

APPLICATION FOR PATENT

Title: A SYSTEM FOR TREATING EXTERIOR SURFACES

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FIELD OF THE INVENTION

The present invention is a system which employs steam powered vacuum to clean, treat and maintain exterior surfaces.

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BACKGROUND OF THE INVENTION

The external surfaces of tall buildings require treatment from time to time for aesthetic and/or functional reasons. For example, it is desirable to clean the outside surfaces of the buildings' windows.

Several techniques are adopted to gain access to a building exterior for the purpose of effecting required treatments of the building. The majority of buildings do not feature external access ways surrounding each floor, which could be used by a worker to execute external cleaning of the building. In these cases, one normally relies on erecting scaffolding. Alternatively, some buildings use a small scaffold platform, which may be supported by a cable and is attached to an appropriate securing device on the roof of the building.

The disadvantages of these practices include the following. Firstly, there is a danger of the worker falling due to adverse weather conditions, or due to human error. Secondly, the worker is exposed to high concentrations of the materials being used to treat or clean the building. Thirdly, this work is labor intensive and repetitive and therefore as the worker tires, the job takes a longer time.

The background art contains several automated devices to try to overcome the aforementioned problems, such as U.S. Patent Application No. 5,240,503, and U.S. Patent Application No. 5,707,455, which disclose systems for treating exterior surfaces of a building. These devices use a separate power supply for the driving source.

The background art includes devices that can be used for automated cleaning of building surfaces and machines that use suction. U.S. Patent Application No. 5487440,

U.S. Patent Application No. 5366038, U.S. Patent Application No. 3958652 and U.S. Patent Application No. 4095378 disclose robots for performing a working operation on a surface, which use a series of vacuum cups to engage the surface to be traversed. However, these devices are all powered by a specially provided power source.

5 The known devices for cleaning tall buildings suffer from the following disadvantages. Many of these devices are very heavy due to the presence of weights (used to stabilize the devices) and electrical motors. The devices that do not use suction are affected by the weather conditions. In conditions of strong wind, these devices are unable to stay in one position. None of the existing devices can move at the same time as
10 cleaning. In addition, they cannot access angled surfaces on buildings, such as corners, and consequently cannot clean such surfaces.

There is therefore a need for a system and method, such as is disclosed in the present invention, to provide a solution to the aforementioned problems and to be more efficient and cost-effective than known automated cleaning devices.

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SUMMARY OF THE INVENTION

The device of the present invention is a system that is used for steam cleaning, other treatments and maintenance of external surfaces, such as of tall buildings, or ships. It can also be used for accessibility to positions in high buildings, such as in the case of a
20 fire. The movement of the system is powered by a pressurized fluid, such as steam, which also powers a vacuum pump used to generate suction retention against the wall of the building. A pressurized fluid can be a liquid or gas or a mixture thereof and may include a suspension of solid particles.

In a first embodiment the present invention provides a system for treating an
25 external surface, the system comprising: (a) at least one treatment unit, the treatment unit employing a pressurized fluid for treating the external surface; (b) at least one suspension system for suspending the at least one treatment unit adjacent to the external surface, (c) at least one suction unit associated with the treatment unit, the suction unit being activated by the pressurized fluid to generate suction at a suction port; and (d) at least one
30 suction head in fluid connection with the suction port and deployed to clamp against the external surface.

In a preferred embodiment the at least one suspension system comprises: (a) a first anchor attached to an upper portion of the external surface; (b) a second anchor attached to a lower portion of the external surface; and (c) at least one cable attached at one end to the first anchor and at an opposing end to the second anchor; and (d) at least one cable connector associated with the at least one treatment unit, the at least one cable passing through the cable connector, such that that the treatment unit is suspended by the at least one cable.

In a preferred embodiment the treatment unit is a cleaning unit.

In a preferred embodiment the treatment unit adds to the pressurized fluid a paint.

10 In a preferred embodiment the treatment unit adds to the pressurized fluid a sealant.

In a preferred embodiment the pressurized fluid includes steam.

In a preferred embodiment the system further comprises a drive mechanism for moving the treatment unit, the drive mechanism including a belt, wherein the at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along the belt.

In a preferred embodiment the system further comprises a drive mechanism for moving the treatment unit, the drive mechanism including a plurality of wheels, wherein the at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along the plurality of wheels.

