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(54) Process for painting various objects and artefacts with powder paints, painted products obtained thereby and related apparatus

(57) Process for painting various objects and artefacts with powder paints, comprising a step of preparation of the surface to be painted by washing, degreasing or the like; a step of application of at least a layer of paint powder on the surface to be painted, carried out by projecting against said surface said paint powder in association with a powder material, substantially a peening material; and a step of firing and/or polymerisation of the so applied paint, by heating, irradiation and the like.

Apparatus for carrying out said process.

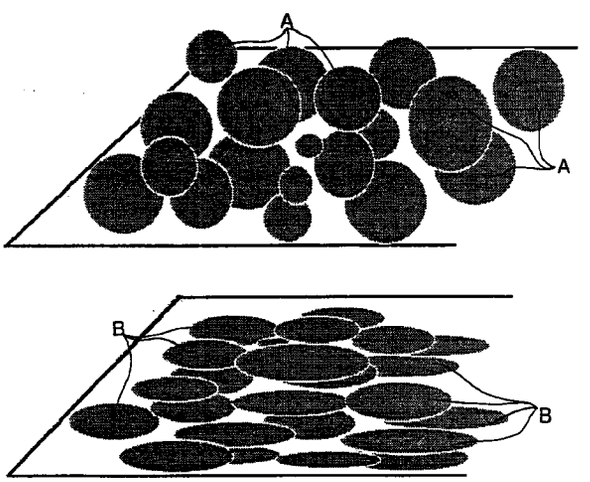

fig.1

EP 0 900 672 A2

Description

[0001] The present invention relates to a process for painting with powder paints various objects and artefacts, made of materials either conductive or non conductive, such as metal, glass, ceramic and like materials.

[0002] The invention also relates to the so obtained painted products and the apparatus for carrying out said process.

[0003] As is known, powder paints are produced by mixing the semi-fluid state resins in a one or double-screw extruder together with hardeners, pigments and the most suitable additives.

[0004] After the heat-extrusion there takes place the lamination, with following cooling of the extruded product and the subsequent flaking.

[0005] Afterwards, the scales are ground by a mechanical system (for instance, a pin type mill) until a powder is obtained having a controlled particle size.

[0006] The average particle size of the powders obtained by the aforesaid process is usually comprised between 10 and 100μ (preferably, between 40 and 80μ), as greater or smaller size powder particles may create severe application problems that cause the application process to be not economical.

[0007] As is known, the painting treatment with thermoplastic or thermosetting powder paints takes place by an electrostatic process or by pre-heating the object.

[0008] Electrostatic painting takes place by electrically charging the powder particles by means of the electric field generated by an electrode and a high-voltage generator, or by triboelectricity due to the rubbing of the powder particles on surfaces of suitable materials.

[0009] The object to be painted must be a good earthen conductor; in this case, the electrostatically charged powder particles adhere to the object to be painted, coating it uniformly until the deposited layer prevents a further deposition by electrically insulating the object.

[0010] Another commonly used system is heat-painting which takes place by pre-heating the object to be painted to a temperature sufficiently high to allow the start of the melting of the powder paint.

[0011] In both cases one starts from powder paints having an average particle size of about 40-80μ, and controllable paint thicknesses of about 50-60μ in the case of electrostatic system or higher than 100μ, up to some hundred microns in the case of heat-painting.

[0012] Directly after each treatment step, a final firing is usually provided, for instance with hot air for fixed times (180-200°C for 20 min), to stabilise the finishing following the resin cross-linking with hardeners in the case of thermosetting powders.

[0013] Instead, for thermoplastic powders, a firing temperature proportional to the melting point of the thermoplastic resin used is necessary.

