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(71) Applicant: **ELETTRO MAULE S.R.L.** [IT/IT]; Via Vigazzolo, 118, I-36054 Montebello Vicentino (VI) (IT).

(72) Inventors: **MAULE, Renato**; Viale Vicenza, 5/A, I-36071 Arzignano (VI) (IT). **MAULE, Mirco**; Via N. Paganini, 7, I-36050 Zermeghedo (VI) (IT).

(74) Agent: **TRENTIN, Michele**; Eureka IP Consulting, Borgo Santa Lucia, 31, I-36100 Vicenza (IT).

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(54) Title: AN ELECTRIC SWITCH FOR TRANSFORMERS

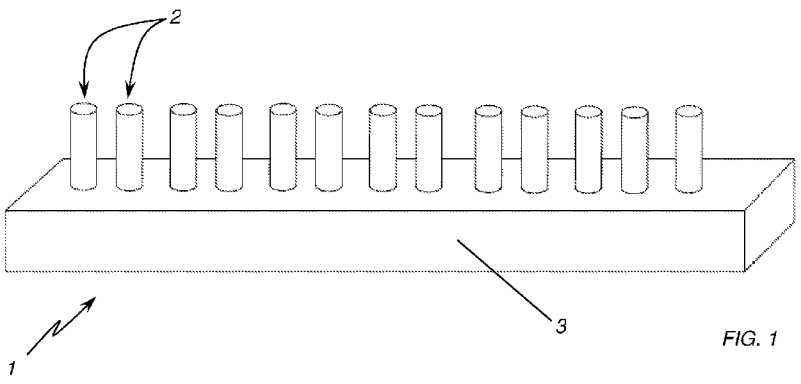

FIG. 1

(57) Abstract: An electric switch for electric transformers comprising: a plurality of pins (2) for the electric contact; a supporting bar (3) provided with a plurality of first through holes (4) suitable to stably accommodate said pins (2). The latter have on the outer surface (6) and in correspondence to the first through holes (4) a shaping (6) which interacts with a counter-shaping (7) realized on the inner surface (8) of the first through holes (4) so as to prevent the rotation and the sliding of the pins (2) in the first through holes (4).

AN ELECTRIC SWITCH FOR TRANSFORMERS

DESCRIPTION

Field of the invention

The present invention is generally applicable in the technical field of the electric transformers and particularly relates to an electric switch for transformers.

More in detail, the present invention is applied in particular to the oil-immersed electric transformers.

Prior art

In the field of the electric transformers it is known the use of pressure switches. The implementation of such pressure switches is particularly delicate in case of electric transformers for high electric potentials, since the high potentials in play may provoke electric discharges between the poles of the electric switches. One case is that of oil-immersed electric transformers. They are used for electric lines carrying high electric potentials.

The electric switches used in electric transformers operating with high electric potentials typically have a plurality of pins for the electric contact, usually made of copper or of a copper alloy, arranged aligned on a supporting bar. The handling of the bar causes the modification of the electric contacts switching, in this way, the lines of the electric transformer between them. Because the high voltages used, in order to avoid the induction of discharges, the pins have to be placed at a minimum distance which is calculated on the basis not only of the value of the electric potentials but also of the dielectrics separating the pins. They may be in free air or immersed in oil, however, a dielectric is also the bar itself which has then to be realized with suitable materials.

In this sense, according to the known prior art, the bar is typically manufactured in bakelite which is, as known, a good electric insulator. Such bar is then pierced in order to accommodate the pins. The latter, however, must be firmly attached to the bar so that they neither detach from it nor rotate around their own longitudinal extension axis.

In order to attain this, in the prior art the pins are crimped or it is made use of clamping nuts which are screwed in corresponding threads realized on the internal walls of the through holes.

Both by crimping the pins and by using clamping nuts, the insulation between the pins is decreased. In other words, such solutions oblige the manufacturers to place at a greater mutual distance the through holes, sacrificing in this way the optimization of the spaces and increasing the implementation costs because more material is needed.

It is also noted that the implementation of the described electric switches is complex because it goes through different steps: the manufacturing of the bar, the piercing of the bar, the threading of the holes in case of fastening with clamping nuts, the insertion of the pins, the crimping or the fastening of the clamping nuts.

