Active Magnetic Bearings

Working Principles of Active Magnetic Bearings (AMB)

An Active Magnetic Bearing (AMB) is an electro-magnetic system for controlling the position of a rotor, e.g. in a turbomachine. The active magnetic bearing (also called “bearing stator”) comprises a number of electro-magnets, positioned around the rotor, which generate attracting forces to maintain the position of the rotor relative to the stator. An advanced electronic control system adjusts the power supply and, thereby, the magnetic forces generated, to ensure stable rotation of the rotor, independent of the forces induced by the machinery process.

Magnetic bearings require no lubricants, are frictionless and mechanically wear-free. They have the capability of tailoring bearing characteristics to optimise operation.

Their use in turbomachinery reduces process down time, lengthens machine life, enables more efficient high-speed machines, eliminates gears and reduces maintenance costs.

Advantages of Active Magnetic Bearings

- Active damping of rotor vibrations
- Unlimited starts / stops
- „Instant“ availability: only a few seconds from stand-by mode to full speed
- Operable in process gas stream
- Oil-free operation: no contamination to process gas
- Extremely low power consumption: typically 2 - 5 kW
- Load capacity up to 7 bars
- UPS for safe operation included
- No wearing parts in normal operation
- Integrated “Machine Monitoring System”
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Basic Components of AMB

Radial Bearing
Each radial bearing stator consists of several pairs of electro-magnets, arranged radially around the rotor. The stator’s counterpart, the rotor elements, are steel laminations fitted to the rotor. The radial bearings are designed to position the rotor radially.

Touch-down Bearing
The touch-down bearings support the rotor during stand-still or in the very unlikely event of a power electronics’ failure. They also prevent damage to the magnetic bearings during overload or in the event of system fault.

Thrust Bearing
The thrust bearing uses two ring-shaped magnets positioned on both sides of the so-called “thrust disc”. The thrust disc is a flat, solid, ferromagnetic disc attached to the rotor. The axial bearing positions the rotor in the axial direction.

Control System Cabinet
The control system uses the inputs from the position sensors (input signals) to determine the actual rotor position. It then adjusts the power (output signal) to the individual magnets thus ensuring that the rotor stays in the desired position. The main components of the control system are the processor, the amplifiers for the individual magnetic bearings, the UPS and interfaces to connect with other systems. The control system ensures safe operation of the magnetic bearing system under all conditions, such as start-up, normal operation and shut-down.

Position Sensor
The position sensors detect the axial and radial position, as well as the movement of the rotor during stand-by and operation. Alternative, established technologies can be applied, such as inductive, eddy current and magnetic, depending on the application and system performance requirements.