[0014] The use of the conventional technology of powder resin application involves several difficulties, the main limits being for instance the following ones:

- difficulty in realising paint layers having thicknesses lower than 10μ, because of the inadequate systems of powder micronisation and the ensuing problems during application,
- difficulty in realising paint layers having thicknesses higher than 100μ, with tolerances of only some microns. Actually, with the electrostatic system, the deposited paint layer that insulates the object to be painted becomes a barrier to a further electrostatic deposition. By the pre-heating system it is possible to easily apply thicknesses much higher than 100μ, but it is almost impossible to control the final thicknesses adequately,
- difficulty in covering non conductive artefacts such as artefacts from glass, ceramic, etc.,
- difficulty in obtaining multi-layer protection systems comprised of different powder materials,
- difficulty in using thermoplastic powders in general. Object of this invention is to provide a powder painting system allowing to utilise all the conventional powder paint types, thermoplastic, thermosetting or also mixes thereof, and allowing to apply said powders on the object to be painted at room temperature and without having recourse to the electrostatic effect and/or heat, and such as to be therefore utilisable with any type of material either conductive or non conductive, such as metal, ceramic, glass, plastic materials, and the like.

[0015] Another object of the invention is to provide a powder painting process allowing to obtain paint layers of any desired thickness, from thicknesses lower than 10μ to some hundred microns, homogeneous and with a perfectly controlled final thickness, and allowing also to realise multilayer coatings and/or mixed coatings.

[0016] A further object of the invention is to provide objects or artefacts powder painted to low paint thicknesses, even lower than 10μ, but coating completely and without solution of continuity the surface to be painted.

[0017] Another object is to provide an apparatus allowing to carry out such process.

[0018] These and still other objects and related advantages which will be stressed by the following description are achieved by a process for painting various objects and artefacts with powder paints, which process, according to the present invention, comprises the following steps:

- preparation of the surface of the artefact to be submitted to painting by degreasing with suitable solvents, brushing, sandblasting or the like, according to known processes and as function of the final performances required;
- application of at least a layer of powder paint on the surface to be painted, carried out by projecting against said surface said paint powder in association with a powder material, substantially a peening material;
- firing and/or polymerisation of the so applied paint powder layer at the suitable temperature by means of heat, irradiation or the like.

[0019] Preferably, said paint powder is intimately pre-mixed with said peening powder material and the so obtained mixture is projected against the surface to be painted by compressed air, centrifugal rotors or the like.

[0020] Besides, the compressed air used is dry, separated from oil, and at a pressure comprised between 1 and 50 atm, preferably between 6 and 10 atm.

[0021] Also according to the present invention, said peening material has substantially the shape of beads having a diameter comprised between 10μ and 500μ, preferably between 100μ and 200μ, and a specific weight greater than the specific weight of the particles of the paint powder to be applied to the surface to be painted. Said peening powder material is constituted by beads preferably from glass, steel, bronze or other materials known and utilisable to carry out peening, according to the type of powder paint used and/or the material which the artefact to be painted is made from.

[0022] For instance, the powder paint to be applied has a specific weight lower than 2,45 and a particle size comprised between 1 and 300μ, preferably between 10μ and 100μ; the peening particles are substantially spherical, made from glass, and have a specific weight higher than 2,45 and a harness of at least 5,5 Mohs and a diameter comprised between 10μ and 500μ, preferably between 100μ and 200μ. The particles may be also from metal or other materials, provided they have a specific weight higher than that of the powder to be applied, for instance alloy steel with a specific weight higher than 5,585 and a diameter comprised between 10μ and 500μ, preferably between 100μ and 200μ.

[0023] In said application step, the weight ratio between said paint powder and said peening material in said mixture is comprised between 1:100 and 50:100, preferably between 5:100 and 30:100.

[0024] Having carried out said application, the powder overspray and said peening material are suitably collected, separated from one another by screening, ventilation or the like, and re-used in said application step.

[0025] Also according to the present invention, when said artefact is from aluminium or aluminium alloy, a further surface pre-treatment step, consisting in a chemical conversion according to known means or anodic oxidation may be advantageously introduced between said surface preparation step and said powder paint layer application step.

[0026] According to the present invention, instead of using the known electrostatic powder painting systems or fluid bed systems with a pre-heated object, the powder particles are adhered to the support by mechanically supplied energy.

[0027] Because of the impact of particles having a shape similar to that of the powder paint but a higher density, the powder particles are squashed on the surface to be coated while being at the same time partly melt by the heat generated by the impact.

[0028] By this process, more or less thick coatings are obtained starting from a same powder paint.

[0029] Substantially, any type of powder paint may be used by the process according to the invention to produce coatings ready for firing, with thicknesses ranging from a few microns to hundreds microns.

[0030] By such process, the powder yield may reach 90-95%, while treatment times may range from a few seconds to some minutes.

