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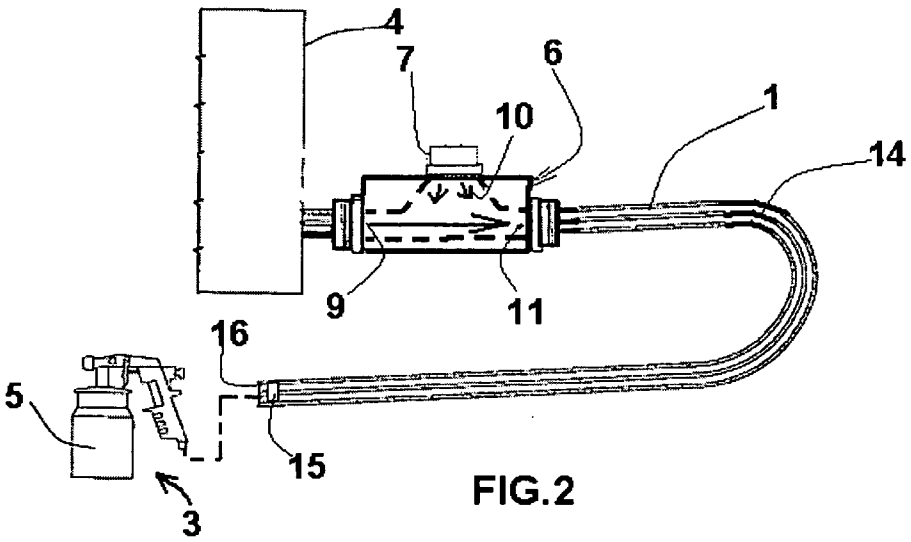

FIG.2

(57) Abstract: Device for spray painting, comprising a conduit (1) for passage of a carrier fluid under pressure (2) and an airbrush (3) connected to the conduit (1) for the mixing of carrier fluid (2), in which an ionization device of the carrier fluid (2) and electrostatic shielding of at least part of the passage path of the fluid are provided.

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SPRAY PAINTING DEVICE WITH IONIZATION OF THE CARRIER FLUID

Field of the Invention

The present invention relates to the field of the spray painting and in particular it refers to a device intended to improve the quality of the painting.

Background art

At the present, airbrushes are known consisting of a spray gun connected to a tube transporting the carrier fluid and to a container of the paint, in such a way that when the carrier fluid is sent the airbrush provides to mix the pressurized flow of the carrier fluid with a suitable amount of paint.

It was anyway observed that the passage of the carrier fluid through the airbrush and the tube, particularly in presence of heating elements contacting the fluid, originates the presence of electrostatic charges in the paint, which cause or contribute to the so called "overspray" effect, i.e. an unwilled dispersion of the mix of fluid and paint coming out the airbrush.

The overspray effect involves waste of material, a poor accuracy and uniformity of the painting, and saturation of the working environment with suspended "bounce paint" particles which make much more complicated the work conditions for the users.

In this field, there is also a need of obtaining rapid evaporation and drying of the painted object in order to reduce the working costs and to limit the risk of loss of quality of the painting caused by the drying time, and to get a uniform thickness of the paint layer on the objects.

Another drawback of such known systems is to be unable to obtain a satisfactory hardness of the layer of paint and a layer more resistant to wear.

A further drawback is still the need to reduce to the maximum extent the use of volatile solvents for paints.

Summary of the invention

It is therefore felt the need for a device able to overcome the drawbacks mentioned above.

According to the invention, this aim is achieved with a device according to the main claim.

Further aims are achieved with a device and an apparatus according to the

subsidiary claims.

The advantages of the device of the invention consist essentially in the elimination of the phenomenon of the electrostatic overspray of the paint, in all conditions of application and any type of objects, metal, plastic, wood or other material.

Moreover, a painting apparatus according to the invention can present even the benefits due to use of a heated carrier fluid (quick drying, reduction or elimination of synthetic solvents) and to the use of modified air rich in nitrogen as carrier fluid (low dew point, no oxidation of the paint, no impurities - particularly for equipment with local production of nitrogen with osmosis membranes - and a more neutral electrical behaviour than air).