In a preferred embodiment the system further comprises a drive mechanism for moving the treatment unit, the drive mechanism including at least one four-bar system, wherein the at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along the at least one four-bar system.

25 In a preferred embodiment the drive mechanism is powered by pressure of the pressurized fluid.

In a preferred embodiment the system further comprises a valve associated with each of the plurality of suction heads and a control system associated with each of the valves, the control system being configured to selectively open a subset of the valves corresponding to those of the suction heads in contact with the exterior surface at any given time.

In a preferred embodiment the suction unit includes a piston system.

In a preferred embodiment the treatment unit further includes a secondary movement mechanism, the secondary movement mechanism being activated by pressure of the pressurized fluid.

5 In a preferred embodiment the system further comprises a track containing a plurality of suction units, wherein the suction units are activated by the pressurized fluid to generate suction at a suction port and the suction port is deployed to clamp against an object.

In a preferred embodiment the object is a window.

10 In a preferred embodiment the system further comprises a control unit associated with the drive mechanism and configured to control the movement of the treatment unit.

In a preferred embodiment the control unit is further configured to control the treatment unit.

15 In a preferred embodiment the belt is configured to conform to the contours of a non-planar surface.

In a second embodiment the present invention provides a system for treating an external surface of a building, the system comprising: (a) at least one treatment unit, the treatment unit being configured to treat the external surface of the building; (b) at least one suspension system for suspending the at least one treatment unit adjacent to the external surface, (c) at least one suction unit associated with the treatment unit, the suction unit being activated to generate suction at a suction port; (d) a plurality of suction heads in fluid connection with the suction port and deployed to clamp against the external surface; and (e) a drive mechanism for moving the treatment unit, the drive mechanism including a belt, and a plurality of suction heads are deployed in spaced relation along the belt.

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In a preferred embodiment the system for treating an external surface of a building further comprises: (a) a fluid connection hub rotatably mounted with respect to a supply of the pressurized fluid; and (b) a plurality of tubes forming fluid connections between the fluid connection hub and each of the suction heads.

30 In a third embodiment the present invention provides a system for treating an external surface, the system comprising: (a) at least one treatment unit, said treatment unit

employing a pressurized fluid for treating the external surface; (b) at least one suction unit associated with said treatment unit, said suction unit being activated by said pressurized fluid to generate suction at a suction port; and (c) at least one suction head in fluid connection with said suction port and deployed to clamp against the external surface.

In a fourth embodiment the present invention provides a method of suction clamping a device configured for treating an external surface of a building by use of a pressurized fluid, the method comprising employing the pressure of the pressurized fluid to operate a suction unit to generate suction.

In a preferred embodiment the device is a cleaning device.

In a preferred embodiment the device is a window replacing device.

In a preferred embodiment the device is a device for sealing cracks and holes.

In a preferred embodiment the device is a painting device.

In a preferred embodiment the painting device is a device for painting pictures on an external surface.

In a preferred embodiment the device includes a means for checking the state of the external surface.

In a preferred embodiment the state of the external surface is the state of the paint.

In a preferred embodiment the state of the external surface is the structural state.

In a preferred embodiment the device is a device for at least two of the following functions selected from the group consisting of a cleaning device, a window replacing device, a device for sealing cracks and holes and a painting device.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic side view of the system of the present invention;

FIG. 2 shows a schematic structure of the rotary fluid attachment device and drive mechanism;

FIG. 3 shows a schematic structure of the flow of pressurized fluid to the treatment unit;

FIG. 4 shows a schematic structure of suction activation of the suction units;

FIG. 5 shows a schematic structure of replacement of the belt structure with a plurality of wheels;

FIG. 6 shows a schematic structure of replacement of the belt structure with a four-bar system; and

FIG. 7 shows a cross-section of the present invention used as a window fitting device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 The present invention is a system for treating an external surface, such as of a building, which includes at least one treatment unit, the treatment unit being configured to treat an external surface, such as of a building with pressurized fluid, at least one suspension system for suspending cables and at least one suction unit associated with the treatment unit and activated by the pressure of the pressurized fluid. In an alternative
15 embodiment the system can optionally contain no cables or suspension system. This is preferably possible in a situation when a small sized system is used, such as when using an example of the system of the present invention weighing about 1Kg which is capable of carrying about 5 tons.

