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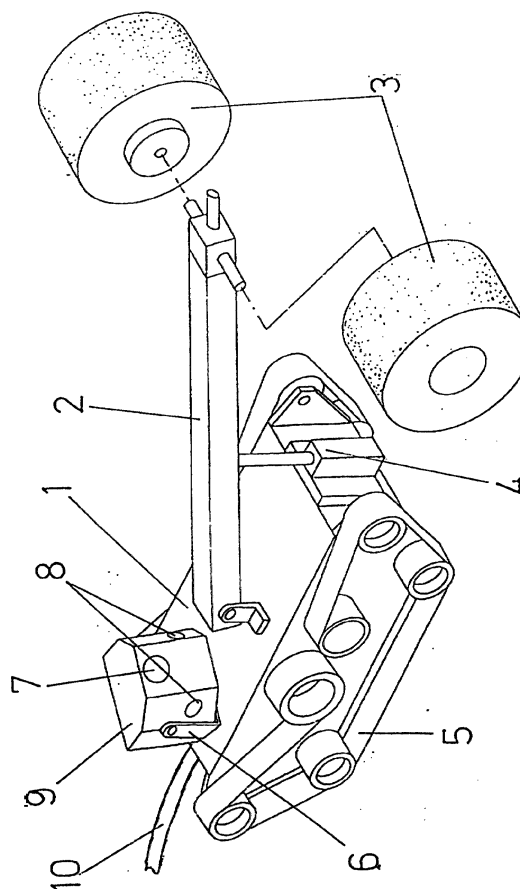
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(54) **Machine for cleaning air vents**

(57) An improved machine (1) for cleaning air vents, of the type that is introduced into air vents for cleaning the same and which moves by means of casters or tracks (5) and is provided with a camera (7) for recording the inside of the vent, which is situated on the machine and connected to an outside monitor, the machine being controlled from the outside of said vent. Cleaning of the vent is carried out by means of rotating devices (3) which eliminate dirt from the vents and which are also controlled from the external control panel.

Figure 1



EP 1 145 775 A2

Description

OBJECT OF THE INVENTION

[0001] The present invention, "**an improved machine for cleaning air vents**", refers to a machine of the type that is introduced into air vents, normally those of air-conditioning systems, in order to clean them. The machine moves upon tracks inside the vents and the user controls the machine's movements by means of a video camera mounted on it and connected to a monitor situated outside. The machine is provided with brushes for cleaning the vents which, as they turn, eliminate the dirt from the walls, floor and ceiling of the air vent. The turning of these brushes is also controlled by the user from the external control panel.

DESCRIPTION OF THE STATE OF THE ART

[0002] In the State of the Art different machines are used to clean vents and they have different operating principles. The present specification of patent of invention application, "**an improved machine for cleaning air vents**", refers to those which are automated and have two tracks at the sides of the base, a camera in their upper part and cleaning brushes.

[0003] Said robots have certain technical limitations which prevent an optimal use being made of the functional and technical qualities of these machines. The limited use of their characteristics make cleaning operations longer and considerably increase the costs of the operation. The duration of the cleaning operation influences not only the cost of same, but also affects the place where the air vents are situated and, therefore, the people who work there, since the place where the vents pass must be devoid of people due to the dust or pollution thrown out during cleaning.

[0004] These machines are supplied with power and controlled through a hose through which the different cables run which control each function that said machine can carry out. In addition to this hose, there is another one through which air is introduced. The first hose joins the air vent-cleaning machine with the control unit in which both the control panel and the colour monitor are situated and from which the user controls the machine. The second hose joins the machine with the air compressor, which will drive the air through the hose to a pneumatic motor that activates the brushes which clean the inside of the vent. Because there are two hoses, the different manoeuvres of the machine inside the vent are affected. Moreover, it is necessary to transport an additional compressor to supply this air, which means an additional cost in machinery and transport, thus making the operation of cleaning the inside of the vent more expensive.

