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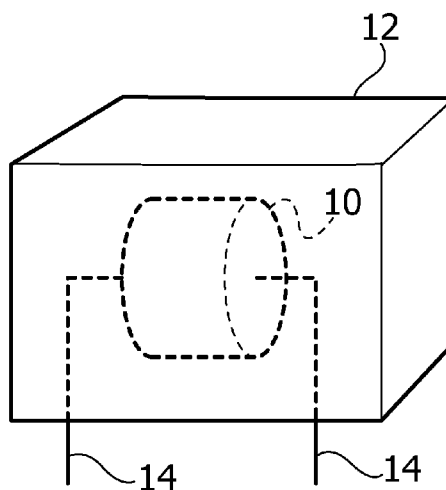
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(54) Title: ELECTRONIC COMPONENT WITH PROTECTION CASING AND RELATED PRODUCTION METHOD

FIG. 2



(57) Abstract: An electrical component (10) includes a component body enclosed in a protection casing (12) for mounting onto a printed circuit board with a Pin-In-Hole or PIH technique, or with a Surface Mount Technology or SMT. The casing (12) defines around the body of the component (10) a volume which, instead of being filled with a potting mass, is left empty, i.e. filled with a mass of gas, so as to avoid worsening the spark gap characteristics in the case of the triggering of electric arcs.

"Electronic component with protection casing and related production method"

* * *

Field of the invention

5 This disclosure relates to techniques for producing electronic components provided with protection casings.

This disclosure was devised with specific attention paid to its possible application to components adapted to be mounted onto printed circuit boards (PCBs), of the type currently known as Pin-In-Hole (PIH) or Surface Mount Technology (SMT). Such components can be used, for example, in Electronic Control Gear (ECG) for light sources.

15 Description of the related art

PIH components usually comprise a component body, with one or more (e.g. two) pins for mounting onto a printed circuit board. Such pins are adapted to perform, e.g. via a wave soldering mechanism, both the electrical and the mechanical connection of the component on a PCB, through the insertion of the pins into corresponding holes provided in the PCB: hence the name Pin-In-Hole or PIH.

Particularly in view of an outdoor use, these components are provided with a protection casing, which is filled with a resinous mass currently known as "potting" mass.

For example, such a resinous material can be one of the materials known as "Potting Asphalt CHP1" or "Potting Asphalt AP2000".

Experiences during the use of the previously mentioned components (and similar considerations also apply to components adapted to be mounted on a PCB with an SMT technique) show that the presence of the casing leads to an alteration of the behaviour of the

circuit/component itself, as far as its spark gap is concerned: once the component is inserted into the casing, the component is more susceptible to an undesired triggering of electric arcs, due to the ionisation of the mass of gas (typically air) present within the component. This dielectric "breakdown" causes malfunctions in the component that may jeopardise its operation and its safety.

The presence of a protection casing with a potting mass within is traditionally considered to be an essential need, particularly in view of environmental conditions such as those encountered in outdoor use.

Object and summary of the invention

The object of the invention is to overcome the previously described disadvantage, therefore allowing the production of electronic components which, albeit provided with a protection casing, are not subjected to drawbacks as concerns their spark gap behaviour.

According to the invention, such an object is achieved through a component having the features set forth in the claims that follow.

The invention also concerns a related method.

The claims are an integral part of the technical teaching of the invention provided herein.

Various embodiments are based on the acknowledgement of the fact that, rather unexpectedly, such a worsening of the spark gap behaviour is not due in general to the presence of the protection casing, but is to be attributed particularly to the potting mass surrounding the component within the casing.

Various embodiments propose therefore to provide the component with the above-mentioned casing, with the provision of leaving the space between the component body and the protection casing empty, without resorting to the use of a potting mass.

In various embodiments, the resulting component will have a casing with exactly the same exterior appearance as a PIH or SMT component provided with a potting mass.

5 Brief description of the annexed views

The invention will now be described, by way of example only, with reference to the enclosed views, wherein:

10 - Figure 1 shows in general an electrical component,

 - Figure 2 shows an embodiment of a component provided with a casing, and

 - Figures 3 - 5 show the operation modes of various embodiments of the invention.

15 Detailed description of embodiments

 In the following description, numerous specific details are given to provide a thorough understanding of embodiments. The embodiments can be practiced without one or more of the specific details, or with 20 other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the embodiments.

