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(30) 1989/05/03 (A 1055/89) AT
(54) **METHODE DE REVETEMENT DE SURFACES**
(54) **METHOD OF COATING SURFACES**

(57) For coating surfaces by flame spraying a powder mixture including a high-temperature resistant plastic and a metal, the high-temperature resistant plastic is a polyimide having a glass transition point of above 250°C and containing low-molecular emittable components in an amount of at least 1.0 % by weight, preferably of between 1.0 and 10 % by weight. In this manner, the production of high-temperature resistant coatings on surfaces in excellent quality is feasible.

ABSTRACT OF THE DISCLOSURE:

For coating surfaces by flame spraying a powder mixture including a high-temperature resistant plastic and a metal, the high-temperature resistant plastic is a polyimide having a glass transition point of above 250°C and containing low-molecular emittable components in an amount of at least 1.0 % by weight, preferably of between 1.0 and 10 % by weight. In this manner, the production of high-temperature resistant coatings on surfaces in excellent quality is feasible.

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The invention relates to a method of coating surfaces by flame spraying a powder mixture of a high-temperature resistant plastic and a metal.

Such a method is known from US-A-3,723,165. Among 5 others, also a polyimide is mentioned as a high-temperature resistant plastic, and aluminum alloys, nickel, copper and bronze, i.a., are cited as metals. By flame spraying a powder mixture of these components, hard corrosion resistant coatings can be applied to various surfaces.

10 However, with this method it is possible to apply coatings of a satisfactory quality only if the plastic powder used has a relatively narrow particle size distribution range. Moreover, it is disadvantageous that only such polyimides may be processed whose glass transition point lies below 250°C.

15 Due to this limitation, the temperature resistance of the presently producible polyimide coatings frequently is not sufficiently satisfactory for certain applications.

20 The invention aims at avoiding these disadvantages and has as its object to provide a method of the initially defined kind which allows for the production of flame-retardant and particularly temperature resistant coatings.

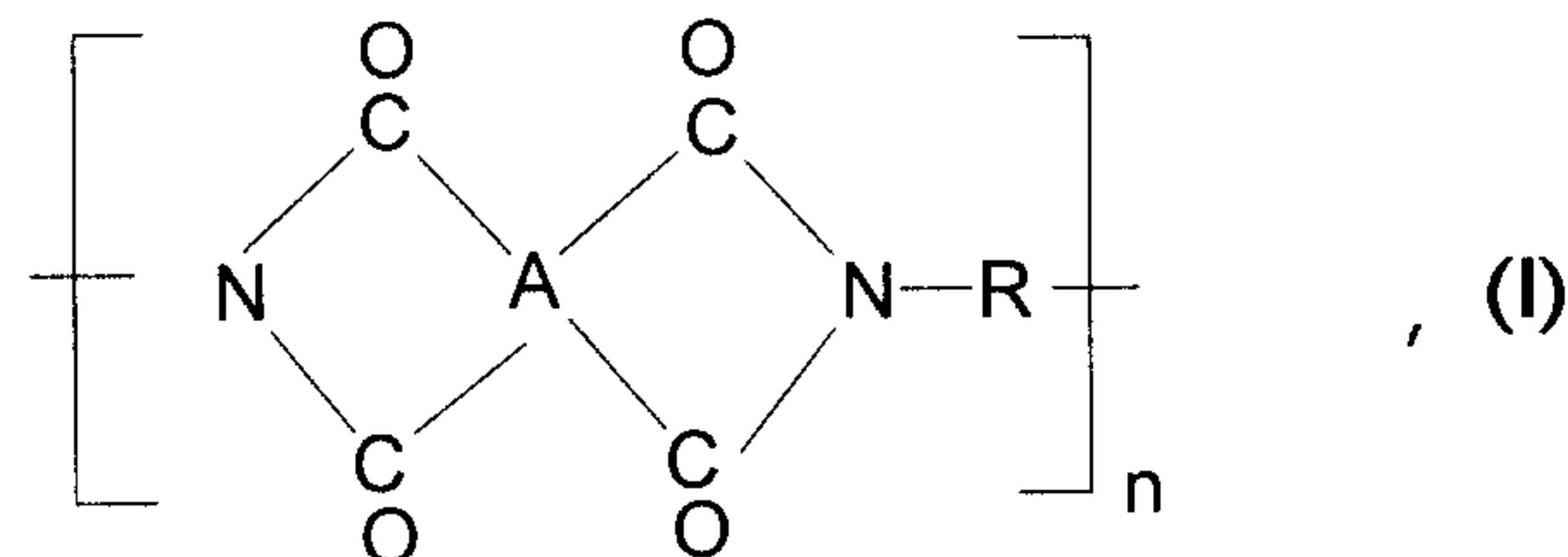
25 In accordance with the invention, this object is achieved in that a polyimide having a glass transition point of above 250°C and containing low-molecular emittable components in an amount of at least 1.0 % by weight, preferably of between 1.0 and 10 % by weight, is used as the high-temperature resistant plastic material.

