PATENT SPECIFICATION (11) 1 574 356

1 574 356

(21) Application No. 9966/77 (22) Filed 9 Mar. 1977 (19)

(31) Convention Application No. 2616299 (32) Filed 13 Apr. 1976 in

(33) Fed. Rep. of Germany (DE)

(44) Complete Specification Published 3 Sep. 1980

(51) INT. CL.[3] H05K 5/06

(52) Index at Acceptance
H1N 302 343 368 616 703 744 805
H2E 18

(54) IMPROVEMENTS IN OR RELATING TO ELECTRICAL COMPONENTS

(71) We, SIEMENS AKTIENGESELLSCHAFT, a German Company of Berlin and Munich, German Federal Rupublic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to electrical components, for example, relays, having casings with joins or apertures therein which require to be sealed, and to a method of sealing such joins or apertures.

Where electrical components are used on circuit boards, modern soldering techniques require that, not only the circuit boards themselves, but also the individual components, are at least partially immersed in soldering and cleaning baths. This involves the risk of liquid and gaseous substances penetrating through gaps and apertures in the casing into the interior of a component and there contaminating vulnerable elements, such as contact surfaces. Components such as, for example, relays which are usually merely provided with a dust cap but are not equipped with a hermetically sealed casing, would become much more expensive if such a hermetically sealed casing had to be provided just for protection during the soldering process, such a casing being unnecessary for their subsequent operation. Consequently, many attempts have been made to make such components fluid-tight before they are soldered onto circuit boards using simple and inexpensive protection means, which will, at the same time, give them a certain degree of protection against the damaging effects of industrial atmospheres.

In the case of relays, the problem is mainly one of sealing the joints between the casing base and the protective cap and also the apertures provided in the base for the contact connections. Various possibilities have already been suggested for this, for example thermoplastic distortion of the parts of the casing using ultrasonics or using a hot die, or by potting the casing in a synthetic resin mass. In many cases, these methods only provide the desired degree of sealing at the cost of an increased expense; potting materials can rarely be used, because the potting material itself may flow inside the casing and thus produce contamination. In Germany Patent Specification No. 2,129,918, it is proposed to fit a thermoplastic insulating element in the form of a film or shell with close-fitting holes over the connecting pins. Even this method does not provide adequate sealing in every case, since such films are frequently affected by temperature and become distorted and then possibly no longer fit snugly enough around the connecting pins of the component to provide an adequate seal.

It is an object of the present invention to provide an electrical component which is reliably sealed against contamination during soldering without any great increase in the production costs.

According to one aspect of the invention, there is provided an electrical component having a casing with an outer surface having at least one join or aperture therein, the or each said join or aperture being sealed by a layer of capillary absorbent material extending over said surface to cover the or each said join or aperture, the absorbent material having been impregnated with a sealing material in the form of a mobile liquid, which liquid sealing material has subsequently solidified or hardened.

According to another aspect of the invention, there is provided a method of sealing an electrical component having a casing with an outer surface with one or more joins or apertures therein, comprising the steps of covering said surface with a dry layer of a

capillary absorbent material so as to cover said one or more joins or apertures, causing a sealing material introduced into said layer in the form of a mobile liquid to spread over said surface, and thereafter allowing said liquid to solidify or hardening the liquid.

The absorbent material used in accordance with the invention, which may be in the form of a fibrous mat, causes the sealing material to spread in a very uniform manner over the entire surface of the component to be sealed, so that by means of capillary forces a uniformly thin covering layer is produced. This only leads to a minimal increase in the overall height of the component. In addition, the absorbent material holds the sealing material securely, so that it can neither contaminate projecting connecting pins nor flow through apertures in the casing into the interior of the component in undesirably large quantities, which has previously been a danger when adhesives and similar sealing means were used. Preferably, the absorbent material is cut exactly to a size such that it extends to the edges of the surface to be sealed, so that even peripheral apertures, for example between the base and a protective cap in a relay, are reliably sealed.