 Reference throughout this specification to "one 25 embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various 30 places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

The headings provided herein are for convenience only and do not interpret the scope or meaning of the embodiments.

5 In Figure 1, reference 10 denotes in general a PIH (Pin-In-Hole) electrical component, comprising a component body whence one or more (for example two) pins protrude.

10 These pins are adapted to perform, for example through a wave soldering mechanism, both the electrical and the mechanical connection of the component on a PCB (not shown in the drawings). This is achieved through the insertion of the pins in corresponding holes provided in the PCB; hence the name Pin-In-Hole or PIH.

15 Components of this kind can be employed in electronic control gear (ECG) such as ballasts, in such a way as to control lighting sources such as halogen lamps or LED lamps.

20 A component 10 of this kind (once again, similar considerations apply to components adapted to be mounted onto a PCB with the SMT technique) can experience, for example in case of overvoltage at its end, an undesired triggering of ionised gas arcs.

25 In Figure 2, which equally refers e.g. to a PIH component, reference 12 denotes a casing which is adapted to enclose component 10, forming a closed structure (for example hermetic) whence one or two pins 14 protrude which, as has already been said, are adapted to achieve, for example through a wave soldering mechanism, both the electrical and the
30 mechanical connection of the component onto a PCB.

Casing 12 can be made of any non-metallic material (for example plastic) adapted to withstand the high temperature (e.g. up to 150°C) which develops when, according to a traditional solution, the space or

volume defined by the wall of the casing 12 around component 10 is filled by a potting mass.

In various embodiments, the presently described component 10 is enclosed within casing 12 without inserting a potting mass into the above mentioned space or volume.

Stated differently, in the presently considered embodiments casing 12 makes up a sort of cap, which protects (according to the current solution for PIH components) the body of component 10. The inner space of casing 12 which surrounds component 10 is however left empty, because instead of a potting mass it contains air.

According to the tests carried out by the inventors, quite unexpectedly, the use of a casing of this kind, i.e. a casing without potting, allows on the one hand to preserve the ability to protect component 10 from the outer environment, and on the other hand to avoid a worsening of the spark gap characteristics of the component 10 itself.

Figure 3 shows a possible explanation of such a behaviour, based on a schematic diagram of what takes place in an electromagnetic field E , H at the interface between a first volume $V1$ having a dielectric constant ϵ_1 and a magnetic permeability μ_1 , and a volume $V2$ surrounding volume $V1$ and having a dielectric constant ϵ_2 and a magnetic permeability μ_2 if ϵ_2 is higher than ϵ_1 .

Figure 3 shows that in such conditions a general electromagnetic field undergoes a "deflection" event, so that a field which, within volume $V1$, is generally oriented towards outside volume $V1$ is so to say "deflected" at the transition into volume $V2$ and therefore it is deviated towards volume $V1$.

Specifically, by applying Stokes' Law, it is possible to demonstrate that the following relation is true:

$$E_{n1}/E_{n2} = \varepsilon_2/\varepsilon_1$$

- 5 In other words, the component E_{n1} of the electric field, which is oriented radially with respect to volume V1, is reduced, while transitioning to volume V2, to a value E_{n2} decreased by a value amounting to the ratio between the dielectric constants ε_2 (outer
10 volume V2) and ε_1 (internal volume V1).

- Figures 4 and 5 show the practical utility of this observation referred to the case of a volume V1, having an ellipsoidal shape with dielectric constant ε_1 , surrounded by a (virtually endless) volume V2,
15 containing a medium with dielectric constant ε_2 , having
- a value which approximately equals the value of ε_1 (Figure 4),
 - a higher value than ε_1 , e.g. with a ratio $\varepsilon_2/\varepsilon_1=3$ (Figure 5).

- 20 Such a ratio, amounting to 3, is generally representative of the ratio between the dielectric constants which are likely to occur between a currently employed material for a potting mass of a PIH or SMT component and air.

- 25 In the cases of both Figure 4 and 5, one may assume that the dividing surface between volume V1 and volume V2 consists of a casing of a generally thin material, whose dielectric characteristics can in practice be neglected for the purposes of what has been
30 described herein.

- Figures 4 and 5 show (in a schematic and illustrative way) the possible behaviour of the electric field lines that develop between two facing tip electrodes A and B, between which a direct voltage
35 is applied with value V.

