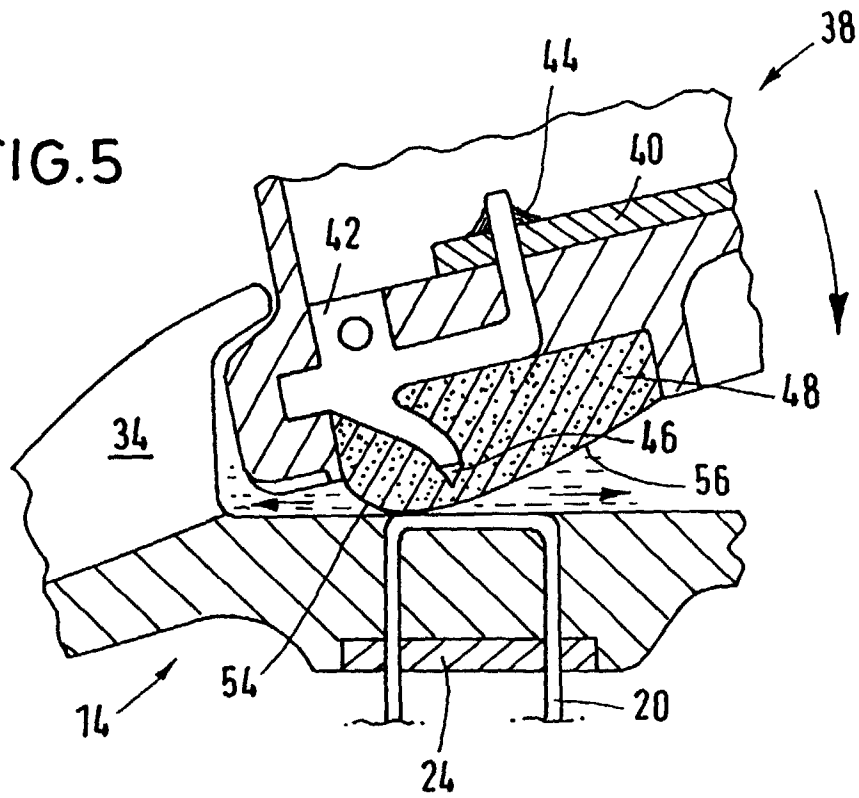


FIG.6

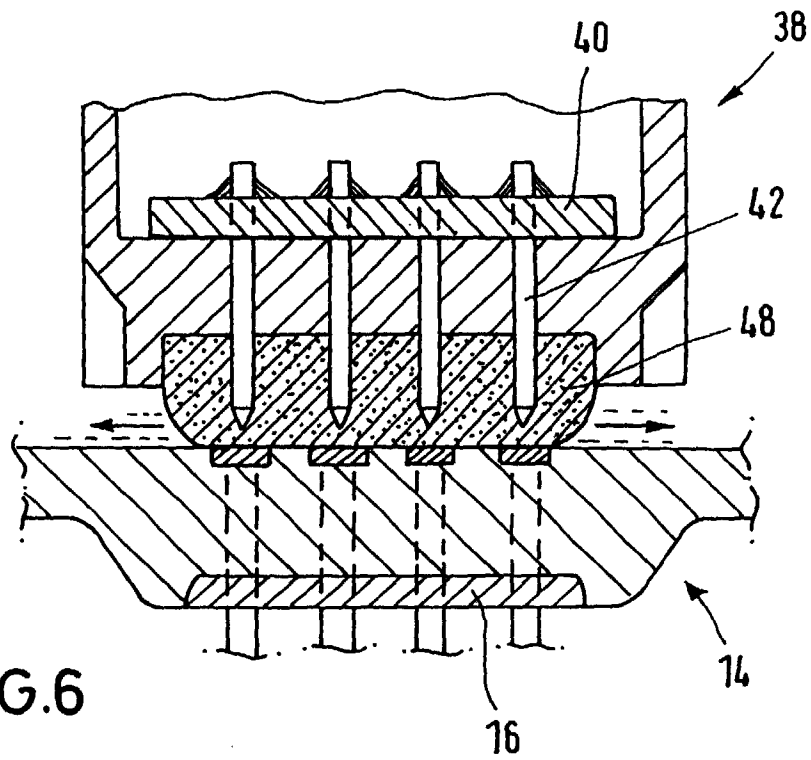


FIG. 7

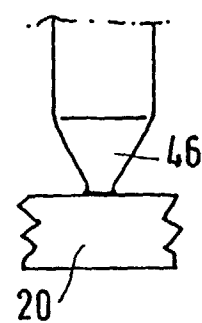