Further advantages are obtained by use of a device and a method for painting that provides for the use of a carrier fluid at the state of cold plasma obtained by ionization of the carrier fluid.

Within this invention, it is specified that for “plasma” it is meant an ionized gas, consisting of a collection of electrons and ions, but which is globally neutral (i.e. the total electrical charge is null).

Being made of charged particles, the overall motion of particles of plasma are largely due to long-range forces that are continuously created, and which tend to maintain the neutral plasma; this provides an important difference compared with ordinary gas in which particles motions are due to forces that extend for a maximum of a few nearest neighbours (history of plasma physics).

As such, reference is made to plasma consisting of ionized gas that is where a significantly large fraction of electrons has been removed from atoms.

As it is known, the free electric charges make the plasma a good conductor of electricity and which strongly react to electromagnetic fields.

The processes of ionization and recombination of electrons with the newly formed ions reach thus a balance and, if the fraction of ionized gas is sufficiently large, gas has become neutral "plasma".

In the case of the invention, reference is made in particular to a plasma at room temperature so-called "cold plasma" for which ions are actually at

room temperature, while the electrons have a temperature of some electron volt.

List of drawings

The technical characteristics of the invention, according to the above mentioned aims, are apparent from the content of the claims below, and the technical advantages of the same will be more evident in the detailed description that follows and the attached drawings, in which:

- Figure 1 shows schematically a side view of a ionizing device according to the invention;
- Figure 2 shows an embodiment of a spray painting device according to the invention, in which the tube is shown in partial longitudinal section with some parts removed for clarity;
- Figure 3 shows a preferred embodiment of an isolated joint for a ionising device according to the invention;
- Figure 4 shows a preferred embodiment of a device according the invention;
- Figures 5 and 6 show details of the device of Figure 4.

Detailed description

With reference to the enclose drawings, a device according to the invention comprises a conduit or tube 1 for the passage of a carrier fluid under pressure from a source 4 of the same fluid to an airbrush 3 for the mixing of fluid with the paint contained in a container 5 of known type.

The source 4, which is here described and illustrated in brief because it is "per se" of common type, can be a source of compressed air or, preferably, of air modified rich in nitrogen, of the type produced by membrane separation or by a PSA (Pressure Swing Absorption) or similar procedures.

According to the invention in a portion of the passage path followed by the carrier fluid flow between source 4 and airbrush 3, a joint 6 is provided to connect a head 7 of a ionizer 8 to a passage region of the fluid.

Preferably, the joint 6 is isolated statically, and inside the joint there is provided an inlet 9 of pressurized fluid carrier, an inlet 10 of ions emitted by the head 7 in communication with the flow of fluid, and an exit 11 of the flow

of fluid carrier ionized .

The ionizer 8 can also be fitted with a selector 12, such as a selector with three positions, to select the positive, neutral or negative ions emitted by the head 7 or from any additional heads of the ionizer.

The joint 6 is connected via a known connection to the ends of a tube 1, which consists for example of a sheath of rubber or neoprene, in which advantageously may be provided a heater element 14, preferably composed by a double wire resistance arranged along the tube and that in the use it is in thermal contact with the fluid to warm it to a desired temperature at the point of mixing with the paint, but which is at the same time statically isolated from fluid in order to eliminate the dispersion or modification of the preset ionization charge.

Moreover, it can be provided a temperature sensor 15, for example a thermocouple PT100 arranged near the end 16 of tube 1 which is intended to be connected to airbrush 3.

The sensor 15, connected to a control unit of the heater, advantageously allows to control the temperature of fluid in the vicinity of the outlet form airbrush and thus it allows to control the on/off switch of the heater.

In operation, the fluid source 4 is connected to the tube 1 provided with the airbrush so that the flow of carrier fluid passes through the ionization region 17, defined by inner chamber of joint 6 communicating with the head 7 of Ionizer 8.

Depending on the type of object to be painted, and depending on the conditions of painting, the operator may decide by the selector 12 the sign of the emission of ions, in order to maximize the electrostatic effect in the painting of the object.

For example, surfaces and plastic resins normally have a negative surface charge.

