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(54) Benævnelse: **KORROSIONSSENSOR, DER HAR DOBBELT INDKAPSLEDE WIREFORBINDELSER OG FREMSTILLINGSMÅDE TIL DET**

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DESCRIPTION

[0001] This invention relates to the manufacture of sensors for detecting corrosion on a metallic material when the sensor is mounted on or adjacent the metallic material, in use.

[0002] Such corrosion sensors are often placed in inaccessible or difficult to access locations on movable structures such as aircraft, ships or other vehicles. Corrosion of metallic structures, particularly in corrosive environments such as on seagoing vessels or carrier-based aircraft, is an enormous financial problem for operators and can amount to billions of dollars per annum, as is the case, for example, for the US military. The use of such corrosion sensors, which can be used to signal various stages of corrosion of a structure on which they are mounted, can give the owner remote information on the state of corrosion of areas which are hard-to-access, are functionally critical or are highly numerous and would lead to excessive inspection time.

[0003] Examples of sealed sensors can be found in the documents WO2011/148441, US2009/195260, US5097317 and the presentation "Sensors in Corrosion - Electrochemical Bimetallic Galvanic Sensor' given by Erfan Zaher Esfahani during the course "Corrosion in Natural Environments" at the Najaf Abad University (Iran) in 2012.

[0004] Corrosion is a problem which leads to high maintenance and repair overheads in many different industries. The paper "Naval Aviation Corrosion Challenges and Solutions", Dale L. Moore, Corrosion 2000, paper 00270 (NACE, Orlando, USA, 2000) describes the problem areas in aircraft component corrosion and classifies corrosion types found in the aircraft industry.

[0005] Looking now at the construction of the corrosion sensor, the sensor consists of a chip coupled with a connecting module containing electrical connections between the chip and external monitoring means. The electrical connections are housed in a weather-proof and corrosion-proof capsule, whereby to form the module. The basic sensor chip consists of a thin substrate, which may be of silicon, coated with a coating of an insulator such as silicon dioxide. The substrate may be flexible and may be of a material such as polyimide which may act as both substrate and insulator. Onto the insulator is deposited at least one layer of conducting material, such as aluminium alloy, which may be formed, using masking technology, into a single strip or into strips of different width. The thickness of the layer forming the strip or strips may be approximately 150nm, so it will be appreciated that the sensor is potentially very fragile.

[0006] The circuitry is designed to communicate signals from the strip or strips, which reflect the occurrence of corrosion, to remote monitoring equipment.

[0007] The conducting strip or strips and connecting tracks are integrally formed on the substrate from a conducting material designed to be the same as or to mimic the corrodible material on which the sensor is to be mounted in use. An example of this conducting material

would be aluminium alloy for use on aircraft. The chip is then usually painted. This paint may be the same paint as will be used to cover the corrodible material on which the sensor is to be mounted although, for "time of wetness" sensors for example, the chip would not generally be painted and may consist simply of a single area of thin film track on an insulating material. For ships and aircraft, the paint would be a paint containing a corrosion inhibitor and, although not essential, such chips are primarily designed to be used with paints containing a corrosion inhibitor.

[0008] For maritime applications, sensors are generally coated all over with paint. However, not all paint layers are present in all areas. Paint layers are selectively applied to different areas of the sensor in order that the difference in the rates of coating breakdown can be monitored individually for each paint layer, e.g. primer, undercoat & topcoat. Thin film metallic resistors are strategically positioned beneath the paint and, when coating breakdown occurs, the resistance of the underlying thin film resistors changes in the specific area, as they are no longer fully protected against corrosion. Such sensors may also be used for land vehicles.

[0009] For aircraft applications, the paint is generally applied all over the sensor chip save for the conducting strip, or strips, which are left bare. The relatively narrow width of the exposed strips is designed to represent paint flaws or other damage which may occur to the paintwork such as cracks, scratches, chips etc. If corrosion inhibitor paint is used, the inhibitor will leach out from the paint and spread over the bare strips. Depending upon the width of the strip, the leaching inhibitor will either fully or partially extend over the area of the strip and will therefore either fully or partially protect the strip from corrosion. For wider strips, the strip may be only partly protected by inhibitor and corrosion will then attack the strip almost immediately. The strip will therefore fail before other, narrower strips for which protection will last longer. In this way, the sensor will provide corrosion sensing with different sensitivities and with different lifetimes, depending upon strip width. Although, primarily aimed at aircraft applications, this type of sensor may also be used for other applications where appropriate, e.g. for certain types of land vehicle.

