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(54) **Method and set for cleaning surfaces, especially surfaces of electrical devices being under voltage**

(57) In a method of cleaning surfaces, especially surfaces of electric devices under voltage, using a dry ice method, a stream of compressed air is applied onto a cleaned surface at a safe distance. Before applying, the compressed air is dried to humidity of 0,008 - 0,0002 g/m^3 and then, is passed through a container with dry ice of the temperature from -70°C to -30°C and granulation from 1,5 to 5 mm.

A set for cleaning surfaces comprises a nozzle embedded on a lance connected by a house with a dispensing device (6) of a dry ice and compressed air supplied by a compressor (2). Between the compressor (2) and the dispensing device (6) of dry ice there is mounted a dehumidifier (4) of compressed air connected by a hose (3) with the compressor (2) and by a second hose (5) with the dispensing device (6) of dry ice.

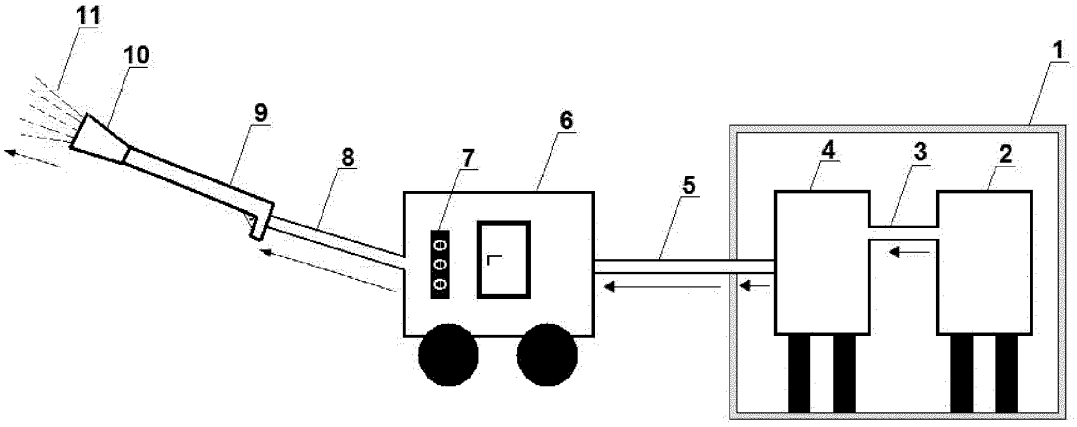

Fig. 1

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Description

[0001] The object of the invention is a method and set for cleaning surfaces, especially surfaces of electrical devices being under voltage.

[0002] From patent specification PL 169486 there is known a method for cleaning indoor electric substations, using the effect of sucking the dirt by the vacuum generated by an industrial vacuum device and reciprocating motion of cleaning devices, in which on the basis of measurements of humidity and temperature graphically on a plane in a rectangular coordinate system (humidity, temperature) there is determined a forbidden area of work and a safe area of work under voltage and afterwards the measurements of humidity and temperature outside the electric substation are taken, then the measurement point with the coordinates based on the difference of the temperatures outside and inside of the substation is set, and if the point is placed in the safe work area, the dust and sediment are removed from the respective elements of the substation equipment.

[0003] From patent specification 185360 there is known a method for cleaning of indoor electromagnetic devices using liquid cleaning agent. In this method for rated voltage, there is the allowable isolating clearance determined and from air temperature and humidity measurements vertical dimensions, horizontal danger areas and the minimum distance of horizontal close up are set. Comparison of the horizontal close up distance with size of the isolating clearance is made, then from the distance of close up a spray-gun with adjustable pressure of spraying, under low pressure, hydrodynamic steady stream of hydrophobic liquid of high electric resistance is directed onto the dirty surface, in direction from the top to the down. Afterward, the brush attached to the insulated rod abrades the wet surface mechanically within the safe close up distance.

