

Air Bearings-Application Review

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Abstract: In Air bearings pressured air acts as a lubrication between the moving element and the stationary element which nearly creates a smooth frictionless motion. They are broadly divided into two types AERODYNAMIC and AEROSTATIC. As air is the lubricant there is no mess due to oil-based lubricants. The air prevents the compounds from sliding, wearing and the life of the compounds are increased. Graphite is used as a porous film so that air is disturbed evenly on the surface or a small hole is made in center of the bearing so that the air can pass to form a thin layer between the elements, this are of aerostatic type. The aerodynamic bearings do not have any external source of air when the mechanical components are stationary, they are in contact with each other, once they start the motion a thin layer of air is formed. Air bearings come in various shapes and sizes and are used in manufacturing tools which include lathe, grinders and CMM as they are very precious and accurate in working, which reduces the errors and time in manufacturing this precious tools.

Keywords: Air Bearings, Lubrication, Frictionless, Aerostatic, Aerodynamic

1. Introduction

Air bearings are the example of Hydrodynamic bearings. Bearings are an important mechanical component which are used when relative motion occurs between two machine elements, they are used to support the moving element.

Types of Bearing

Mainly bearings are divided into two types—

- Anti-Friction Bearings
- Hydrodynamic Bearings

a) Anti-friction bearings use rolling contact, that is there is a rolling contact between the two mechanical elements which are in relative motion. Ball bearings are the important example of anti-friction bearings.



Figure 1: Anti-friction bearings

b) Hydrodynamic bearings use lubrication in between the two mechanical elements so that the elements or the compounds do not wear and there is no friction.



Figure 2: Hydrodynamic bearings

Air Bearing

Air bearings are hydrodynamic type of bearings which use air as the lubrication between the mechanical components which are in relative motion. A thin layer of pressurized air is formed which acts as a lubricant for the elements, the moving components are floating on a thin stiff layer of air with smooth near frictionless motion over super flat surfaces.

Types of Air Bearing:

Mainly air bearings are broadly divided into two types—

- Aerodynamic bearings
- Aerostatic bearings

a) Aerodynamic bearings do not need any external supply of air, when the components are stationary, they are in contact with each other as the components are in relative motion, they are separated by a layer of pressurized air which is formed as the velocity increases.

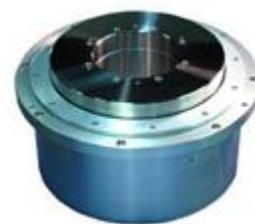


Figure 3: Aerodynamic bearings

b) Aerostatic bearings do need external supply of pressurized air to form a thin layer between the surfaces which is the lubrication for this type of bearings.



Figure 4: Aerostatic bearings Aerostatic bearings are further classified into two types: i) Orifice feeding ii) Porous Media

- 1) Orifice feeding – There are one or more small holes at the surface of the bearing which allows the air to pass and to form a thin layer. The size of the hole is hard to calculate the size is so small which is in the range of 0.1 to 1.0 mm. If the size of the orifice is little bigger than the calculated size then there are vibrations and noise at the bearing which can damage the bearing.
- 2) Porous Media – A porous film is placed at the surface of the bearings which is used to pass the air uniformly over the surfaces which is easier than the orifices feed as the size of the hole does not matter, even the bearing is not damaged due to wrong size of orifice. Mostly graphite is used as a porous media as it is soft, they can be shaped in many shapes and sizes.

2. Literature Survey

With the help of various research papers and by reviewing them we have come to know that; air bearings use pressurized air to support load in components in relative motion. Best type of these bearings is the spindle, they can be made in many shapes and sizes which is difficult in other types of bearings. Lot of research is done in this field and the main use is in maturing ultra-precise inspection instruments and work piece.

3. Working

Air bearing work with pressurized air film which separates the bearing surface and component, there is no contact between the surfaces so there is nearly frictionless motion which is the main function of bearings. The pressurized air film between the surfaces is produced mainly in two different ways

- 1) External supply of air (Aerostatic)
 - 2) No external supply of air (Aerodynamic)
- 1) External supply of air is given to the bearing which forms a pressurized air film between the surfaces there can be various ways to form that film by orifice feeding or by porous media feeding.

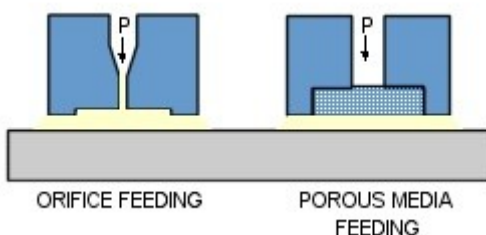


Figure 5: Orifice and Porous media feeding

- 2) No external supply of air bearings are in contact with each when they are stationary as the relative motion starts the speed increases and pressure gradient is formed the speed keeps on increasing which increases the pressure and the load carrying system is formed between the surfaces, this is aerodynamic type of air bearings.

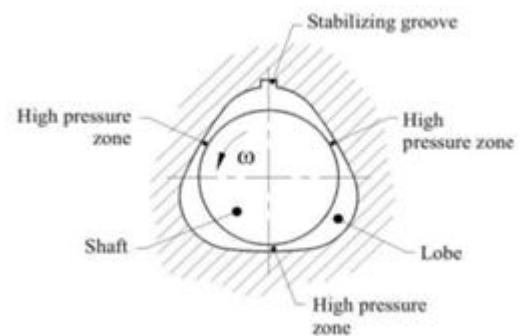
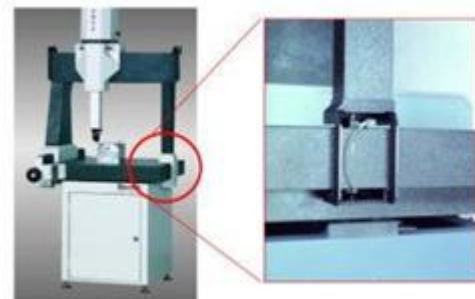


Figure 6: Working of Aerodynamic bearings

4. Applications

The main application of air bearings is in accurate inspecting instruments which can move smoothly with this bearing for example co-ordinate measuring machine. Air bearings are also used in medical fields like medical research, precious machine tools, optical grinding, friction and tensile testing instruments, it is also used for making precious working components for industrial use.



Co-ordinate Measuring Machine

5. Conclusion

From all the research and studies of air bearing, the conclusion is air bearings are better than any anti-friction bearings or oil-based lubrication bearings there is less friction, they are more accurate and easier to use and manufacture. They can be used in place of any other contact bearings as they come in various shapes and sizes.

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