It is also noted that some of the abovementioned steps are carried out carefully in order to avoid chipping the bar or damaging the used components. For example, the piercing or the crimping may provoke breaks or chippings of the bar.

Besides using bakelite, it is also known the use of thermosetting resins or the like which have higher resistivity values than those of bakelite. However such resins do not allow to overcome the drawbacks outlined above.

Summary of the invention

It is an object of the present invention to at least partly overcome the above mentioned drawbacks by providing an electric switch for electrical transformers which has limited implementation costs but which always guarantee the correct insulation between the pins.

Another object is that the electric switch of the invention is more compact compared to the equivalent known electric switches, the insulation between the pins being equal.

Another object is that the electric switch, despite being more compact than the equivalent known electric switches, is capable of having higher coefficients of electric insulation.

Another object is that the electric switch of the invention has easy

implementation and the parts constituting it has a low risk of damaging during the manufacturing step.

These and other objects, as better explained hereafter, are fulfilled by an electric switch for electric transformers according to the following claims, which are an integral part of the present description.

In particular, it comprises a plurality of pins for the electric contact mutually spaced in order to guarantee the mutual electric insulation. For this reason, the electric switch of the invention also comprises at least one supporting bar provided with a plurality of first through holes suitable to stably accommodate said pins for the electric contact.

According to an aspect of the invention, the pins have on the outer surface and in correspondence to the first through holes a shaping which interacts with a counter-shaping realized on the inner surface of such first through holes so as to prevent the rotation and the sliding of the pins in the holes.

Advantageously, the stability of the connection of the pins to the supporting bar is guaranteed by the mechanical contrast between the shapings and the counter-shapings. No crimping or screwing of clamping nuts is needed, so the implementation costs and the risk of damaging of the components are, as a result, lower then in the known devices.

The size of the bar is optimized, since it is not anymore necessary, as it happen on the known art, to increase the distance between the pins because of the crimping or of the presence of clamping nuts, such operations diminish the dielectric between the pins.

According to another aspect of the invention, the supporting bar is realized by thermoplastic material. In this way, the bar is moulded on the pins. Advantageously, it is avoided the operation of piercing the bar for the insertion of the pins and, as a consequence, there is a decreasing in the damaging risk of the bar and in the difficulty in using the electric switch. Also the building costs of the electric switch is, as a result, decreased.

Furthermore, it is noted that, advantageously, the counter-shapings may be realized automatically after the moulding of the bar on the pins; by doing that, it is avoided the manufacturing step.

Brief description of the drawings

Further features and advantages of the invention will appear more evident upon reading the detailed description of some preferred, non-exclusive embodiments of an electric switch for transformers according to the invention, which are described as non limiting examples with the help of the annexed drawings, in which:

the FIG. 1 is an electric switch system belonging to the electric switch for electric transformers of the invention;

the FIG. 2 is the electric switch system of FIG. 1 in exploded view:

the FIGS. 3 and 4 are particulars of the electric switch system of FIG. 1;

the FIG. 5 is another embodiment of the electric switch system of FIG. 1.

Detailed description of some preferred embodiments

With reference to the cited figures, and in particular to the figs. 1 and 2, an electric switch for electric transformers is described. In particular, the electric switch system 1 of the electric switch of the invention comprises a plurality of pins for the electric contact 2 to switch the contacts of the electric transformer.

The pins 2 are typically made by copper or by a copper alloy, but this is a non-limiting example for different embodiments in which other electrically conductive materials are used.

The pins 2, as known, are typically supported by a supporting bar 3 provided with a plurality of first through holes 4 which stably accommodate the pins 2 for the electric contact.

Unlike the prior art in which typically the supporting bar is made of bakelite, according to a feature of the invention, the bar 3 is made of thermoplastic materials. This allows to increase the resistivity coefficient between the pins 2 by choosing the most suitable material for the object. By doing that, it is guaranteed not only that the electric switch 1 has an improved insulation between the pins 2, but that it is also more compact, that is the space occupied is optimized without the risk of electric losses or the risk of damages due to electric discharges between the pins 2 caused by the perforation of the dielectric. In other words, the higher cost of the material used is compensated by less material used and by a higher quality of the obtained product.

