

If  $P$  = the pressure on the whole bearing;  
 $Z$  = the number of balls;  
 $P_o$  = the pressure on each ball;  
 then  $P_o = \frac{5 \times P}{Z}$ .

Fig. 5 shows the construction of a cone ball bearing.

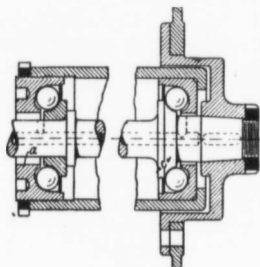


Fig. 5.

There are two cones (h and c): one (h) is connected solid to the shaft; the other (c) is adjustable, and is held in position by a washer (d) and lock nut (a).

The balls are held in position by the ball receivers (b and r); by two short pipe-ends (v and n); and by two washers (u and o).

The spaces between the shaft cones (h and c) and the washers (o, v and u) are packed with felt, to keep the dust from getting in, and the oil from getting out. The whole hub (f) is filled with oil.

Fig. 6 shows a cone ball bearing used in the crank bearing of bicycles in this case one of the ball receivers (a) is used for adjusting. One cone is part of the shaft, the other is pressed on the shaft, and the ball receivers are shaped to hold the balls in place. Figs. 7, 8, and 9 show ball bearings where several sets of balls are used.

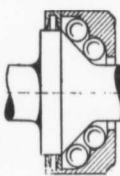


Fig. 7.

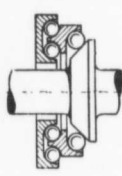


Fig. 8.

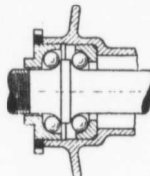


Fig. 9.

These constructions have not proven successful. In Fig. 7 the grooves will wear differently because the pressure on them is uneven; in Fig. 8 it is intended to get the best results by having an intermediate ring, and this bearing would work satisfactorily if it could be kept tight all the time, but a slight wear of one of the seats will give the shaft considerable play. The bearing in Fig. 9 has a better chance of success as it can be evenly adjusted.

Cone shaped ball bearings have not been standardized so far as they are only used for light machinery which requires special construction in many cases. Another reason is there is no standard for the threading of adjustable cones.

#### RING BALL BEARINGS.

The oldest type of ring ball bearings is shown in Figs. 10 and 11. The balls run in the groove of a ring (a), which is fastened to the shaft, and are kept in their position by two cone shaped ball receivers (c and c).

that are screwed into the hub, one of the two can be adjusted and may be held in position by a slotted washer (Fig. 11). Though it would seem right and necessary to make ring ball bearings adjustable, practice has shown it to be wrong and unnecessary. For one reason, it is very hard to thread ball receivers true, and if not true, the balls will not rest on four places; and if the receiver is screwed too tight it will spoil the whole bearing as uneven wear cannot be made good by adjusting.

Fig. 2 shows another attempt made to adjust ball bearings by placing very thin washers (c), between the two plain ball receivers (a and b); the tightening of this bearing was to be affected by removing one of these washers. At present the adjusting of ring ball bearings has been entirely abandoned to lessen the number of parts, and so cheapen and simplify their manufacture.

Fig. 13 shows an up-to-date ring ball bearing. Its four main parts are: balls, inner ring, outer ring, and ball cage, which last, however, is not necessary in every case.

Three types of ring ball bearings have been adopted: bearings for light work, fitted with small balls; bearings

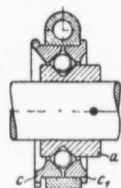


Fig. 10.

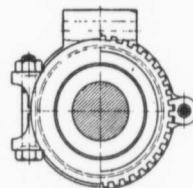


Fig. 11.

for medium heavy work, fitted with medium sized balls; and bearings for heavy work, fitted with large balls.

The measures D-d-b, as in Fig. 13, are standardized.

The different manufacturers can only change the method of introducing the balls into the ring, the shape of the ball cage, and the shape of the running surface. The rings are hardened and the outside diameter (D) and inside diameter (d) are ground to the exact size; the variation in size permitted is .00004 to .0002 in. for d, and .0006 to .0012 in. for D.

Three sizes light, medium, and heavy, will suit most requirements. Ball bearings will stand double the strain for the same width of bearing as babbit bearings. For instance, a 1½ inch shaft requires a babbit bearing 1 inch wide for 1,000 pounds pressure, a ball bearing of the same width will stand 2,000 pounds pressure.

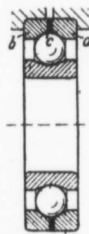


Fig. 12.

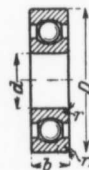


Fig. 13.

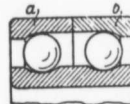


Fig. 18.

The pressure guaranteed by the manufacturer of ball bearings should not be exceeded to insure safety and to hold him responsible. For sudden load variations, ball bearings should be selected which stand 1.6 times the guaranteed pressure.