[0031] A particular characteristic of the process is the possibility of realising multilayer coatings or homogeneous coatings starting from powder mixtures.

[0032] In fact, for some applications, thermosetting and thermoplastic powders may be sequentially used for multilayer coatings or in admixture for mixed coatings.

[0033] The co-deposition coatings are acquiring an always increasing acceptance as they may be easily adapted to the most different problems of protection against corrosion, modification of surface properties or also only to ensure a better adhesion to a finishing coat.

[0034] Besides batch-finishing, the process according to the invention can be adapted to the continuous treatment of either long objects such as tubes or extruded products or flat surfaces such as sheets and coils.

[0035] The process may be used for metal parts from iron, cast iron, brass or aluminium, in the form of cast, extruded or laminated objects.

[0036] As the electric conductivity of the substrate to be treated is not required, also artefacts from cement, ceramic, plastic materials can be coated.

[0037] As said, oil-, grease or oxide-dirt parts are cleaned before the pre-treatment with organic solvents, alkaline degreasers, mechanical brushing or sandblasting.

[0038] The shape and composition of the peening material affects both the effectiveness of the process and the quality of the coating and its cost.

[0039] The particles of said material are generally spherical, as they ensure in this manner a better spreading effect

of the paint powder on the surfaces to be painted, have a better resistance to impact and therefore a longer average life.

[0040] The sizes of holes, cavities and internal radiuses of the parts to be treated determine the shape and size of the peening material. Generally, one or two different mixtures are sufficient to treat the majority of objects. The mixture transported by compressed air is projected or sprayed through a suitable dispenser on the surfaces to be coated and therefore all what does not reach the target is collected on the bottom of the painting cabin. The mixture recovered from the bottom of the cabin in conveyed to a sieve which separates the two fractions, sending them to the respective storage tanks.

[0041] For powder paints, a conventional fluid bed tank or a vibrating or mechanically stirred tank is used to mix the recovered powder and the fresh powder to be conveyed to the application dispenser, while for the peening material a feed-valve pressure tank is preferably used.

[0042] The percent peening powder included in the mixture to be sprayed depends on the surface to be coated, the process time and the final thickness desired.

Table 1

Amount of powder necessary to obtain a known coating thickness on a pre-defined area	
type of powder	specific weight and powder weight in g/μ/m^2
epoxy with pigments and fillers	1.7
transparent polyester Teflon	1.3
	2.2

[0043] One of the main advantages of the process according to the invention lies in that the thickness of the coating may be rendered partly independent on the treatment time by suitably controlling the percent peening powder added to the mixture.

[0044] As a consequence, coatings of 10 or 60μ are obtainable in comparable times.

[0045] However, as is known, the best final performances of the coatings are obtained by dividing the total coating thickness into several steps, instead of one only coat.

[0046] A mixture containing 10% painting powder and 90% peening powder by volume, projected by a 6 bar compressed air gun, at a distance of 20 cm from the object to be treated, can cover 1 dm^2 of surface with 10μ of paint in less than 2 minutes.

[0047] By the process according to the invention, multilayer coatings may be obtained wherein the different powders spread into each other, so as to ensure after the firing the best possible adhesion. This characteristic is particularly important when Teflon or PVDF powders are used which usually wet the substrate only slightly and have therefore a poor adhesion.

[0048] Before firing, the coating morphology or structure obtained by the process according to the invention seem generally rather different relatively to those known for powder paints.

[0049] In fact, the coating appears to be constituted by discrete powder particles, which however are molten one on top of the other and smashed on the surface of the object to be painted, by effect of the impact of the peening powder, until a continuous structure is obtained.

[0050] This flat particle structure is particularly interesting as it allows to obtain very thin continuous layers also starting from painting powders having a markedly higher average diameter.

[0051] With the process according to the invention, no intermediate firing is needed between two subsequent coats; the physical state of the coating is sufficiently resistant to a subsequent re-painting, always with the process according to the invention by electrostatic painting with powders.

[0052] After the firing, the coating may show different properties according to the firing type chosen. In fact, if the parameters chosen for the firing are such as to ensure a good cross-linking of the thermosetting component of the coating - without however reaching the melting temperature of the thermoplastic component - uniformity cannot be as good as it is in the case of a firing temperature higher than the melting temperature of the thermoplastic component.