30 Successful processing has proved to be possible only if this lower limit of 1.0 % by weight of emittable components is not fallen short of, which term implies substances that

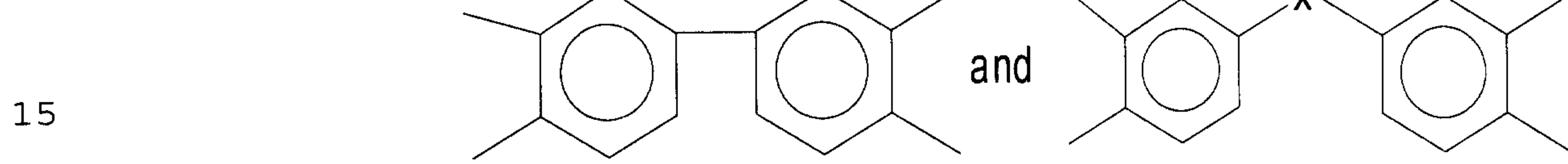
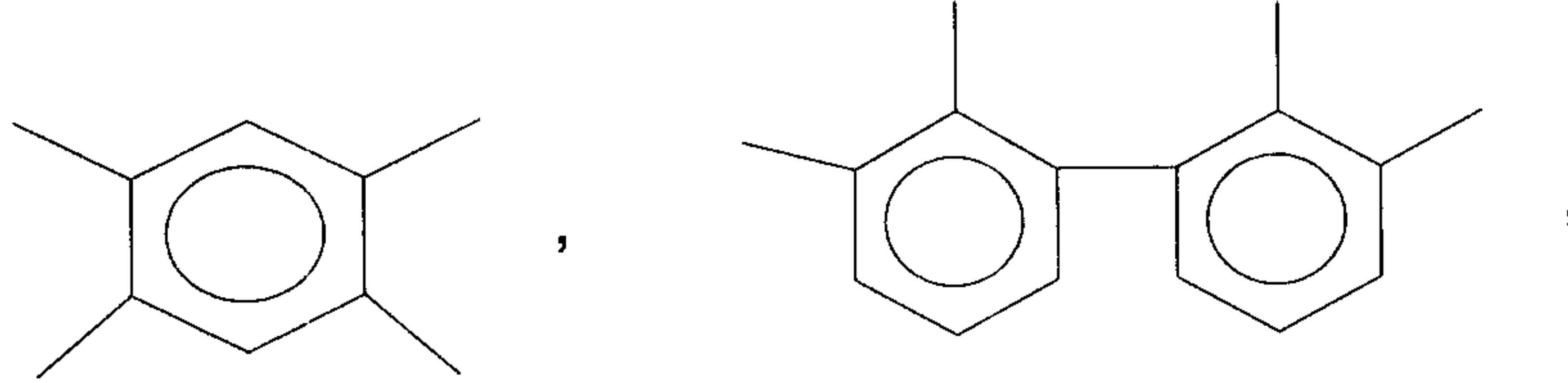
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escape from the polyimide in a temperature range of between 150 and 350°C.

The method according to the invention is particularly suited to process polyimides having structural units of the 5 general formula



