INTRODUCTION

SPEED CONTROL

Air capacity control of fans is most efficiently done by controlling the fan speed and the principle benefits to be gained are:-

- control of capacity
- control of noise
- control of power absorbed.

There are a number of methods that can be used to do this, including:-

- auto-transformers
- star/delta switches
- triacs
- capacitance
- frequency inverters
- multi-speed motors

There are many applications where the full exhaust capacity is required for only a short period of time and if no speed control system is available, there is an unnecessary waste of heated or conditioned air taking place. In addition, the substantial reductions in generated noise and power absorbed that can be obtained are also lost.

Controlling the speed of a fan by means of changing the supply voltage is a simple and often-used method, but it does require certain conditions to be fulfilled:-

- the motor must have a high resistance rotor (single phase)
- the motor must have above average cooling

If more than one fan is to be controlled by a single controller, the fans must be identical. Dissimilar fans should not be connected to the same controller.

SPEED CONTROL OF EXTERNAL ROTOR MOTORS

External rotor motors generally have a high resistance rotor as an inherent feature of their design, and the motors' torque curve is quite different from those of ordinary motors.

In addition the cooling of these motors is very efficient, so these motors meet the basic requirements necessary for speed control by voltage control.

With voltage control, heat is generated in the rotor, particularly at around two thirds of full speed. This heat is then transmitted directly to the impeller mounted on the motor and hence into the surrounding air without adding additional thermal stresses on the stator.

Unless otherwise stated, motors operating with a speed-controller should not be run in ambient temperatures exceeding 40°C.

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AUTO TRANSFORMERS

The auto-transformer is the best known method of reducing the supply voltage to a fan motor and Fantech have a wide range of 5-step units for three-phase fans. They are very reliable and minimise motor hum and electromagnetic emissions which would upset sensitive electronic equipment.

If controlling more than one fan, the total amperage of all the connected fans should not exceed 75% of the maximum rating of the controller. A speed reduction to as low as 30% is achievable.

STAR/DELTA CONTROL

The three-phase external rotor motors fitted to the backward-curved centrifugal fans have star/delta motors fitted to them as standard (except Ex e motors which have single-speed motors). This facility enables two speeds to be obtained using either a star/delta switch or star/delta controller. In addition some axial fans, fitted with conventional motors, have the star/delta feature.

The speed ratio obtained with the star/delta feature is approximately 1.3:1.

TRIACS

The triac is a type of semi-conductor device and is widely used to speed control single-phase external rotor motors. It functions as a quick-acting switch which turns on the current to the motor during each period of alternating current when it receives an ignition pulse. The power to the motor can be regulated depending on the point in the period at which the ignition pulse is received. If the current is switched on early in the period, the whole period is included and the motor receives full voltage and thus full power. The later the current is switched on, the smaller the amount of voltage is released to the motor and thus the power to the motor is lower.

As the voltage supplied to the fan is no longer sine shaped, magnetic oscillations occur in the fan motor. This is most noticeable at very low speeds. This noise, which is loudest at 100 Hz, may spread throughout the duct system if the motor is not properly vibration-suppressed.

The triacs are provided with radio interference suppression chokes to reduce radio interference produced on medium and short-wave bands. The interference suppression is such that no special precautions have to be taken in normal installations. On premises where there is very sensitive electronic equipment, it may be advisable to use shielded cables and a separate supply or, alternatively, use an auto-transformer control.

If more than one fan is connected to a triac-type controller, the amperage of all the fans should not exceed 85% of the maximum rating of the controller. A speed ratio as low as 10:1 is possible.

FREQUENCY INVERTERS

External rotor motors can be speed-controlled using frequency inverters.

See the special notes on page *N-2* for requirements.

CAPACITANCE CONTROL

The SSC controller provides 2-speeds to a selected range of single phase motors. This controller utilises capacitors and provides a noiseless control.

SPEED CONTROL OF STANDARD FOOT AND FLANGE-MOUNTED MOTORS

We do not recommend standard motors being controlled by voltage reduction unless they have specially designed high-resistance rotors and suitable cooling systems.

Experience has shown that trying to control the speed of a conventional motor by voltage reduction is seldom satisfactory. On a standard motor, all changes in speed when using a voltage reducing device, occur over a very narrow band of voltage and it is therefore hard to achieve an acceptable accuracy of adjustment. In addition, due to the level of heat generated, there is a risk of damage to the windings and bearings.

Motors with these facilities are available on request.

FREQUENCY INVERTERS

Standard motors can be speed-controlled satisfactorily using frequency inverters which vary the frequency and voltage of the electricity supply to the motor.

This system provides infinite variation of the fan speed but the motors can become noisy.

See the special note on page *L-9* relating to EMC requirements.

MULTI-SPEED MOTORS

These can be either tap (Dahlander) or dual-wound.

Tap-wound motors use a single set of windings with a control 'tap' in each coil. The speed ratio is 2:1 and the maximum speed can be any synchronous speed. i.e 48, 24, 16, 12, rev/sec etc.

Dual-wound motors are effectively two motors in one as there are two separate sets of windings in the one motor frame. With dual-wound motors almost any combination of standard motor speeds is possible.

Multi-speed motors provide excellent power saving and the noise reduction is the same as any other fan with the same speed difference.

The capacities available are directly proportional to the speeds.

Although by no means exclusive the above methods are more frequently applied to conventional motors.

GENERAL

If you have requirements not detailed here, contact our Sales Engineers for assistance, as not all control devices have been covered in this catalogue.

SUMMARY OF AIR CAPACITY CONTROL OPTIONS

Control Type	Speed Ratio	Approx. Power Savings	Relative Cost
Auto-transformer	3:1	to 95%	low/moderate
Star/delta switch	1.3:1	50%	low
Star/delta controller	1.3:1	50%	moderate
Triac	10:1	to 70%	low
Capacitance	Down to 2:1	varies	low/moderate
Frequency inverter	5:1	to 90%	highest
Tap winding	2:1	87%	low/moderate
Dual-wound	3:2	70%	low/moderate

