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Bladeless Fan with Cleaner

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ABSTRACT: In this paper we designed a Bladeless Fan with Cleaner (hereafter referred to as the BFC device) to overcome the safety considerations and space problem in our house by keeping a normal table fan and a vacuum cleaner separately. The fan has blades which are not visible and is relatively better in all relative aspects such as wind speed, distribution of air, and safety. The attached vacuum cleaner looks small but is powerful and has the capacity to suck all the dust around you. The whole BFC device was prepared by our team in our college workshop by the use of normal daily purpose stuffs like plastic bucket, water pipe (PVC pipe), Washing Machine outlet pipe, Plastic Bottle, Spray Bottle and many more. Our BFC device contains 3 major parts we named them as Base, Joint 1 and Joint 2. The base contains the D.C. motor with blades, Joint 1 is referred to the cylindrical part of the fan which passes the air, and the Joint 2 is the cleaner part which contains a net inside it so that after attaching with the base the dust doesn't infiltrate the base where the blades are present. The Fan part appears to be a circular tube mounted on a pedestal. We had started with the base of the fan i.e. pedestal and mounted a D.C. motor within it and attached the motor with the help of small wooden block. Then we prepared the upper part (Joint 1) of the fan with the help of bucket by cutting it into the required size. Then both the parts are attached together. Thereafter we prepared the vacuum cleaner part (Joint 2) with the help of a PVC pipe and the washing machine's outlet pipe and covered the exit with mesh (net). After constructing the BFC device, we tested our fan and compared it with the normal table fan. We conclude that this type of fan can be used in future efficiently with less sound and more safety as compared to normal table fan.

I. INTRODUCTION

In this paper we have modified the general structure of a table fan and a regular Vacuum cleaner and combine them together (mainly we focused more on fan than vacuum cleaner, cleaner is like a bonus function of our BFC device) to overcome various problems associated with it such as noise, more space requirement, efficiency, non-uniform flow of air etc. The result came out to be a dual functionality device which is a Transformation of blade consisting fan to bladeless fan (i.e. the Fan doesn't have any visible blades) with eject-able vacuum cleaner.

II. PRINCIPLE

The fan consists of mainly three parts-

- Pedestal (Base)
- Circular Tube (Joint 1)
- DC motor with attached fan. (Inside the base)

The cleaner consists of mainly two parts-

- Pedestal (Base)
- Joint 2 (Vacuum cleaner part)

Bladeless Fan

The pedestal has a number of minute holes from where the suction of air (from the surrounding) takes place and thereafter is circulated in the circular tube, inside which it is deflected by the water pipe provided at the back

peripheralside of the circular tube, which thereafter emerges out from the Slits present at the inner peripheral side of the tube. This fan Acts as an air multiplier as the speed of air is increasedmanifold as compared to table fan.

Vacuum Cleaner

A vacuum cleaner is a device that uses an air pump to create a partial vacuum to suck up dust and dirt, usually from floors, and from other surfaces such as upholstery and draperies. The dirt is collected by either a dust bag or a cyclone for later disposal. Vacuum cleaners, which are used in homes as well as in industry, exist in a variety of sizes and models small battery-powered hand-held devices, domestic central vacuum cleaner, huge stationary industrial appliances that can handle several hundred litres of dust before being emptied, and self-propelled vacuum trucks for recovery of large spills or removal of contaminated soil.

Specialized shop vacuums can be used to suck up both dust and liquids.

III. LITERATURE REVIEW

Bladeless Fan

The Bladeless Fan was first presented before the world by James Dyson in October 2009. It was then called the Dyson Air Multiplier. Though the concept was first given by the Japanese company, Toshiba, in 1981, James Dyson improved upon the design and technology to give us the Dyson Air Multiplier.

