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Custom Angle Ceiling Fan

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ABSTRACT
Custom Angle Ceiling fan can be used to regulate air flow only into areas where we need air flow, by changing the angles. (i.e.) both swiveling and tilting of the ceiling fan down-rod. The reason for the innovation of this mechanism is that, we found several areas, where the ceiling fans were installed at the wrong locations on the ceiling. Normally, the rooms are designed, according to personal wish, only after concreting the roof slab. Therefore, the hooks for hooking up the ceiling fan are to be placed during the concreting process of roof slab. But, they might not be in the correct position to blow air into all areas of the room. This is the case where, Custom angle ceiling fan can be used. The relevance of this mechanism lies in, reducing the power wastage in conditions like, fans blowing air, where it is not required.

Keywords **–** Ceiling Fan, Down Rod, Geared Motor, Perpendicular shaft, Threaded link mechanism

I. INTRODUCTION

Ceiling fans are commonly used in tropical climate for providing comfort in domestic buildings. Although fan energy consumption is relatively low in comparison to air conditioning, it suffers from some degree of electricity loss which is mainly due to its mechanical inefficiency.

The electrically powered ceiling fan was invented in 1882 by Philip Diehl. Ceiling fans are essentially used to provide thermal comfort in most household and commercial sites due to their favorable attributes including high portability, having considerably low cost per unit value as well as low maintenance cost in comparison to air conditioning unit. They are commonly found in abundant in most tropical countries which experience high level humidity and hot weather condition. They comprise between 3 to 5 paddles or blades and in some model, a lighting facility is incorporated as ornamental. This type of fan is most practical to be used in tropical climate area where heat dissipation through convection is essential due to the high level of humidity and temperature.

Moreover, they are cheap and easy to install and these criteria allow them to be widely used in large scales. Even with the extensive use of air conditioning units, ceiling fans remain their vital role in providing thermal comfort. Although ceiling fans use a relatively low amount of energy in comparison to the air-conditioning units, they suffer from significant level of electricity loss due to their inefficiencies. The unreasonably high consumption of energy of the conventional ceiling fan is due to high losses at the blades, as they are not designed for optimum aerodynamic performance and also due to ineffective diffusing of the air.

Conventional ceiling fan typically encompasses 3 to 5 fan blades mounted concentrically around a circular disc with full scale diameter ranging between 68 and 150 cm. The diameter of the fan blade is generally related to the room size and cooling capacity. A number of factors including the size, shape, number of blades, and blade pitch contribute to airflow effectiveness. From energy consumption perspective, conventional ceiling fan constitutes a complex mechanism, with four basic components that contribute to the total energy consumption: motor, blades, control, and lighting. As there are in average of 1 to 2 ceiling fans in each room of every household in the tropical and subtropical countries, and each fan operates continuously over long periods of time, often more than 8 hours per day, the operational expenditures accumulate substantially over time. The average energy consumption of a conventional ceiling fan is about 346 kWh/year.

I. PARTS OF A CEILING FAN

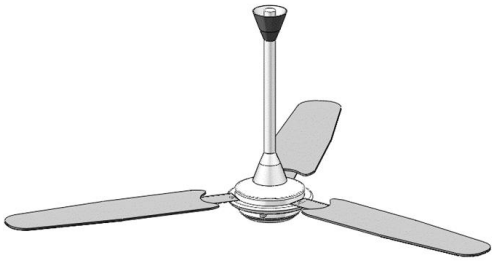

Fig.1 *A standard Ceiling fan*

The key components of a standard ceiling fan are as following:
1. An electric motor.
2. Blades (Wood, plywood, iron, etc.)
3. Metal arms, which hold the blades and connect them to the motor.
4. Flywheel, which is attached to the motor shaft, and to which the blade irons may be attached.
5. A mechanism for mounting the fan to the ceiling such as: a. Ball-and-socket system. b. J-hook (Claw hook) system.
6. A down-rod (shaft), a metal pipe used to suspend the fan from the ceiling.
7. Motor housing
8. A switch housing
9. Switches used for turning the fan on and off.

II. WOBBLING EFFECT

Wobbling is caused by the weight of fan blades being out of balance with each other. This can happen due to a variety of factors, including blades being warped, blade irons being bent, blades or blade irons not being screwed on straight, or blades being different weights or shapes or sizes. Also, if all the blades do not exert an equal force on the air, the vertical reaction forces can cause wobbling. Wobbling is not affected by the way in which the fan is mounted or the mounting surface. Contrary to popular misconception, wobbling will not cause a ceiling fan to fall.

Ceiling fans are secured by Clevis pins locked with either Split pins or R-clips, so wobbling won't have an effect on the fan's security. To date, there are no reports of a fan wobbling itself off the ceiling and falling. However, a severe wobble can cause light fixture shades or covers to gradually loosen over time and potentially fall, posing a risk of injury to anyone under the fan, and also from any resulting broken glass.

It is important that, when installing the fan, the installer closely follows the manufacturer's instructions with regard to using proper mounting screws. It is also important that all screws be tight, and any ceiling fan light fixtures are properly assembled with their shades and covers securely attached.

III. MAIN COMPONENTS OF CUSTOM ANGLE CEILING FAN

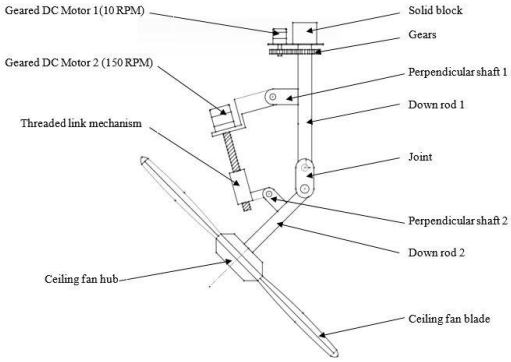

Fig.2 *Custom Angle Ceiling Fan*

1. **Ceiling fan:**

a. Voltage rating: 220-240v (50 Hz, AC)
b. Sweep: 1200mm
c. Power consumption: 60W

2.**Geared DC Motors:**

a. Geared DC Motor 1 (12v, 10RPM) It is used to give the rotary motion to the ceiling fan down rod.
b. Geared DC Motor 2 (12v, 150RPM) It is used to tilt the down rod 2 of the ceiling fan, further tilting the whole ceiling fan.