With randomly matter absorbent material spreads uniformly in a concentric manner, but with longitudinally orientated fibrous mats it spreads more rapidly in the direction of orientation. To ensure that the absorbent material layer is completely impregnated in the shortest possible time, it may be advantageous to seal elongate components using longitudinally orientated fibrous mats. The absorbent covering layer can previously be provided with holes to accommodate projecting parts of the component, before it is fitted onto the component. In many applications, however, it may be advantageous from the production viewpoint not to provide the covering layer with holes beforehand but to perforate it using the projecting connecting pins of the component when the layer is fitted onto the component. Differences in level or parts located on the surface of the component can also be sealed off with the absorbent covering layer used in the invention; the thickness of the layer is then preferably greater than the difference in level in the surface to be sealed. To adapt the covering layer to differences in level in the surface of the component, the layer can be pressed down using a die; this die preferably has a surface that cannot be wetted by the sealing material, for example, a surface of polytetrafluoroethylene. The sealing material absorbed by the covering layer may be such as to solidify on cooling, or can even be hardened depending upon the application for which it is to be used.

In one embodiment of the invention, the absorbent covering layer is additionally coated with an impermeable film on its side facing away from the component. Such a film is easy to stamp or provide with lettering and can also be die-pressed, for example, to accommodate relatively large differences in level of the surface of the component. Naturally, the use of such an impermeable film ensures better sealing because its powers of adhesion can also act to hold the fibrous mat in position. In this way, fairly large apertures can be sealed well using relatively thin fibrous mats. In addition, it is also possible first to reduce the size of large apertures using an impermeable film, or even to cover them over altogether, and then to apply the absorbent covering layer in the manner described.

Advantageously, such an impermeable film can be arranged to act as a carrier for the absorbent covering layer which can, for example, be applied to the die-pressed film electrostatically. By the use of appropriate measures, the absorbent covering layer can also be applied directly to the component by electrostatic means. In both methods, it is expedient to provide a thin coating of an adhesive to hold the covering layer in position. When impregnating the absorbent material, it is desirable to provide the impermeable film with a filling aperture for the entry of the liquid sealing composition. In certain cases, it may be advantageous for the component to exhibit a depression in the area of the filling aperture. Channels emanating from such a depression may also be useful in many sealing operations. Instead of carrying out the impregnation of the absorbent material through a filling aperture, the component can also be at least partially dipped into a mobile liquid casting resin composition. In this case, the sealing compound is again uniformly spread through the absorbent fibrous mat. In this case, when removing the component from the casting resin, it must be ensured that the thin liquid casting resin composition is allowed to run off at an angle at one corner of the component.

The invention will now be further described with reference to the drawings, in which :-

Figure 1 is a schematic side view of part of an electrical component in accordance with the invention;

Figure 2 is a schematic side-sectional view of a relay in accordance with the invention;

Figure 3 is a plan view of the relay of Figure 1 with the absorbent material layer removed;

Figure 4 is a plan view of an absorbent material layer for use in the relay of Figures 2 and 3;

Figure 5 is a schematic side-sectional view of a part of a modified form of the relay of

Figures 2 and 3;

Figures 6 to *9* are similar schematic side-sectional views of parts of four different components according to the invention; and

Figure 10 is a schematic side-sectional view of impregnating apparatus for use in producing a component according to the invention.

Referring to Figure 1, an electrical component 1 has a casing surface which is broken by a projecting pin 2 and an aperture 3; a gap 4 is also present around the pin 2. The entire area of this surface is sealed by means of a covering layer 5 which is made of an absorbent material in the form of a fibrous mat, and is impregnated with a mobile liquid casting resin composition. This sealing composition is uniformly distributed within the covering layer because of the capillary action of the latter and at the same time is securely held by the fibrous mat so that the composition fits snugly around the pin 2 but does not run far into the apertures 3 and 4. To avoid contamination of the connecting pin 2, the fibrous mat is applied in the dry state and is then impregnated using a device adapted to deliver a predetermined amount of the liquid casting resin composition. However, a pre-impregnated material can be used, provided this is also dry when fitted and that the sealing compound can be re-liquefied by heating after fitting of the fibrous mat has been carried out.