In the case of Figure 4 (i.e. ϵ_2 equal or approximately equal to ϵ_1 , i.e. a case representative of a possible situation wherein volume V1 is filled with air and is surrounded by a volume V2 which is filled with air as well), the distribution of the electric field lines is in many respects "widened" as compared with the situation of Figure 5 (i.e. for example ϵ_2 three times as high as ϵ_1 , a case representative of a possible situation wherein volume V1 is filled with air and is surrounded by a volume V2, which is filled with a potting mass) wherein, under the application of the same voltage V, the electric field lines are much more concentrated towards volume V1 as a consequence of the inward deflection effect, schematically referred to in Figure 3.

In the case shown in Figure 5, the dielectric breakdown (i.e. for instance the triggering of ionised gas arcs within volume V1) can occur for voltage values V which are lower than the case referred to in Figure 4. In other words, in the situation of Figure 5, if the other conditions are the same, within volume V1 undesired phenomena of dielectric breakdown are more likely to occur.

The presently disclosed solution makes use of this very feature, by surrounding component 10, as regards the internal volume of casing 12, with an air buffer (and not with a potting mass, which would be likely to worsen the spark gap characteristics of component 10).

Of course, without prejudice to the underlying principle of the invention, the details and the embodiments may vary, even appreciably, with respect to what has been described by way of example only, without departing from the scope of the invention as defined by the claims that follow.

CLAIMS

1. An electrical component (10) including a component body enclosed in a protection casing (12) for mounting onto a printed circuit board with a Pin-In-Hole or PIH technique or with a Surface Mount Technology or SMT technique, said casing (12) defining a volume around the body of the component (10), wherein said volume is filled with a mass of gas.

10

2. The device of claim 1, wherein said gas is air.

3. The device of claim 1 or claim 2, wherein said casing (12) is hermetic and is traversed by one or more pins (14).

15

4. A method of producing an electrical component (10) including a component body enclosed in a protection casing (12) for mounting onto a printed circuit board with a Pin-In-Hole or PIH technique or with a Surface Mount Technology or SMT technique, said casing (12) defining a volume around the body of the component (10), including leaving said volume filled with a mass of gas.

