

PATENT SPECIFICATION

(11)

1 588 129

1 588 129

(21) Application No. 51558/76 (22) Filed 9 Dec. 1976

(23) Complete Specification Filed 7 Dec. 1977

(44) Complete Specification Published 15 Apr. 1981

(51) INT. CL.³ B32B 27/16
B05D 1/18

(52) Index at Acceptance
B2E 1120 1302 1722 FA

(72) Inventors: MICHEL FARRUGIA
MAXIME ALLARD

(19)



(54) PROCESSES FOR COATING OR SEALING ELECTRONIC COMPONENTS WITH SYNTHETIC VARNISHES

(71) We, S.A. DITE HELIC VAN CAUWENBERGHE, a French Company of 46 Rue Du Commandant Rolland, 93350 Le Bourget, France, 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:-

In the electro-technical industry processes are known for coating or sealing electrical or electronic components such as resistors, condensers, semi-conductors, hybrid circuits, self-induction coils, micro-processors and the like by means of various synthetic resin compositions, such as polyesters, epoxy, polyacrylates etc.

These compositions can be used in different processes, each of which combines certain advantages with disadvantages which limit its use.

For example, a casting process can be used, the compositions being prepared and immediately used to fill moulds in order to coat the electronic component in its final shape. In this way finished products having good mechanical and electrical qualities are obtained, but the process is little used, as it is too costly due to the limited life of the compositions and the long polymerisation time.

A transfer process can be used, i.e. injection under pressure of a powder (which can be thermo-set) into an automatic mould made up of the impressions of the component. Although high levels of production of products having sharply-defined geometrical shapes can be achieved in this way, the quality of these products is often mediocre, the necessary stripping agents often causing adhesion defects in the composition of the product.

A process of dipping can also be used either into a liquid composition, or into a powder, which can be thermo-set.

In the first case, the component is immersed in the liquid composition, which has been rendered thixotropic and which has a life of several days, then placed in an oven to undergo polymerisation. The process is economical and allows the achievement of high standards, but in addition to a very long polymerisation period, it has the inconvenience that the viscosity of the bath varies with time and sedimentation phenomena can be produced.

In the second case, the component is pre-heated to approx. 100°C and immersed several times into a bath containing powder in a fluidised state. When the desired thickness has been deposited, the coating is set in an oven. This is a rapid process and leads to high quality products, but it requires polymerisation at temperatures above 100°C.

The present invention achieves the advantages of all these processes without being limited by any of their inconveniences. It relies on the property, which is known in itself, of certain monomers to undergo extremely rapid polymerisation under ionising rays, such as ultraviolet rays or beta rays.

In accordance with the present invention there is provided a method of coating or sealing electrical or electronic components with a synthetic resin composition, comprising advancing each component along a fixed path through a coating station at which at least one surface of the component receives a coating of synthetic resin, and advancing each coated component further along the said path through a beam of ionising radiation for a period sufficient to induce polymerisation of the resin.

An advantage of this method is that the synthetic resins can be maintained at normal atmospheric temperatures at which they can have unlimited life.

The invention is illustrated here by way of examples and two methods of operation are described with reference to the attached drawings in which:

Figure 1 illustrates diagrammatically an installation for coating electrical components by a dipping process

Figure 2 illustrates diagrammatically a plan view of an installation for sealing electrical components, and

5 Figure 3 illustrates diagrammatically a side view of the installation of Figure 2. 5

Referring firstly to figure 1, it is seen that the electrical components 1, which are to be coated, are hung from a chain 2, which is unwound little by little and which pulls them between starting roll 3 and finishing roll 3' through three successive stages A, B and C, at a speed of progress dependent on the residue time of the components in the coating composition. 10

At stage A, a jack 5 supporting a trough 4, which is filled with a liquid composition of resin, as will be specified further on, is actuated to produce a reciprocating movement F, F'. When a component 1 arrives above the trough 4 in the low position, the trough is raised by means of the jack 5 up to the level of the component until the active part of the component is properly immersed. The level of the bath is regulated in terms of the thixotropy of the composition and the depth of insulating material to be placed on the wires leading from the component. 15

After some seconds inside the bath, the trough 4 is re-lowered and the chain 2 continues its progress towards stage B, constituted by a polymerisation tunnel 6 which is provided with a quartz tube, (power 83 watts/cm of tube length) filled with a xenon/mercury vapour mixture and fed by pulses in accordance with a known system. In addition, the tube is provided with two parabolic demi-reflectors producing two intersected beams. The exposure time of the component 1 at 10 cm. from the tube can vary from 0.6 seconds for 100 microns to 6 seconds for 400 microns of deposited composition. These items are valid for non-pigmented resins and would, of course be different for pigmented resins. 20

At the exit of the tunnel 6, the coating has finished polymerisation and the finished component 1 is advanced to stage C where it is released from the chain into a trough 7. 25