This system can be used for steam cleaning and maintenance of tall buildings. It
20 can be used for checking the state of the exterior surface such as for finding structural faults, cracks and holes and areas that are not properly sealed on the exterior surface. Additionally, the system of the present invention can be used to seal cracks and holes or alternatively for painting surfaces and even for replacing or fitting windows. The system of the present invention can perform more than one treatment simultaneously. The present
25 invention is not limited to treating surfaces of tall building, but can be used for all external surfaces including treating ships both above and underneath the surface of the water.

The movement of the system is preferably powered by a pressurized fluid, such as steam and a pressurized fluid powered vacuum pump is preferably used to generate
30 suction retention against the wall of the building or other external surface. The device is light weight, due to not requiring an electrical motor and not containing stabilizing

weights, or cleaning implements such as brushes. The system is able to simultaneously treat and move and can conform to all contours of any non-planar surface of a building. The system of the present invention can be used in hostile environments, such as below water.

5 The principles and operation of systems according to the present invention may be better understood with reference to the figures. The figures show one embodiment of the present invention and are not limiting.

Figure 1 shows schematically an overview of the system according to the present invention. This system can be used to clean and treat the exterior surfaces of a building 19 as well as being used for applications necessitating climbing up the face of a building, such as in a fire rescue. The main components of the system include supporting members 16 and 20, control units 18 and 29, treatment units 23 and 24, a vacuum supply system, suction units 30 and a drive mechanism.

Supporting members 20 are preferably cables and can be made up by connecting more conveniently smaller sized units to give the full length supporting members 20. The supporting members 20 are connected to the building above the point being treated, by a securing mechanism attached to supporting member 16, which extends away from and overhangs the building. The supporting member 16 is preferably, secured at one end to the top of the building 17 and at the other end to a surface 32, which can be the ground or any lower point of the building.

The pressure for the treatment device of the present invention can be provided by a pressurized fluid producing unit 12. The pressurized fluid can have various functions: (a) to be used to provide pressurized fluid to the treatment units 23 and 24; (b) to produce suction of the suction units 30; and (c) to power the drive mechanism. Optionally, one or more of these functions can be provided by pressure produced by unit 11. Unit 11 can provide pressure preferably by using a piston or a hydraulic pump. These devices can work optionally by using air pressure or hydraulic pressure. Unit 11 can be but is not limited to being connected to a steam producing unit 12. This is dependent on the type of situation that is being treated with the device of the present invention. In the case of a very tall skyscraper it is not viable to have unit 11 attached to unit 12. Pressure tubing 13 is attached to unit 12 and unit 11. Units 11 and 12 can alternatively be attached to an

electrical motor or can use pressure to move the treatment system 10. Units 11 and 12 are located at one end of the system.

Pressure tubing 13 connects units 11 and 12 to the treatment units 23 and 24. The example shown of the system of the present invention provides two treatment units 23 and 24, which are preferably cleaning units, or units that provide other treatments, such as waterproofing exterior surfaces of buildings. For the purpose of description of one embodiment of the present invention in figure 1, treatment units 23 and 24 will be referred to as cleaning units and the treatment system 10 can optionally be referred to as a cleaning system 10. One of the cleaning units 23 and 24 preferentially cleans when the device is descending the building, while the second cleaning unit cleans on ascending the building. Alternatively both cleaning units can clean at the same time. The two cleaning units 23 and 24 as shown are separated by the main body of the cleaning device 10, which contains the other components of the cleaning device.

Tubing 13 also connects the pressurized fluid to the attachment system comprising a belt 22 with attached suction units 30. The belt can be made of flexible material or made of rigid links connected to provide the required flexibility. The belt 22 uses a drive wheel 35 to rotate. The drive wheels are connected to a hydraulic motor 25. Figure 1 is only a schematic representation of the system of the present invention. The hydraulic motor 25 may be directly associated with the drive wheels 35 and can be used to drive both or either of the drive wheels 35. Suction units 30 are used to attach the system of the present invention 10 to the exterior surface of the building 19. There are a plurality of suction heads 28 in fluid connection with a suction port 27 and they are deployed to clamp against the external surface 19. A valve 21 is associated with each suction head 28. A control system is configured to selectively open a subset of the valves 21. A drive mechanism for moving the treatment units 23 and 24, uses the aforementioned belt 22, with a plurality of suction heads 28 deployed in spaced relation along the belt 22. The suction units 28 can be used optionally only for attachment to the building with a motor being used for moving the device up and down the building. Alternatively, the suction units 28 can be used for both moving the device up and down the building and also for attachment to the building.