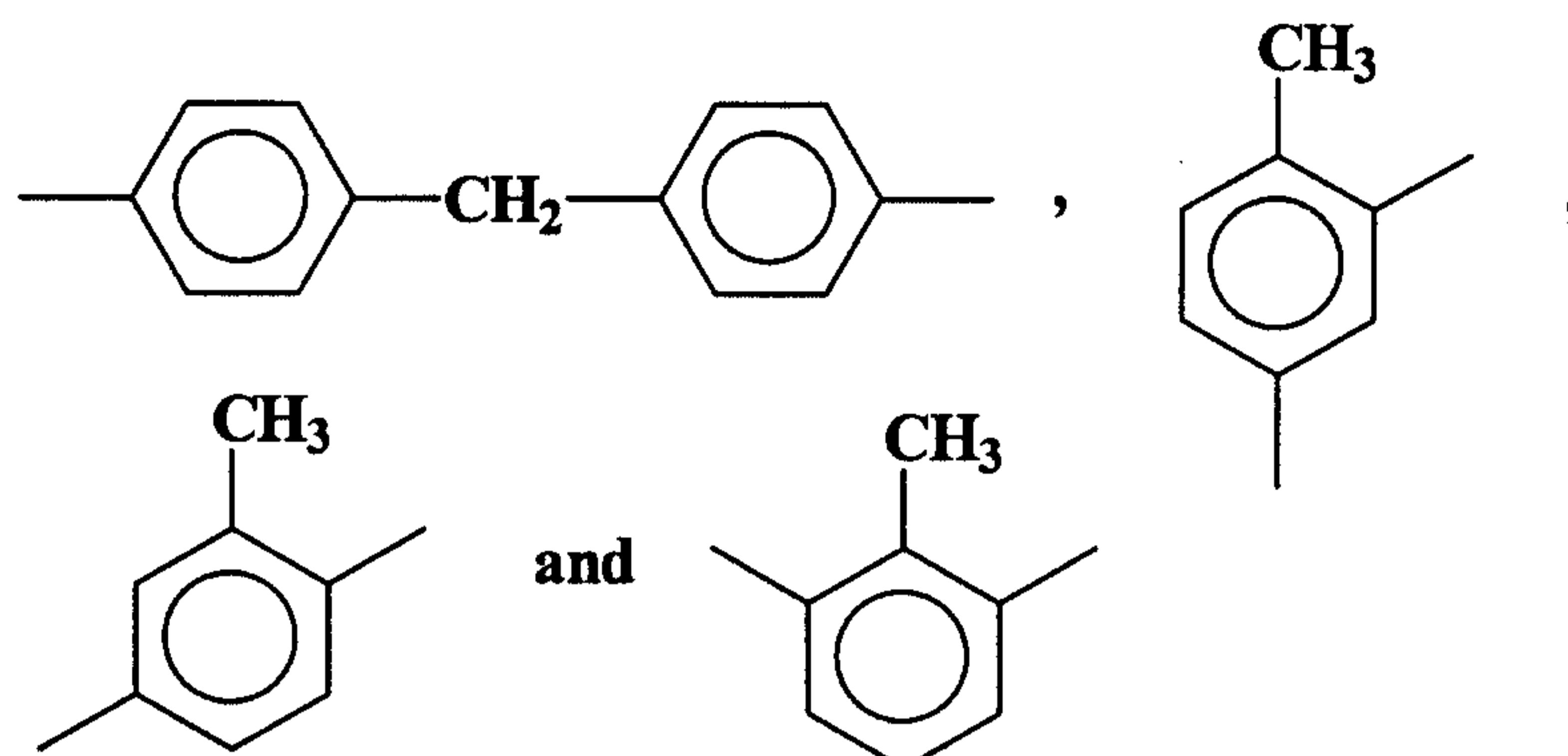
wherein n is an integer larger than 1 and A is a four-valent 10 aromatic group selected from



wherein X is selected from the group consisting of CO, CH₂, O, S, and CF₂ and R represents at least one two-valent aromatic group selected from the group consisting of

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The molecular weight of the polyimide used according to the invention, preferably, has a mean numerical value of about 6,000 to 60,000 and a mean weight value of about 30,000 to 300,000.

10 The polyimide used according to the invention may be present in the powder mixture in an amount of between 10 and 90% by weight, preferably of between 50 and 70% by weight, the diameter of the polyimide particles being between 25 and 200 microns.

15 The metals that may be used are, preferably copper, bronze, steel, aluminum alloys and nickel alloys.

20 An advantageous embodiment of the method according to the invention consists in that the powder mixture of polyimide and metal is applied onto the surface to be coated by means of a plasma flame.

25 The preparation of the polyimide powder used according to the invention may be effected according to known techniques and is described, for instance, in U.S. Pat. No. 4,897,227. To dry moist polyimide powder or to adjust the desired content of emittable components, a high-frequency operated belt dryer or a vacuum operated drum drier may be used. The drying temperature of the polymer powder preferably lies below 300°C.

The invention will be explained in more detail by the

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following examples, a statistical copolymer of 3,3',4,4'-benzophenonetetracarboxylic acid dianhydride and 0.8 % by mole 2,4-toluenediamine and 0.2 % by mole 4,4'-diaminodiphenylmethane being used as the polyimide. The 5 polyimide was ground to a powder having particle sizes of between 25 and 200 mym in a grinding and screening mill.

