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The Truth About Anti-Friction Bearings



THEIR DESIGN

THEIR FUNCTION

THEIR NECESSITY

THEIR PERFORMANCE



Types of Anti-Friction Bearings

Anti-friction bearings are in such common use today, in automotive vehicles and industrial machinery, that most people are familiar with their characteristics as distinguished from "plain" bearings.

Plain bearings are merely cylinders of metal different in composition from that of the shafts which they support. The anti-friction bearing, on the other hand, consists of a circular group of steel rollers or balls revolving between two circular raceways.

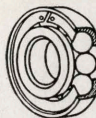
There are in use today five general types of anti-friction bearings: (1) tapered roller bearings; (2) straight roller bearings; (3) cup-and-cone ball bearings; (4) annular ball bearings; and (5) ball thrust bearings.

Most types of anti-friction bearings have four principal parts:

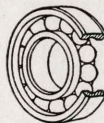
1. A "cone" or inner race which fits over the shaft or spindle.
2. A "cup" or outer race which fits inside the wheel hub or other carrier.
3. A series of "rollers" or balls which revolve between the cone and the cup.
4. A "cage" or other device to keep the rollers or balls in position between the cup and cone.

The way in which these elements are designed and assembled has a marked effect on the ability of the bearing to stand up in service. The different types of bearings are illustrated in the diagrams on page 3.

CUP-AND-CONE BALL BEARING

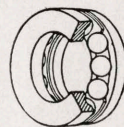


Radial (vertical) load capacity is the chief function of this bearing, although the cup and cone are set at an angle in order to stand occasional end-thrust.



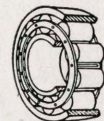
ANNULAR BALL BEARING

The radial (vertical) load capacity is sufficient, although the end thrust capacity of this bearing is considerably less than the radial capacity.



BALL THRUST BEARING

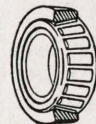
The ball thrust bearing carries thrust loads only. It is usually used to supplement annular ball bearings at points where thrust loads are encountered.



STRAIGHT ROLLER BEARING

The vertical load capacity is greater than a ball bearing of the same size.

When thrust loads are present it is usually used with special thrust bearings.



TAPERED ROLLER BEARING

The Timken Tapered Roller Bearing has greater radial (vertical) load capacity and in addition it carries end thrust loads and all combinations of both radial and thrust loads.



The Timken Bearing

The Timken Tapered Roller Bearing consists of four elements, as shown in Figure 1,—the cone, the cup, the cage and the rollers.

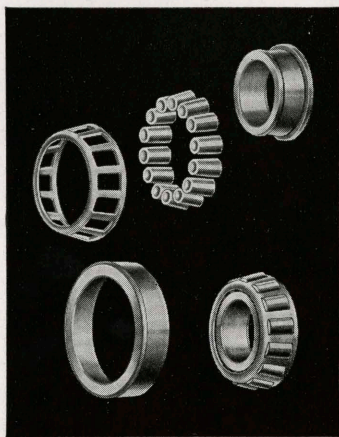


Fig. 1.
Component Parts of a Timken Bearing.

The appearance of an assembled bearing is shown clearly in Figure 2, while the principle of construction is given in Figure 3.

A careful examination of Figure 3 will show clearly that true rolling motion is obtained, since lines produced coincident with the faces of the rollers, cone and cup meet at a common point on the axis of the bearing.

It will be seen therefore that radial loads, that is, loads imposed at right angles to the

bearing, such as the dead weight of a car or truck or the force of a spur gear or a pinion driving another gear, are well handled on the tapered rolling surfaces. Thrust loads which exist along with radial loads in practically

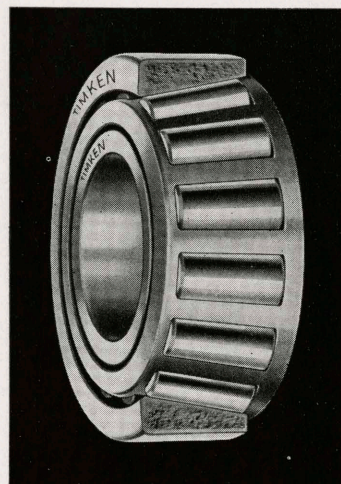


Fig. 2.
The Timken Tapered Roller Bearing.

every bearing application are loads parallel to the axis of the bearing. These are represented by the forces which tend to push bevel gears out of mesh, or any other force which tends to slide a shaft through a bearing.

In actual everyday work the loads or forces exerted on a bearing are rarely, if ever, wholly thrust or radial, but a combination of both acting simultaneously. The anti-friction bear-

ing therefore, to be the most nearly ideal, must possess versatility and function unhampered when loads are momentarily changing from one direction to the other.

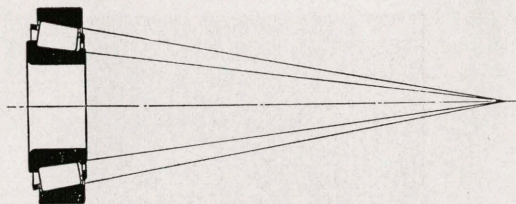


Fig. 3.
How true rolling motion is obtained in a Timken Bearing.