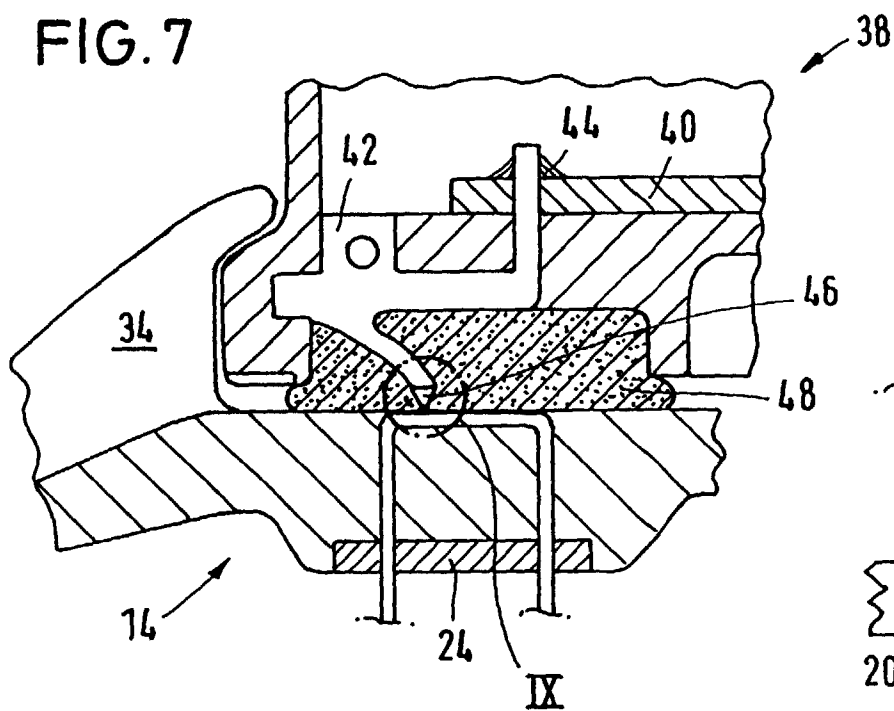


FIG. 9

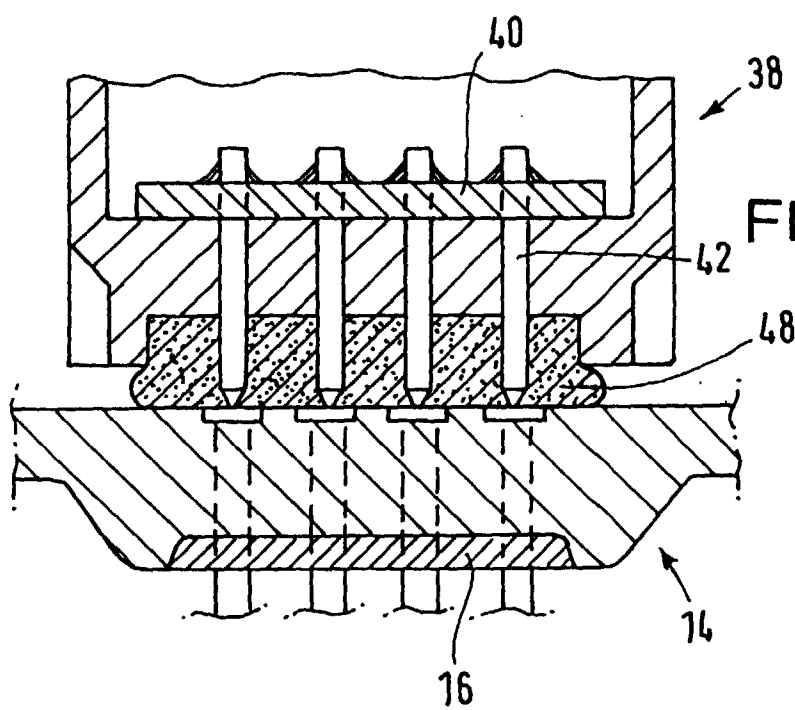


FIG. 8