[0005] The machines currently used in cleaning vents, to which the present specification of patent application refers, have a camera in their upper part which

allows the user to guide the machine along the air vent and concentrate its dirt elimination effect on the most contaminated parts. Said cameras have the serious limitation that their ability to turn is restricted by being controlled by a cable of a determinate length. When the camera turns on its axis, the control cable winds around said axis until it reaches a limit determined by the length of the cable, which limits the freedom of movement of the camera, since once the cable is wound around the axis after having turned in one direction, the camera has to be turned in the opposite direction to retrace the path previously followed. This limitation obliges the user to attend to the turning of the camera, because the consecutive windings of the cable around the turning axis cause continual wearing of the connections as well as constant wearing of the cable, thus increasing maintenance costs and increasing the operation time due to the additional attention that must be given by the operator of the machine.

[0006] Current cameras can turn only in the above-mentioned ground plane, thus limiting the user's view of the machine to said ground plane, which means that the machine's movements and manoeuvres must be increased in order to see the details of those places that are situated above or below the camera's ground plane.

[0007] Cleaning of the vent is carried out mainly by means of brushes that are selected according to the dimensions of the vent, at least in height. The accumulated dirt is dragged by means of friction, said friction being aided by the suction of a vacuum cleaner situated at the end of the vent opposite to that which the robot entered by. Said brushes cannot move vertically and have only one turning direction, thus significantly increasing cleaning time, since it is necessary to pass more than once over the same place; and even so, optimal cleaning is not achieved.

[0008] The machines move inside the vents on wheels or roller bands. Wheels present a problem when they are used in vents made of fibreglass, since they break the same as it is very delicate and as the weight of the machine is centred on the specific supports of the wheels. On the other hand, this does not happen with the roller bands, as the weight distribution is more balanced on the fibre surface. Another problem arising from fibre vents is that the material becomes detached as the machine passes. Another type of material for manufacturing air vents is compacted fibreglass lined inside with a sheet of aluminium, which give fewer problems for cleaning. Currently, the same type of tracks are used for cleaning all types of vents, which affects the performance of the machine and the cleaning operation, since each material requires a different procedure according to its physical characteristics. The vent made of simple fibreglass gives greater adherence to the tracks, therefore smooth bands can be used. On the other hand, the use of tracks provided with a tread or rough surface causes erosion of the fibre and subsequent detachment of same. Vents made of steel plate or fibre lined with

aluminium do not undergo such erosion but give less adherence, so that the robot must have bands with rough contact surfaces to stop it slipping when negotiating height differences or having difficulty in pulling the weight of the electrical conduit hose which joins it to the outside.

[0009] When the machine is cleaning a vent, it is usually necessary for it to go over certain places again or to focus its cleaning action on certain points where there is a greater concentration of dirt. To do this, machines with total freedom of movement are required. Currently, the machines are turned by stopping one of the tracks and making the other one to turn in one direction, thus turning the whole machine in an arc on the ground plane. This is a slow operation which also causes unequal wearing of the tracks, thus affecting vent cleaning time and maintenance costs.

DESCRIPTION

[0010] The present patent application, "**An improved machine for cleaning air vents**", has been developed to satisfactorily resolve all the above mentioned problems.

[0011] The operation of these machines involves the use of different elements, so that cleaning the vent is not limited to introducing the machine into it. The cleaning process consists of making two apertures in the air vent, one at each end of the same, in such a way that the cleaning machine is introduced into one aperture and a hose or conduit connected to a vacuum cleaner is placed at the opposite aperture. The automated machine is controlled by a joy-stick operated by the operator situated outside, allowing him to control the movements of the same at a distance through the control post or unit. There is a colour monitor in said control post on which all images transmitted by the camera situated on the machine can be observed. In said control post there is also a control panel for controlling the different functions of the apparatus and a video device for recording the vent cleaning operation. Electrification of the motors that drive the brushes makes it unnecessary to transport an additional compressor and also allows a connection hose to be eliminated.