Example 1:

10 A polyimide powder prepared according to the method described in U.S. Pat. No. 4,897,227 served as a starting material. The adjustment of the content of emittable components was effected in a belt drier with an output of 10 kW at an electrode voltage of about 70 kV and a frequency of 15 27 MHz. The powder was dried in the belt drier, the temperature of the feed zone amounting to 50°C and the temperature at the exit amounting to 40°C.

20 After a drying period of 45 min, the content of emittable components was 2.5 % by weight. This value was determined by means of a thermogravimetric analytical instrument of Perkin Elma (heating rate 10°C/min; temperature range: 150 to 350°C).

Subsequently, the polyimide powder was mixed with SiAl powder at a ratio of 60 : 40 and applied on steel grade

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ST50 by means of a plasma spraying device of Plasmatechnik AG (Switzerland), the following parameters having been observed:

Plasma gas:	Ar (84 l/min and hydrogen) (2 l/min)
Current consumption:	500 A at 53 V
Powder conveying rate:	50 to 60 g/min
Powder conveying gas:	10 l Ar/min
Distance burner-workpiece:	110 mm

During plasma spraying, the surface of the workpiece
5 was cooled with compressed air.

A high-temperature resistant coating of excellent
quality having a hardness (HV) of 110 could be applied.

Example 2:

Starting material: as in Example 1, yet the content
10 of emittable components was adjusted to 1.8 % by weight in a
heated vacuum drier (1 Torr) at a temperature of 250°C. The
vacuum drier was a tumble drier (20 rpm). Drying was observed
thermogravimetrically.

The polyimide powder obtained was plasma sprayed with
15 SiAl powder as described in Example 1. A coating of equal
quality could be applied.

At a comparative test, the content of emittable
components was adjusted to 0.35 % by weight (vacuum in tumbling
drier: 1 mbar; temperature: 270°C; drying time: 300 min). When
20 plasma spraying such a polyimide powder, bonding could be
achieved neither with the surface to be coated nor among the
particles.

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Example 3:

A polyimide prepared according to the method described in DE-C 21 43 080 was used as the starting material.

5 The content of emittable components was adjusted to 2.9 % by weight in a belt drier analogously to Example 1.

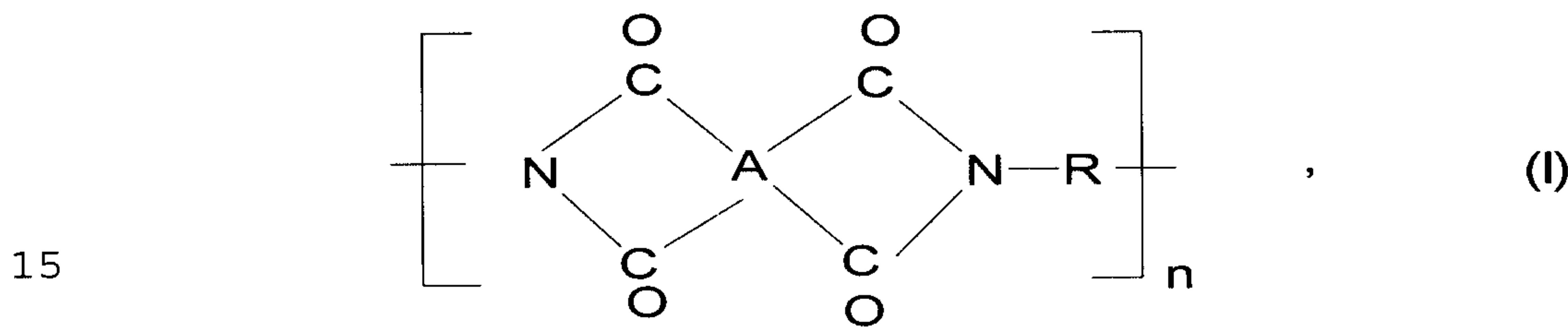
The polyimide powder obtained was plasma sprayed as described in Example 1, with SiAl powder, to form a coating of equal quality.

10 At a comparative test, the content of emittable components was adjusted to less than 1 % by weight in a heated vacuum drier (vacuum: 1 mbar; temperature: 180°C; drying time: 48 h). When plasma spraying such a polyimide powder, bonding could be achieved neither with the surface to 15 be coated nor among the particles.

