HIGH-SPEED BEARINGS.*

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When considered in connection with the subject of this paper, the term "high speed of revolution" is somewhat misleading, for one should speak of the speed of journal surface rather than of speed of revolution. For example, take the case of a De Laval steam turbine having a shaft 10 mm. diameter revolving at 30,000 revolutions per minute, and compare the surface velocity of it with that of a steam turbine shaft of 100 mm. diameter revolving at 3,000 revolutions per minute. The surface velocity of each is about 51.6 feet per second, but the speed of revolution of the first is ten times that of the second.

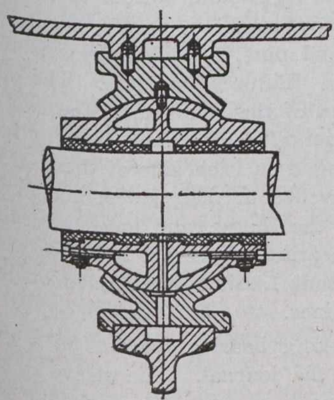

Fig. 1.

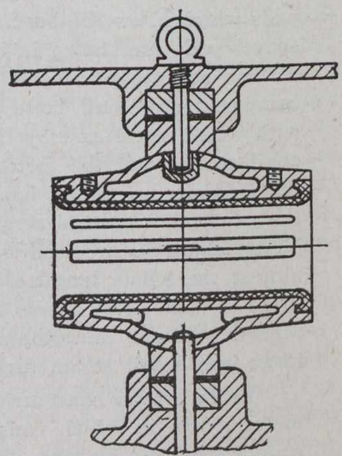

Fig. 2.

With rotary machines of the turbine or electrical kind, it may be considered that surface speeds of 50 feet per second are quite ordinary, and 100 feet per second as high. Pressures, per unit area of projected bearing surface, in common use with the kinds of bearings under consideration are small when compared with those met with in, e.g., modern railway practice, where 300 lb. per sq. in. of projected bearing surface is not at all exceptional in the case of driving axle journals; but the conditions under which these work are very different. Briefly, 50 lb. per sq. in. of projected bearing surface may be considered ordinary, and 90 lb. per sq. in. high for bearings of the class being dealt with.

Steam Turbine Bearings.—These may be grouped under three heads: (1) Rigid bearings; (2) swivel bearings; (3) concentric ring bearings.

1. By a rigid bearing is meant one wherein the shell is held rigidly in the housing or pedestal surrounding it. It is adaptable where shaft deflection is very small, the slight slackness or clearance between the journal and the bearing, and also the presence of a film of oil around the journal, being taken advantage of. Obviously, these bearings are of use only where journal centres are comparatively small.

2. The swivel bearing is no doubt the most widely used kind in turbine practice to-day. Its name indicates one of its outstanding features. It is adaptable practically to all kinds of turbines and generators. It allows itself to radiate in the housing about its centre, thus accommodating itself to the deflection of the shaft, so that its use with shafts having great length between journal centres is almost universal. It is easy to design the shell in such a way that lateral and vertical movement, required for alignment when bearings are being set at a considerable distance apart, is readily attained.

3. The concentric ring bearing has characteristics which are set forth in the description of it which appears further on.

The shell of the "rigid" type of bearing is usually made of good, close-grained cast iron, and is lined on the inside with white metal; babbitt, delta, or magnolia metals are found suitable for this purpose. It is turned on the outside of the shell to fit the pedestal, in which it is prevented from rotating by means of dowels engaging in holes in the cap or cover of the housing; a flange at each end prevents end movement. There are, of course, other methods of preventing rotation and end movement, but the above is perhaps the simplest. If it is found necessary to water-cool such a bearing, the problem is much simpler than that which presents itself when the same treatment is desired for a bearing of the swivel type.

A bearing of the rigid type is fitted to a 2,000 kw. steam turbine of the A.E.G. type. In this instance the shell is made of brass, and is lined with white metal. Among the interesting features it possesses may be mentioned that the oil, before being admitted to the journal, is passed around the space between the housing and the shell to render the oil thinner before use. This appears to have a double effect on improving conditions of working—the shell is cooled by the circulating oil, and the friction losses in the bearing are reduced by the higher oil temperature. The surface speed of the journal is said to be 96 ft. per second.

The Swivel type is illustrated in Figs. 1, 2, 3, 4 and 5. Fig. 1 is used with a Melms Pfenninger steam turbine of 3,000 h.p. at 1,500 revolutions per minute. It is 180 mm. diameter by 380 mm. long, and the journal surface speed is 46 ft. per second. The shell, which is made in halves, is of cast iron, and is lined with white metal. The temperature of the bearing can be kept below the danger point by circulating water through the chamber shown. A cage is provided giving ample bearing surface for the shell. The housing is, of course, on the outside, the cage being provided with lugs to prevent end movement. Dowels prevent cage and bearing from rotating. Oil is fed under pressure into the annular space in the housing, through a hole in the bottom of both cage and shell, into a partly annular space around the journal.

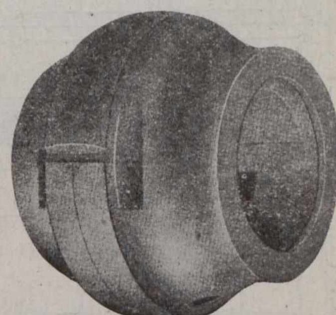

Fig. 3.

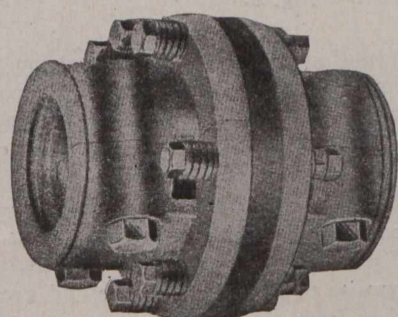

Fig. 4.

Fig. 2 illustrates a bearing used with a 1,500 kw. 1,500 revolutions per minute steam turbine made by the Brush Electrical Engineering Company. The shell is hollow, and is lined with white metal. The diameter of journal is 5 in., and length 15 in. The bearing is capable of being easily aligned both vertically and laterally, shinplates being provided between the cage, which is immediately without the shell, and radial pads which are screwed to the cage. Both shell and cage are made in halves, and both are prevented from rotation in

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