[0010] In operation, the sensor is affixed either to the structure being monitored for corrosion or adjacent to it and in a position subject to the same corrosive influence. The sensor is connected to monitoring equipment, usually remote, either directly by wires or via radio link or other remote connection means. It will be appreciated that many locations in which the sensor is to be mounted will suffer harsh environments and the sensor may be subject to twisting forces, vibration and of course corrosive influence. The sensor must therefore be robust in construction and the electrical circuitry must additionally be corrosion proof.

[0011] To date, such corrosion proofing has proved difficult, if not impossible, to achieve. The sensor has tended to flex and damage the strips or wires attached to the strips or their connections and the protection for the circuitry has thus proved inadequate. In addition, the connecting module has proved troublesome to manufacture, for reliable operation. In particular, faults in the sealant such as air bubbles have tended to form. Such air bubbles can lead to cracks forming in the sealant at high altitude where the atmospheric pressure is

reduced. Such cracks can lead to destruction of the structural integrity of the sensor which may cause immediate failure of one or more electrical connections and/or may allow moisture to enter the sensor and corrosion to set in.

[0012] An improved potting method was required to encapsulate the pads and connections, to avoid the above difficulties. Only the pad area of the sensor chip needs to be encapsulated or "potted", the rest must be exposed to the environment and the fragile (thin film) sensor elements must remain perfectly clean until the sensor is installed. Standard potting techniques, for example encapsulation in epoxy resin, were not suitable for two reasons. Firstly, the surface of the sensor chip must be painted with a platform specific paint, e.g. aircraft paint, and there is no obvious way of ensuring a good seal between this painted surface and any standard potting compound. Secondly, there was no obvious way of using an aircraft sealant to form any intermediate seal between the paint and any standard potting compound.

[0013] The connecting module contains three series of connections, firstly, connections from a first set of pads on the chip, secondly, connections to a second set of pads and, thirdly, connections from a third set of pads to wires leading from the sensor.

[0014] The connecting pads on the chip are typically constructed using an aluminium alloy and these pads are extremely thin, of the order of 1μm. Therefore, it has not been possible to solder wires to these pads. Instead, at least one further set of pads is provided, preferably two sets and preferably of copper. These further pads preferably comprise a set of printed input pads and a matched set of printed output pads. Each input pad is connected by a printed track to a matched output pad. Between each chip pad and its matched printed input pad there is connected, by ultrasonic wedge bonding, a series of very thin wires. To each output pad is connected, by soldering, a wire leading from the sensor.

[0015] It will be appreciated that the wire bonds and the thin wires themselves will be fragile. This is particularly the case because each thin wire loops upwardly from the surface of the chip pad and down again to the surface of its matched input pad. Breakage of these thin wires or their bonds, either during manufacture or during use of the sensor, has been common. Breakage during manufacture can occur when protective sealant or potting compound is applied to encapsulate all the connections. Breakage during use can occur owing to slight flexing of the sensor or due to moisture entering the sensor through, or alongside, the sealant or potting compound.

[0016] Further problems can occur with the wires leading from the sensor. The potting compound has proved inadequate to securely locate the wires with respect to the output pads and thus prevent fracture of the soldered connections.

[0017] The cable used for the sensors may need to be qualified for use on-board naval vessels & high altitude jet aircraft. The most suitable cables for such applications (and indeed the only qualified cables in existence for certain platforms) are PTFE coated and sealing to PTFE surfaces to potting compounds is known to be difficult.

[0018] Furthermore, in order to make volume production of the sensors viable and to enable sufficiently high quality potting, aircraft sealant would need to be injection moulded. Injection moulding of aircraft sealants has not been attempted, previously.

[0019] For all the above reasons it has so far not proved possible to manufacture a sensor of the above type which will operate reliably.