Figure 2 shows an electromagnetic relay 11 according to the invention having a protective cap 12 and a base 13 in which gaps around connecting pins 14 and a gap 15 between the base and the protective cap are to be sealed. For this purpose, an absorbent fibrous mat 16 is provided which reliably seals not only the gaps round the connecting pins 14 but also unused apertures 17 in the base (see Figure 3). The fibrous mat is cut as shown in Figure 4 either so that it can be laid over the edge of the cap 18 as shown in Figure 2, or pressed into the cap 12 as shown in Figure 5. At the points corresponding to the positions of the contact pins 14, the fibrous mat 16 is provided with slots 19. At a suitable point sufficiently far from the connecting pins (so that these are not contaminated), a metered quantity (which does not have to be very accurately metered) of mobile liquid adhesive 20 is dripped onto the pressed-on fibrous mat (see Figure 2). With a thickness of the fibrous mat of only a few tenths of a millimetre, which is all that is necessary, the height of the relay is only minimally increased by the sealing means.

Figures 6 to 9 illustrate various embodiments of the invention. Figures 6 and 7 show a component 21, the surface to be sealed of which shows differences in level because of members 22 and 23 lying on the surface. In such cases also, sealing with an absorbent covering layer 24 is possible if the impregnated fibrous mat is pressed down with an appropriate die which will not stick to the impregnating material. With this method also, recesses in the surface to be sealed do not have any adverse effect on the quality of the seal. If possible, however, differences in level ($h1$ in Figure 7) in the surface to be sealed should not be greater than the thickness $h2$ of the impregnated fibrous mat 24.

Another embodiment of the invention is illustrated in Figure 8 where a component 31 having a casing surface with an aperture 32, a connecting pin 33 and a protective cap 34 is covered with an impregnatable covering layer 35. This layer 35 is provided with a covering of an impermeable film 36, so that when applied with a tamping die, for example, no adhesive sealing compound appears on the surface of the covered component. A filling aperture 37 is provided for impregnating the layer 35. In addition, a depression 38 is provided in the surface of the component to be sealed in the region of the filling aperture so that the layer 35 can suck up the sealing compound from its underside 39 over a larger area. The film 36 can easily be stamped and provided with lettering, which is advantageous with many components. The layer 35 may be applied to an adhesive layer applied either to the film or to the surface to be sealed.

Figure 9 shows a modification of the method of sealing used in the component of Figure 8. In this, the film 41 is die-pressed so as to seal even greater differences in level in the surface of the casing to be sealed. The film 41 is covered with an absorbent fibrous mat 42 and is provided with a filling aperture 43 as in Figure 8. An adhesive layer 44 is previously provided between the impermeable film and the absorbent fibrous mat to secure the two together. The coating operation itself can be carried out electrostatically, for example, or by any other suitable method.

Instead of impregnating the fibrous mat through a filling aperture as in the embodiments of Figures 8 and 9, other methods can be used; one of these is illustrated in Figure 10. In this method, a component 51 to be sealed is dipped in a mobile liquid casting resin composition 52 to an extent such that the fibrous mat 54 coated with an impermeable film 53 can absorb the sealing composition 52 at its uncovered edge. Through the capillary action of the fibrous mat 54, the casting resin composition spreads uniformly over the surface of the component and provides a seal after setting. When the component is removed from the liquid sealing composition 52, it must be ensured that the mobile liquid casting resin composi-

tion can run off from a corner by holding the component at an angle.

As previously mentioned, pre-impregnated fibrous mats can also be used to provide the covering layer used in the invention. These are impregnated with a resin which is still not cross-linked. The resin is softened again when it is heated after the covering layer has been applied to the component, and only then does cross-linking start. The liquefied resin spreads in the desired manner by virtue of the capillary action of the fibrous mat and seals the component reliably when it sets. Naturally these pre-impregnated covering layers can also be stamped in the manner previously described and made to adapt to differences in level in the surface of the component, i.e. pressed down with a tamping die.

When a tamping die is used to press down the covering layer, it may at the same time serve to imprint lettering in the covering layer, or the impermeable film, when such a film is used.