In this case, selecting a positive sign from the selector, the head emits positive ions to positively charged the fluid which is so attracted by the negatively charged surface of the object, reducing the phenomenon of overspray.

Similar considerations apply to the surfaces having normally a positive charge, such as metal surfaces, for which it is useful to select an emission of negative ions.

According to the invention, the ionization of the fluid is done in such a way that the flow of fluid is kept isolated and to prevent the electric charge of the flow from discharging to ground.

To this aim at least a shielded region of ionisation is provided, for example using an isolated joint 6.

Similar arrangements to isolate from ground can be used to isolate the ionized fluid along the path through the tube 1 and / or through the airbrush 3.

Advantageously under certain environmental conditions, such as in a painting booth, it may also be useful to use the device of the invention to charge negatively the flow of fluid carrier in order to remove dust released into the environment, which have typically a positive charge. In this way, the dust is rejected from the so called "painting cone" and it is prevented from being dragged on the object during the painting.

In a further advantageous way of applying the invention, for example, when the object does not have a well defined surface charge, it is possible to send on the object a flow of only ionized carrier fluid with a certain sign, without paint. After that, the normal process of painting may follow with an opposite sign of the ionization.

In this way it is possible to assign a prevailing charge to the object and then to select the appropriate electrostatic charge to be induced in the fluid.

Referring to Figure 4-6 a device and a method of painting according to the invention are described, in which the carrier fluid is in the form of cold plasma obtained preferably by ionization.

In this embodiment, the device comprises:

- a source of a pressurized carrier gas 100,
- a spray gun 200 fitted with an inlet 60 of gas, an inlet 70 of paint, and an outlet 80 for the spraying of a mixture of gas and paint on a object to be painted,

- at least one conduit or tube 300 extended from the source 100 to gun 200, and
- at least one ionization device 330 to ionize the carrier gas from the source 100 with a flow of positively charged ions and a flow of negatively charged ions to obtain a carrier in the form of a cold plasma to be mixed with the paint.

In more detail, the ionization device comprises two ioniser 50 connected to respective heads of ionization 40, which are arranged along respective conduits 300 separate from each other to send a stream of ions of opposite sign on two separate flows of carrier gas. In the example of Figure 1, the heads 40 are arranged in cylinders 14 through which the of carrier gas flows and communicating with conduits 300. Preferably, the cylinders 140 are made of glass tube protected by a container made of insulating material, for example arnite (R).

Preferably, the source 100 comprises a source of compressed air 150 communicating via a solenoid valve 160 and filters 200 with a separation membrane 170 for the production from air of nitrogen or argon to be used as carrier fluid.

The membrane 170 is also communicating through a check valve 190 with a reservoir 180 which is to its turn in communication with the cylinders 140 through separate pipes 260, 270.

From cylinders 140, conduits 300 extend, being preferably made of flexible hoses of plastic material or Teflon, fitted with internals heating elements 110, such as heating wires, which are designed to heat the flow of carrier gas passing through conduits 300.

Conduits 300 are preferably coupled side to side and lined throughout their length by a rubber sheath 230 and are connected by insulating washers 240 on a frame 280 of containment of the source 100 and of the ionization device 330.

To avoid static dispersion, conduits 300 and wires 110 are preferably statically isolated from the outlet of the gas from cylinders 140 and converge at a point 130 in which the flow charged positively and the flow charged

negatively from their respective ionizers meet, generating a flow of gas in the form of plasma, in other words, of a highly ionized gas having a neutral overall charge.

Preferably, each heated tube 300 is equipped with a temperature sensor, for example, a thermocouple 111 located near the inlet 60 of gun 200, and a safety insulating block 120 placed between wire 110 and gun 200.

Advantageously, the use of block 120 allows to have the device certified and approved according to ATEX regulations in force in relation to risk of explosion.

With this solution the temperature of the gas at the gun outlet can be adjusted to optimize the mixing and, at the same time, it is obtained to put both the operator and the work environment under safe conditions from the point of view of possible electrical risk and of risks due to the presence of flammable substances.

In the example of Figure 1, the converging point 130 is made by a "Y" junction 90, arranged upstream the inlet 60 to the spray gun.