Furthermore, the use of thermoplastic materials allows to mould the bar 3 on pins 2. This inevitably leads to a remarkable saving in terms of building costs because of such easier implementation. In fact, there are fewer implementation steps, since it is not necessary to pierce the bar 3 and to insert the pins 2 on the holes. The components, besides this, with particular reference to the bar 3, are less subject to damage or breaks since they are not subjected to stresses like perforation or forced insertion of the pins 2.

As concerns the specific thermoplastic material, this is a non-limiting characteristic of the patent. However, a good example is a 30% glass-filled polyamide.

A fundamental aspect for the electric switches of electric transformers is that the pins 2 are stably coupled to the bar 3. To reach such result, the pins 2 of the electric switch of the invention have, as observed in the particular of fig. 3, on the outer surface 5 and in correspondence to the first through holes 4, a shaping 6 which interacts with a counter-shaping 7, visible in fig. 4, realized on the inner surface 8 of the first through holes 4 in order to prevent the rotation and the sliding of the pins 2 on the same first through holes 4.

Advantageously, the contrast between shapings 6 and counter-shapings 7 allows to avoid movements of the pins 2 in the first through holes 3 without the necessity of using clamping nuts, sealants, crimping or other. It is also noted that, since the bar 3 is moulded on the pins 2, the counter-shapings 7 are automatically obtained during the production process of the bar 3 and there is no risk of breaks or damage of the bar 3 or of the pins 2 during the insertion of the latter due to the possibly protruding shapings 6, since no insertion operation is necessary. Besides that, advantageously, the moulding process allows to reach a nearly perfect adhesion between shapings 6 and counter-shapings 7 guaranteeing that between the pins 2 and the first through holes 4 there is no play.

According to an aspect of the invention, the shaping 6 comprises a plurality of first protrusions 10 susceptible to fit themselves in respective first recesses 11 realized in the inner surface 8 of the first through holes 4. In particular, the first protrusions 10 are constituted by ribs 12 which develop along

the longitudinal extension axis X of the pin 2. Such plurality of ribs 12 constitutes a knurled band on the outer surface 5 of the pins 2 which allows to prevent rotation of the pin 2 around its longitudinal extension axis X inside the respective first through hole 4.

Obviously, what has been described above is only one possible embodiment of the first protrusions which is non limiting for different embodiments of the invention. For example, there may be only one protrusion or the protrusions can be differently shaped then ribs.

According to a further aspect of the invention, the shaping 6 of the pin 2 comprises also a plurality of second protrusions 14. Such protrusions, too, are constituted by ribs 15 developing along the longitudinal extension axis X of the pin 2 and which are susceptible to fit themselves in respective second recesses 16 realized on the inner surface 8 of the first through holes 4. Such second protrusions are substantially aligned with the first protrusions 10 along the longitudinal extension axis X of the pin 2 and spaced from them, along the same longitudinal extension axis X, by a predefined distance. In this way, not only they contribute, together with the first protrusions 10, to prevent rotation of the pin 2 around itself, but they also contribute, always together with the first protrusions 10, to prevent the pin 2 from pulling out from the respective through hole 4. In fact, between the first 10 and the second protrusions 14 there is a natural depression which allows to reach such a result. In other words, between the first 10 and the second protrusions 14 an intermediate channel is defined 20 to hold the pin 2 in the bar 3.

Obviously what has been described above is just one possible embodiment of the second protrusions which is non limiting for other embodiments of the invention. For example, there may be only one protrusion and the protrusions may have shapings which differ from the ribs.

There may also be no protrusions. Especially in this case, according to another aspect of the invention, the shaping 6 comprises also an annular groove 21 susceptible to hold a corresponding third protrusion 22 realized in the inner surface 8 of the first through holes 4. The intermediate channel 20 mentioned above is then realized by such annular groove 21.

According to embodiments of the invention, the presence of the annular groove 21, together with first 10 and second protrusions 14, leads to an increase in the tightness of the pin 2 in the bar 3.