WHAT WE CLAIM IS:-

1. An electrical component having a casing with an outer surface having at least one join or aperture therein, the or each said join or aperture being sealed by a layer of capillary absorbent material extending over said surface to cover the or each said join or aperture, the absorbent material having been impregnated with a sealing material in the form of a mobile liquid, which liquid sealing material has subsequently solidified or hardened.

2. A component as claimed in Claim 1, wherein said layer is provided with apertures for the passage of parts which project from said surface.

3. A component as claimed in Claim 1 or Claim 2, wherein said layer is shaped to conform to differences in level in said surface.

4. A component as claimed in any one of Claims 1 to 3, wherein said sealing material is hardenable.

5. A component as claimed in any one of the preceding Claims, wherein said layer is covered with an impermeable film at its side remote from said surface.

6. A component as claimed in Claim 5, wherein said absorbent layer is fixed to the innerside of said impermeable film.

7. A component as claimed in any one of Claims 1 to 5, wherein said absorbent layer is fixed to said surface of the casing.

8. A component as claimed in Claim 6 or Claim 7, wherein said layer is fixed to said film or said surface by means of an adhesive layer.

9. A component as claimed in Claim 5 or Claim 6, or either of Claims 7 and 8 as appendent thereto, wherein said impermeable film is provided with a filling aperture for the introduction of said sealing material.

10. A component as claimed in Claim 9, wherein in the region of said filling aperture said surface has a depression the diameter of which is greater than that of said filling aperture.

11. A component as claimed in Claim 5 or Claim 6, or any one of Claims 7 to 10 as appendent thereto, wherein said impermeable film is die-pressed to adapt it to the contours of said surface.

12. A component as claimed in Claim 5 or Claim 6, or any one of Claims 7 to 11 as appendent thereto, wherein said impermeable film is provided with stamped markings.

13. A component as claimed in any one of the preceding Claims, wherein said sealing material is a composition which can be re-liquefied after application on the component.

14. An electrical component, substantially as hereinbefore described with reference to and as illustrated in Figure 1, or Figures 2 to 4, or any of Figures 5 to 9, of the drawings.

15. A method of sealing an electrical component having a casing with an outer surface with one or more joins or apertures therein, comprising the steps of covering said surface with a dry layer of a capillary absorbent material so as to cover said one or more joins or apertures, causing a sealing material introduced into said layer in the form of a mobile liquid to spread over said surface, and thereafter allowing said liquid to solidify or hardening said liquid.

16. A method as claimed in Claim 15, wherein said layer is cut exactly to the size of the surface to be sealed before it is applied to said surface, and is provided with slots for the passage of parts of said component projecting from said surface.

17. A method as claimed in Claim 15 or Claim 16, wherein said mobile liquid is dripped onto said layer after said layer has been applied to said surface.

18. A method as claimed in any one of Claims 15 to 17, wherein said layer is applied to said surface by electrostatic coating.

19. A method as claimed in Claim 15 or Claim 16, wherein said layer is covered with an impermeable film before it is applied to said surface, and is applied to said surface as a sandwich with the absorbent layer adjacent said surface.

20. A method as claimed in Claim 19, wherein said layer is applied to said impermeable film by electrostatic coating.

21. A method as claimed in Claim 18, wherein said layer is applied to a layer of an adhesive previously applied to said surface.

22. A method as claimed in Claim 19 or Claim 20, wherein said layer is applied to a

layer of an adhesive previously applied to said film.

23. A method as claimed in any one of Claims 19 to 22, wherein said impermeable film is adapted to the contours of the component to be sealed by die-pressing.

24. A method as claimed in any one of Claims 19 to 23, wherein said layer is impregnated with said mobile liquid through a filling aperture in said film.

25. A method as claimed in any one of Claims 15 to 23, wherein said layer is impregnated by at least partial immersion of the component to be sealed in said sealing material in the form of a mobile liquid.

26. A method as claimed in Claim 15, wherein said layer is first impregnated with a solidifiable sealing composition and is thereafter applied to said surface in a dry state, said sealing composition then being converted to a mobile liquid by heating and caused to spread over said surface.