Similarly, a point of confluence 130 can be provided downstream of the inlet of the fluid in the gun 200, with conduits 300 ending within the same gun 200. In this case, the portion of conduits 300 inside the gun 200 will be properly insulated from the metal body of the gun.

Into the gun 200, in a way "per se" known, the flow of pressurized gas plasma is mixed with a flow of paint 210 and sprayed on the objects to be treated.

According to the invention, is also provided to use a sensor 220 of electrical charge that can detect a signal 250 related to the type and intensity of electric polarity of the object to be painted.

This detected signal 250 can be used to adjust the ionisers 50 to determine the intensity and polarity of ions to be sent into the flow of carrier gas in order to have a completely neutral carrier fluid. In operation, the source 100 is fed by compressed air and the membrane begins to produce a stream of nitrogen or argon (both ionizing gas) that is accumulated in the pressurized reservoir 180. From the reservoir, the ionizing gas is injected into the

cylinders 140 and is invested by the flow of ions emitted by heads 40, having opposite sign in the two conduits 300.

At the outlet form cylinders 140 sensors 251 can be provided to read the main parameters of the carrier fluid, such as gas composition, temperature and pressure.

Conduits 300 are electrostatically isolated, so the two separate streams of ionized gas retain their charge sign until the confluence point 130. Here the two streams flow together by generating a plasma consisting of an strongly ionized gas having an overall neutral charge and forming a spray cone 230 to reach the object to be painted, with the advantages detailed above.

The invention obtains the important advantages described above.

A further advantage is that the formation of paint drops is eliminated thanks to the acceleration of the blocking time of the paint (time needed for the adhesion of the paint to the object).

A still further advantage in the use of plasma at a temperature lower than 100 degrees, is to allow a reduction of about 50% in the pressure necessary to spray the paint. In this way a strong reduction in consumption of paint is obtained by removing the effect of the bouncing of paint from the object since the plasma enables a perfect adhesion of the paint on the substrate, because the spray cone is electrically neutral and free of electrostatic charges.

It was also found that a still further advantage of the use of plasma is in combination with the use of nanometre paints as fine powders.

Advantageously, the plasma can be also used to clean objects before painting.

The use of plasma also gives an effect of increased brightness of the layer of paint, since the same plasma is neutral in terms of chemical composition and neutral with regard to electric charges.

Another advantage is achieved finally in painting of plastic objects (problematic as offering strong electrostatic charges) allowing a perfect layering of paint using a neutral spray cone.

It was also found that using a fluid carrier at the state of cold plasma, it is

eliminated the formation of micro bubbles between layer of paint and painted objects, and therefore it is improved the adhesion of the paint film to the object when the film is subject to tension and it is also prevented the occurrence over time of micro cracks in the paint.

The invention so conceived is clearly open to industrial application, and it may also be the subject of numerous changes and variations, all falling under the inventive concept, all details can be replaced also, by other technically equivalent elements.

CLAIMS

1. A spray painting device, comprising a source of a pressurized carrier fluid (4, 100), an airbrush or gun (3, 200) attached to said source through a flexible conduit (1, 300) for spraying of a mixture of fluid and paint on a object to be painted, characterized by the fact that it comprises an emitter of ions (8, 330) to invest said carrier fluid with an emission of ions in a ionization region arranged along the passage path of the fluid between the source of carrier fluid and said airbrush, it further comprising a shield for electrostatically isolating the fluid at least along a portion of the passage path between the ioniser and the airbrush.

2. Device according to claim 1, in which the shield comprises a joint (6) in insulating material to operatively connect a source of emission of ions with the flow of fluid.

3. Device according to claim 1 or 2, in which the shield comprises an isolation inside said airbrush, arranged to isolate the flow of fluid from the airbrush.

4. Device according to any of the previous claims, in which the emitter of ions comprises a three positions switch for the emission of positive and negative ions and a neutral position.