Vacuum Cleaner

The birth of the vacuum cleaner is due to a number of advancements in science and technology brought about by the Industrial Revolution. By the mid 1800s factories were producing tens of thousands of manufactured items along with tons of pollution. Dirt and soot were everywhere. About that time scientist Louis Pasteur made several significant discoveries which led him to theorize that infectious diseases were caused by micro-organisms or “germs.” Thus the development of the germ theory and the reaction against industrial pollution caused people to focus for the first time on hygiene and cleanliness.

Daniel Hess appears to have been the first to patent a vacuum cleaner. Hess, a resident of West Union, Iowa, called his invention a carpet sweeper, not a vacuum. The machine did, in fact, have a rotating brush like other sweepers, however, the machine also possessed an elaborate bellows mechanism on top of the body to generate suction. The amazing thing about his machine was that it incorporated two water chambers to capture the dust and fine dirt. He states that the air is cleansed as it passes through the device. There is no record that this machine was ever produced.

In this project we have made an attempt to build a simple vacuum cleaner by organizing the simple materials that are available in our surrounding environment. The simple materials we used here are Plastic bottles, deodorant cans, meshes, flexible pipes.

IV. WORKING PRINCIPLE

● Bladeless Fan

It all starts with air entering through slits at the fan’s base. A small brushless electric motor runs a tiny fan with asymmetrically aligned blades which pushes air through a set of stationary blades that smooth the airflow.

The air is directed up into the hoop-like tube at the top of the device where it’s forced out of a circular narrow slit running around the hoop. At the base of the hoop, the passage is wide. But it narrows near the top of the hoop, squeezing the air and accelerating it, just as water sprays faster out of a hose if you place your thumb over the end. This is the first point at which the air is multiplied. The inside of the hoop-like tube is curved like the top of an aircraft’s wing too, so as air is forced out through the slit it clings to the curved surface. This means surrounding air is sucked through the hoop too, thanks to a principle of fluid dynamics known as inducement. Put simply, the airflow induces the air behind the tube to be pulled along too.

At this point, the fan has still not finished multiplying its initial air intake. By taking advantage of another principle of fluid dynamics known as entrainment, air surrounding the edge of the tube is drawn through in the same direction as the

electrically propelled air. Altogether, this allows the Air Multiplier to multiply its initial air intake by about 15 times. Dyson says that the fan can draw in about 20 litres of air, about three times the total volume of our lungs, every second. This means it can pump out about 300 litres by accelerating just 20 litres – a massively efficient conversion.

The Mechanics of the BladeLess Fan

A fan with no blades is perhaps a touch misleading. There are blades in the fan -- you just can't see them because they're hidden in the pedestal. A motor rotates four asymmetrically aligned blades to pull air into the device. These blades can pull in up to 3.28 gallons of air per second.

The air flows through a channel in the pedestal up to the tube, which is hollow. The interior of the tube acts like a ramp. Air flows along the ramp, which curves around and ends in slits in the back of the fan. Then, the air flows along the surface of the inside of the tube and out toward the front of the fan. But how does the fan multiply the amount of air coming into the pedestal of the device?

It boils down to physics. While it's true that the atmosphere is gaseous, gases obey the physical laws of fluid dynamics. As air flows through the slits in the tube and out through the front of the fan, air behind the fan is drawn through the tube as well. This is called **inducement**. The flowing air pushed by the motor induces the air behind the fan to follow.

Air surrounding the edges of the fan will also begin to flow in the direction of the breeze. This process is called **entrainment**. Through inducement and entrainment, the Air Multiplier increases the output of airflow by 10 times the amount it takes in through the pedestal's motor.