27. A method as claimed in any one of Claims 15 to 26, wherein said layer impregnated with sealing material is pressed onto said surface by means of a tamping die.

28. A method as claimed in Claim 27, wherein lettering is imprinted in said layer, or said impermeable film when present, by means of said tamping die.

29. A method of sealing an electrical component substantially as hereinbefore described with reference to the drawings.

For the Applicants.
G. F. REDFERN & CO.,
Marlborough Lodge,
14 Farncombe Road,
Worthing - West Sussex.

Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

1574356 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig.1

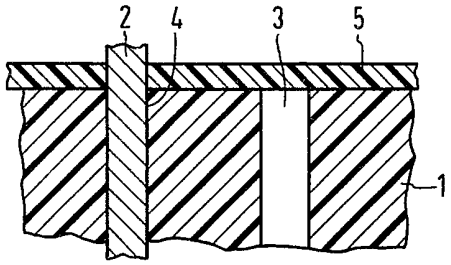

Fig.2

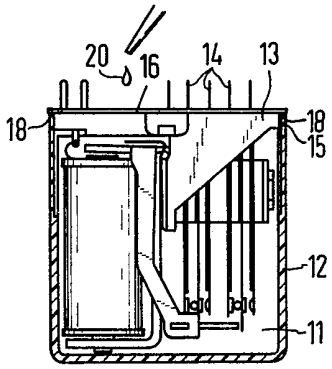

Fig.3

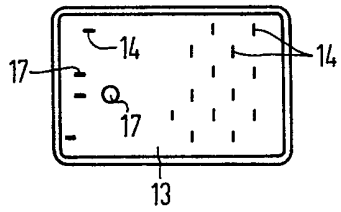

Fig.4

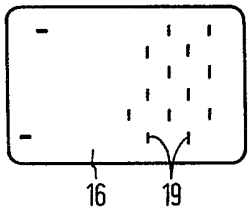

Fig.5

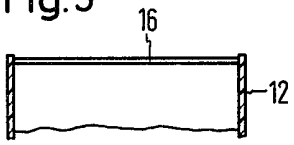

Fig.6

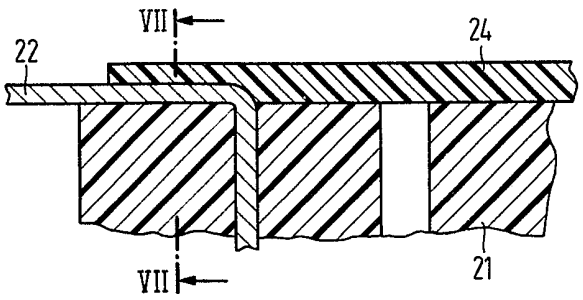

Fig.7

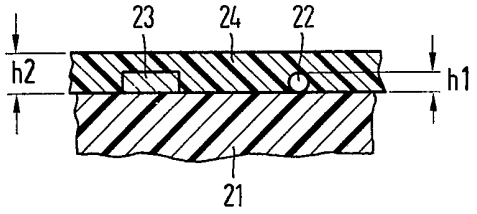

Fig.8

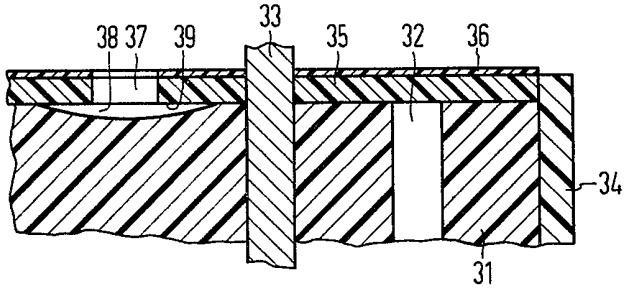

Fig.9

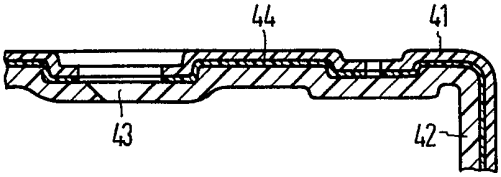

Fig.10