If figures 2 and 3 are now referred to, it can be seen that the components 10, placed in swivelling metal frames 11, are first coated or filled on one side with photo-sensitive resin from a proportioning machine 12. After filling or coating, each frame passes through a polymerisation tunnel 13, containing ultra-violet or beta ray generators. At the tunnel exit the frame swivels on its axis as shown by the arrow F and allows the other end of the component to be coated or filled from a proportioning machine 12'. The frame is then conveyed in the reverse direction by means of a conveyor belt 14 towards the polymerisation tunnel 13, as indicated by arrows F₂ and F₃. This process can be used with a wide variety of resin compositions and a list of possible compositions, along with essential, subsidiary constituents of these compositions, is given below. 30

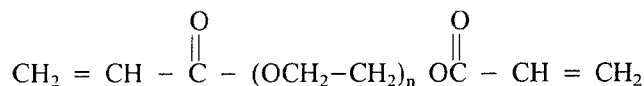
Thus, examples of resin compositions which can be used with the above described processes are:- 35

40 A - Prepolymers which can have the following composition: 40

- 1 - aliphatic polyesters modified by acrylic acid, of which the number of acrylic unsaturations by pattern can vary from 2 to 6.
- 2 - Epoxy resins modified by acrylic acid of the biophenol A type
- 45 3 - Polyisocyanates resulting from the reaction produced by adding aliphatic, cyclo-aliphatic and aromatic di-isocyanates to aliphatic diols, polyesters, allyl alcohol or hydroxy-ethyl-acrylate or hydroxy-propylacrylate 45

B - Polyfunctioning dilution monomers such as: 50

- 1 - Hexane diol di-acrylate 50
- 2 - Neopentylglycol di-acrylate
- 3 - Trimethyl-propanol di-acrylate
- 4 - Di-acrylates of ethylene glycol or polyethylene glycol with *n* varying from 1 to 10 in the formula 55



60 5 - 1,1'-isopropylidene-bis-(P-phenylene-oxy) di-β-ethanol di-acrylate 60

C - Plasticizers which do not react in this system such as:

- | | | | |
|---|-----|---------------------------|---|
| | 1 - | Tri-butoxyethyl phosphate | |
| | 2 - | Dioctyl-phthalate | |
| 5 | 3 - | Tri-ethyl-phosphate | |
| | 4 - | Butyl phthalate | 5 |
| | 5 - | Benzyl butyl phthalate | |

D - Adjuvants to accelerate polymerisation:

- | | | | |
|----|------|---|----|
| 10 | 1 - | Benzyl dimethyl ketal | |
| | 2 - | Benzophenone | 10 |
| | 3 - | Mischler ketone | |
| | 4 - | 2.2 di-ethoxyacetophenone | |
| | 5 - | 2 chloro thioxanthone | |
| 15 | 6 - | Ethyl or methyl 2 anthraquinone | |
| | 7 - | Paraphenoxy chloroacetophenone | 15 |
| | 8 - | Co-polymers of benzophenone sold under the commercial trade-mark UCB
(Registered Trade Mark)
e.g. Ureacryl (Registered Trade Mark) P 36 | |
| 20 | 9 - | Non-saturated derivatives of tertiary amines sold under the registered
trade-mark UCB
e.g. 9a Uvecryl P 102
9b Ureacryl P 104 | 20 |
| | 10 - | Tertiary amines either substituted alkanol-amines or not, such as: | |
| 25 | | 10a tri-ethylamine | 25 |
| | | 10b tri-ethanolamine | |
| | | 10c N, methyl di-ethanolamine | |

E - Pigment and mineral additives to give opacity and colour to the coating. Below, examples of formulae which give rise to the following observations:

- | | | | |
|----|-----|---|----|
| 30 | 1 - | the softest formulae preferably require the use of: | 30 |
| | | - A3 prepolymers | |
| | | - non-reacting plasticisers | |
| | | - polyfunctional monomers, such as hexane diol di-acrylate polyethylene glycol di-acrylate with N = 6 to 10 | |
| 35 | 2 - | Stability when heated and chemical resistance require the addition of a minimum of 25% of B 5 monomer | 35 |
| | 3 - | The hardest formulae are obtained from epoxy prepolymers and/or polyester prepolymers | |
| 40 | 4 - | Pigmented formulae require the use of a combination of photo-energisers and accelerating adjuvants. | 40 |

For example for black

Benzophenone + Mischler ketone + tertiary amines

- | | | | |
|----|--|--|----|
| 45 | | | 45 |
|----|--|--|----|

For example for thermo-stable formulae

D7 or D1 + D8 + D9a hard
D7 DA + D8 + D9b soft

- | | | | |
|----|--|--|----|
| 50 | | | 50 |
|----|--|--|----|

For example for white formulae

D1 + D5 + D8 + 10b
D4 + D8 + 10b or 10c
D6 + D2 + 10a or 10b or 9a
D7 + D2 + 10a or 10b

- | | | | |
|----|--|--|----|
| 55 | | | 55 |
|----|--|--|----|

This list is not exhaustive.