In an alternative embodiment the belt 22 (figure 5) can be replaced by wheels 86, preferably one or more wheels and most preferably four or more wheels. In Figure 5 it can be seen that the wheels contain a plurality of suction units 30, which are activated in the same way as is described for the belt structure. The use of at least four wheels renders the attachment system more stable and safe.

In another embodiment the belt 22 can be replaced by a conventional four bar system 87, made up of bars connected by hinges 91 (figure 6). The pressurized fluid enters the four-bar system through one of the bars 87 and the suction units 30 are then activated in the same way as described for the belt structure. The four-bar system contains tracks 90, on which wheels with teeth 88 can move. The wheels are powered by an engine 89, which can optionally be activated by the pressurized fluid.

Replacement of the belt 22 with wheels 86 or a conventional four bar system 87 would be preferable when the exterior surface is planar and there is no need for the flexibility provided by the more complex belt system.

Optionally, protective foam cushions (not shown) on either side of the main body of the cleaning device 10 may be added. The cushions are preferably made from materials such as polyethylene foam. They prevent damage to the external surface 19 such as windows and to the main body of the cleaning device 10.

A control unit 29 is preferably used to provide quality control of the cleaning. In addition control units 18 control flow of the pressurized fluid and consequently the activation of the system. The control systems are shown schematically in Figure 1. The control system can optionally be situated at the top of the exterior surface or in any other appropriate position. The control system can employ any conventional technique, such as, but not limited to using I.R., U.V., ultrasound and video. The control units 18 and 29 are electrically connected to each other and to the units whose function they are controlling. The system can be automatically or remotely controlled. Using any of these techniques, the treatment system 10 can monitor the condition of the exterior, such as of the building 19 and deduce whether more treatment is needed.

The cleaning system 10 can move up the exterior surface, or down as the need arises. The cleaning system can optionally move sideways or diagonally and can also swivel. The movement of the system 10 up and down the building can be achieved by

conventional techniques such as using a winch. In a preferred implementation, the drive mechanism and suction of the cleaning system is used to raise and lower the system 10. The different directions in which the cleaning system 10 can move are achieved by differing the rate of movement of the belts 22.

5 The supporting members 20, which are preferably cables secure a track 14 at the top of the system 17 and another track 33 at the bottom of the system 32. Both tracks 14 and 33 can in a preferred embodiment contain a motor 15 or 34, which can optionally move the device sideways. A control unit can monitor by the distance between the two motors 15 and 34, how the system 10 has proceeded and where it is located.

10 In one embodiment of the present invention, the treatment system 10 is optionally used to clean or treat an exterior surface in a hostile environment such as, but not limited to cleaning a ship under the surface of the water, or treating an exterior surface in a toxic environment. The treatment system 10 works in a hostile environment in the same way as in a non-hostile environment as is described in figures 1-4. However, in a hostile
15 environment (not shown) the treatment system 10 is contained in a closed container under vacuum to ensure the system is not in direct contact with the hostile environment with one side of the container open. The side that is open is situated so that the suction units can contact the exterior surface to be treated or cleaned resulting in a closed environment for the treatment system 10. The container is preferably made from a material that is non-
20 reactive with the environment in which the treatment system 10 is being used, such as a water proof material for use under water.

In an alternative embodiment the treatment system of the present invention 10 can be optionally used for painting such as painting a picture on an exterior surface 19 (figure 1). On the supporting member at one end of the cleaning system is optionally located the
25 coloring agent/s, such as, but not limited to about 32 different colors or alternatively red, green and blue colors. Control unit 29 contains a computer which is connected to the treatment system of the present invention 10 and is optionally programmed by a diskette with a scanned picture of what is to be painted on the exterior surface 19. The computer is programmed with the color of the different pixels of the picture to be applied to the
30 external surface 19. The paint or alternative color tool is carried by the pressurized fluid to the treatment unit 23 and/or 24 and the first pixel is applied by the treatment unit 23

and/or 24 to the external surface 19. Control unit 29 preferably contains a CCD control unit, which checks the paint on the external surface and relays to the computer if the color of the pixel was correct and either to continue with the same color or to change the color for the next pixel. The CCD also checks that the shade is correct and controls either the
5 choice of the nearest available color or mixing of red green and blue to achieve the correct shade of color.