[0020] According to a first aspect of the present invention there is provided a method of manufacturing a corrosion sensor, the sensor including at least one metallic strip mounted on a non-conducting substrate and a module for forming electrical connections from external monitoring equipment to the at least one strip, the module including a number of wire connections, the method including the steps of encapsulating the wire connections within a flexible chemical and heat resistant sealing compound/adhesive, and subsequently, encapsulating the flexible sealing compound within a second sealing compound by an injection moulding process.

[0021] The flexible chemical and heat resistant sealing compound may be, for example, Raychem S1125 epoxy and the second sealing compound may be, for example, PR2001B2 two-part epoxy aircraft sealant, for use on aircraft.

[0022] The second sealing compound may be PR-2001 Class B. This is a two-part, epoxy cured Permapol® P-3.1 polythioether compound. It is a rapid cure, low odour, aircraft integral fuel tank sealant with a service temperature range from -62°C to 160°C, with intermittent excursions up to 216°C. This compound is designed for fillet sealing of fuel tanks and other aircraft fuselage sealing

[0023] The wire connections may be formed by first, second and third wire connections, respectively. The first and second wire connections may be made at pads on the chip and at a set of intermediate pads in the module, respectively, and the third wire connections may be made at a set of output pads in the module. The first and second wire connections may be made by ultrasonically bonding very fine wires, at first ends thereof, to the chip pads and, at second ends thereof, to the intermediate pads. The third wire connections may be made by soldering the output pads to output wires for the module.

[0024] The intermediate pads, the output pads and tracks interconnecting them together may be formed of copper topped with gold, with the pads and tracks being applied to the substrate of the sensor in a known manner.

[0025] Prior to the first encapsulation step, at least some of the wire connections are manually coated with a preliminary sealing compound, for example, Dymax 9001, an ultraviolet-cured encapsulant, with Araldite 2014, a two-part epoxy adhesive, or with M-Coat D acrylic. Thus, for example, the Dymax or the Araldite may be used on the fine wires and ultrasonically bonded joints and the M-Coat D may be used on the soldered joints. Where appropriate, the

preliminary sealing compound may be cured, for example, by ultra-violet radiation.

[0026] For simplicity and for strength of the sensor, the chip and the module may be mounted on a single substrate. This may be flexible or rigid, according to specific design requirements, and may be of printed circuit board material such as FR4. The chip may be glued into position on the substrate using an adhesive such as Araldite 2014, Marine.

[0027] Once the wires have been attached to the output pads, they may be clamped in position to the module to protect the soldered joints from any pushing, pulling or vibration forces acting on the wires.

[0028] Where the substrate is FR4 material, this same material may be suitably employed as a clamp to place over the wires leading from the sensor and may be fixed in position, for example by use of an adhesive applied between the substrate and the clamp. The clamp may be formed with wire feed-through passages to receive the wires as they pass from the output pads and exit the sensor unit.

[0029] Once the clamp has been applied, a flexible sealant such as Raychem S1125 flexible epoxy may be applied to all the wire connections and to the feed-through passages. The flexible sealant may be applied manually or may be injection moulded if the sensor is first placed in a suitable mould. This mould may of course be used to provide a desired external shape for the flexible sealant as well. Raychem S1125 is particularly suitable for sealing the wires to the substrate and the clamp at the feed-through passages, because this product has been found to seal effectively to any PTFE sleeve applied as covering for the wires. A further enhanced seal between the flexible sealant and the PTFE sleeve may be obtained by etching the PTFE sleeve with an etching product such as Tetra Etch before the flexible sealant is applied.

[0030] The mould, for the injection moulding step, may be connectible to a vacuum source at an outlet from the mould, whereby the vacuum may assist in evacuating the mould of any gas bubbles or voids in the mould sealant. The step of connecting at least one mould outlet to a vacuum source may comprise placing the injection mould in a vacuum chamber whereby to carry out the injection moulding step within a vacuum. It should be emphasised that placing the injection mould in a vacuum chamber enables the moulding within the mould to be subject to the vacuum for the whole time that injection moulding takes place, if required.

[0031] The moulding material or sealing compound may be supplied, for injection moulding, in an air-tight container such as an evacuated tube. The injection moulding step may be carried out by connecting the air-tight container to a mould inlet and forcing the sealing compound from the air-tight container into the mould. This step may be carried out, where the container is a tube, by compressing part of the tube whereby to reduce the volume inside the tube and thereby to expel the sealing compound from the tube.

