INNOVATIVE CONCEPT IN ABSORBING THE DUSTS PARTICLES

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ABSTRACT: The removal of dust particles from the surface has become a very difficult task now a days. The conventional dust removal takes place by means of hands using the sponge (duster). Another expensive method is the vacuum cleaner, as said it is expensive and not handy in nature. The removal of dust is done by the designed model which uses the bernoulli`s principle used in the vacuum cleaner. The rotating impellor absorbs the dust by the suction of air particles. The absorbed dust particles are settled in the filter and allows the filtered air molecules to the atmosphere.

I. INTRODUCTION

Normally sponges and cloths is used to wipe the surface of any object. While wiping they accumulate the dust quickly and often become dirty. Once the felt surface is dirty, the dust will no longer be removed with the duster, but shifted and smudged. Due to its very small size it is easily carried away by the wind and accumulates in the human respiratory system, which can create long-term health problems due to overexposure. Nowadays the duster cleaner is available in which the wiped duster is placed on the machine which suck the dust air completely and discharge the clean air. Even though this method is adopted the hazard due to dust persist because it is not collecting the dust at the time of wiping instead it cleans the duster after wiping. So the dust released while rubbing is easily carried away and cause problems. Nowadays the duster cleaner is available in which the wiped duster is placed on the machine which suck the dust air completely and discharge the clean air. Especially the Chalk dusts produced from the classroom boards are generally made from the mineral gypsum (calcium sulphate and calcium carbonate) which is considered hazardous. Gypsum powders/dust may irritate eyes or sensitive skin and affect the respiratory system. While erasing the chalk piece dust particles are carried away by the wind and accumulates in human respiratory system, furniture, skin, hair, eye lashes etc., This may cause serious problem like asthma, wheezing, skin allergy, etc.

II. COMPONENTS USED IN THE DESIGNED MODEL

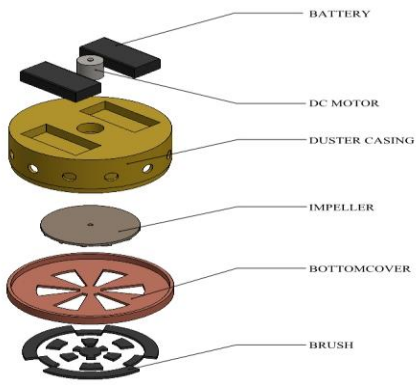
- Casing made of plastic
- Bottom cover
- DC motor
- Impeller
- Dust filtering cloth
- Sponge

III. 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

IV. DESIGNED MODEL

The model designed using the design software is shown below.



V. SPECIFICATIONS

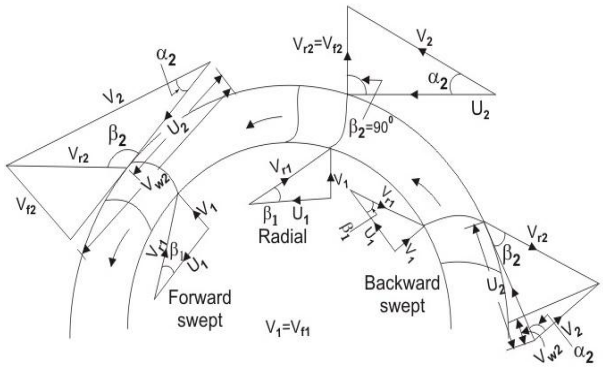
Outer Diameter of the casing : 85 mm
Diameter of the motor shaft : 2 mm
Inner Diameter of casing : 82 mm
Power Source : Battery
Brushless DC motor : 6V, 15A (at no Load)
Spindle Speed (rated rpm) :12500
Weight of Dust absorber : 300 grams
Diameter of the radial blade impeller : 50 mm
Number of Tangential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

VI. DESIGN CALCULATION

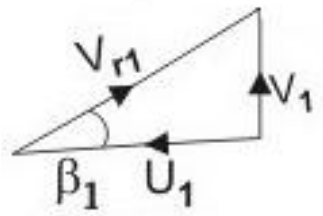
A. DENOTIONS USED IN THE DESIGN CALCULATION