Let it be understood that the described embodiments are only a non limiting example of the invention. In fact, all the protrusions may be recesses and vice versa. Also their shapings and their number are non limiting characteristics for the invention.

Previously it was stated that the bar 3 of the electric switch of the invention allows a higher insulation between the pins 2 than what is reached by the prior art. According to another aspect of the invention, the insulation is increased by making, as it is showed in fig. 5, a plurality of second through holes 30 which interpose individually or in groups between pairs of first through holes 4. In this way, the resistivity of the dielectric is increased.

In view of the foregoing, operatively it is enough to realize the pins 2 with the desired surface shaping 6. After that, the bar 3 is moulded on the pins 2 so that the shaping 6 is embedded in the bar 3. So, the electric switch system 1 is realized and ready to be used.

In light of the foregoing, it is evident that the electric switch for transformers of the invention overcomes the highlighted drawbacks of the prior art, since it has limited costs even though it ensures the correct insulation between the pins. Especially, the implementation step is simplified and without risks of damaging the components.

The insulation between the pins is increased and this allows to put them closer making, in this way, the electric switch more compact and using less material.

The electric switch for electric transformers of the invention is susceptible to many changes and variants, all falling within the inventive concept expressed in the annexed claims. All particulars may be replaced by other technically equivalent elements, and the materials may be different according to the needs, without departing from the scope of the invention.

While the electric switch for electric transformers has been described with particular reference to the accompanying figures, the numerals referred to in the

disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

CLAIMS

1. An electric switch for electric transformers comprising:

- a plurality of pins (**2**) for the electric contact;
- at least one supporting bar (**3**) provided with a plurality of first through holes (**4**) suitable to stably accommodate said pins (**2**),

characterized in that said pins (**2**) have on the outer surface (**6**) and in correspondence to said first through holes (**4**) a shaping (**6**) which interacts with a counter-shaping (**7**) realized on the inner surface (**8**) of said first through holes (**4**) so as to prevent the rotation and the sliding of said pins (**2**) in said through holes (**4**).

2. Electric switch according to claim 1, **characterized in that** said shaping (**6**) comprises at least one first protrusion (**10**) susceptible to fit itself in a respective first recess_(**11**) realized in said inner surface (**8**) of said first through holes (**4**).

3. Electric switch according to claim 1 or 2, **characterized in that** said shaping (**6**) comprises at least one second protrusion (**14**) substantially aligned along the longitudinal extension axis (**X**) of said pin (**2**) with said first protrusion (**10**) and spaced from it, along said longitudinal extension axis (**X**), by a predefined distance to define an intermediate channel (**20**) to hold said pin (**2**) in said bar (**3**), said second protrusion (**14**) being susceptible to fit itself in a respective second recess (**16**) realized in said inner surface (**8**) of said first through holes (**4**).

4. Electric switch according to one of the preceding claims, **characterized in** comprising an annular groove (**21**) capable to hold a corresponding third protrusion (**22**) realized in said inner surface (**8**) of said first through holes (**4**).

5. Electric switch according to any of the claims from 1 to 3, **characterized in** comprising an annular protrusion susceptible to fit itself into a corresponding third recess present in said inner surface of said first through holes.

6. Electric switch according to any of the preceding claims, **characterized in that** said bar (**3**) is made by overmolding thermoplastic

material on said pins (**2**).

7. Electric switch according to claim 6, **characterized in that** said thermoplastic material is glass-filled polyamide.

8. Electric switch according to any of the preceding claims, **characterized in that** said protrusions (**10**, **14**) are each constituted by a knurled annular band realized on the outer surface (**5**) of said pins (**2**).

9. Electric switch according to any of the preceding claims, **characterized in that** said bar (**3**) comprises a plurality of second through holes (**30**) individually or in groups interposed between pairs of said first through holes (**4**).