[0032] Placing the mould in a vacuum chamber, prior to injection of the moulding compound,

provides the necessary enhanced moulding conditions to give the required structural integrity to this highly specified component.

[0033] In the past, vacuum has traditionally been either (i) applied to evacuate a container, holding the moulding compound, prior to injection or (ii) applied after injection moulding has taken place and only once an upper portion of the mould had been removed, to allow a sufficient surface area of the moulded material to be exposed to the vacuum. It will be appreciated that removal of any part of the mould tool of an injection mould whilst the moulded material is still within the mould and is not fully set or cured may result in distortion of the surface of the moulded material from its intended shape. In the case of aircraft sealant, this will not self level, in the absence of the forming shape of the mould tool, and removal of any part of the mould tool surface tends to result in defects to the surface of the finished component.

[0034] This evacuation feature can be particularly important when the injected sealant is to be used at altitude when expansion of any gasses trapped within the moulded sealant can cause stress fractures in the sealant which may in turn lead to moisture entering the device and/or electrical breakdown.

[0035] Unlike in other applications, re-heating of the moulding compound cannot be safely undertaken in order to re-flow it. Such a process is not suitable when using an aircraft sealant as the moulding compound. Indeed, initial moulding cannot be carried out at elevated temperatures either, for the same reason. Here, in any event, the solder and initial encapsulants used for the sensor cannot take the temperatures required for a hot moulding process.

[0036] According to a second aspect of the present invention, there is provided a corrosion sensor including a number of metallic strips mounted on a non-conducting substrate and a module for forming electrical connections to the strips whereby to enable communication between the strips and monitoring equipment for the sensor, the module including a number of wire connections the wire connections being encapsulated within a flexible chemical and heat resistant sealing compound and the flexible sealing compound being encapsulated within an injection moulded second sealing compound of aircraft sealant.

[0037] According to an example which is presently not claimed, there is provided a corrosion sensor manufactured according to the method of the first aspect of the invention.

[0038] According to another example which is presently not claimed, there is provided an injection mould for the manufacture of a corrosion sensor according to the second aspect of the invention, the injection mould comprising a bed and first and second upper portions defining a mould cavity therewithin, the bed containing a hollowed out portion into which is placed the non-conducting substrate and the module unencapsulated by the injection moulded second sealing compound of aircraft sealant, and means to inject the aircraft sealant under pressure into the cavity through one or more injection ports.

[0039] The injection mould may have a vacuum source connected to one or more outlet ports of the mould and the vacuum source may comprise a vacuum chamber in which a remainder of the injection mould is housed.

[0040] The invention will now be further described by way of example with reference to the accompanying drawings of which:

Figure 1 is a ghosted three dimensional sketch of a sensor made according to the invention, and

Figure 2 is a cutaway side view of a mould for applying sealant to the sensor whereby to form the capsule thereof.

[0041] Referring to Figure 1, a sensor 1 made according to the invention is shown. The sensor 1 comprises a chip portion 2 and a connecting module 3. Both the chip portion 2 and the module 3 are formed on a single rigid substrate 4 of FR4 printed circuit board material.

[0042] Referring initially to the chip portion 2, this consists of a substrate of silicon (not separately shown) on which is formed a thin layer of silicon dioxide (again not separately shown) which acts as an insulator. Onto the layer of silicon dioxide is deposited a double layer of aluminium alloy material. This layer appears in the drawing as strips 5, 6 and 7 and strip pads 8, 9, 10 and 11. Over the double layer of aluminium alloy is applied at least one layer of paint 12 which has gaps corresponding to the strips 5, 6 and 7 and the strip pads 8, 9, 10 and 11.

[0043] The paint 12 and the aluminium alloy will be selected to correspond as closely as practicable to those in use on the metallic painted material whose corrosion is to be monitored by the sensor. Where the paint contains corrosion inhibitor, this will leach out of the paint over the otherwise unprotected strips 5, 6 and 7. That part of the strip covered by the inhibitor will be protected from corrosion. If the inhibitor fails to reach right across the strip, however, such as for the widest strip 7, then corrosion of that strip will set in as soon as it becomes subject to corrosive influence. In a similar manner, once corrosion inhibitor has ceased to leach out of the paint onto the remaining strips, the strips will be left unprotected and corrosion will begin. With the strips shown, widest strip 7 will begin to corrode first, followed by the centre strip 6 and finally by the narrowest strip 5. The sensor thus enables measurement of corrosion at different sensitivities and over differing periods, using the sensor strips of differing widths.