DIMENSIONS :

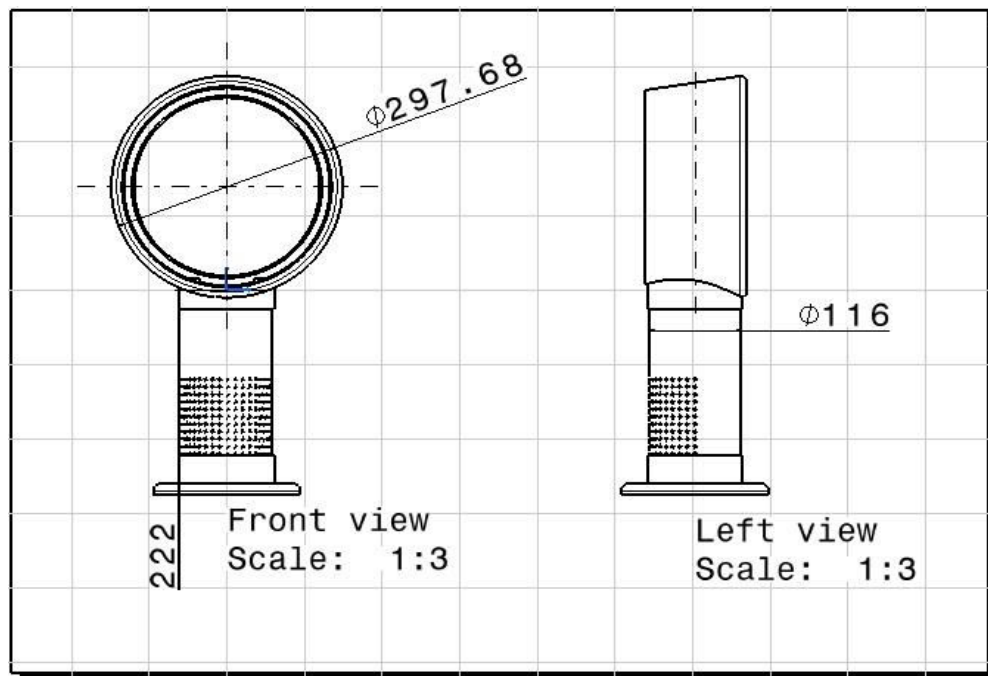
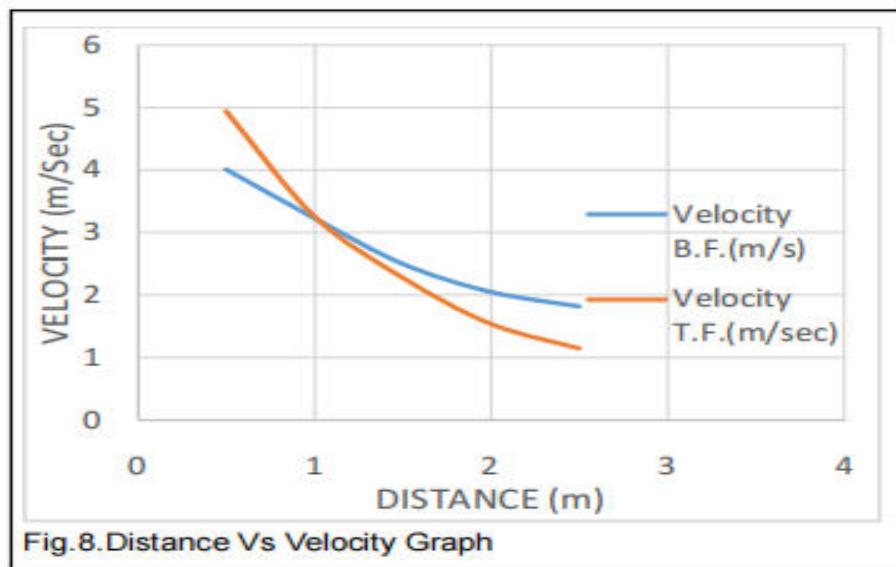


Figure 1: Dimension of Bladeless Fan

Velocity Distribution			
S No	Distance (m)	Bladeless Fan (m/s)	Table Fan (m/s)
1.	0.5	4.01	4.94
2.	1.0	3.23	3.26
3.	1.5	2.50	2.28
4.	2.0	2.05	1.54
5.	2.5	1.82	1.15

Figure2: Comparison of Velocity Distribution of Air Between Bladeless & Table Fan



