DESIGN AND DEVELOPMENT OF EXTERNAL GLASS WALL CLEANING SYSTEM.

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Abstract:
The increasing number of skyscrapers calls for an increasing demand for regular maintenance and cleaning of the large glass panes or windows of these buildings. Cleaning these windows, is not only tough and a risky job but also time consuming. Thus, an effort has been made to introduce a new system which not only reduces the human effort but also aims in cleaning the windows effectively as well asefficiently.This system or machine being autonomous in its cleaning process also aims to ensure the time taken and the cost involved to carry out this process is greatly reduced when it is to be compared with the time taken and the labor cost involved when humans are hired for the cleaning of the external glass walls. This window cleaning system is designed to be compact and light weight so that companies can use it with great ease, without taking the struggle of having to hire men to clean their windows. Thus, this system can clean windows as long as it flat and plain.
Keywords: Glass Windows, Effective Cleaning, Less Duration.

I. INTRODUCTION

There are always a lot of glass windows in high rise buildings. All these panes of glass or windows need to be clean to be kept shining and nice to maintain its aesthetic view and for this job to be done the owners of the high rise buildings hire contractors to get the glass walls cleaned manually. This manual labor method is not only time consuming and dangerous for the person who cleans it, this also is considered to be costly affair. The problem statement can be summarized as below:

i. Safety of labour is preferred.
ii. Clean view via windows is preferable.
iii. Less time required in cleaning windows.
iv. Less or No labor involved and also effectively reduce the cost of labor
v. .

Figure 1: Workers cleaning windows by Abseiling Method

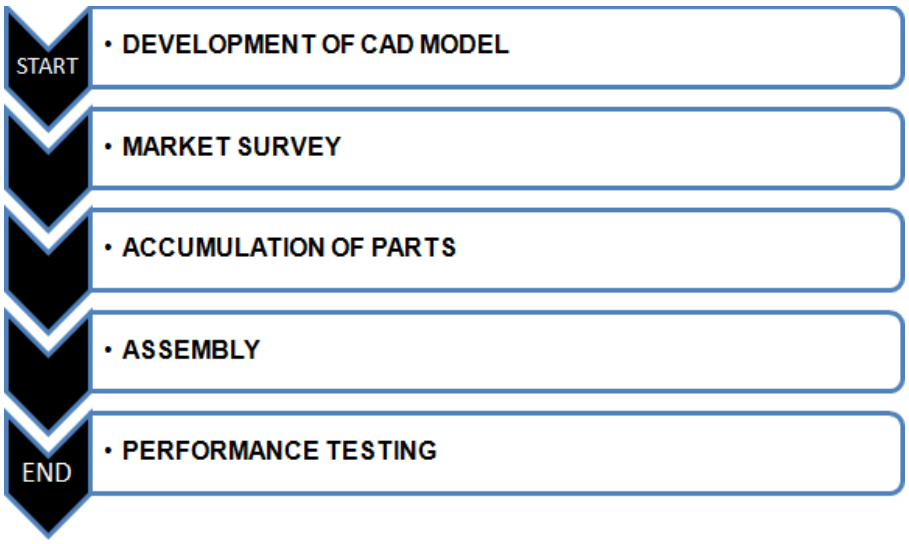

Figure 2: Flow chart to fabricate the model

II. EQUIPMENT DESIGN

Table 1: Bill of Materials

Sl No	Part Name	Number of Units	Material	Dimensions (mm)
1	Screw Rod	1	Stainless Steel	D=12 ; L=560 ; 1.75p V-thread
2	Brush	1	Nylon	Di=12 ; Do=54 ; L=330
3	Semi Cylindrical Cover • Sides • Gap	1	Acrylic	L=470 ; t=6 ; R=165 ; Curvature=370 • 170x165x10 • 12x70
4	Stiffener	1	Acrylic	450x25x10
5	Bearing 6201ZE	2	Steel	Di=1 ; Do=32 ; t=10
6	Bearing Support	2	Acrylic	50x100x16
7	Bush	1	Steel	D=18 ; L=45 ; Di=12
8	SprayNozzle (40)	1	Brass	Di=4.9 ; Do=2.9 ; L=34
9	SprayNozzle (15)	3	Brass	Di=4.9 ; Do=2.9 ; L=34
10	Motor	1	_	12V D.C. Variable Gear Motor with Brush rpm=500 ; O/P rpm=55 T=1500Nm
11	Transformer	1	_	230V I/P 12V O/P (step down)
12	Speed Regulator	1	Plastic	5 steps
13	Clamping	2	Mild Steel	t=2
14	Control Unit	1	Mild Steel	L=400 ; W=250 ; t=200

15	Sump Tank	1	FRP	24.5 Ltr
16	Pump	1	–	Centrifugal Type 0.5hp (370W) ; 6-28m Head Q= 3200-750 lph
17	Pipe	2	Polyurethane	• 8 x5.5 • 6x4
18	Gear (Pulley)	1	Cast Iron	D= 99; N= 31 teeth

III. Functions of partsemployed

Rod:
The rod is used to rotate the Brush about its central axis.

Brush:
The Brush is the Cleaning tool to perform the Cleaning operation of the vertical plain glass Walls.

Semi CylindricalCover:
This part resists the flow path of the dust removed by the brush. it obstructs the Centrifugal action of the dust particles.

Stiffener:
This member is used to provide stiffness to the Cylindrical cover .

Bearing6201ZE:
The bearing used is a double side closed type used to affix to members of a system.