[0044] Strip pads 8, 9, 10 and 11 are connected, under the paint, to strips 5, 6 and 7 such that the voltage or current from each strip can be measured separately.

[0045] Turning now to the connecting module 3, each strip pad 8, 9, 10 and 11 is connected to a corresponding intermediate pad 12, 13, 14 and 15 by very fine wires 16 ultrasonically wedge bonded at either end. The whole of the connecting module 3 is encapsulated in PR2001B2

aircraft sealant 34 which has been injection moulded around the connecting module 3 and an enclosed part 35 of the chip portion 2. It will be observed that the tracks 18 and 19 are of different lengths to tracks 17 and 20. This length variation facilitates the use of a Wheatstone bridge arrangement, in the sensor.

[0046] The intermediate pads 12, 13, 14 and 15 are themselves connected by conducting tracks 17, 18, 19 and 20 to output pads 21, 22, 23 and 24, respectively.

[0047] Soldered to each output pad 21, 22, 23 and 24 are four wires 25, 26, 27 and 28 (a two wire version is also envisaged). Wires 25 and 26 are carried within a PTFE cable sleeve 29 and wires 27 and 28 are carried within a second cable sleeve 30. The pads, 12 - 15, 21 to 24 and tracks 17 to 20 are copper, topped with gold, and are printed onto the FR4 substrate 4 in conventional manner.

[0048] The wires 25 to 28, within their sleeves 29, 30 pass under a clamp 31 of FR4 material which is glued to the substrate 4 along a line 32. It will be seen that the wires 25 to 28 sit in a hollowed out portion 33 of the substrate 4.

[0049] All wire wedge bonds are enclosed in an initial sealant, either Araldite 2014, at 60 deg.C, or Dymax 9001 (not separately shown). The connections for the wires 25 to 28, together with the PTFE cable sleeves 29 and 30, at feed-throughs 36, 37, are then enclosed in Raychem S1125 flexible epoxy (again, not separately shown). To enhance the seal between the PTFE sleeves 29, 30 and FR4 feed-throughs 36, 37 of the clamp 31, the sleeves are first etched with Tetra Etch and washed off, before the Raychem sealant is applied.

[0050] The connections of the wires 25 to 28 to the output pads 21 to 24 are made by soldering and are then coated with M-Coat-D acrylic (not separately shown).

[0051] The Raychem S1125 may be brushed on or injection moulded over all the connections and over the FR4 board. This sealant then forms an interface to which PR2001B2 aircraft sealant can be injection moulded. PR2001B2 will not seal well to the FR4 or to the PTFE and so the Raychem provides an effective intermediate structure to which the PR2001B2 will effectively seal. The PR2001B2 effectively acts as a potting compound for all the connections and an effective outer sealant for aircraft use.

[0052] Turning now to Figure 2, this shows a side cutaway view of the sensor of Figure 1 within an injection mould 38. The mould 38 comprises a bed 39 and first and second upper portions 40, 41. The bed 39 contains a hollowed out portion 42 into which is placed the FR4 board 4 with all the wires bonded and soldered into place and the clamp 31 attached. The application of the various sealants, as described above, to the wire connections may be made with the board 4 resting in the mould or before it is inserted.

[0053] Once all the wire connections and the feed-throughs have had initial sealant applied to them, the mould 38 is closed. The PTFE cable sleeves 29, 30 are sealed against the upper

portion 41 of the mould in known manner. Aircraft sealant such as PR2001B2 is then injected under pressure into a cavity 45 of the mould through one or more injection ports 43. One or more outlet ports 44 may be connected to a vacuum source, to reduce the possibility of gas bubbles forming in the injected sealant by aiding complete filling of the mould cavity 45 with PR2001B2 sealant. It is preferred that the mould 38 is in fact placed in a vacuum chamber for the injection moulding step to be carried out there, as described above.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