3.**Wires:** For supplying electricity to the auxiliary components.

4.**Voltage Adapter:** (220-240v AC to 12v DC) For running the 12V Geared DC Motors.

5.**Gears:** (Two gears-25 teeth and 40 teeth) Used to transfer the rotary motion from geared DC motor to the down rod.

6.**Joint:** This joint helps to rotate the fan freely in all directions.

7.**Threaded link mechanism:** Used to tilt the ceiling fan, and to stop it from coming back to its initial position.

8.**Solid block:** It was used to increase the overall weight of the mechanism, to prevent wobbling and vibration of ceiling fan.

Fig.3 *Geared DC Motor 1 (10 RPM)*

Fig.4 *Geared DC Motor 2 (150 RPM)*

IV. WORKING AND USAGE OF NORMAL CEILING FAN

The Ceiling fan is wired through the ceiling and it is connected to the wire that controls either a remote box or a switch on the wall for operating. The ceiling fan capacitor torques up the electric motor, allowing it to start and run. An electrical current reaches the motor and then enters coils of wire that are wrapped around a metal base. As this current passes through the wire, a magnetic field is caused that expends force in a clockwise motion that actually changes the electric energy into mechanical energy. This action causes the motor coils to spin.

As the coils are spinning, the fan captures this spinning motion, transferring it to the fan blades. The slicing of the air caused by the fan blades is what pushes the air downward, causing the breeze created by the ceiling fan. This whole process circulates the air through the room, as air moves in to replace the air that has been pushed down from the ceiling. Ceiling fans work are so effective because of the fact that hot air rises. As the hot air reaches the ceiling, it builds up the heat in the entire room.

A fan mounted on the ceiling forces this hot air away from the top of the room, and this action leaves room for more hot air to rise, thus circulating the air in the room causing the breeze. It is this action that can make ceiling fans effective in any season.

V. WORKING OF CUSTOM ANGLE CEILING FAN

Fig.5 *Threaded link mechanism*

The Custom angle ceiling fan, is a special type of ceiling fan that helps us to customize the angle of the down-rod of the ceiling fan, as per our interest. By changing the angle of the down-rod, we can actually change the direction of the air flow into a specific area of our interest. This new idea came across, when we saw ceiling fans wasting lots of energy by blowing air into areas, where it's not needed, or to an area which is much larger or smaller than actually required. All these difficulties including higher power consumption, can be reduced by the Custom Angle Ceiling Fan.

Here two motors are used for changing the direction of airflow. One, is 12v Geared DC Motor of 150 RPM for changing the tilt angle of the down-rod. Second, is the 12v Geared DC motor of 10 RPM, for changing the swivel (down rod rotation) angle. Both the motors are connected to a suitable power supply unit. The motors can be turned ON and OFF by switching the supply to each motors, using normal switches. The switches for controlling the angle of the down-rod will be placed near to the speed control unit of the Ceiling fan. The user can control the fan completely from the wall unit.

VI. ADVANTAGES

- Ability to direct the airflow into a specific direction as per the user interest. The normal ceiling fan is able to direct the wind into an area which is much wider or lesser than we need. This leads to large power wastage in cubicles, large halls or auditoriums in which the fan is rotating in a position where no one is capable of obtaining its effect.
- During cementing of the roof, we usually place hooks for hanging the ceiling fan in a position, which may sometimes change after planning the rooms, and other facilities. Since the hooks placed are permanent, the ceiling fan hang on it, not at a place of our interest, cannot be changed in anyway. At these instances, the Custom angle ceiling fan can be installed.
- It can be simply controlled by using a switch placed near the regulator and can be operated very simply. This can provide much better performance than a normal table fan or wall fan. This may also provide better circulation of air in the room, increasing pleasant atmosphere in the rooms.

VII. FUTURE SCOPE

As the idea of "Custom angle ceiling fan" is of a new type, we are looking forward for taking a patent. We are also planning to install an auxiliary PCB to control the fan via remote control. This makes controlling the fan, more user friendly. Analysis of blade angle can also be done that gives the optimum angle under which fan works so efficiently and effectively. Here, we have used a small blade length ceiling fan of 1200mm sweep. By calculation we found that, the safe angle by which the ceiling fan can be tilted is at 500.

Fig.6 *Gear assembly*

When a standard ceiling fan of larger blade length want to be used, the down rod length of the shaft has to be proportionally increased in order to achieve this same safe angle. We are also planning to introduce this mechanism to the normal standar ceiling fan, which is found commonly.

VIII. CONCLUSION

The fabrication of the custom angle ceiling fan was successful. The prototype gave satisfactory results. The main problem that could occur was vibration and wobbling, but it did not effected the working of the fan, because of the addition of extra solid block for increasing the weight. It was possible to tilt and rotate the ceiling fan without any vibration.

The full sweep of 3600 was possible by the help of mating gears. The main advantage was, by introduction of the threaded link mechanism, it became easy to maintain the ceiling fan at specific angle, with the help of a simple geared DC motor. If the mechanism was not used, then we might have to buy an expensive DC Servo motor with detention torque of about 40kgcm, which is very expensive. The efficiency was not reduced much by the addition of two motors, since, they consume only little power, compared to ceiling fan

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