It is advantageous to look at each component of the present invention in greater detail in order to understand the structure and function of the present invention.

The pressurized fluid drive mechanism is shown schematically in figure 2.
10 Pressurized fluid enters the system through pressure tubing 70 and reaches the hub 41. The pressure is controlled by a valve 71, preferably a three way valve. Valve 71 can optionally be located on the roof of the building. The hub 41 has a plurality of outlets 40, which are connected by pressure tubing to the suction units 30 on the belt 22. In this way the suction units 30 on the belt 22 rotate at the same rate as the rotating hub 41. An
15 alternative to pressure distributed through the hub is provided.

In one embodiment of the device of the present invention, vacuum is provided to the suction units via the vacuum pump (not shown) and vacuum tubing (not shown). In an alternative embodiment the suction units are activated by a piston attached to each suction unit, as described in figure 4.

20 The following shown schematically in figure 2 is a more detailed description of the case where vacuum is provided to the suction units via the vacuum pump and vacuum tubing 42. The pressurized fluid producing unit (not shown) produces pressurized fluid, such as steam, which can pass through pressure tubing 70 to a pressure valve 71. An additional valve (not shown) controls the production of the pressurized fluid and can be
25 used to shut off the pressurized fluid. The valves are typically electrically connected to the control units and in this way there is communication between the valves and controls. The valve 71 contains a plurality of outlets, which can be optionally open or shut. The control decides which to open and which to close. The pressurized fluid can then travel through pressure tubing 42 to the suction units 30.

30 In addition figure 2 shows schematically the rotary fluid attachment device 45. The rotatable fluid connection hub 41 contains numerous outlets 40. Optionally, when

pressure driven, each outlet 40 is connected by pressure tubing 42 to a corresponding piston unit 43 on a suction unit 30 (as described in figure 4) to produce a rotary fluid connection system.

Alternatively, when vacuum driven, each outlet 40 is connected directly by vacuum tubing 42 to a corresponding suction unit 30 on the belt structure 22 (or alternative wheel structure) as previously described. Therefore, the rate of movement of the suction unit belt 22 is by necessity the same as the rate of the movement of the hub 41.

Figure 3 schematically shows that the valve 71 controls the flow of the pressurized fluid to the treatment systems. Valve 71 can optionally be located on the roof of the building. When the system of the present invention is stationary, the valve 71 opens through tube 74 to provide pressure and pressurized fluid to the cleaning units 23 and 24. When the cleaning unit is moving, the valve passes the pressurized fluid through tube 76 or tube 77, which drive the drive wheel 35. Tube 76 is used preferably when the device of the present invention is ascending the exterior surface, such as of a building and the pressurized fluid drives the drive wheel 35 in one direction. Tube 77 is preferably used when the device of the present invention is descending the exterior surface, such as of a building and drives the drive wheel 35 in the opposite direction. The pressure and pressurized fluid for treatment is then provided to the cleaning apparatus via tube 78.

The treatment unit 23 or 24 is schematically shown in figure 3. For description purposes, one particular cleaning unit will be described. The pressurized fluid is provided through tube 78, (in the case of the device moving), or tube 74 (in the case of the device being stationary). The treatment units 23 or 24 can move sideways, left and right, or move inwards and outwards using state of the art techniques, such as a screw system, whereby applied pressure moves the screw, which in turn moves the system along the screw. Alternatively a secondary movement mechanism activated by the pressure of the system can be used to move the treatment units 23 and 24 independently of the movement of the cleaning system 10.

The treatment unit can contain as is shown in figure 3 a spray and cleaning unit 63, which sprays through its nozzle 65 the materials needed for treatment of the building, such as the pressurized fluid. It should be understood that the cleaning unit may use the

pressurized fluid alone, such as in steam cleaning, or as a carrier fluid for additives used in other applications of the unit. Other additives for other applications of the cleaning unit include treatment and cleaning materials. Materials used for cleaning or treatment preferably include but are not limited to conventional industrial cleaning agents, crystal cleaning materials and cleaning powders containing plastic particles in gas or liquid form, paint, treatment materials in powder, liquid or gas form, sealants and glue. These materials are carried by the pressurized fluid to the treatment unit. A blower unit 64 can be optionally connected to the spray and cleaning unit 63 and removes the dirt and water residues and any other residue. A valve 66 connected to the spray and cleaning unit 63 is open only at the time of cleaning. When the valve 62 is open the pressurized fluid and other treatment material flow into the spray and cleaning unit 63, which expels the pressurized fluid and other treatment material through a nozzle 65 onto the surface of the building 19. The cleaning device can move and clean simultaneously.