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Patentkrav

1. Fremgangsmåde til fremstilling af en korrosionssensor, hvor sensoren omfatter et chipmodul (2) og et forbindelsesmodul (3), som begge er dannet på et substrat (4), hvor et lag af isolationsmateriale er aflejret på nævnte substrat, og hvor, på nævnte isolationsmateriale, et antal af metalliske strimler (5,6,7) er monteret på nævnte substrat, der omfatter nævnte isolationsmateriale, hvor nævnte modul (3) danner elektriske forbindelser til de metalliske strimler for at muliggøre kommunikation mellem strimlerne og overvågningsudstyr til sensoren, hvor modulet (3) omfatter et antal af wireforbindelser, hvor fremgangsmåden omfatter trinnene til manuel belægning af hver af wireforbindelserne med en af valgte forberedende tætningsforbindelser, henholdsvis, og at hærde de forberedende tætningsforbindelser efterfulgt af at indkapsle wireforbindelserne i en fleksibel kemikalie- og varmeresistent tætningsforbindelse, og derefter, at indkapsle hele forbindelsesmodulet (3), der omfatter den fleksible tætningsforbindelse såvel som en lukket del (35) af chippen (2) i en anden tætningsforbindelse af flytætningsmiddel ved en injektionsstøbningsproces.

2. Fremgangsmåde ifølge krav 1, hvor trinnet med at indkapsle wireforbindelserne i en fleksibel kemikalie- og en varmeresistent tætningsforbindelse fremstilles ved et injektionsstøbningstrin.

3. Fremgangsmåde ifølge krav 1 eller 2, hvor første og anden wireforbindelser fremstilles ved lag på chippen og ved et sæt mellemliggende lag i modulet, henholdsvis, ved ultrasonisk at binde meget fine wires, ved første ender deraf, til chiplagene og, ved anden ender deraf, til de mellemliggende lag.

4. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, hvor udgangswires fra sensoren er fastgjort til udløbslag og derefter fastklemt i position til modulet med en klemme.

5. Fremgangsmåde ifølge krav 4, hvor klemmen definerer gennemføringspassager for udløbswirene og den fleksible tætningsforbindelse påføres gennemføringspassagerne.

6. Fremgangsmåde ifølge krav 5, hvor udløbswirene har PTFE-muffer og fremgangsmåden omfatter trinnet med at ætse PTFE-mufferne med et ætseprodukt.

5 **7.** Fremgangsmåde ifølge et hvilket som helst af de foregående krav, hvor en støbeform til injektionsstøbningsprocessen er forbindelig med en vakuumkilde ved et udløb derfra.

8. Fremgangsmåde ifølge krav 7, hvor trinnet med at forbinde et nævnt
10 støbeformsudløb til en vakuumkilde omfatter at placere injektionsstøbningen i et vakuumkammer derved for at forbinde et hvilket som helst støbeformsudløb til vakuumet i vakuumkammeret.

9. Fremgangsmåde ifølge et hvilket som helst af de foregående krav omfattende
15 trinnet med at forsyne tætningsforbindelsen til en injektionsstøbeform, for injektionsstøbningstrinnet, i en fabrikantforsynet lufttæt beholder.

10. Fremgangsmåde ifølge krav 9, hvor den lufttætte beholder omfatter et evakueret rør.
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11. Fremgangsmåde ifølge krav 9 eller 10, hvor injektionsstøbningstrinnet udføres ved at forbinde den lufttætte beholder til et støbeformsindløb og tvinge tætningsforbindelsen fra den lufttætte beholder ind i støbeformen.

25 **12.** Fremgangsmåde ifølge krav 11, når afhængig af krav 10, hvor trinnet med at tvinge tætningsforbindelsen fra røret omfatter at komprimere en del af røret, hvorved volumen inde i røret reduceres.