20
25

FIG. 1

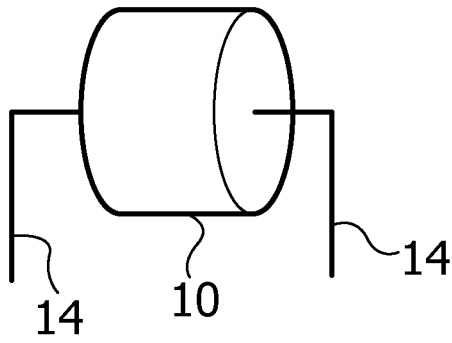


FIG. 2

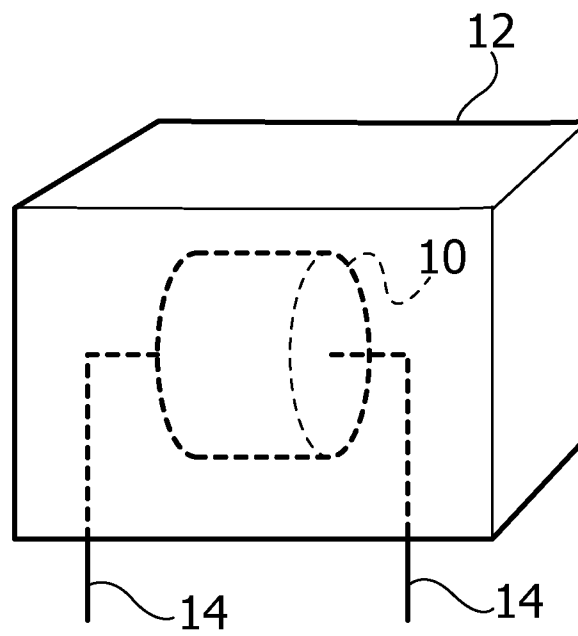


FIG. 3

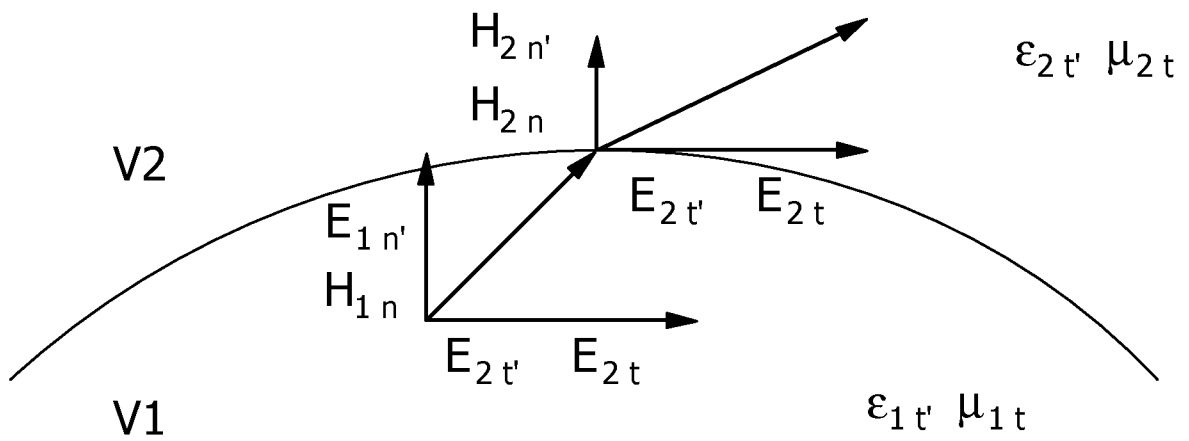


FIG. 4

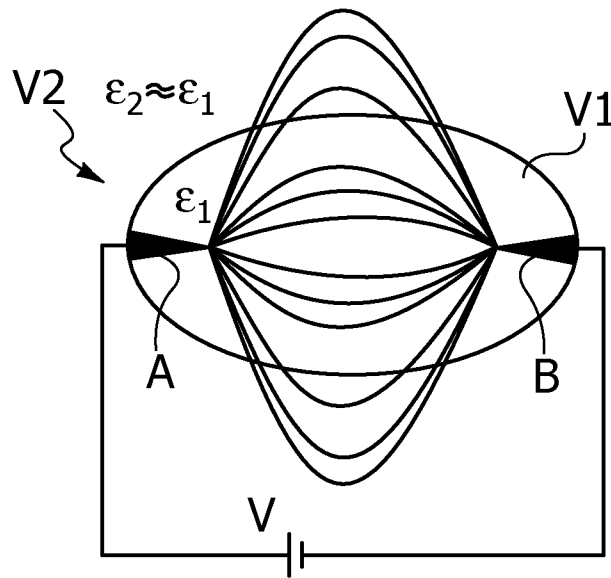
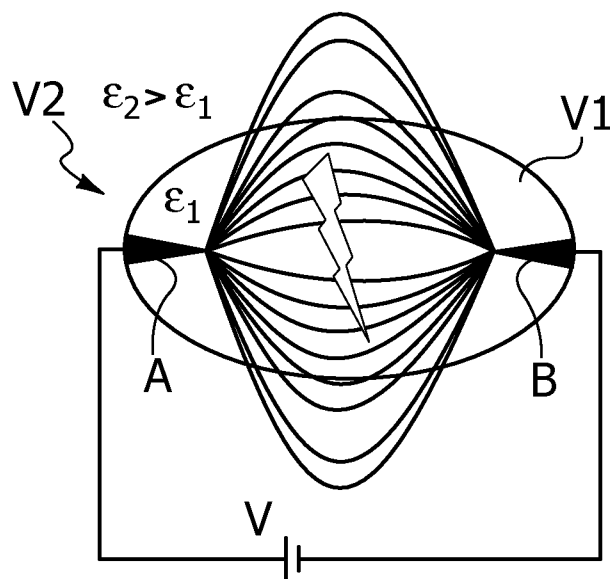


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L21/54 H01L23/20 H01L23/053 H01L23/055 H01L23/057
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)
H01L

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 111 199 A (WYLAND CHRISTOPHER P [US] ET AL) 29 August 2000 (2000-08-29) figure 2B column 6, lines 20-22 column 6, paragraph 32-33 column 6, lines 39-41 -----	1-4
X	EP 0 122 687 A2 (MITSUBISHI ELECTRIC CORP [JP]) 24 October 1984 (1984-10-24) figure 7 -----	1-4
X	WO 94/22168 A1 (OLIN CORP [US]) 29 September 1994 (1994-09-29) figure 2 -----	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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