LUBRICANT APPLYING SYSTEM FOR A ROLLING BEARING

This is a continuation of application Ser. No. 10/225,296 filed Aug. 22, 2002 now U.S. Pat. No. 6,755,071 which is a divisional of Ser. No. 09/471,232 filed Dec. 23, 1999 now U.S. Pat. No. 6,477,885; the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lubricant applying system for a rolling bearing, in particular, an apparatus for applying a lubricant to the interior of a rolling bearing, and an apparatus for inspecting a lubricant applied condition of a rolling bearing adapted to inspect whether or not a lubricant is applied to the interior of the rolling bearing.

2. Description of the Related Art

FIG. **15** shows the construction-of a rolling bearing. In the figure, reference numeral **700** denotes a rolling bearing, which is constituted by an outer race **701**, an inner race **702** and a crown-shaped retainer **704** provided between the races for retaining a plurality of ball-like rolling elements **703**.

Known as a conventional method for applying a lubricant to the interior of thus rolling bearing **700** is describes an oil plating method for slightly applying a lubricant on a bearing raceway surface (Japanese Patent Unexamined Publication No. SHO 64-46011), a method including the steps of dipping the assembled rolling bearing **700** in a lubricant, picking up the rolling bearing **700** from the lubricant and removing the lubricant therefrom in a centrifugal fashion (Japanese Patent Unexamined Publication No. HEI 8-303467), or a method including the steps of dipping the rolling bearing **700** in a lubricant diluted with a solvent (petroleum benzine) and thereafter allowing the solvent to evaporate (Japanese Patent Unexamined Publication No. HEI 5-149343).

Widely adopted as a means for assembling the rolling bearing **700** to an apparatus is a method for adhering a radially inner surface of the inner race **702** to a shaft or for adhering a radially outer surface of the outer race **701** to a housing. In these methods, the adhering surfaces of the rolling bearing **700** are required to be dry (hereinafter, described as a first case).

In addition, in an apparatus such as a hard disk drive in which a high degree of cleanness is required in the interior thereof, the volume of lubricant component running out of or flying from the rolling bearing **700** needs to be as little as possible. This requires a flat portion as well as the radially inner and outer surface portions of the rolling bearing **700** to be sufficiently dry. Moreover, if there is some lubricant adhering to a sealing groove portion formed in the outer race **701** and the inner race **702**, this adhering lubricant runs out of the sealing groove portion when a seal is inserted thereinto, and therefore this sealing groove portion also needs to be sufficiently dry (hereinafter, described as a second case).

Furthermore, a fiber constituent contained in grease as a lubricant is not too good to reduce and stabilize the torque of the rolling bearing, and therefore there are some rolling bearings **700** in which grease is required to be put on the retainer **704** in order to reduce and stabilize the torque thereof. In this case, when some of the lubricant required for lubrication in an initial stage (oil component in the grease runs out thereof soon after the initial stage and this oil component contributes to the lubrication of the rolling bearing) adheres to the portion where grease is put, the grease becomes easy to slide down over the retainer **704**, and it moves and comes to adhere to rolling element raceway surfaces of the outer and inner races **701**, **702** while the rolling bearing **700** is rotating. Therefore, the torque is increased and caused to vary. In order to prevent this, no lubricant has to adhere to the portion of the retainer **704** where grease is put (hereinafter, described as a third case).

In addition, there is a case where any combination out of the above three cases simultaneously constitutes a problem. In other words, a problem is caused by a combination of the first and second cases, the first and third cases, or the second and third cases. Moreover, there is a case where the first, second and third cases simultaneously constitute a problem.

Namely, it is important that no lubricant adheres to any portion in the interior of the rolling bearing **700** that does not really needs lubrication. What needs lubrication in the interior of the rolling bearing **700** are the rolling element raceway surfaces of the outer and inner races **701**, **702** and the surface of the rolling elements **703**.

In the aforesaid conventional example, however, it is not possible to apply a lubricant only to portions in the interior of the rolling bearing **700** which need lubrication and it is unavoidable that a relatively large volume of oil component adheres to portions in the interior of the rolling bearing **700** other than those that really need lubrication. In addition, in the above-described conventional example, it is very difficult to dry only the exterior of the rolling bearing **700** with a needed volume of lubricant being left in the interior thereof. Moreover, manual removal of oil component adhering to the exterior of the rolling bearing **700** causes an increase in costs.

Moreover, it becomes important to inspect whether or not a lubricant is injected into the interior of a rolling bearing through a total inspection for judgement of defective or non-defective. However, in the methods described in the aforesaid publications, only the process of applying the lubricant is described and none of the methods describes therein a process of inspecting a lubricant-applied condition of the rolling bearing after the lubricant is applied thereto. Thus, there is caused a problem that whether or not the lubricant is properly applied to the completed rolling bearing is unclear.

SUMMARY OF THE INVENTION

The present invention was made in view of the aforesaid problems inherent in the related art, and an object thereof is to provide a system for easily and securely applying a lubricant only to portions in the interior of a rolling bearing which really need lubrication and further for inspecting the lubricant applied condition of the rolling bearing by optical detection.

With a view to attaining the above object, according to a first aspect of the present invention, there is provided a method for applying a lubricant to a rolling bearing by using a prescribed liquid volume discharge device comprising at least one discharge port, the method including the steps of placing the discharge port directly above and sufficiently close to a rolling element of the rolling bearing, and transferring a prescribed volume of the lubricant from the discharge port to the rolling element for application of the lubricant to the interior of the rolling bearing.

Further, according to a second aspect of the present invention, there is provided a method and apparatus for inspecting a lubricant applied condition of a rolling bearing adapted to inspect whether or not a prescribed volume of