DESIGN AND FABRICATION OF AUTOMATIC CHALK BOARD CLEANER AND DUST OBSERVER

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Abstract:

The intensification of technology requested superior performance machine in order to accomplish human needs and market. This project is chosen to make human work easier and can trim down use of human power because of its potential application. Teaching and continuous learning processes in schools and colleges have been sustain from the past. Dissimilar method of cleaning the board have been developed. In this paper automatic chalk board cleaner with dust observer has been fabricated to reduce the human time and also minimize the dust related health problem to the teachers. The working of this system is based on the rotation of rectangular duster with dust absorbing provision on its bottom surface. Upward and downward movement of the duster is controlled by the belt drive which is provided o the size of the board. A vacuum pump is fixed inside the duster to observe the chalk dust particle

Keywords: Chalk board, cleaner observer, Automatic, Design, Fabrication

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I. Introduction

Blackboards are used in the class room for teaching purpose. These blackboards form the basis for an effective learning in the class room environment. Chalk pieces are used to write on the blackboard. The chalk powder obtained from the chalk pieces while erasing the blackboard, when inhaled by human cause problems to the respiratory organ. The Asthma patients and those who are allergic to dust cannot sit near the blackboard. Based on the problems faced by the faculty and the students, a case study was made. The case study illustrated about major issues, caused by chalk dust which can accumulate in the human respiratory system and cause problems. Other than this there are few more issues. Like hair loss, burning of eyes etc. Manual work is needed to clean a board which further extends time Consumption while taking classes. Moreover chalk dusts not only harm the human but also the machines. Equipments that are used in the class rooms like projectors when exposed to the chalk dusts which is not heavy get easily settle on the equipments. This is one of the reasons for heat production in the equipments, when large amount of heat is produced the equipment may wear out before its actual life period ends. The Real Time Automated Blackboard Eraser can be used in the class rooms to avoid the above faced problems and to modernize the class rooms.
2. Components Used In the Designed Model

- Casing made of plastic
- Bottom cover
- DC motor
- Impeller
- Dust filtering cloth
- Sponge

3. Construction and Working

The designed model is handy and it collects the dust at the time of rubbing. It sucks the dust while wiping the surface and it is collected inside the container and can be disposed safely. It consists of top and bottom cover and impeller is attached to DC motor through top cover. The DC motor receives the power from battery attached at the top and it is enclosed inside the handle. The bottom cover consists of housing with holes at the circumference and at the bottom. Exhaust hole is provided at the circumference of bottom cover. Sponge is attached at the end of bottom cover which enables rubbing. The impeller is rotated by a DC motor which gets power from a 9V battery. The suction thus created is used to pull the chalk dust into the duster while rubbing the board. Filter is provided along the circumference of the duster so that only air is allowed to the atmosphere and not the dust particles collected. The collected dust particles can be recycled or disposed of safely without causing any harm to the human beings.

4. Designed Model

The model designed using the design software is shown below.

5. Specifications

Outer Diameter of the casing : 85 mm Diameter of the motor shaft : 2 mm Inner Diameter of casing : 82 mm Power Source : Battery Brushless DC motor : 6V, 15A (at no Load) Spindle
Speed (rated rpm): 12500
Weight of Dust absorber: 300 grams
Diameter of the radial blade impeller: 50 mm
Number of Tangential holes: 8
Diameter of Tangential hole: 8 mm

6. Design calculation

A. DENOTATIONS USED IN THE DESIGN CALCULATION

U1 = Tangential velocity at inlet (m/s)
U2 = Tangential velocity at exit (m/s)
Vw1 = Whirl velocity at inlet (m/s)
Vw2 = Whirl velocity at exit (m/s)
b1 = blade width at inlet (m)
b2 = blade width at exit (m)
Φ = speed ratio (no unit)
Vf1 = flow velocity at inlet (m/s)
Vf2 = flow velocity at exit (m/s)
Q = Discharge (m³/s)
Vr1 = Relative velocity at inlet (m/s)
Vr2 = Relative velocity at exit (m/s)
α2 = Angle between absolute velocity and tangential velocity at outlet
β1 = inlet blade angle (in degrees)
β2 = Exit blade angle (in degrees)

B. DESIGNED IMPELLOR

1. Outer Diameter, D2 = 50 mm
   Inner Diameter, D1 = 0.5 * D2 = 25 mm
   Speed of the shaft, N = 12500 rpm

   U1 = (π D1 N)/60 = 16.362 m/s
   U2 = (π D2 N)/60 = 32.725 m/s

   Since for radial blade impeller, Vw2 = U2
   = 32.725 m/s
   β2 = 90°

   The blade width to the diameter ratio is given by
   b1 / D1 = 0.2
   b1 = 0.2 * 25 = 5 mm
   b2 = 25 mm

   Diameter ratio, D1 / D2 = 1.2 (φ)(1/3)
   φ = 0.0723
   Φ = Vf2 / U2
   Vf2 = 2.37
   Q = Vf2 * π D2 * b2
   Q = 9.307 * 10^-4 m³/s
   Q = Vf1 * π * D1 * b1
   Vf1 = 2.37 m/s
   V1 = Vf1 = 2.37 m/s
   U1 = 16.362 m/s

   By Pythagoras theorem,
   U1² + V1² = Vr1²
   Vr1 = 16.533 m/s

   Sin β1 = V1/Vr1
   β1 = 8.24°

   Vr2 = Vf2 = 2.37 rad/s

   U2 = 32.725 m/s
   U2² + Vr2² = V2²
   V2 = 32.81 m/s

   Sin α2 = Vr2 / V2
   Vr2 / V2 = 2.37 / 32.81
   α2 = 4.14°

C. VELOCITY DIAGRAM

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7. Calculation of suction pressure

\[ P = \rho gh \]

Where \( P \) = suction pressure (N/m²) \( \rho \) = Density of the fluid (Kg/m³) \( h \) = head (m) \( g \) = acceleration due to gravity (m/sec²) Head \( h \) = 0.2 mm of mercury Density of mercury = 13600Kg/m³ Acceleration due to gravity \( g \) = 9.81 m/sec² \( P \) = 13600 * 9.81 * 0.2 * 10^-3 \( P \) = 26.683 N/m²

8. Cost estimation
9. Conclusion

The Real-Time Automated Blackboard Eraser Using Embedded System is used for erasing the blackboard automatically. Thus provides a better solution for the health hazards, time constraints and electric component damages in the class rooms.

References
