SPLIT ROLLER BEARINGS

By K. J. SAUNDERS

Up to now only cylindrical roller bearings have been produced with the split feature but there is little doubt that other types of split anti-friction bearings will eventually be available. The split roller bearing although only recently used in great numbers in the sugar industry is by no means a new development. Its first known applications were for crank journals of steam traction engines and diggers. Since its conception much work has gone in to developing a bearing with higher load capacity and better speed capabilities and the stage has been reached where it must now be considered as a cylindrical roller bearing with many advantages.

It is my intention in this paper to accentuate the similarity to the solid cylindrical roller bearing, to allay possible misgivings about the split and briefly discuss the advantages and shortcomings to enable you to possibly re-align your views on split bearings and obtain the full benefits of the advantages offered.

The bearing itself consists of the usual components, an inner race, a cage carrying rollers and an outer race normally carried in a self aligning housing — the only real difference lies in the fact that all these components are split. All materials used in the manufacture are similar to those used in all other anti-friction bearings and manufacturing procedures are similar except for the split inner and outer race.

A comprehensive range of split roller bearings are offered and the load carrying capacities may be compared with those of solid bearings by virtue of the fact that these loads have been calculated according to the recommendations of the International Standards Organisation, these formulae are accepted and used by most bearing manufacturers today. The factors for life, speed and temperature are exactly the same as those applying in the selection of solid bearings. As many bearing failures are due to the fact that the bearing duty is changed during the life of the bearing, it is absolutely essential that in this event carrying capacities are re-assessed subject to the new factors, a point often overlooked.

Lubrication procedure is exactly the same as for the solid roller bearing but is facilitated by the split feature which enables positive greasing of all components. Unfortunately the common controversy of the type and amount of grease to be used still prevails. For high speed and high temperature applications oil lubrication is normally recommended.

The split in the bearing races is a deliberate split in good material and cannot be considered in the same light as a crack — a crack in the surface of the bearing is usually a symptom of faulty material and with faulty material a bearing will fail. To those who have not used the split roller bearing there is often the fear that the rollers 'bump' as they go over the joint and that damage may occur to the inner and outer races at the joints. This is not true. If fitted correctly the total joint gap should be between .010 in. and .025 in. and when it is appreciated that the inner race is split diagonally to the axis of the shaft and the outer race with a Vee joint, constant contact between the roller and almost the full width of the track is achieved. As the load of the shaft is never carried by one roller only and is shared proportionally between several rollers it will be appreciated that even if the roller passing over the joint were considered to be absent the load would be carried on adjacent rollers and the shaft would not 'bump'. The fear that damage may occur to the inner and outer races due to the over stressing at the joints may be allayed by the fact that material here is able to spread in to the gap thus relieving excess stresses.

There are many reasons why the split roller bearing should be considered as superior to the solid cylindrical roller bearing and it is not hard to understand why bearings with this feature have been developed. Probably the most important feature of the bearing is the ease with which it can be replaced. This can generally be done *in situ*, with hand tools. It is not necessary to remove the whole shaft to the Workshops to replace the bearings, quite often just by jacking the shaft a few thousandths of an inch the whole job can be done. In consequence heavy lifting tackle and scaffolding is not always required and a complete bearing change can be made in a very little time. This is a proven fact and has saved many hours of downtime.

Another distinct advantage offered by this bearing is that it can be assembled at any point on the shaft with little consideration of how to get the bearing on — there is no worry of how to fit the bearing between assembled components such as gears, pulleys, etc. — the bearing can even be assembled on a recess journal. This can save designers endless time and is often the only solution to some difficult bearing problems. The bearing facilitates easy inspection and cleaning, in fact it is the only bearing which will allow complete inspection and cleaning of all the rolling parts *in situ* a feature which is most useful particularly where it is impossible to exclude dust from a bearing indefinitely and regular cleaning is necessary.