The system of the present invention optionally provides two cleaning units 23 and 24. One of the cleaning units 23 and 24 preferentially cleans when the device is descending the building, while the second cleaning unit cleans on ascending the building. Alternatively both cleaning units can clean at the same time.

Figure 4 shows schematically the attachment system. The cleaning system 10 uses a multiplicity of suction units 30 to attach the cleaning system 10 to the exterior surface of the building 19. The suction unit 30 consists preferably of a suction head 28 that has access to the exterior surface of the building and a suction port 27 that is connected to a suction activation mechanism.

The suction can use either a vacuum pump 46, such as an oil pump, or a piston unit 43, or any other type of suction activating unit. Figure 2 shows the belt 22, to which the suction units 30 are attached. It should be noted that the belt 22 can conform to any contour of an exterior surface 19 and therefore all surfaces can be treated. Existing devices are unable to do this. A rotatable fluid connection hub 41 is positioned at the center of the belt 22.

Vacuum can be supplied to the suction units 30 in a number of ways. In one example of the present invention (figure 4), a vacuum pump 46 passes vacuum via vacuum tubing 52 directly to the suction heads 28. In an alternative embodiment, pressure

is provided through pressure tubing 50 which enters a first piston 53 of the piston unit 43, and which is connected with a pivot 48 to a second piston 54. When the pressure enters the system the first piston 53 will move downwards inducing the second piston 54 to move upwards and producing a vacuum between the suction heads 28 and surface 19. The suction units 30 can work using both these embodiments simultaneously or either embodiment by itself. In an alternative embodiment, the suction units can use pressurized fluid powered vacuum together with an electric piston to produce greater suction.

The suction heads 28 can be made from a range of materials, preferably from flexible silicone. Valves 49 and 47 are connected electrically to a control unit (not shown), which can control the vacuum supply to the suction units 30.

An alternative embodiment of the present invention is shown in figure 7. The treatment system of the present invention 10 can optionally be used for fitting and replacing windows 80 on an exterior surface 19. The treatment system 10 of the present invention is modified from that described in figure 1 in that a track 81, connected from one end to the other end of the supporting members 20 contains a plurality of suction units 82 independently activated from the suction units 30 connected to the movement and attachment systems of the present invention. Pressurized fluid 83 is used to activate the suction units 82 in the same way as the suction units 30 of the attachment and movement systems. The suction units 82 can be used to hold an object such as a window 80. The distance between the movement and attachment systems and the track 81 is large enough for a window 80 to be carried between the two belts 22. Attached to the track 81 are treatment units 92, which can treat the exterior surface, independently of the treatment units 23, such as, but not limited to gluing the window in place. The control unit 84 contains a computer which controls where and when to put the window into the frame on the exterior surface 19. The control unit also contains the CCD unit 29, which checks when the window 80 is in place and whether enough glue is present for the suction units 82 to release the window 80. A mechanical operation 93 can be used to move the track 81, in which way the window 80 can be moved in any desired direction. The track 81 containing suction units 82 can optionally be used for carrying other objects, such as tools up or down the exterior surface 19 that is being treated.

Advantages of various embodiments of the present invention include, use at night, use in hostile environments, such as under water or in a toxic chemical environment and not being affected by adverse weather conditions. The device can move at the same time it cleans and it is relatively light. In addition, due to the flexibility of the belt containing
5 the suction units, the device of the present invention can access contours of any non-planar surface of a building.

What is claimed is:

1. A system for treating an external surface, the system comprising:
 - (a) at least one treatment unit, said treatment unit employing a pressurized fluid for treating the external surface;
 - (b) at least one suspension system for suspending said at least one treatment unit adjacent to the external surface,
 - (c) at least one suction unit associated with said treatment unit, said suction unit being activated by said pressurized fluid to generate suction at a suction port; and
 - (d) at least one suction head in fluid connection with said suction port and deployed to clamp against the external surface.
2. The system of claim 1, wherein said at least one suspension system comprises:
 - (a) a first anchor attached to an upper portion of the external surface;
 - (b) a second anchor attached to a lower portion of the external surface; and
 - (c) at least one cable attached at one end to said first anchor and at an opposing end to said second anchor; and
 - (d) at least one cable connector associated with said at least one treatment unit, said at least one cable passing through said cable connector, such that that said treatment unit is suspended by said at least one cable.
3. The system of claim 1, wherein said treatment unit is a cleaning unit.
4. The system of claim 1, wherein said treatment unit adds to said pressurized fluid a paint.
5. The system of claim 1, wherein said treatment unit adds to said pressurized fluid a sealant.
6. The system of claim 1, wherein said pressurized fluid includes steam.



