Cooling Fans

Structure of Cooling Fans

The following explains the structure of axial flow fans, centrifugal blowers and cross flow fans as well as how these fans blow air.

Axial Flow Fans

The propellers (fan blades) located in the circular flow path between the cylindrical hub and casing are used to force-feed air in order to generate air flow in the direction of the axis of rotation.
Since air flows along the axis of rotation, the structure is kept compact. Capable of generating a large air flow, axial flow fans are suited for applications requiring ventilation cooling where the entire space inside the equipment must be cooled.

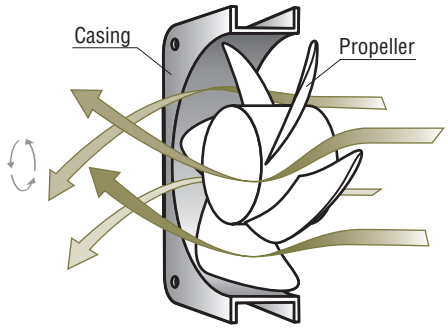

Fig. 1 Structure and Air Flow Mechanism of Axial Flow Fans

Centrifugal Blowers

The centrifugal force of the cylindrically positioned runner (forward-facing blades) generates rotational flows roughly perpendicular to the axis of rotation. The generated rotational flows are aligned in a uni-direction through scroll action and the pressure rises accordingly.
Since the exhaust outlet is reduced to focus air in a specified direction, these blowers are used for spot cooling. The static pressure is also high, which makes them a suitable choice when cooling equipment through which air cannot flow easily or when blowing air using a duct.

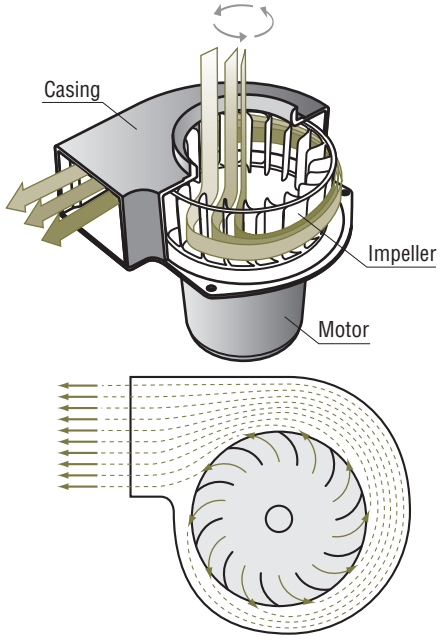

Fig. 2 Structure and Air Flow Mechanism of Centrifugal Blowers

Cross Flow Fans

A cross flow fan has an impeller similar to that of a centrifugal blower, but both sides of the fan are covered with side panels and thus no air enters from the axial direction. As a result, air flows that pass through the impeller are generated. Cross flow fans utilize these air flows. Since a long cylindrical impeller is used to blow air, air travels over a wide width. Also, uniform air can be achieved because air is exhausted sideways along the circumference of the impeller.