13. En korrosionssensor, der omfatter et chipmodul (2) og et forbindelsesmodul
30 (3), som begge er dannet på et substrat (4), hvor et isolationsmateriale er aflejret på nævnte substrat, og hvor, på nævnte isolationsmateriale, et antal af metalliske strimler (5,6,7) er monteret på substratet (4), der omfatter nævnte isolationsmateriale, og nævnte modul (3) er konfigureret til at danne elektriske forbindelser til strimlerne (5,6,7) for at muliggøre kommunikation mellem
35 strimlerne og overvågningsudstyret til sensoren, hvor modulet omfatter et antal af

wireforbindelser, hvor wireforbindelserne er belagt i en forberedende
hærdningstætningsforbindelse og hvor nævnte belagte wireforbindelser er
indkapslede i en fleksibel kemikalie- og varmeresist tætningsforbindelse og hele
forbindelsesmodulet (3) omfatter den fleksible tætningsforbindelse såvel som en
5 lukket del (35) af chippen (2), der er indkapslet i en injektionsstøbt anden
tætningsforbindelse af flytætningsmiddel.

DRAWINGS

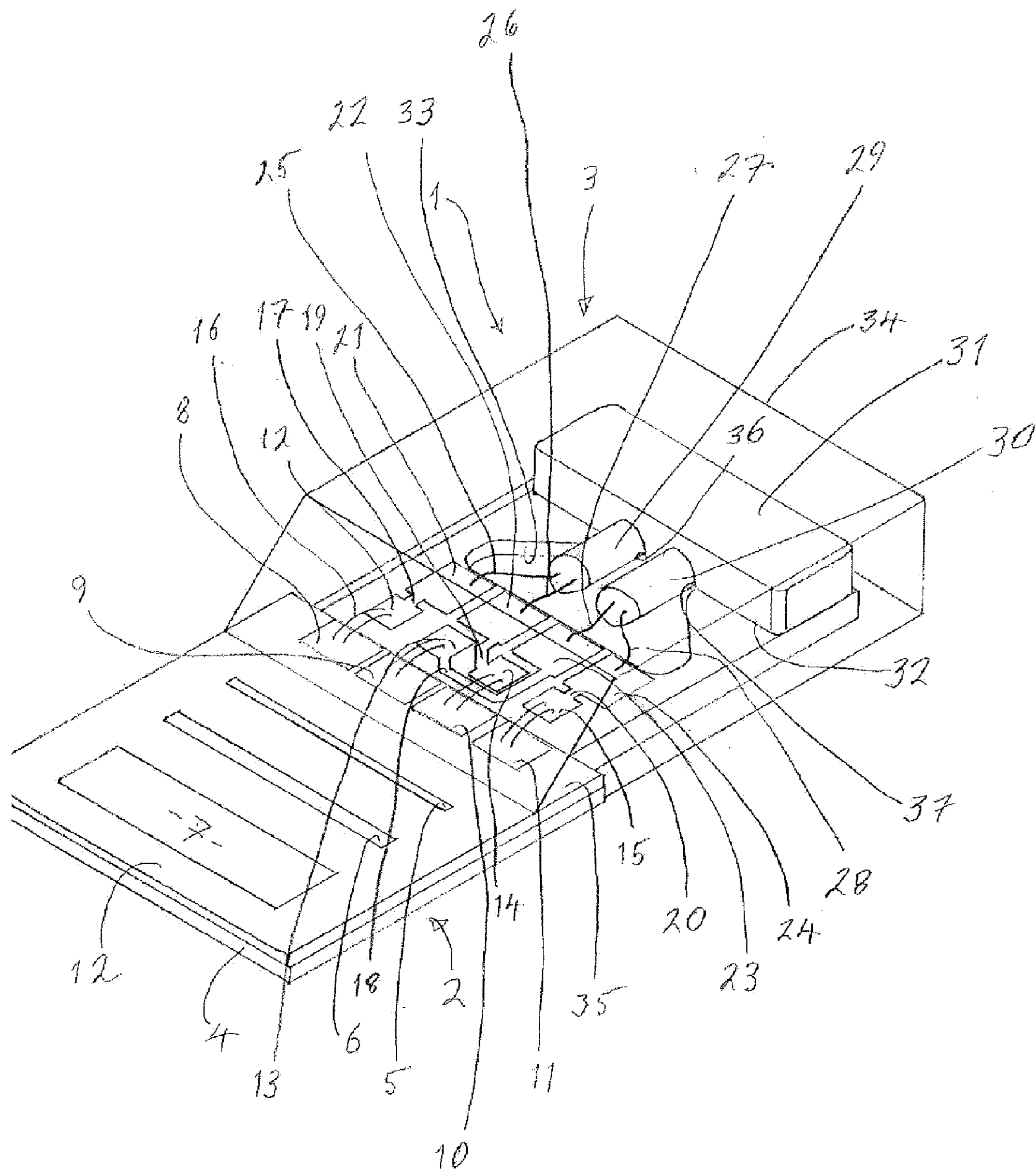

Fig. 1.

