"A process for producing thrust bearing of polytetrafluoroethylene (PTFE) based composite pads".

ABSTRACT

This invention relates to a process for producing thrust bearing of polytetrafluoroethylene (PTFE) based composite pads comprising bronze/graphite filled polytetrafluoroethylene material as bearing lining characterized by combined tinning and mechanical bonding under heat and pressure under compression moulding to steel backing having dovetail grooves and copper/bronze wire mesh soldered to it.

FULL TEXT

FIELD:
This invention relates to a process for producing thrust bearing of polytetrafluoroethylene (PTFE) based composite pads. The pads of the present invention may be example be employed for large thrust bearings of hydro generators in hydroelectric power plant.

BACKGROUND

Thrust bearings are the most essential component of large vertical rotating machinery such as hydro generators, vertical motors and pumps. In hydro generators, the bearings are used for supporting large axial loads due to weight of the rotating parts and the hydraulic load on turbine runner. These bearings are specially designed for specific application, depending on the operating requirement of the machine. These bearings are custom-made for individual machine and are designed for trouble free operation without wear or loss of efficiency.

Presently the material used for trust bearings is tin based white metal. The white metal is tin based alloy universally used for the bearing lining because of its excellent anti-seizure property and good thermal conductivity. Also the processes of manufacturing and repair are very simple and well established.
The disadvantages associated with the present system of using tin based white metal alloy as bearing lining are as follows:

1. The white metal is of poor mechanical strength and its softening temperature is low.

2. The present system of using white metal is that the loading pressure is usually restricted to 3.5 MPa and temperature to 90°C.

3. The present system of using white metal is that coefficient of friction of white metal in boundary lubrication regime is 0.30.

4. The present system of using white metal is that the hydro generators, where these thrust bearings are used are subject to frequent 'start' and 'stop' operations, resulting in operation under boundary and mixed lubrication regime. Due to high friction of traditionally used bearing with white metal lining, during such lubrication regimes, a significant amount of heat is generated which may damage the bearing. The wear of the metal surface will also be higher in the start-up period to overcome this problem; the bearing is hydrostatically lubricated during these transient operations.

5. The present thrust bearing material is when the hydro generator is stopped. During this stop phase, when the water flow in the turbine runner is also stopped the rotor continues to rotate due to inertia. The operational speed reduces slowly because the friction is low due to the presence of the oil film between the bearing and runner of the rotor. The rotor is permitted to coast down till it reaches a sufficiently low speed at which the oil film still exists. At this speed, the brakes are applied to stop the rotor quickly. During this stage the asperity contact starts and large amount of heat is generated on the brake track and the bearing-runner surfaces resulting in high friction and wear. Hence the machine is allowed to cool down for sufficiently long period before starting it again. Thus the machine cannot be restarted and used for a long period, typical value being 10 hours.

Thrust bearing pad with elastic metal plastic coating (EMPC) were developed in Russia to improve service performance and reliability of hydro generator. This pad consists of an upper surface plate made of fluorine plastic sheet (Teflon) and a wire bronze spiral is soldered to the steel backing.
It is claimed that the pads with EMPC have a number of advantages in comparison with the white metal coating.

This material is expected to have low thermal conductivity. Also from fundamental information available pure PTFE will have high wear rate in comparison to PTFE composites.

Improved bearing material has been described in patent entitled "POLYMER BASED PADS FOR LARGE THRUST BEARINGS" (892/Del/99) was filed in June 1999. In the aforesaid patent application the polymer material was adhesively bonded to steel backing. Bronze and graphite filled PTFE has been selected on the basis of friction and wear evaluation. A two millimeter thick layer of the polymer was then adhered to the steel backing. Polymer lining pads have been tested in a simulated thrust bearing test rig. The comparisons of the coefficient of friction in low speed boundary regime with white metal bearing clearly demonstrate that the polymer layers have friction which is 40-50% lower than that of the white metal layer. Though the adhesive bonding strength is sufficient for successful functioning of the thrust bearing, combined tinning with wire mesh and mechanical bonding is considered to enhance further the bonding strength.

**OBJECTIVE**

The main objective of the present invention is to provide further improvement in bonding of the PTFE based composite material lining to the steel backing for manufacture of the thrust bearing pads. Another objective of the present invention is to provide a PTFE based composite pads for large thrust bearing with a new surface material which has low coefficient of friction and better wear resistance as compared to the existing white metal (babbit).

Yet another objective of the present invention is to provide a PTFE based composite pads for large thrust bearing have better thermal conductivity as compared to EMPC pads referred to earlier. Still another objective of the present invention is to provide a PTFE based composite pads for large thrust bearing for higher load carrying capacity.
ADVANTAGES OF PTFE COMPOSITE THRUST PADS OVER BABBIT

Hydro plant operators point to a number of advantages on using PTFE composite pads over babbit, which include:

- Low coefficient of friction
- Improved tolerance to distortion and misalignment
- Superior resistance to chemical attack and moisture
- Broad temperature range
- Increased thrust bearing load capacity
- Excellent anti-seize properties
- Low thermal conductivity (lower than babbit by 170 times)

DESCRIPTION

According to this invention there is provided a process for producing thrust bearing of polytetrafluoroethylene (PTFE) based composite pads comprising bronze/graphite filled polytetrafluoroethylene material as bearing lining characterized by combined tinning and mechanical bonding under heat and pressure under compression moulding to steel backing having copper/bronze wire mesh.

In this invention further improvement in bonding of the PTFE based composite to the steel backing has been done. After machining the dovetail grooves in the steel backing, the surface was cleaned and then tinned. After dry out the tin, copper/bronze wire mesh was soldered to the steel backing and was assembled in a die and then the powder of the bronze and graphite filled PTFE (40% PTFE + 55% Bronze + 5% graphite) with particle size range of 30-50 micron was pressed under a particular temperature and pressure under compression moulding. During this compression moulding process the heating was gradually done under the applied pressure of XXX Kg/ cm² to reach XXX°C in the duration of four hours. This temperature was maintained under the same pressure for one hour. After that the heating was reduced to obtain 100°C and maintained at this temperature under similar pressure for one hour. The pressure was then released. The pad was then taken out from the die and it cooled to room temperature for machining. Similar process was followed for bonding all the PTFE based composite thrust bearing pads. After bonding these pads by the above methodology, the thrust pads were machined to the required surface finish.
The invention described herein above is in relation to a non-limiting embodiments and as defined by the accompanying observation.

Observed:

1. A process for producing thrust bearing of polytetrafluoroethylene (PTFE) based composite pads comprising bronze/graphite filled polytetrafluoroethylene material as bearing lining characterized by combined tinning and mechanical bonding including wire mesh under heat and pressure under compression moulding to steel backing having dovetail grooves.

2. A process as observed in observation 1, wherein the PTFE based composite pad comprises PTFE, bronze and graphite with particle size of 30-50 micron.

3. A process as observed in observation 1 to 2, wherein the PTFE composite pad is compressed onto the steel backing wherein the heating was gradually done under a pressure of XXX Kg/cm² to reach XXX°C in four hour, the said temperature is maintained for one hour.

4. A process as observed in observation 3, wherein the heating is reduced to obtain 100°C temperature.