[0012] The machine has great traction power, which allows different accessories to be coupled to its body or bodywork without affecting its output or performance. Once the machine is introduced into the air vent, the operator can see the inside of the latter and thus focus the cleaning action on the places that most need it. To carry out this work correctly, the machine must have as few limitations on its movements as possible, since its manoeuvrability is clearly a crucial advantage given the small space in which it has to move and operate.

[0013] To facilitate the movements of the machine inside the vent, said machine can turn 360° on its own axis without moving from the spot, turning both tracks at the same time, but with one turning in the opposite

direction to the other, according to which side one wishes to turn or where one wishes to focus the cleaning. While one track turns in one direction, the opposite track turns in the opposite direction, in such a way that the machine can turn in the ground plane on its vertical axis.

[0014] The machine has a camera in its upper part to allow the inside of the vent to be seen, by means of which the operator guides and moves the machine to the appropriate place and is able to check whether the vent is clean after the machine has passed in any situation. To make this possible, the camera must have total freedom of movement and be able to turn without limit on the horizontal plane thanks to the fact that the turning axis of the camera support is provided with a rotating connector. Thus, the need to have a connection cable disappears and so does the limitation on turning that this imposes. The end checks on the rotation arc disappear and the camera can rotate on its axis as many times as necessary, in either direction without any hindrance. Another similar connector allows the camera to move 90° in the vertical plane. By these means the operator can thoroughly examine the inside of the vent and check that after it has been cleaned it is in a state to be used again. Said camera is situated inside a head which also contains the spotlights needed to be able to see inside the air vent.

[0015] Cleaning of the inside of the vent is carried out by means of rotating brushes situated at the end of the brush-holding arm, on the upper part of the machine. Said brush-holding arm can be adjusted in height and the turning direction of the brushes is variable. The brush-holding arm is adjusted in height by means of activating a hydraulic cylinder controlled from the control unit and the floors or ceilings can be cleaned according to the turning of the brushes and the machine's direction of movement. The fact that the height position of the brushes and their turning direction on their axis are controlled from outside, allows any part of the inside of the vent to be operated upon without having to extract the robot to adjust it, as occurs in conventional apparatus. This also allows us to clean ceilings in the forward path inside the vent and floors in the return path, or vice versa, which means that work time and, therefore its costs, are reduced by half.

[0016] The machine is provided with two different types of tracks, which are determined according to the material of which the air vent is made, whether of steel plate or fibre. These tracks are made of rubber and plastic material and their contact surface with the floor may be smooth or rough or striated, thus providing bands which do little damage to the surface of the vent, which are selected for vents made of bare fibreglass; and others with a rough contact surface that are used when the inner surface is metallic and one wishes to maximise adherence capacity.

[0017] The work carried out, from when the machine is introduced into the vent until the latter is clean, is recorded and stored on high-quality, Super-VHS, video

tapes, which allows subsequent processing and mounting of the images for presenting the work done for the approval of the client, without losing picture quality in this process.

[0018] The advantages described in the present patent application specification can easily be transferred to other previous models of machines for cleaning air vents due to the modular nature of the machine.

DESCRIPTION OF THE DRAWINGS

[0019] To facilitate the presentation of this "improved machine for cleaning air vents", a drawing is attached to the present patent application in order to promote a better understanding of the principles on which the invention in question is based and also a better understanding of the description of a preferred embodiment, taking into account that the drawings are illustrative and non-restrictive in nature.

[0020] Figure 1 shows a machine for cleaning the inside of air vents in which the improvements that are the object of the present application can be observed.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0021] The proposed improvements in machines for cleaning the inside of air vents are described below according to a preferred embodiment.

[0022] The improved machine for cleaning air vents (1) is introduced inside the air vents with the object of cleaning them inside. For cleaning the walls, ceiling and floor of the vent, the machine (1) uses turning rollers (3) which move vertically through the brush-holding arm (2). Said vertical movement of the brush-holding arm (2) and therefore of the brushes (3) is controlled by a hydraulic cylinder (4). The brushes (3) can turn in both directions, so that the vent is cleaned in two stages: in the first one, the machine (1) moves forward and the rollers (3) turn in one direction while they clean the ceiling and, in the second stage, the rollers (3) are lowered and turn in the opposite direction to that of the previous stage while the machine (1) reverses and retraces all its previous path. These movements and those of the different components are controlled by a control unit situated outside the vent, which is provided with a joy-stick operated by the operator in charge of cleaning the vent.

