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# FOREIGN TECHNOLOGY DIVISION



ELASTIC BEARING

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# EDITED TRANSLATION

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## ELASTIC BEARING

The common ball bearings and sliding bearings are well known to people since they are widely employed in modern industries such as trains, automobiles, ships, aircraft, machine tools, instruments, etc. They have also been used in many household appliances or equipment such as fan, sewing machine, bicycle, clock, etc. The elastic bearings are rather unfamiliar to people.

*Figure 1 describes the features of elastic bearings and compares them to sliding and ball bearings. An elastic bearing*

Figure 1 shows the structure of a elastic bearing. It has a thick inner sleeve and an outer sleeve similar to most common bearings. However it contains no steel balls or cylindrical rods of the ball bearings. It has <sup>layers of</sup> a laminated structure with alternative layers of metal and rubber. It usually contains 30-40 layers or more. Why does this structure used as a bearing? The basic principle is discussed in following.

As we know, a bearing is the support of a shaft. Most bearings have two functions. One is to support the load, the other is to provide rotation which is a relative movement of the inner and the outer rings including repeated oscillation with an angle less than 360 degree. Figure 2 shows a ball bearing which can transmit the load from the shaft to the support of the bearing and provides rotation simultaneously by the inner ring. The rotation is accomplished by the rolling of the balls within the groove between the inner and the outer rings. The principle of operation of the elastic bearing is different from that of the common bearings. Rubber materials have the characteristics of high elasticity. The elastic elongation can be 5

to 10 times of the original length. The enlongation of the metal is very small. The movement of the elastic bearing is accomplished by the shear deformation of the rubber layers. The body of the elastic bearing can only oscillate but not rotate, otherwise the rubber layers will be torn off. Rubber material has the special characteristics that the compressibility decreases and the loading capacity increases with increasing area and decreasing thickness of the laminate .

This is the reason that the elastic bearing is composed of many thin layers. The composite structure of metal and rubber laminates can provide the two basic functions of a bearing - load carrying and rotation. Therefore, this composite laminated structure is also a type of bearing. Since it is made of material having high elasticity - rubber, it is named elastic bearing.

The elastic bearing has the following advantages.

1. It needs no lubrication. The common ball bearing and sliding bearing contain surfaces having relative movements of rotation and sliding. They need lubrication to reduce the friction and to extend the service life. The movement of the elastic bearing results from shear deformation and does not contain any relative movement of surfaces. Therefore, it needs no lubrication, neither needs the corresponding sealing system.

2. The elastic bearing is safe and has long service life. Deadlock which usually happens to the ball bearings will not occur with the elastic bearings. Rubber is a polymer material. The breakdown of this material is a slow progression process. It is safe without sudden defects in operation. The defective elastic bearings can be detected

visually from the extrusion of the rubber layers and the formation of powdery particles on the surface.

3. The elastic bearing allows the shaft to oscillate as well as to rotate. Actually, the common ball bearings and sliding bearings are not suitable for oscillation, especially not for oscillation with small angle. The elastic bearings are well suitable for this type of operations. For example, the service life of the ball bearing used for the rotor of the helicopter is only about 1000 hrs, while the life of an elastic bearing used for the same application is usually over 2000 hrs and occasionally can be as high as 10,000 hrs.

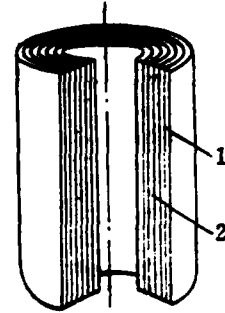
The elastic bearing has also other advantages such as simple maintenance, capability of providing moderation or vibration reduction function, etc. Current high production cost is the main problem of the elastic bearings.

Elastic bearing is a new technology and many studies and tests have been carried out in foreign countries. It is well suitable for applications in helicopter for the rotor. It reduces significantly the weight, cost and the number of parts of the rotor shaft and increases the service life of the shaft. It reduces also significantly the maintenance and improves the performance of the helicopters. Presently, the elastic bearings have been used in most new helicopters produced in foreign countries. The elastic bearing employed in the helicopters produced by U. S. Bell Co. has been regarded as a new technology developed for helicopters in the eighties

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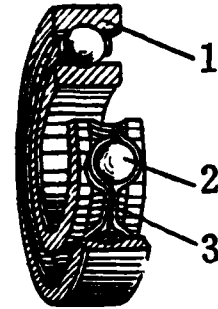
**Figure 1. Elastic Bearing**

- 1. metal separators
- 2. rubber layers



**Figure 2. Ball Bearing**

- 1. outer ring, the ring under the balls is the inner ring.
- 2. balls
- 3. ball keeping frame.



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