[0053] For the process according to the invention, in case of multilayer coatings with mixtures of thermosetting and thermoplastic components, quick firing times at high temperatures should be preferred (for instance, IR or induction firing).

[0054] An apparatus for carrying out the process according to the present invention comprises:

- a container/tank for powder paints wherein both fresh and overspray paints are stored,
- a powder paint pneumatic conveying system from said container to the dispenser,
- a container/tank for the bead-based peening material, kept pressurised and provided with feed and exhaust valve,
- a pneumatic conveying system for said peening beads from the tank to the dispenser,
- a spray-dispenser which combines the flow of said powder paint with said peening beads into a uniform cloud transported at the desired speed by compressed air,
- a production, storing and metering system for dry and oil-separated compressed air constituting the transport element for said powder paint and said beads from the respective tanks to the dispenser,
- a recovery system provided, on the bottom of the painting cabin, with a vibrating sieve which provides to separate the non utilised powder paint from the beads that are conveyed to the respective storing tanks, said pressurised storing tank for said beads been provided with a rotary feed valve,
- a control board with a mechanical or electronic programmer allowing to pre-fix work times and conditions.

[0055] The operating parameter of the process are bound to the characteristics of the painting product and the peening material used.

[0056] Compressed air is used within a range of between 2 and 10 bar, and a gun can deliver 40 to 50 kg product per hour (about 8-10 kg product per hour).

[0057] According to the shape and size of the objects to be painted, the dispenser may be fixed, oscillating or mounted on pump bobs.

[0058] Generally, the overspray problem is not as important as in conventional painting systems with powder paints, as the dispensers are much nearer to the objects to be treated and the cloud size is much more reduced.

[0059] In any case, an overspray recovery system with final filtration is necessary to reduce any type of pollution of air exiting the application cabin.

[0060] By suitably operating on the amount of paint powder and/or peening powder and/or transport air volumes, the dosage of the flow of said two powders is made independently from one another and therefore their mutual rate may be suitably adjusted according to need. The storing tanks for the paint powder and the peening material may be fed either fresh products or recovery products coming from the overspray collected in the application cabin, said collected overspray being conveyed to a mechanical screening using a screen having suitably sized meshes, so as to separate the recovery powder paint from the peening beads,

[0061] The object to be painted is kept in a painting cabin at a distance from the dispenser comprised between 10 and 1000 mm, preferably between 100 and 200 mm.

[0062] The invention will be now further described with reference to the attached drawings wherein:

Figure 1 shows schematically the morphology of the powder paint layer applied to the surface to be painted according to the processes of the known art and the process of the invention, while Figure 2 shows, schematically and in a simplified form, an apparatus suitable to carry out the process of the present invention.

[0063] With reference to such figures, there is stressed the morphology of the paint layer on the surface to be painted, realised with powder paint by the electrostatic system according to the known art A, compared with the morphology of the paint layer realised by applying the paint powder associated to the peening powder material B, according to the present invention. As can be seen, with the process according to the invention, paint particles are flattened and their coating capacity is strongly increased.

[0064] In the container/tank 1, both fresh powder and overspray recovery powder coming from the painting cabin are stored. Paint is conveyed to dispenser 3 by means of the pneumatic transport system 2. Bead peening powder is stored in the pressurised container/tank 4, which is provided with feed and exhaust valve. Through the pneumatic transport system 5, the peening material is conveyed to the spray-type dispenser 3, which combines the flow of both materials in a uniform cloud 9 transported at the pre-fixed speed by means of compressed air and projected against surface 10 of the object to be painted, contained within the painting cabin 7.

[0065] On the bottom of the painting cabin 7 a recovery device is provided consisting of a vibrating sieve 8 that provides to separating the powder paint that has not been utilised from beads; the non utilised paint and the beads are conveyed by gravity to the respective storing tanks. As bead tank is pressurised, feeding is through a rotary valve 11. Besides, a control board with a mechanical or electronic programmer (not shown in the figure) is also provided which allows to pre-fix work and time conditions.