The split bearing may be fitted to a shaft where the journal has been badly worn — the worn part of the journal has only to be machined and the bearing fitted into the sunken journal. This will save expensive shaft replacements in a lot of cases.

The split bearing is always easily removed from the shaft, a feature not credited to its solid counterpart which often seizes to the shaft causing damage on removal and excessive downtime.

Like all other roller bearings the split bearing has its limitation in speed. The maximum recommended speeds are comparatively lower than the solid cylindrical roller bearing, this limitation being caused by

the split roller cages which tend to throw apart due to the centrifugal forces. This however has been overcome to a degree by the fitting of spring clips for joining the cage halves and speeds of 4,000 r.p.m. have been achieved on 15 in. bearings under test. This I must stress was only under experimental conditions and is not recommended to normal users of these bearings. Fortunately the lower maximum speeds do not seriously limit the sugar mill applications.

The noise level of the split roller bearing is somewhat higher than that of the solid bearing but this is due to the fact that more components are involved. To the uninitiated a disturbing clicking noise is to be heard, this comes from the cage halves coming together as the rollers pass in and out of the loaded zone therefore can be neglected provided there are no other side effects. It will be agreed that the higher noise level is no serious malady in an already noisy sugar mill.

Generally speaking the split roller bearing is slightly more expensive than it's solid counterpart, the reason for this lying in the difficult methods of manufacture necessary to achieve round split parts. This extra initial outlay is normally recouped after the first breakdown. Many planned maintenance schemes recommend that a bearing which cannot be completely inspected be rejected after a certain number of running hours, in the case of the split bearing all components can be thoroughly inspected and would only necessitate replacement if damaged. This you will appreciate can make tremendous savings in the generally overstrained maintenance budget.

There are unlimited applications in the sugar industry for the split roller bearing. Those who have used them generously have found them suitable for most applications and have proved that the savings mentioned are not only hypothetical. Unfortunately there are still many who only use the split roller bearing where absolutely necessary the resistance coming mainly from the initial cost and the unwarranted fear of the split.

I list below many of the successful applications of the split roller bearing in the sugar industry; it is not my intention at present to discuss these at any length but I must point out that most of the applications are common to all sugar mills. It is hoped that by reading through this list you will appreciate the confidence that has already been placed in the split roller bearing.

Cranes:	Long travel shafts, wheel axles.
Carriers:	Main and auxiliary carriers and intercarriers, feeder tables — all head and tail shafts.
Preparation Machinery:	Cane knives and shredder shafts.
Prime Movers:	Steam engine — crank and main journals.
Mill Gearing:	Primary and secondary shaft.
Conveyors:	Bagasse, raw and refined sugar and bagging — head and tail shafts. Grass hopper conveyor — main and crank journals. Screw conveyors — all journals.
Line Shafting:	Crystallizer and Workshop Drives.
Crystallizers:	Main journals.

Mr. Kramer: What is the largest size bearing made of this type?

Mr. Saunders: Standard bearings up to 24 in. internal diameter are available, and specials up to 56 in., and possibly larger, are made.

Mr. Ashe: There appears to be a contradiction in the paper. In one place we read "The factors for life, speed and temperature are exactly the same as those applying in the selection of solid bearings" and further on "The maximum recommended speeds are comparatively lower than for the solid cylindrical roller bearing".

Mr. Saunders: The factors used for the selection of bearings, whether solid or split, are exactly the same, and are applied only to determine the life of a bearing. It does not follow, however, that maximum speeds will be the same.

Mr. Dent: Mr. Saunders has omitted one aspect about the use of split roller bearings which is very important, namely, that a so-called locating bearing will not carry any end-thrust and special grooved-race bearings are available for use where end-thrust is present.

Mr. Saunders: The locating bearing was developed purely to overcome axial movements in shafts and was not designed to take any end-thrust loadings.

Applications with even the slightest end-thrust must be met by the grooved-race bearing.