[0023] In order to see inside the vent and where the dirt is situated, the machine has a moveable head (9) provided with a rotating connector, in which a camera (7) and two spotlights (8) are introduced, said head (9) being situated on a device (6) which allows the head (9) to move. The purpose of the spotlights is to illuminate the inside of the vent so that the operator can see it from outside on the colour monitor. Said head (9) can turn without limits on the ground plane, while its vertical movement is limited to 90°, since the combination of both horizontal and vertical movements makes it possible to view any part of the vent without needing to move

the machine (1).

[0024] Once the machine (1) is inside the vent, it moves along the same in order to clean it completely inside. Sometimes, it will have to pass again over the same place if the accumulated dirt has not been eliminated by a single pass, then, to apply the cleaning action directly to a specific point, instead of making the machine (1) go backwards, it is enough to make it turn on its axis. This movement is achieved by making the two tracks (5) turn at the same time, one turning in the opposite direction to the other. The turning direction of both tracks will depend on which side, left or right, one wishes to make the machine (1) turn.

[0025] Basically, there are two types of vents, characterised by the material of which they are made, which may be steel plate or fibreglass. According to the type of vent in question, it is recommendable to use one type or another of track (5). Therefore the machine (1) of the present invention is provided with tracks that are interchangeable according to the air vent to be cleaned. Vents made of fibreglass offer greater adherence to the tracks, so that smooth tracks would be sufficient; while vents made of steel plate or fibre lined with aluminium offer less adherence, so the tracks must be rough or striated.

[0026] To eliminate transport of the compressor and therefore the use of a second connection hose between said compressor and the machine (1), a greater number of cables have been introduced into the control hose (10), taking advantage of said increase in capacity to replace the compressor by an electric motor that controls the turning of the brushes (3), thus making the transport of an additional compressor and the use of a second hose unnecessary.

[0027] The invention, within the scope of its essential nature, may be put into practice in other embodiments that differ only in detail from that which is indicated only by way of example. The improved machine for cleaning air vents may thus be embodied in any shape and size, with the most appropriate means and materials and with the most convenient accessories; and the components may be replaced by others which are technically equivalent, providing they are comprised within the claims.

Claims

1. An improved machine for cleaning air vents, of the type which are introduced inside the vents and having rotating movement means in their sides, tracks, systems for viewing the inside of the vents and means for cleaning the inside of the same, said machine being connected to a control unit situated outside and controlled by an operator, **characterised in that** it has a brush-holding arm that is adjustable in height and controlled by a hydraulic cylinder, at the end of which there are elements for coupling rotating brushes which can turn in both di-

rections.

2. **An improved machine for cleaning air vents** in accordance with the first claim, **characterised in that** it is provided with a head containing a camera and spotlights to illuminate the inside of the air vent, said head being provided with the possibility of turning without limit in the ground plane thanks to a rotating connector, while in the vertical plane its turning is limited to 90°. 5 10
3. **An improved machine for cleaning air vents** in accordance with the first claim, **characterised in that** it is provided with the possibility of turning 360° in the ground plane with respect to its vertical axis by means of the simultaneous turning in opposite directions of its two tracks. 15
4. **An improved machine for cleaning air vents** in accordance with the first claim, **characterised in that** it has two types of interchangeable tracks, smooth or with a tread, according to whether the air vent is made of fibreglass or steel plate. 20
5. **An improved machine for cleaning air vents** in accordance with the first claim, **characterised in that** it has a single connection hose between the machine and the control unit, including the control cables of the different devices of the machine and the connection cables between the electric motor that makes the brushes turn and the machine. 25 30

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Figure 1