[0066] Substantially, the working cycle comprises the following steps:

- loading of powder paint and beads in the respective storing tanks,
- pressurisation of bead storing tank,
- conveyance of dosed batches of powder and beads to the dispenser, so that the suspension created by each indi-

vidual dispenser hits the object to be painted with uniformity and continuity during a treatment time ranging from 1 and 100 min/kg applied paint/m^2 coated,

- overspray recovery in the painting cabin, by separation of powder particles and peening beads with a sieve having suitable meshes. The sieve may be static or vibrating and mesh sizes should be such as to separate, for instance, particles smaller than 100μ from those greater than 100μ.

Claims

1. A process for painting various objects and artefacts with powder paints, characterised in that it comprises the following steps:

   - preparation of the surface of the artefact to be submitted to painting by degreasing with suitable solvents, brushing, sandblasting or the like, according to known processes and as function of the final performances required;
   - application of at least a layer of powder paint on the surface to be painted, carried out by projecting against said surface said paint powder in association with a powder material, substantially a peening material;
   - firing and/or polymerisation of the so applied paint powder layer at the suitable temperature by means of heat, irradiation or the like.

2. The process according to claim 1, characterised in that said paint powder is intimately pre-mixed with said peening powder material, and the so obtained mixture is projected against the surface to be painted by compressed air, centrifugal rotors, and the like.

3. The process according to claim 1, characterised in that said compressed air is dry and/or separated from oil, and its pressure ranges between 1 and 50 atm.

4. The process according to claim 1, characterised in that said peening material is substantially in form of beads having a diameter comprised between 10μ and 500μ and a specific weight higher than the specific weight of the particles of the paint powder to be applied.

5. The process according to claim 1, characterised in that said peening material is constituted by beads preferably from glass, steel, bronze or other materials known, and utilisable for carrying out the peening according to the type of powder paint employed and/or the material which the artefact to be painted is made from.

6. The process according to claim 1, characterised in that the powder paint to be applied has a specific weight lower than 2,45 and a particle size comprised between 1 and 300μ.

7. The process according to claim 1, characterised in that the particles constituting said peening material are substantially spherical, made from glass, and have a specific weight higher than 2,45 and a hardness of at least 5,5 Mohs, and a diameter comprised between 10 and 500μ.

8. The process according to claim 1, characterised in that the particles or beads constituting said peening material have a specific weight higher than the specific weight of the paint powder particles and are made from alloy steel having specific weight higher than 5.58, and have a diameter comprised between 10 and 500μ.

9. The process according to claims 1 and 2, characterised in that during said application step the weight ratio between said paint powder and said peening material in said mixture is comprised between 1:100 and 50:100.

10. The process according to claim 1, characterised in that, once the application has been carried out, the oversprayed paint power and said peening material are suitably collected, separated from one another by screening, ventilation or the like, and re-utilised in said application step.

11. The process according to claim 1, characterised in that, when said artefact is from aluminium or aluminium alloy, a further surface pre-treatment step, consisting in a chemical conversion according to known means or anodic oxidation may be advantageously introduced between said surface preparation step and said powder paint layer application step.

12. The process according to claim 1, characterised in that two or more paint powder layers superposed to one another

are sequentially applied, to obtain multilayer paint coatings.

13. The process according to claim 1, characterised in that said paint powder is constituted by a mixture of thermosetting and thermoplastic paint powders, to obtain homogeneous mixed paint layers.

14. The process according to claims 1, 2 and 9, characterised in that by suitably operating on the amount of paint powder and/or peening powder and/or transport air volumes, the dosage of the flow of said two powders is made independently from one another and therefore their mutual rate may be suitably adjusted according to need.

15. An apparatus to carry out the process of claim 1, characterised in that it comprises:

- a container/tank (1) for powder paints wherein both fresh and overspray paints are stored,
- a powder paint pneumatic conveying system (2) from said container (1) to dispenser (3),
- a container/tank (4) for the bead-based peening material, kept pressurised and provided with feed and exhaust valve,
- a pneumatic conveying system (5) for said peening beads from tank (4) to dispenser (3),
- a spray-dispenser (3) which combines the flow of said powder paint with said peening beads into a uniform cloud transported at the desired speed by compressed air,
- a production, storing and metering system for dry and oil-separated compressed air constituting the transport element for said powder paint and said beads from the respective tanks (1, 4) to dispenser (3),
- a recovery system provided, on the bottom of the painting cabin (7), with a vibrating sieve (8) which provides to separate the non utilised powder paint from the beads that are sent to the respective storing tanks, said pressurised storing tank for said beads been provided with a rotary feed valve,
- a control board with a mechanical or electronic programmer allowing to pre-fix work times and conditions.