● Vacuum Cleaner

Materials flow from one location to another when a pressure difference is created between two locations. This phenomenon is the basic working principle of an ideal vacuum cleaner. When a centrifugal fan rotates it makes the air to flow by adding it external kinetic energy. Air is sucked from behind and pushed forward with pressure and so negative pressure it creates behind the fan. An ideal vacuum cleaner has such centrifugal fan in it connected to a motor. This unit has suction and discharge connections, on the suction side filter bag is fitted before the hose connection. The discharge has another air purifier filter and opened to the atmosphere. When the electric power is given the motor rotates and so the centrifugal fan. Air from the suction side is sucked into the unit, along with the air all air born particles, cat allergen, mist, dirt, and small solid particles are carried to the suction filter. They are trapped in the filter and dirt free air is pushed out from the discharge opening.

BLOCK DIAGRAM:

- Bladeless Fan

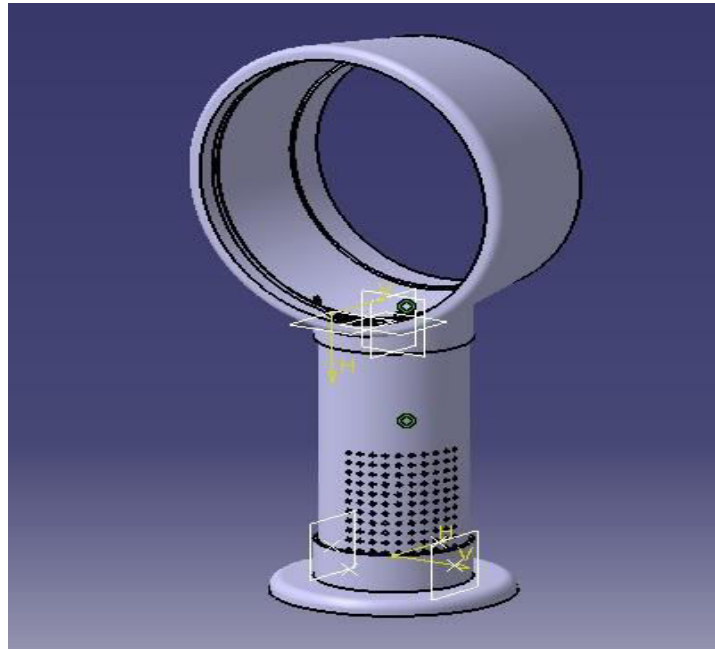


Figure 4: 3D Design of Bladeless Fan

- Vacuum Cleaner

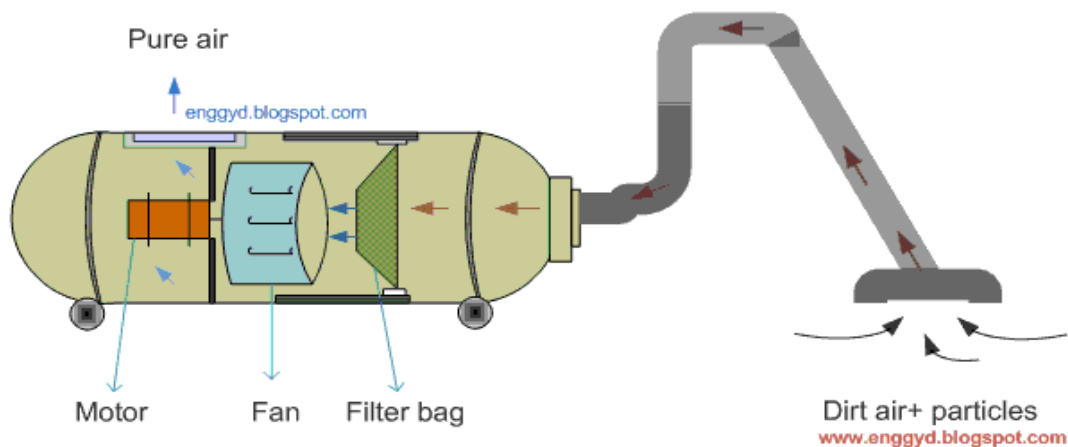


Figure 5: 2D Representation of Vacuum Cleaner

CONSTRUCTION

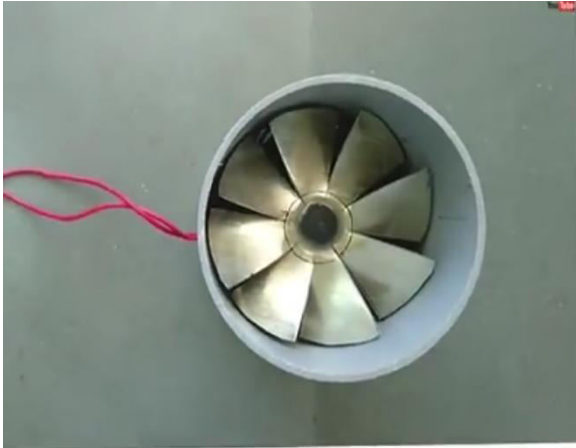


Figure 6: Base of Bladeless Fan

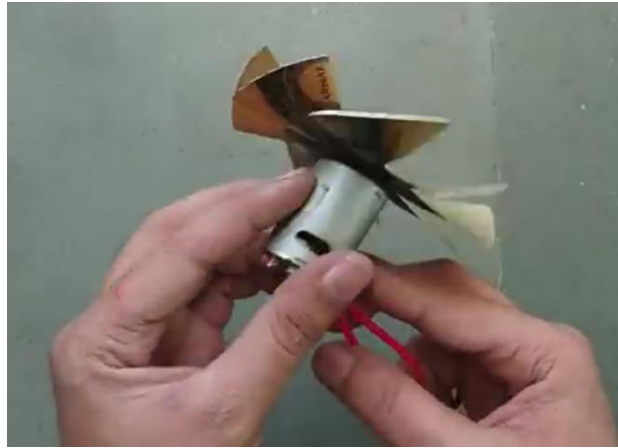


Figure 7: Blade connected with Motor

First of all we had started with the base, it's the essential part that plays a major role in Bladeless Fan as well as Vacuum Cleaner, so we made it carefully. First of all we took a PVC pipe of 2mm thickness and 110mm diameter. The length is according to the height required. The lower half of the pipe was drilled with a number of minute holes for the purpose of suction of air. The upper half of the pipe was mounted with a DC motor with the help of wooden blocks, which were attached with the help of screws to the body of pipe. Then we cut a tin plate of 95mm into eight equal parts and each part was turned into the shape of the blades.

For the upper part i.e; Joint 1, the bucket was cut into two circular parts of 95mm and 100mm width. The two parts were mounted one on top of the other with a strip in between to maintain the gap through which air is circulated in upper portion.

The back peripheral side of the portion is covered with water pipe (garden pipe) from which air is reflected and expelled out. The inner peripheral side was attached with a small circular part of 30mm width with spacers provided in between from where air is expelled out.



Figure 8: Front Part of Vacuum Cleaner

Then the final part i.e; Joint 2 (Vacuum Cleaner part) was made using PVC pipe of diameter 90mm and a 2 litre plastic bottle which was marked around the neck and made two halves with the help of cutter. We only need the neck portion of the bottle, later we joined the neck part to the PVC pipe using glue then we covered the exit of the PVC pipe using mesh (net) which helps in preventing the dust that enters into the exhaust fan chamber. On the bottle neck side we joined the washing machine's outlet pipe to suck the dusts. Finally we attached this part (Joint 2) with the Base.



V. CONCLUSION

This idea of making Bladeless Fan including a Cleaner is very unique and effective in almost every aspect mainly the safety considerations, space problems, noise intensity (as compared to a normal table fan) and usage of lesser volts in the system increases the efficiency and performance of the Vacuum cleaner technology.

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