

# Shaded-pole motor

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A **shaded-pole motor** is the original type of AC single-phase induction motor. A shaded-pole motor is a small squirrel-cage motor in which the auxiliary winding is composed of a copper ring or bar surrounding a portion of each pole.<sup>[1]</sup> This auxiliary single-turn winding is called a shading coil. Currents induced in this coil by the magnetic field create a second electrical phase by delaying the phase of magnetic flux change for that pole (a *shaded pole*) enough to provide a 2-phase rotating magnetic field. The direction of rotation is from the unshaded side to the shaded (ring) side of the pole.<sup>[1]</sup> Since the phase angle between the shaded and unshaded sections is small, shaded pole motors produce only a small starting torque relative to torque at full speed. Shaded-pole motors of the asymmetrical type shown are only reversible via disassembly and flipping over the stator, though some similar-looking motors have small, switch-shortable auxiliary windings of thin wire instead of thick copper bars and can reverse electrically. Another method of electrical reversing involves four coils (two pairs of identical coils).<sup>[2]</sup>

The common, asymmetrical form of these motors (pictured) has only one winding, with no capacitor or starting windings/starting switch, making them economical and reliable. Larger and more modern types may have multiple physical windings, though electrically only one, and a capacitor may be used. Because their starting torque is low, they are best suited to driving fans or



Small C-frame shaded-pole squirrel-cage motor. With the poles shown, the rotor will rotate in the clockwise direction.



Shading coils (*copper bars*)

other loads that are easily started. They may have multiple taps near one electrical end of the winding, which provides variable speed and power via selection of one tap at a time, as in ceiling fans. Moreover, they are compatible with TRIAC-based variable-speed controls, which often are used with fans. They are built in power sizes up to about  $\frac{1}{4}$  horsepower (190 W) output. Above  $\frac{1}{3}$  horsepower (250 W), they are not common, and for larger motors, other designs offer better characteristics.

## Types

- **Squirrel-cage induction motor:** The most common type of shaded-pole motor in fractional horsepower use is the squirrel-cage induction motor. This has a rotor that consists of a laminated steel cylinder with conductive copper or aluminum bars embedded lengthwise in its surface, connected at the ends.

## References

1. Wildi, Theodore (2006). *Electrical machines, drives, and power systems*. Upper Saddle River, NJ: Pearson Prentice Hall. ISBN 0-13-177691-6.
2. US 4017776 (<https://worldwide.espacenet.com/textdoc?DB=EPODOC&IDX=US4017776>), Fiegel, Josef, "Reversible Shaded-Pole Motor and Control Arrangement Therefor", published 11 December 1975, issued 12 April 1977

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