5. Device according to any of the previous claims comprising

a source of a pressurized carrier gas (100),

a gun (200) provided with an inlet (60) of that gas, an inlet (70) of the paint, and an outlet (80) for spraying a mixture of gas and paint on a object,

- at least a conduit (30) extended from the source (100) to that inlet (60), characterized by the fact that they include at least one ionization device (330) active on that carrier gas to invest said carrier gas with a stream of ions positively charged and with a stream of negatively charged ions in order to obtain a gas at the state of plasma at a convergence point (130) arranged upwardly the mixing of the carrier gas and paint.

6. Device according to one or more of the previous claims, in which the ionization device comprises at least a Ionizer (50) provided with at least one head (40) for emission of ions.

7. Device according to claim 6, where the ionization device (330) comprises two ionizers (50) associated with respective heads (40) working on separate conduits (300) converging at point of confluence (130), in order to emit ions having opposite signs to separate streams of carrier gas.

8. A device according to one or more of the previous claims, in which said source of carrier fluid is a source of modified air rich in nitrogen.

9. A device according to one or more of the previous claims, in which said conduit (1, 300) comprise heating elements (14, 110). of the carrier fluid.

10. A device according to one or more of the previous claims, comprising an electrostatic charges detector (220) to measure the surface charge of the object to be painted, operatively associated with the ion emitter (5, 330) for selecting the sign of the emission of ions to be sent to the fluid.

11. A device according to one or more of the previous claims, in which at least one conduit (1, 300) comprises an electrically insulating block (120) between the heating element (110) and the gun (60).

12. Method for the spray painting of objects, comprising mixing of a pressurized carrier gas with a paint and sending a mixture on a object, wherein before that mixing step said carrier gas is treated by ionization and wherein the fluid is electrostatically shielded at least along a portion of a passage path of the gas upstream the mixing.

13. Method according to claim 12 for the spray painting of a object having a surface with an electrostatic charge sign, comprising the step of ionizing of the carrier fluid flow with ions having a prevailing charge sign which is defined in relation to the painting environment and to the electrostatic charge sign of the object surface.

14. Method according to claim 12 or 13 in which said carrier fluid is at the state of cold plasma obtained by ionization of carrier gas.

15. Method according to one of claims 12-14, comprising a preliminary step of sending a stream of only ionized carrier fluid on the object with a either positive or negative charge, followed by a phase of spray painting with a ionized carrier fluid of the opposite sign.

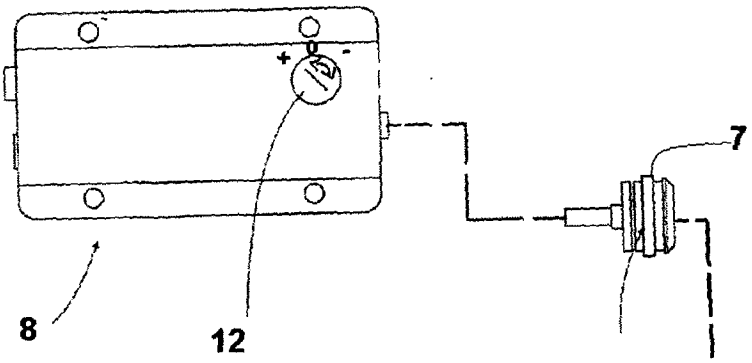
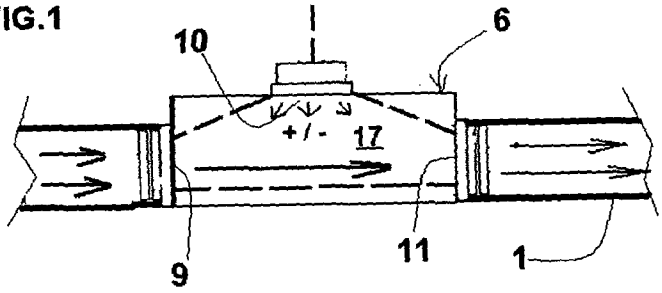