[0004] From the Polish patent application P.296801 there is known a method of cleaning, especially live electrical switch-rooms and cleaning, washing and spraying device for the electrical switch-rooms. The method consists in that an operator stands on an insulating foot-pace wearing insulating rubber boots and insulating helmet with anti-dust screen holding in his both hands secured by insulating gloves a sucking insulating tube and makes with a brush reciprocating movements, whereas the brush adheres to the cleaned surface and sucks in dust and grits under pressure appropriately higher than 14,3 kPa until dust and dirt are removed, and then, the operator puts dielectric chemical and dissolvent onto the brush and standing on the insulated foot-pace makes reciprocating movements on the surfaces of electric apparatus, devices and installations and cleans the dirt. Next, after the surface is cleaned, the operator sprays the electric apparatus, devices and installations with chemical under pressure, conveniently 4 - 6.2 bars, which at the same time flushes away dissolved dirt and leaves a film which secures from dirt and corrosion cleaned surface. A cleaning device consists of vertical fan-filtering system put in electro-insulating case, a dust container and an insulating carriage with an insulating handle. The dust container is connected to a sucking device ended with a brush by means of a sucking and electro-insulating hose and electro-insulating sucking tube. A washing device is a brush with a body having symmetrically drilled sucking holes put between double tufts of bristle on its whole surface connected favourably permanently with the insulating pipe. In a spraying device a compressor is connected by an insulating pressure hose to a check valve of a liquid container, and in turn an outlet of the liquid container, connected with a diffuser touching a bottom of the liquid container, is connected to insulating pressure hose with insulating airbrush. However, this method is very time-consuming. The abovementioned methods of cleaning require mechanical contact with electric devices what may cause its damage.

[0005] There is also known another method for cleaning dirty surfaces using dry ice, in which traditional methods of sandblasting used for cleaning surface from contaminants, for example covered in lacquer, grease and resin, have been replaced by a method using dry ice in form of pellets. Because the pellets of dry ice change into gas and sublimate to the atmosphere immediately after streaming, everything that is left is dirt separated from the cleaned surface and the surface itself is not processed mechanically in any way. This method allows to keep the processed surface properties, reduces the amount of chemical residue and shortens the time of cleaning process. In a cleaning device there is a container from which by a funnel the pellets of dry ice are transported to an output hose. Simultaneously an air gun with compressed air creates vacuum, the effect is that the pellets of dry ice are gently sucked in and accelerated to flow velocity of approximately 300 m/s. Thanks to highly efficient nozzles the stream of pellets is "shot out" onto the surface of the cleaned material. Contact of dry ice pellets of the temperature -79°C with the contaminants makes them crush, and as a consequence of thermal shock separates it from the cleaned surface. High speed of the second stream of pellets causes complete separation a top layer of the contaminants. Effectiveness of this method is caused by thermal shock and pneumatic effect. In contrary to sandblasting, in this method, the cleaned surface of main material is not disturbed. Immediately after contact with the contaminant, dry ice changes into gas and escapes to the atmosphere. Using this method there is a possibility to remove all kinds of surface contaminant such as glue, oils, lacquers, grease, bitumen mass, dissolvent, rust, wax, printing ink, silicones, polyurethane foams, food industry contaminants, scale, seizing and many more.

[0006] This method cannot be used for cleaning electric elements under voltage, because after contact with the cleaned surface, the cleaned surface is water-wet.

[0007] A method of cleaning surfaces, especially surfaces of electric devices under voltage, in which, using

dry ice method, a stream of compressed air is applied onto a cleaned surface at a safe distance. The method according to the invention characterises in that compressed air is dried to humidity of 0,008 - 0,0002 g/m^3 and next is passed through a container with dry ice having the temperature from -70°C to -30°C and granulation 1,5 to 5 mm. Drying of the compressed air before supplying it to a dispensing device of dry ice prevents wetting of the cleaned surface, therefore it enables electric devices under voltage to be cleaned with this method.