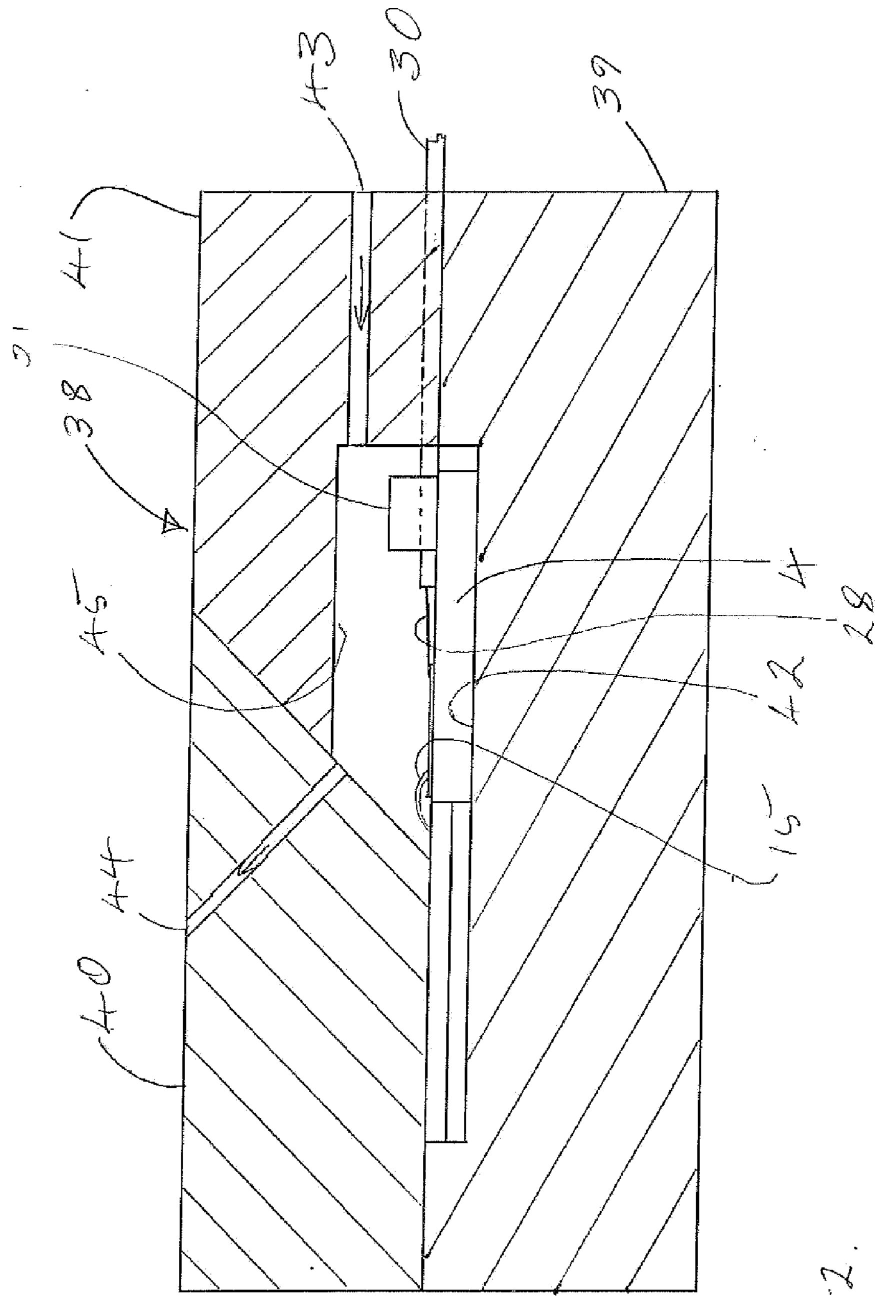

Fig. 2.