7. The system of claim 1, further comprising a drive mechanism for moving said treatment unit, said drive mechanism including a belt, wherein said at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along said belt.

8. The system of claim 1, further comprising a drive mechanism for moving said treatment unit, said drive mechanism including a plurality of wheels, wherein said at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along said plurality of wheels.

9. The system of claim 1, further comprising a drive mechanism for moving said treatment unit, said drive mechanism including at least one four-bar system, wherein said at least one suction head is implemented as a plurality of suction heads deployed in spaced relation along said at least one four-bar system.

10. The system of claim 7, wherein said drive mechanism is powered by pressure of said pressurized fluid.

11. The system of claim 7, further comprising a valve associated with each of said plurality of suction heads and a control system associated with each of said valves, said control system being configured to selectively open a subset of said valves corresponding to those of said suction heads in contact with the exterior surface at any given time.

12. The system of claim 1, wherein said suction unit includes a piston system.

13. The system of claim 1, wherein said treatment unit further includes a secondary movement mechanism, said secondary movement mechanism being activated by pressure of said pressurized fluid.



14. The system of claim 1, further comprising a track containing a plurality of suction units, wherein said suction units are activated by said pressurized fluid to generate suction at a suction port and said suction port is deployed to clamp against an object.

15. The system of claim 1, wherein said object is a window.

16. The system of claim 7, further comprising a control unit associated with said drive mechanism and configured to control the movement of said treatment unit.

17. The system of claim 16, wherein said control unit is further configured to control said treatment unit.

18. The system of claim 7, wherein said belt is configured to conform to the contours of a non-planar surface.

19. A system for treating an external surface of a building, the system comprising:

- (a) at least one treatment unit, said treatment unit being configured to treat the external surface of the building;
- (b) at least one suspension system for suspending said at least one treatment unit adjacent to the external surface,
- (c) at least one suction unit associated with said treatment unit, said suction unit being activated to generate suction at a suction port;
- (d) a plurality of suction heads in fluid connection with said suction port and deployed to clamp against the external surface; and
- (e) a drive mechanism for moving said treatment unit, said drive mechanism including a belt, a plurality of suction heads are deployed in spaced relation along said belt.



20. The system of claim 19 further comprising:

- (a) a fluid connection hub rotatably mounted with respect to a supply of said pressurized fluid; and
 - (b) a plurality of tubes forming fluid connections between said fluid connection hub and each of said suction heads.
21. A system for treating an external surface, the system comprising: —
- (a) at least one treatment unit, said treatment unit employing a pressurized fluid for treating the external surface;
 - (b) at least one suction unit associated with said treatment unit, said suction unit being activated by said pressurized fluid to generate suction at a suction port; and
 - (c) at least one suction head in fluid connection with said suction port and deployed to clamp against the external surface.
22. A method of suction clamping a device configured for treating an external surface of a building by use of a pressurized fluid, the method comprising employing the pressure of the pressurized fluid to operate a suction unit to generate suction.
23. The method of claim 22, wherein the device is a cleaning device.
24. The method of claim 22, wherein the device is a window replacing device.
25. The method of claim 22, wherein the device is a device for sealing cracks and holes.
- A barcode consisting of vertical black bars of varying widths. Below the bars, the letters 'C', 'L', 'M', and 'S' are printed, separated by spaces. There are asterisks on either side of the letters.
26. The method of claim 22, wherein the device is a painting device.
27. The method of claim 26, wherein said painting device is a device for painting pictures on an external surface.

28. The method of claim 22, wherein the device includes a means for checking the state of the external surface.

29. The method of claim 28, wherein said state of the external surface is the state of the paint.

30. The method of claim 28, wherein said state of the external surface is the structural state.

31. The method of claim 22, wherein the device is a device for at least two of the following functions selected from the group consisting of a cleaning device, a window replacing device, a device for sealing cracks and holes and a painting device.