16. The apparatus according to claim 15, characterised in that the storing tanks of the powder paint and the peening material are fed both fresh products and recovery products coming from the overspray collected in the application cabin, said collected overspray being conveyed to a mechanical screening using a sieve with suitably sized meshes, in order to separate the recovery powder paint from the peening beads.

17. The apparatus according to claim 15, characterised in that the object to be painted is kept in a painting cabin at a distance from the dispenser comprised between 10 and 1000 mm.

18. Objects or artefacts according to the process of claim 1, characterised in that they are provided with a paint layer having a thickness lower than 10μ.

19. Objects and artefacts according to claim 1, characterised in that they are provided with several superposed paint layers, also of thermoplastic and thermosetting paints.

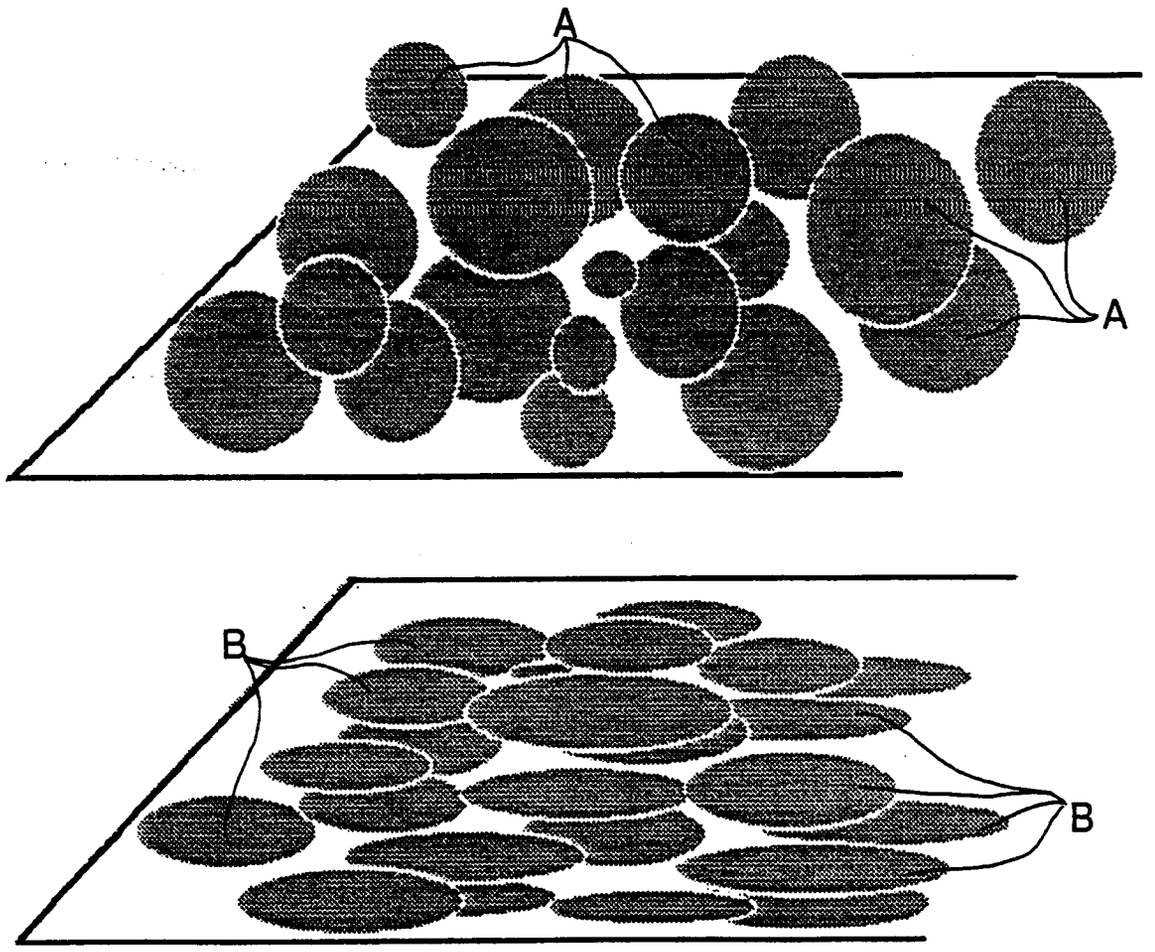

fig.1

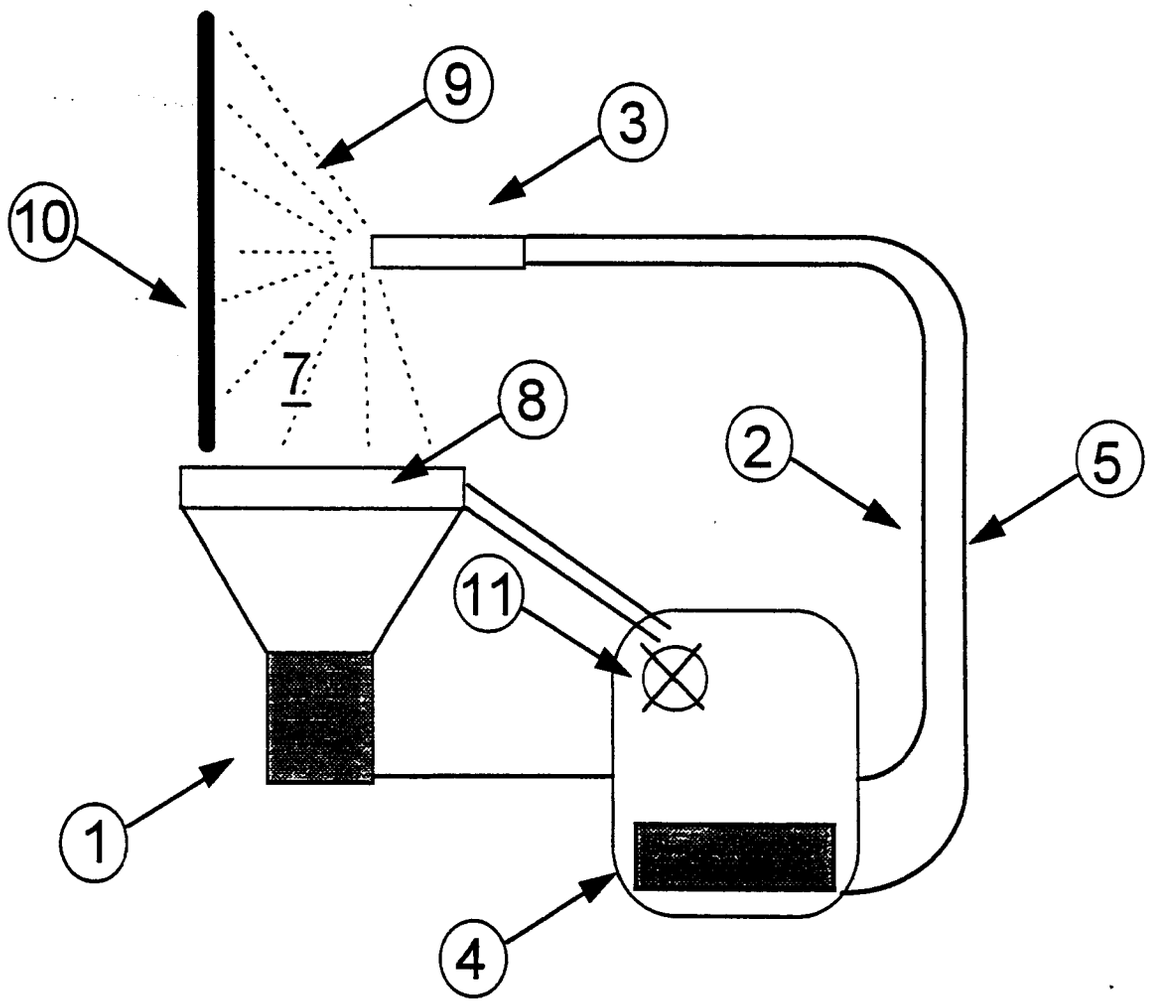

fig.2