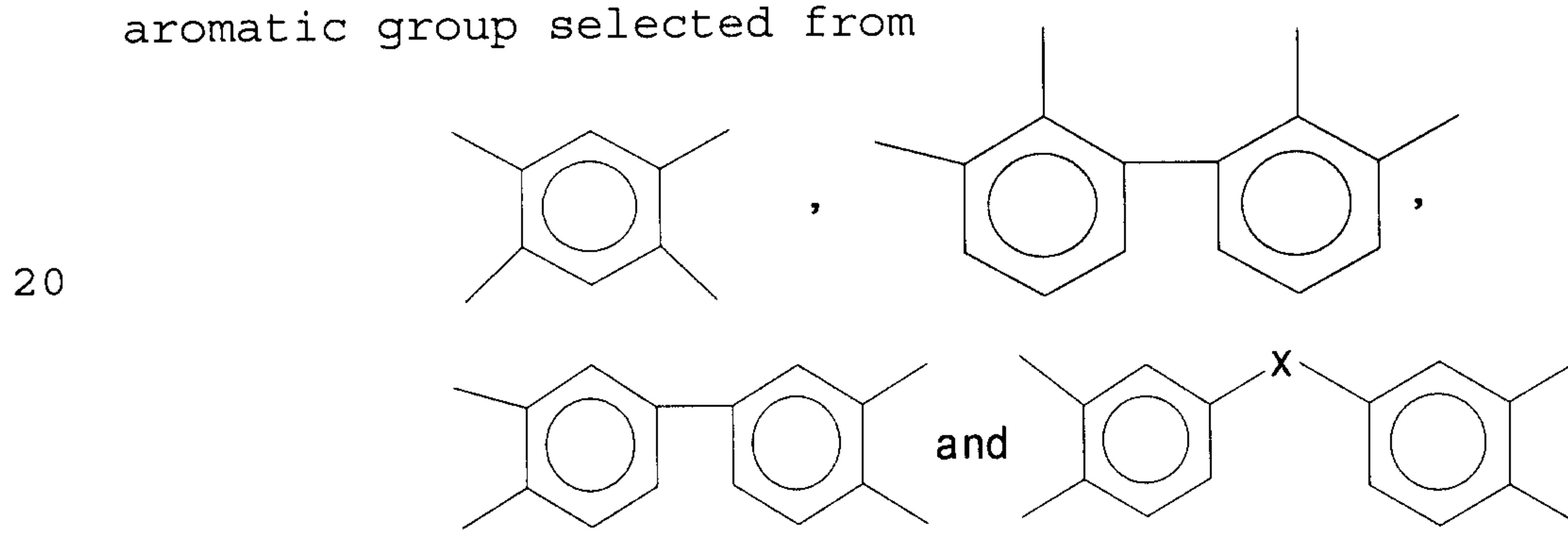
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CLAIMS:

1. A method of coating surfaces by flame spraying a powder mixture including a high-temperature resistant plastic and a metal, wherein a polyimide having a glass transition point of above 250°C and containing low-molecular emittable components in an amount of at least 1.0 % by weight is used as said high-temperature resistant plastic.
- 5
2. A method as set forth in claim 1, wherein the amount of said low-molecular emittable components ranges between 1.0 and 10 % by weight.
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3. A method as set forth in claim 1, wherein said polyimide has structural units of the general formula