U_1 = Tangential velocity at inlet (m/s)
U_2= Tangential velocity at exit (m/s)
V_{w1}= Whirl velocity at inlet (m/s)
V_{w2}= Whirl velocity at exit (m/s)
b_1 = blade width at inlet (m)
b_2 = blade width at exit (m)
Φ = speed ratio (no unit)
V_{f1}=flow velocity at inlet (m/s)
V_{f2}=flow velocity at exit (m/s)
Q=Discharge (m^3/s)
V_{r1}=Relative velocity at inlet (m/s)
V_{r2}=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)

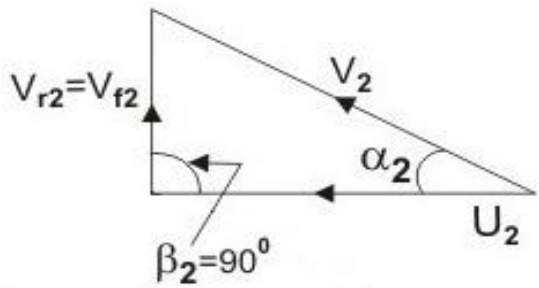
B. DESIGNED IMPELLOR



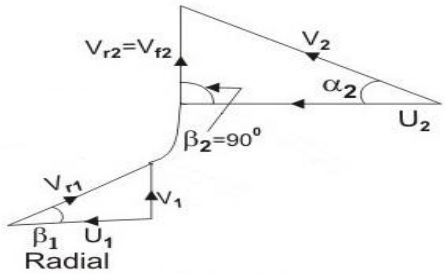
Outer Diameter, D2 = 50mm
Inner Diameter, $D_1 = 0.5 * D_2 = 25$mm
Speed of the shaft, N =12500 rpm
$U_1 = (\pi D_1 N)/60 = 16.362$ m/s
$U_2 = (\pi D_2 N)/60 = 32.725$ m/s
Since for radial blade impeller,
$V_{w2} = U_2 = 32.725$m/s
$\beta 2 = 90^o$
The blade width to the diameter ratio is given by
$b_1 / D_1 = 0.2$
$b_1 = 0.2 * 25$
$b_1 = 5$ mm
$b_1 / b_2 = D_2 / D_1$
$b_2 = 25$ mm
Diameter ratio, $D_1 / D_2 = 1.2 (\varphi)^{(1/3)}$
$\varphi = 0.0723$
$\Phi = V_{f2} / U_2$
$V_{f2} = 2.37$
$Q = V_{f2} * \pi D_2 * b_2$
$Q = 9.307*10^{-4}$ m^3/s
$Q = V_{f1} * \pi * D_1 * b_1$
$V_{f1} = 2.37$ m/s
$V_1 = V_{f1} = 2.37$ m/s
$U_1 = 16.362$ m/s



By Pythagoras theorem,
$U_1^2 + V_1^2 = V_{r1}^2$
$V_{r1} = 16.533$ m/s
$\sin \beta_1 = V_1/V_{r1}$
$\beta_1 = 8.24^o$
$V_{r2} = V_{f2} = 2.37$ rad/s
$U_2 = 32.725$ m/s
$U_2^2 + V_{r2}^2 = V_2^2$
$V_2 = 32.81$ m/s
$\sin \alpha_2 = Vr2/ V2 = 2.37/32.81$
$\alpha_2 = 4.14^o$



C. VELOCITY DIAGRAM



D. CALCULATION OF SUCTION PRESSURE

P= ρgh

Where P = suction pressure (N/m^2)

ρ = Density of the fluid(Kg/m^3) h = head (m)

g= acceleration due to gravity (m/sec^2)

Head h = 0.2 mm of mercury

Density of mercury = $13600 Kg/m^3$

Acceleration due to gravity g = 9.81 m/sec^2

P= 13600*9.81*0.2*10^-3

P= 26.683 N/m^2.

VII. COST ESTIMATION

S. no	Name of the part	Price INR	Number used	Total cost INR
1	Casing	30	1	30
2	DC Motor	55	1	50
3	Battery	20	1	20
4	Impeller(plastic)	55	1	40
5.	Bottom cover	25	1	25
6.	Filter cloth & Brush	40	few	20
7.	Others*	60	-	60
			TOTAL	245

VIII. CONCLUSION

Our project is of social relevance. It makes a difference in our education system. When it comes to making the people understand concepts in detail, the dust and removal method is preferred. With our idea, the product can be successfully manufactured at a price of Rs.120 at mass production level.

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