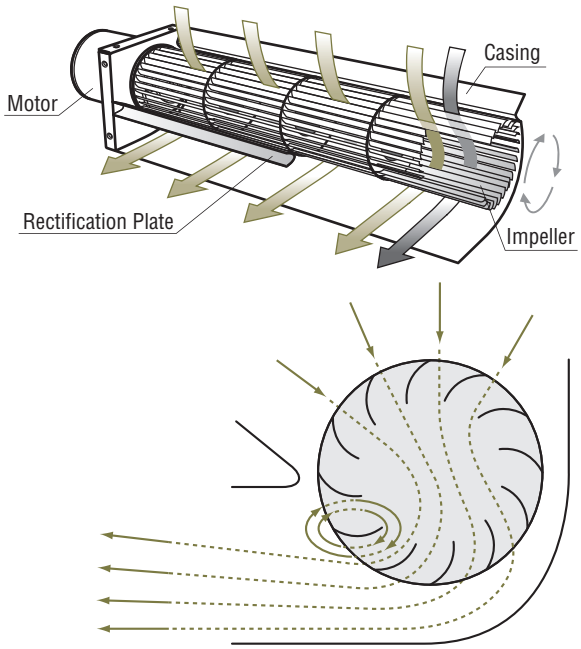

Fig. 3 Structure and Air Flow Mechanism of Cross Flow Fans

Capacitor

Permanent split capacitor motors contain an auxiliary winding offset by 90 electrical degrees from the main winding. The capacitor is connected in series with the auxiliary winding, causing the advance of current phase in the auxiliary winding.
Motors employ vapor-deposition electrode capacitors recognized by UL. This type of capacitor, which uses a metallized paper or plastic film as an element, is also known as a "self-healing (SH) capacitor" because of the self-healing property of the capacitor element. Although most of the previous capacitors used paper elements, the plastic film capacitor has become a mainstream model in recent years due to the growing demand for compact design.

Capacitance

The use of a capacitor with a different capacitance may cause excessive motor vibration and heat generation or may result in torque drops and unstable operation. Be sure to use the capacitor included with the fan. The capacitor's capacitance is expressed in microfarads (μF).

Rated Voltage

Using a capacitor exceeding the rated voltage may cause damage and then smoke or ignite. Be sure to use the capacitor included with the fan. The rated voltage of the capacitor is expressed in volts (V). The capacitor's rated voltage is indicated on the surface of the capacitor case. Take proper precautions, since the capacitor's rated voltage is different from that of the fan.

Rated Conduction Time

The rated conduction time is the minimum design life of the capacitor when operated at the rated load, rated voltage, rated temperature and rated frequency. The standard life expectancy is 40000 hours. A capacitor that breaks at the end of its life expectancy may smoke or ignite. We recommend that the capacitor be replaced after the rated conduction time.
Consider providing a separate protection measure to prevent the equipment from being negatively influenced in the event of capacitor failure.

Overheat Protection Device

If a fan in run mode locks due to overload, ambient temperature rises rapidly, or the input current increases for some reason, the fan's temperature rises abruptly. If the fan is left in this state, the performance of the insulation within the fan may deteriorate, reducing its life and, in extreme cases, scorching the winding and causing a fire. In order to protect the fan from such thermal abnormalities, our fans recognized by UL and CSA Standards and conform to EN and IEC Standards are equipped with the following overheat protection device.

Thermal Protector

The **MRS** Series, **MB** Series (impeller diameter ϕ80 mm (3.15 in.) or more) and **MF** Series fans contain a built-in automatic return type thermal protector. The structure of a thermal protector is shown in the figure below.

The thermal protectors employ bimetal contacts, with solid silver used in the contacts. Solid silver has the lowest electrical resistance of all materials, along with a thermal conductivity second only to copper.

Operating Temperature of Thermal Protector

open 120±5°C (248±9°F)
close 77±15°C (170.6±27°F)
(The fan winding temperature, where the thermal protector is activated, is slightly higher than the operating temperature listed above.)

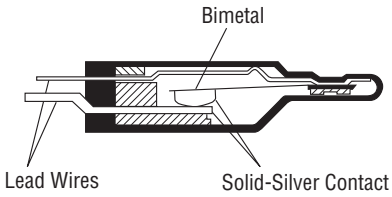

Fig. 14 Structure of Thermal Protector

Impedance Protected

The **MU** and **MB** Series (**MB520** and **MB630** type) fans are equipped with impedance protection.
Impedance protected fans are designed with higher impedance in the fan windings so that even if the fan locks, the increase in current (input) will be minimized and the temperature will not rise above a certain level.

Built-in Burnout Prevention Circuit

DC fans are equipped with a burnout prevention circuit that cuts the power to the windings or limits the current when the rotor is locked.

For overheat protection available for each product, refer to the page explaining the product.