Twenty examples of formulae in accordance with the invention are given in the Table below.

- | | | | |
|----|--|--|----|
| 60 | | | 60 |
|----|--|--|----|

In all these compositions:

- C1 can be replaced by C2, C3, C4 and C5
- D1 can replace D7 and D2
- D9 and D10 are used in association with resin

- | | | | |
|----|---|---|----|
| 65 | - | D1 to D8 are used to eliminate inhibition in the air. | 65 |
|----|---|---|----|

COMPOSITIONS FORMULAE (IN PERCENTAGES)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1			35	40					75	75			40		75		40			
2																75				
3	74,5	69,5			75	75					74,5	65,5						75	71	
1			13		15		15						13	15				15		15
2			10	18									10		15					
3																	14			
4	15	15				15		15		15	15	15				15				15
5			30	30			75	75					30	75			30			75
1		5										5								
2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2		2		2
3	1	1			1	1	1	1	1	1		1		1	1	1			1	
4																		1		
5																				1
6											1									
8			7									6					6		6	
9 ^a	7	7	5		.7	7	7	7	7	7	7	7	5				10			
b				10										7	7	7		7	7	7
1	0,5	0,5									0,5	0,5								

WHAT WE CLAIM IS:

1. A method of coating or sealing electrical or electronic components with a synthetic resin composition, comprising advancing each component along a fixed path through a coating station at which at least one surface of the component receives a coating of synthetic resin, and advancing each coated component further along the said path through a beam of ionising radiation for a period sufficient to induce polymerisation of the resin, 5
2. A method according to claim 1 in which the said period is at least 0.6 seconds but not more than 6.0 seconds.
3. A method according to claim 1 or claim 2 in which the component is coated by immersion in a bath of liquid resin. 10
4. A method according to claim 3 in which the components are suspended at spaced intervals along a common support which is advanced through the said stations.
5. A method according to claim 1 or claim 2 in which each component is mounted in an individual rotatable frame such that a first surface of the component is presented for coating at a first coating station and the component is then turned through substantially 180° to present a second surface for coating at a second coating station. 15
6. A method according to claim 5 in which the first coated layer is polymerised before coating the second surface.
7. A method according to claim 6 in which the second coated surface is polymerised by advancing the component in a reverse direction through the beam of ionising radiation. 20
8. A method according to claim 1 and substantially as herein described with reference to figure 1, or figures 2 and 3 of the accompanying drawings.

25
BROOKES & MARTIN,
High Holborn House,
52-54, High Holborn,
London, WC1V 6SE,
Agents for the Applicants. 25

1588129

COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of the Original on a reduced scale

Sheet 1

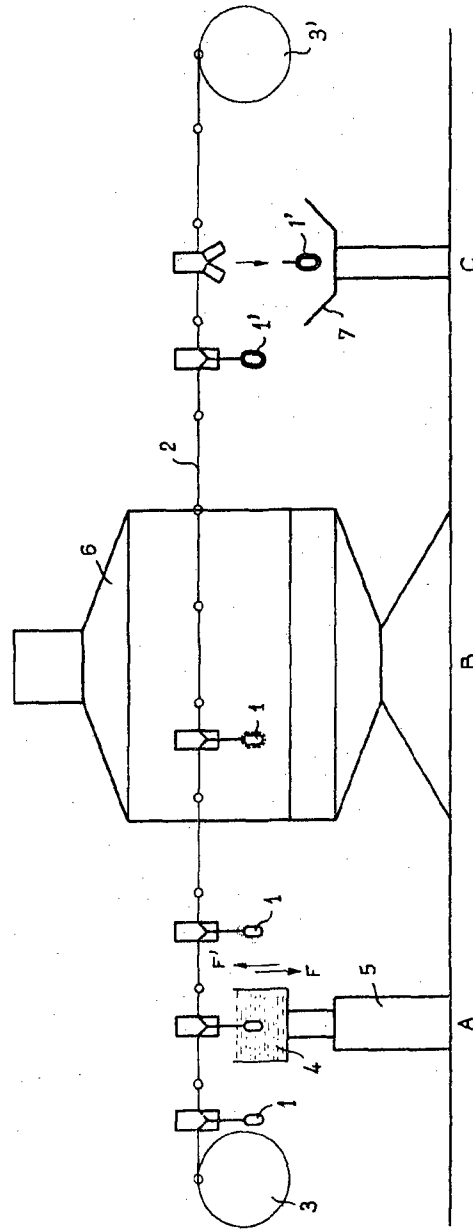


FIG. 1