BearingSupport:
This member is mainly used to support the Rod and displace and fix the brush at a desired height.

Bush:
The Bush is used to hold the rod and the motor extension together.

SprayNozzle:
The nozzles are used to spray the water to the brush so as to wet them causing the cleaning of the window panes.Nozzles of angles 40° and 15° are used for suitable coverage of brush surface area and optimum pressure.

Motor:
The Motor drives the brush and provides the desired speed of revolution for the brush to clean efficiently. A variable type is used to vary the speed of the brush for attributing to the thickness of the glass to be cleaned.

Transformer:
A step down type is used to reduce the amplitude of input and provide a stable input to themotor.

SpeedRegulator:
This element is used to vary the speed of rotation of the brush.

Clamping:
The Clamping is used to provide a frame to the Cleaning Unit.

ControlUnit:
The Control Unit Consists of Fuse, Mains Indicator, Rocker switch, Motor Control and Motor toggle switch. It is used to control the various parameters of different components.

Sump Tank andPump:

Sump Tank is used to store the water required for cleaning and pump is used to regulate water of uniform pressure to the nozzles in the Cleaning Unit.

IV. WORKING OF THE SYSTEM

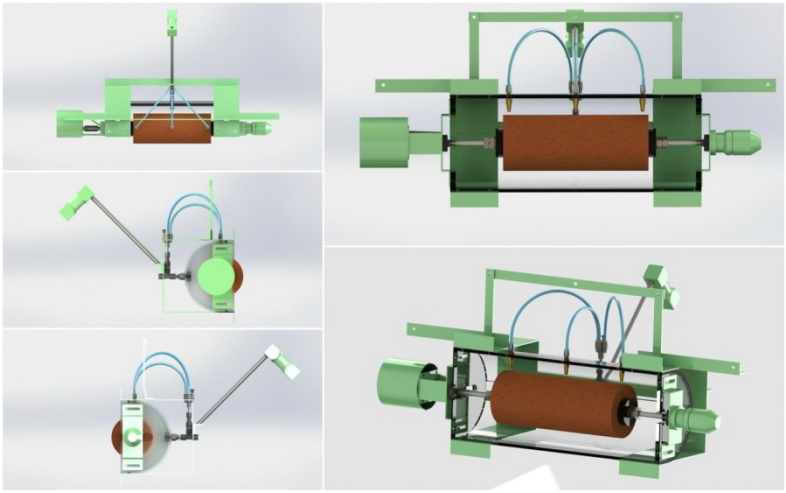

Figure 3: CAD Model of the System

The installation of the Following unit and the Control unit at the roof top of the building to be cleaned. The Cleaning Unit is placed suspended along the face of the building. The connections are checked before starting the cleaning operation. The pump is placed at a head as per the range mentioned in the specifications of the pump. The working of system involves two stages of operation. They are

1. Downward motion.
2. Upward lift

1. Downward motion

The Mains of the Control unit is switched ON and the motor and the pump start running. The motor generates power to rotate the brush at a speed desired to clean the glass walls. This speed of rotation is regulated by a speed regulator in the Control unit. Once the water starts flowing to the nozzles, it wets the brush and the threaded screw fixed to the Cleaning unit is adjusted by adding suitable weights so as to create an optimum contact force between the brush and the glass wall. The rope wound to the pulley of the following unit is released gradually by the manually rotating the hand wheel to different positions marked previously and the Cleaning unit moves in the downward direction. This motion causes the rotating brush to make continuous contact and clean the dust present on the glass. The first set of nozzles continuously wet the brush and the other nozzle placed at the maximum radius of the cylindrical cover cleans the brush for further cleaning of the wall surface. The dust and water mixture projects out tangentially at the exiting side of the brush. This mixture flows outward due to centrifugal force and is restricted by the cylindrical cover. The dust now flows along the inner face of the cylindrical cover and exits through the drain provided at the bottom end of the cylindrical cover. The cleaning unit further moves to the bottom end of the vertical face of the building under cleaning. At the end of first stage of cleaning, the position of the key provided at the gear is reversed and the hand wheel is operated manually.

2. Upward lift

The cleaning unit is lifted slowly upwards by manually rotating the hand wheel. The rope suspended over the pulley now moves in the reverse direction and recoils. The brush further cleans the glass walls for the second time which ensures better cleaning and the

dust and water mixture follows a reversed path as compared to the first stage. The mixture exits through the drain. When the Cleaning unit reaches the top most part of the building. The Follower unit is now moved to the next section of glass walls without lifting the Cleaning unit away from the wall is clamped so that it is fixed to its new position. The Cleaning unit is already engaged to the glass wall and the key is locked in position and the first stage is repeated. This process is done till the entire glass wall is cleaned.

After the face of the glass wall is cleaned, the system is moved to the adjacent wall for cleaning the next glass wall. This way, the entire building is cleaned and the work is completely controlled by a single worker.

V. CONCLUSION

There is a necessity of two people in order to ensure the safety and smooth working of the system; because one personnel is required to manually rotate the pulley and release the cleaning component of the system owly and has to also check the contact happening between the glass and the brush so as to ensure effective as well as efficient cleaning of the glass facades and another person should be available to be replenish the tank whenever the reservoir tank is about to go dry since the tank currently holds just 24.5 liters of water. The second worker should check the length of the glass wall to be cleaned and must check for complete cleaning till the bottom end of the wall. The overhead tank which is commonly available in most of the buildings can be used instead of a separate tank. This way, the work of the second person can be reduced to visually monitoring the cleaningprocess.

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