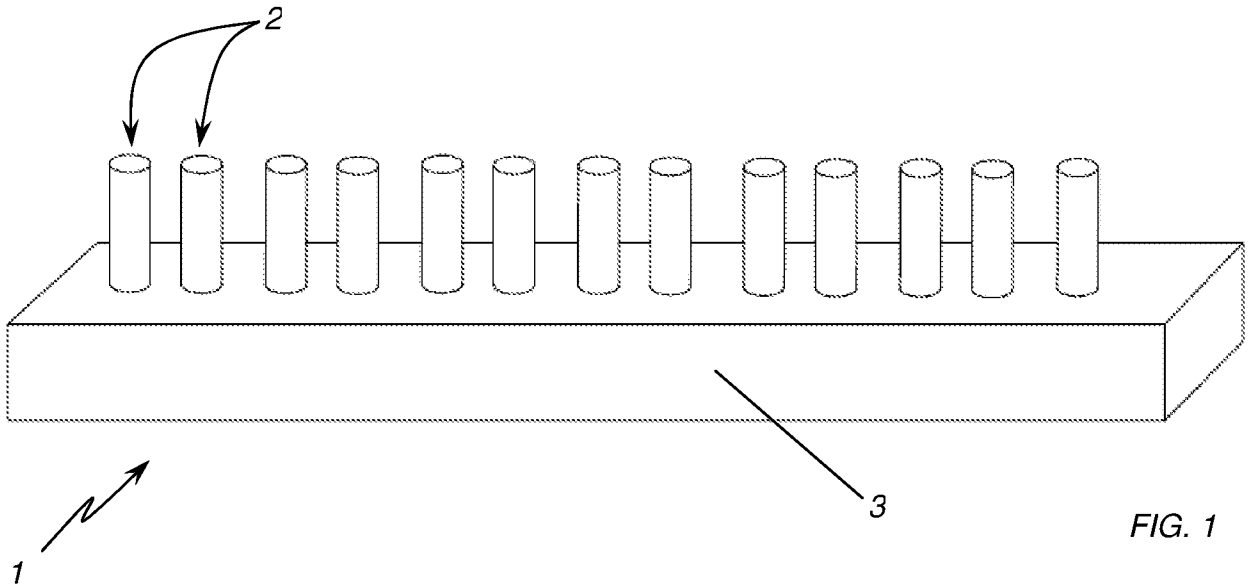

FIG. 1

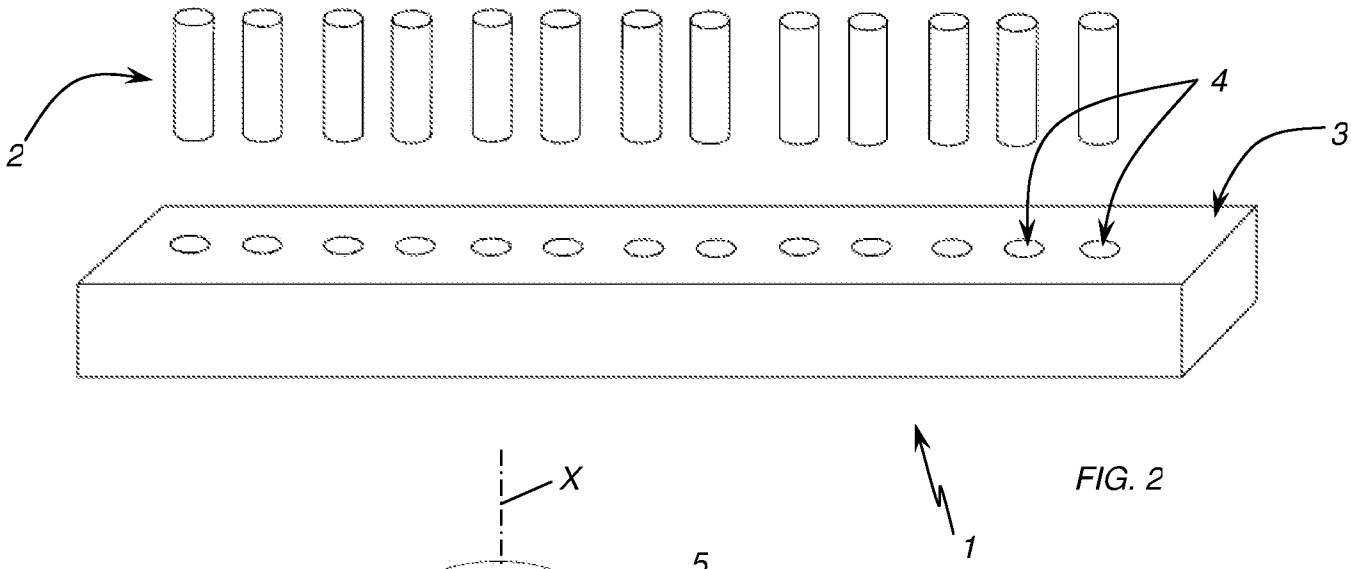

FIG. 2

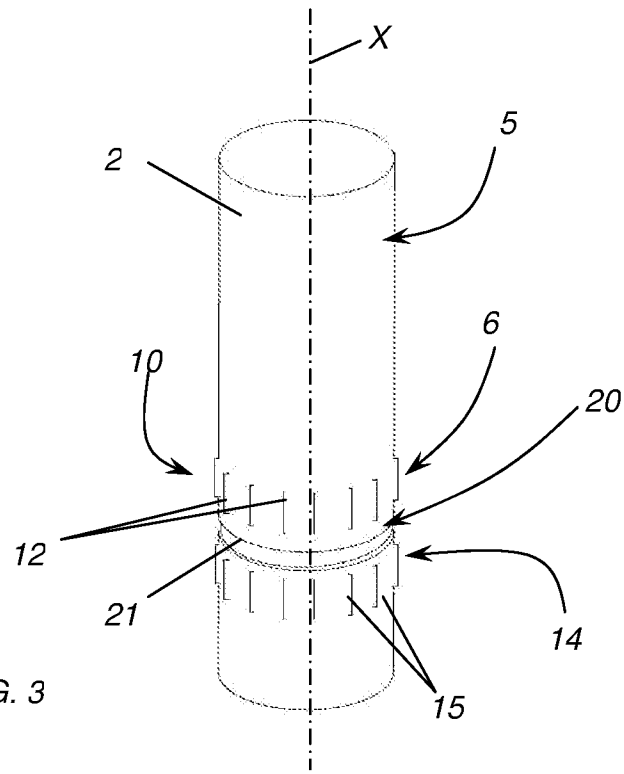

FIG. 3

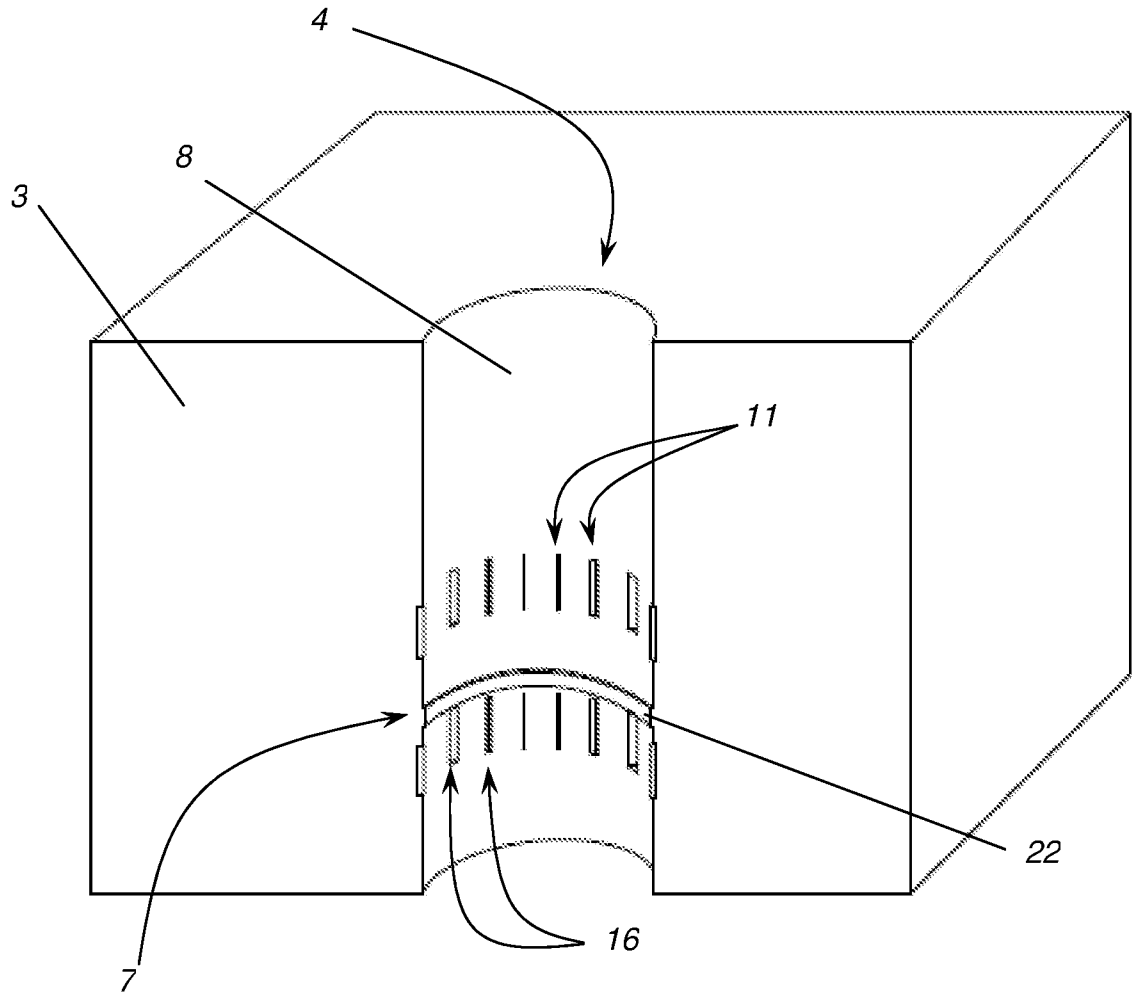

FIG. 4

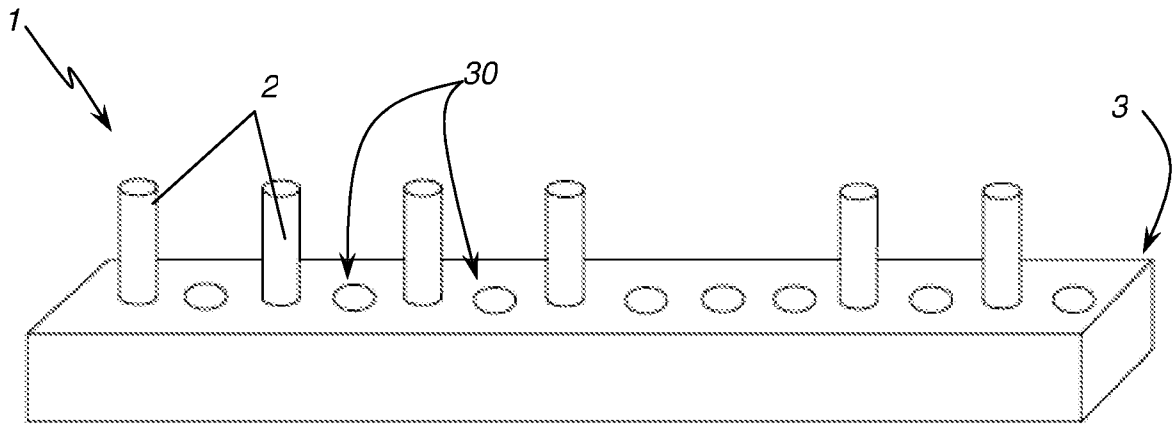

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/058669

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01H9/00 H01H11/06
ADD.

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)
H01H

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 practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 388 903 A (M.GERARDIN, J.PELATAN) 12 February 1965 (1965-02-12) the whole document	1-9
A	DE 42 36 528 A1 (REINHAUSEN MASCHF SCHEUBECK [DE]) 3 June 1993 (1993-06-03) the whole document	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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)

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"P" document published prior to the international filing date but later than the priority date claimed

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
1 May 2014	12/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Simonini, Stefano

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/058669

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1388903 A	12-02-1965	NONE	
DE 4236528 A1	03-06-1993	NONE	