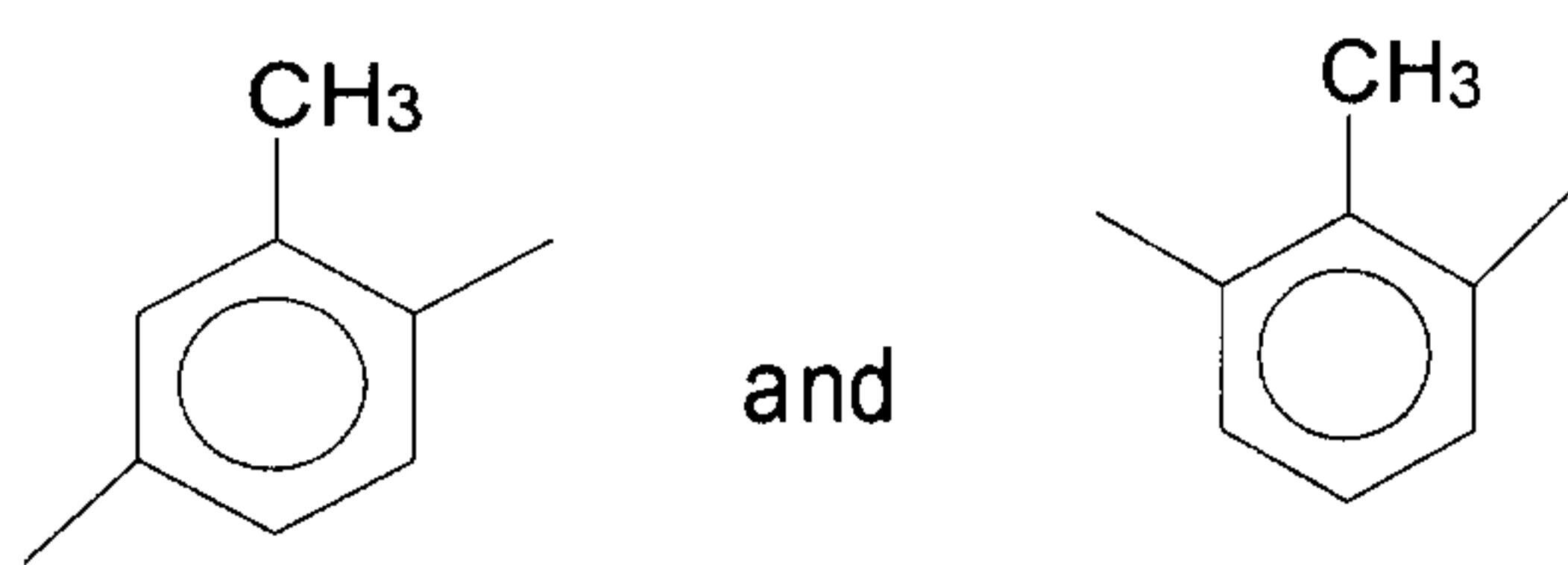
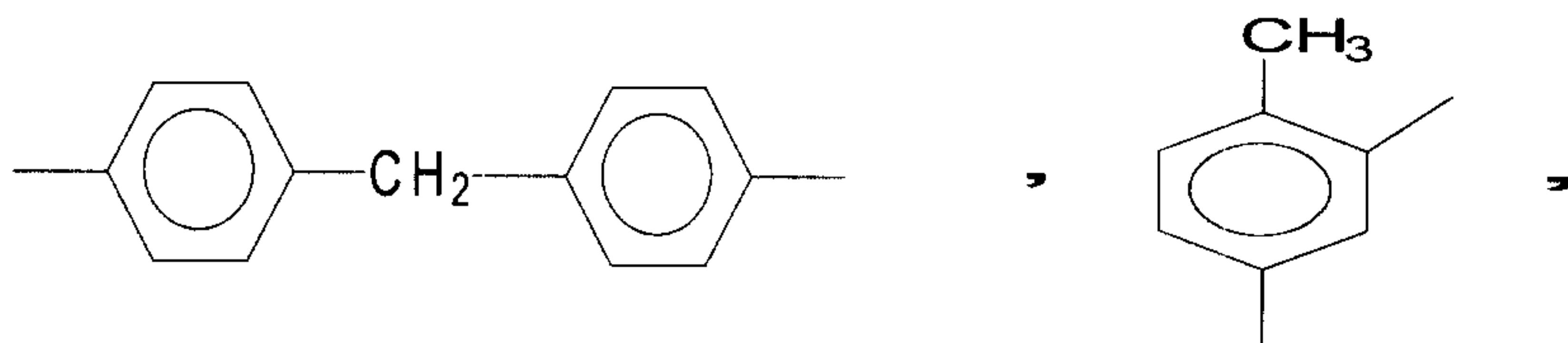
wherein n is an integer larger than 1 and A is a four-valent aromatic group selected from



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4. A method as set forth in claim 1, 2 or 3 wherein said polyimide is comprised of particles having diameters of between 25 and 200 microns.

5. A method as set forth in any one of claims 1 to 4, 5 wherein said powder mixture contains said polyimide in an amount of between 10 and 90% by weight.

6. A method as set forth in claim 5, wherein said polyimide is contained in an amount of between 50 and 70% by weight.

10 7. A method as set forth in any one of claims 1 to 6, wherein said metal is selected from the group consisting of copper, bronze, steel, aluminum alloys and nickel alloys.

8. A method as set forth in any one of claims 1 to 7, wherein said flame spraying is performed by plasma flame 15 spraying.

FETHERSTONHAUGH & CO.
OTTAWA, CANADA

PATENT AGENTS

SUBSTITUTE
REPLACEMENT

SECTION is not Present
Cette Section est Absente