[0008] A set for cleaning surfaces, especially surfaces of electric devices under voltage, comprises a nozzle embedded on a lance connected with a hose with the dry ice dispensing device and a compressor producing compressed air. The set characterises in that between the compressor and the dispensing device of dry ice there is mounted a dehumidifier of the compressed air. It is connected with the compressor by a hose and another hose with the dispensing device. It is very advantageous to put the compressor and the dehumidifier in a thermally insulated container. Mounting the insulated container comprising the compressor and the dehumidifier together on a vehicle makes the set easy to remove to places needed to be cleaned, such as switch-rooms, transformer stations, production lines, buildings.

[0009] The object of the invention is presented in an embodiment in the drawing in which Fig. 1 shows a set for cleaning surfaces.

[0010] In an insulated container 1, shown in Fig.1, a compressor 2 is mounted connected by a hose 3 with a dehumidifier 4 of compressed air. Mounting the container on a chassis makes a set mobile. Dried compressed air is delivered by a hose 5 to a device 6, which contains dry ice. The device has a control panel 7 which controls quantity of pressure or pressure level of the compressed air and the amount of dry ice. From the device 6 there is a hose 8 connected with a lance 9 ended with a nozzle 10, from which the cleaning agents gets out. The arrows show the direction of the air and cleaning agent flow.

Claims

1. A method of cleaning surfaces, especially surfaces of electric devices under voltage, in which, using a dry ice method, a stream of compressed air is applied onto a cleaned surface at a safe distance, **characterized in that** compressed air is dried to humidity of 0,008 - 0,0002 g/m^3 and then, is passed through a container with dry ice of the temperature from -70°C to -30°C and granulation from 1,5 to 5 mm.

2. A set for cleaning surfaces, especially surface of electric devices under voltage, comprising a nozzle embedded on a lance connected by a house with a dispensing device of a dry ice and compressed air supplied by a compressor, **characterized in that** between the compressor (2) and the dispensing device (6) of dry ice there is mounted a dehumidifier (4) of compressed air connected by a hose (3) with the compressor (2) and by a second hose (5) with the dispensing device (6) of dry ice.

3. The set for cleaning surfaces according to claim 2, **characterized in that** the compressor (2) and the dehumidifier (4) are embedded in a thermally insulated container (1).

4. The set for cleaning surfaces according to claim 2, **characterized in that** the insulated container (1) is mounted on a vehicle.

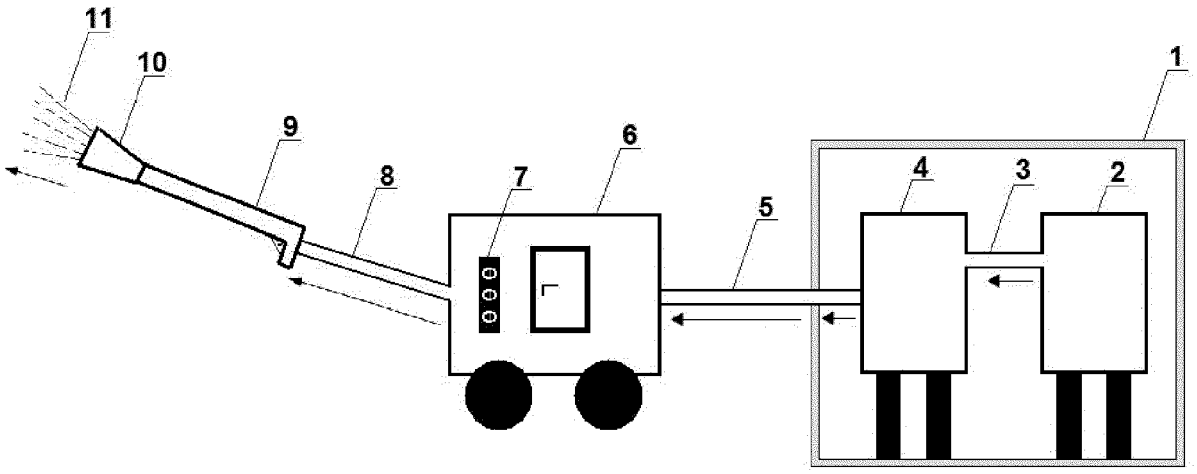

Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL 169486 **[0002]**
- PL 185360 **[0003]**
- PL P296801 **[0004]**