FIG.1



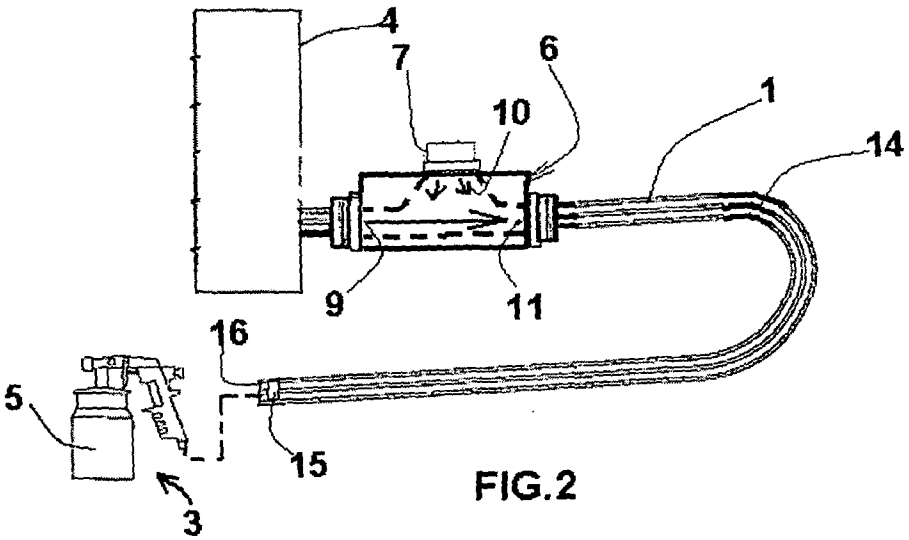
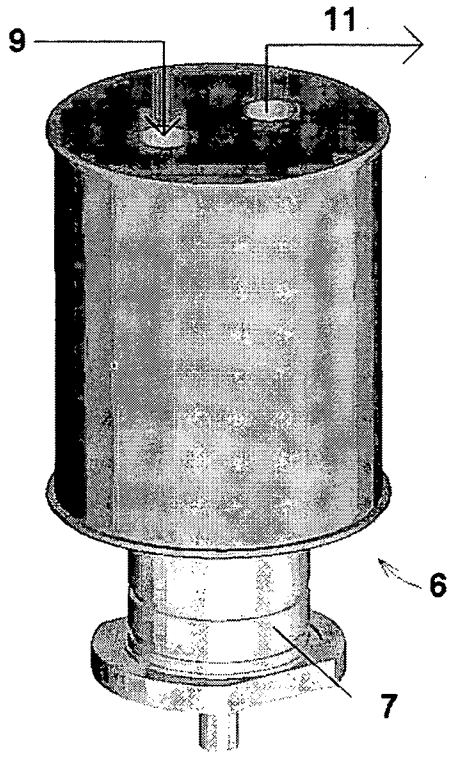