The advantage, therefore, of a bearing which simultaneously carries all types of loads is apparent. The Timken tapered roller bearing does carry all combinations of all loads. This

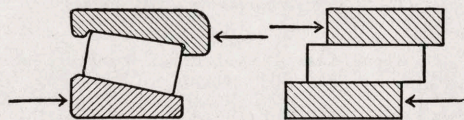


Fig. 4.
Showing how a Tapered Roller Bearing can take a thrust load.

“dual service ability” of Timken Tapered Roller Bearings—their ability to carry radial loads and thrust loads and resultant loads—results in the following, important advantages:

Friction resulting from all types of loads is reduced to a minimum, thus conserving power whether in automotive vehicles or in industrial machinery. Shafts, gears, and wheels are kept in perfect alignment constantly, thus cutting down wear on all parts affected. The complicated construction is eliminated which is necessary when separate bearings are installed to carry each load.

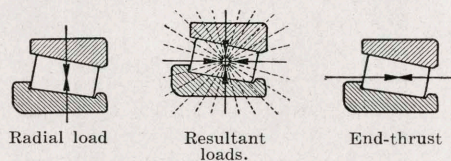


Fig. 5.
How the tapered roller bearing carries all combinations of all loads.

Positive Roll Alignment of Timken Bearings

Not only does the Timken Bearing present marked advantages by reason of its tapered construction, but also the rolls are positively aligned without guidance by the cage. This refinement in bearing design permits greater load and speed possibilities which are essential in many applications.

To accomplish the positive alignment of the rolls, certain improvements were perfected in the rollers as well as in the cone, or inner race of the bearings. By referring to Figure 7 it can be seen that the shoulder of the large

end of the cone is undercut. Likewise the large end of the roll has been ground so that it will square exactly with the center line of the roll itself. As the roll revolves about the

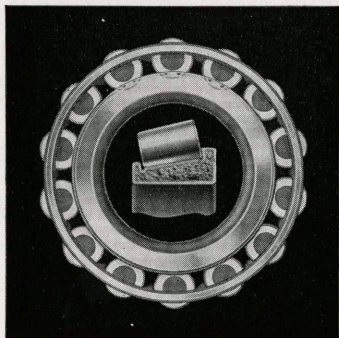


Fig. 7.

The two dark spots show the two points of contact between the end of the roll and the rib of the cone.

cone, there is contact between the end of the roller and the rib or shoulder of the cone in two widely separated areas. Since this contact is in two areas, widely separated, the rollers are compelled to align themselves perfectly at all times. At the same time a full line contact is maintained between the roller and the cone, on the one hand, and the roller and the cup, on the other. Thus, with the rollers positively aligned, the cage does nothing more than space the rolls properly about the cone.

Greater Load Area of Timken Bearings

The design of the Timken Bearing permits the distribution of unit pressures over the full length of the roller. Naturally, with an initial distribution of unit pressures over a line of contact there is minimum distortion under load. Translated into terms of bearing life and service, the less distortion, the greater the precision, the greater the rigidity, the less wear and consequently the longer the life of the bearing and the machine parts which it supports. Complimentary to the above benefits, manufacturers have found that the rigid mountings made possible by Timken Bearings permit machining practices impossible with any other type of mounting.

A Precision Product

So close are some of the limits maintained on Timken Bearings that angles of cup, cone, and rollers are held to a single second of arc—one millionth part of the circumference of a complete circle. Translated into every day language this means an angle made by two lines two miles long and less than an inch apart at the outer end. The angles of the cup, cone and rollers are held within these limits.

The capacity and life of a bearing depends in a large measure on the uniform distribution of stresses over the complete set of rolling elements. It is essential then that the size of these elements be uniform. To maintain this uniformity, machines have been developed

which with unfailing accuracy separate the rollers into identical sizes and deposit them into containers where they are retained until assembled into complete bearings.

Take-Up In Assembly

Quite apart from the advantages of tapered construction to carry loads from all directions, there is the additional and equally important element of take-up in assembly. Manufacturers find that this feature permits wider machining limits of both shaft and housing, which is an important element in the reduction of costs as well as speeding up assembly.

This feature makes possible the closer adjustment of dependent parts such as spiral bevel gears and pinions. Chatter of machine tool spindles is eliminated and noise in running bearings may be measurably damped by the close and accurate bearing adjustment which is possible with Timken construction.

Wear Proof

It is a recognized engineering fundamental that wherever there is motion, wear must result. In the Timken Bearing wear is so slight that even after long periods of service it is scarcely measurable even with the most delicate instruments. Timken Bearings *last longer*:

(a) because all three types of loads—radial, thrust, and resultant—are efficiently carried along the entire length of the *positively aligned* tapered rollers—

(b) because all wear is distributed along the whole surface of the rollers, rather than concentrated on just one spot—

(c) because they are made of special analysis Timken electric furnace steel, manufactured to exacting specifications in the Company's own steel mill.

(d) because the parts of the Timken Bearing are case-hardened to give them a hard outer surface with a tough elastic inner core—

(e) because each part—rollers, cup, and cone—is made to dimensions accurate to microscopic limits as determined by the most accurate gauges in the world.

It is not at all uncommon for Timken Bearings to outlast the vehicle in which they are installed—even though it is operated for hundreds of thousands of miles.

Century of Progress

1934



Timken Tapered Roller Bearings
are used in Chrysler Motors Pro-
ducts in front wheels, rear wheels,
pinion, differential, steering gear
and bell crank, fan and water
pump shaft.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

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