FIG.2

FIG.3



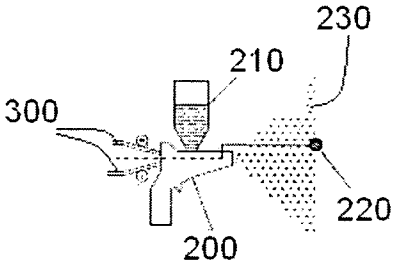


FIG.5

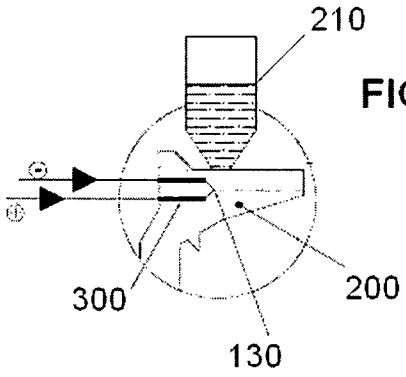
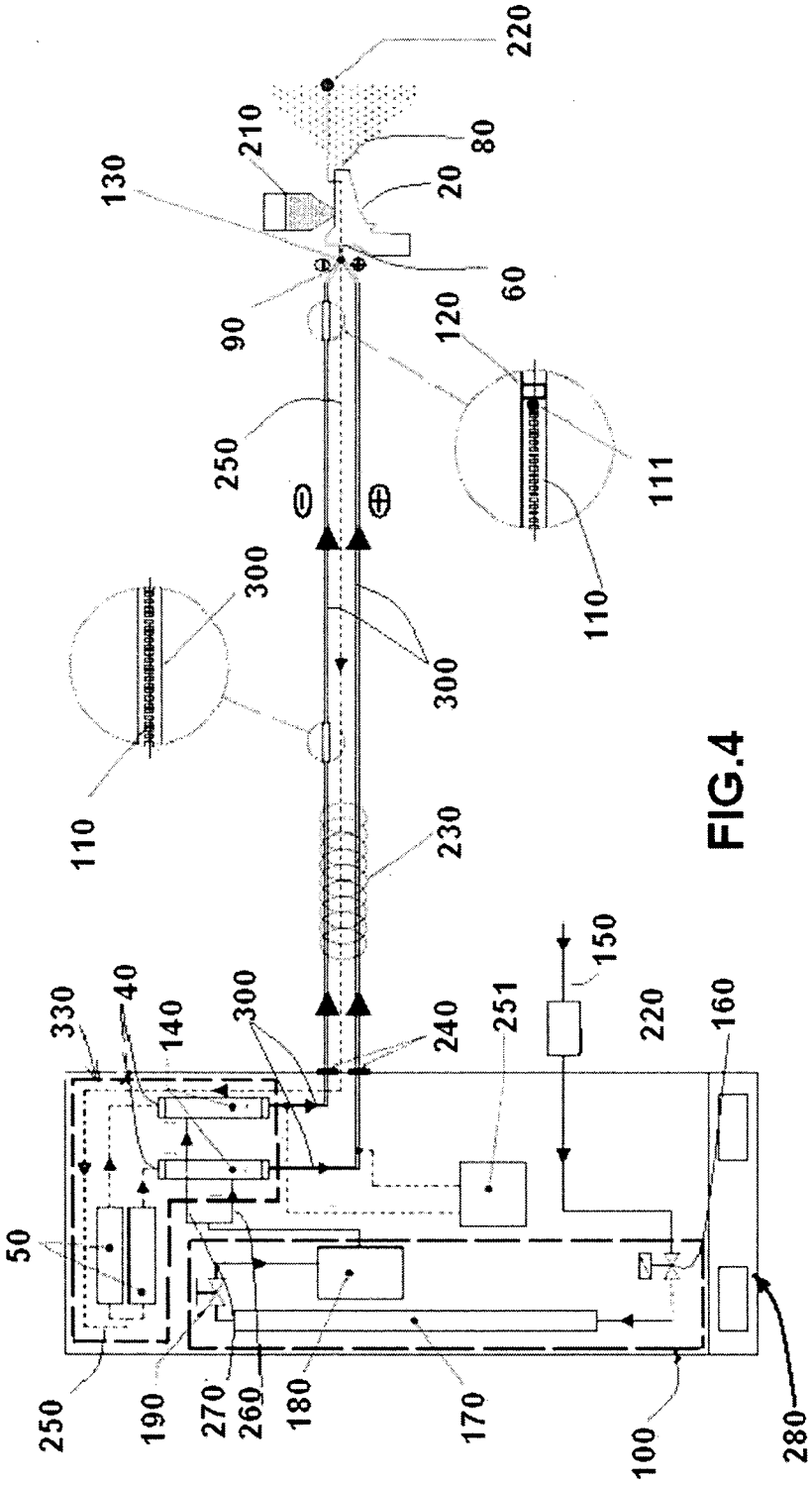


FIG.6


220
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170
100
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FIG.4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/002901

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05B5/03 B05B5/10

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)
B05B

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000 042452 A (ERUNIKKU KK) 15 February 2000 (2000-02-15) abstract paragraphs [0008], [0012] - [0018]; figures	1-3,6, 12,13
X	WO 99/55466 A (MSP CORP [US]) 4 November 1999 (1999-11-04) page 11, line 19 - page 12, line 22 page 13, line 15 - page 14, line 25; figures 2,3	1-3,6,8
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A	paragraphs [0070] - [0078]; figures 4,5	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 April 2009	15/04/2009

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Retevant to claim No.
A	GB 1 188 682 A (RANSBURG ELECTRO COATING CORP [US]) 22 April 1970 (1970-04-22) page 3, lines 81-128; figure 3	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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