

Understanding friction torque limiters

Simple and low cost protection for machinery

Friction torque limiters are simple mechanical devices that can prevent damage to machinery from accidental overloads. For designers they are often considered as old technology and rather neglected. In some cases people have had bad experiences in the past and now prefer to avoid them. However a proper understanding of friction torque limiters with selection of the right options can give machine protection that is low cost, reliable and user-friendly.

One particular feature of friction torque limiters is their very wide range. Taking as an example the range offered by ComInTec, a specialist in this area, torques range from 1 to 23000Nm and shaft sizes from 4 to 140mm. The largest component is the hub A, flanged at one end and threaded at the other. Two rings of friction material C are positioned above the hub flange and between them sits a platewheel G, sprocket, gear or similar. Axial force to squeeze the friction rings and the platewheel together is applied by a disc spring or springs E acting through a pressure plate J. The disc springs are compressed by an adjustment nut F that is screwed onto the threaded end of the hub.

One final component is a plain bearing D that sits on the inside diameter of the platewheel. Torque can now be transmitted from the platewheel to the hub and shaft H, or in the opposite direction without any change in performance. The level of torque is proportional to the force applied by the spring, and hence the compression applied by the adjuster nut. When the set torque is exceeded, the platewheel slips between the two friction rings. The driving torque is maintained, albeit with a small reduction, but the output side can stop rotating if, for example, the machine is jammed.

In a stall state the drive energy passes into the friction surfaces. At low speeds this can be maintained for a considerable time. At higher speeds heating and wear will occur which are undesirable, therefore the drive should be stopped. The slipping torque can be adjusted with the adjuster nut. A key requirement for the use of friction torque limiters is that they should be kept free of oil and grease which cause a dramatic drop in slipping torque. It is practically impossible to clean friction rings of oil and grease so they should be changed. Even contamination with water is

undesirable as that will cause a temporary torque loss.

Selection based on torque

The starting point for product selection is the required drive torque. The torque limiter should be selected to slip at a higher torque in order to avoid repeated nuisance tripping, and also to cover short term peak torques from starting and short-term loads. Defining the slipping torque is often an area of uncertainty. However the torque limiter is of course adjustable using the adjuster nut. Furthermore they can be fitted with different spring sets that give different torque ranges. With a maximum torque of 450Nm, ComInTec offer a 90mm diameter torque limiter with four different spring sets and ratings of 13-105, 74-140, 90-280 and 185-450Nm. Where there is doubt on the torque setting required, the recommendation is to choose one of the middle ranges. Then if the selection proves over or under-sized, it is possible to easily move the torque range up or down.

It is commonplace to set up friction torque limiters on the machine. To do so the adjuster nut is tightened until slip no longer occurs in normal running, then tightened a further half turn. However torque setting need not be all trial and error. A height dimension from the face of the pressure plate to the top of the adjuster nut effectively defines the spring compression and therefore the torque. Comparing this dimension to catalogue values gives an easy estimation of the set torque, although it should not be born in mind that friction torque limiters are not precision devices and the actual torque can vary by typically $\pm 15\%$. Once the required torque is accurately defined, it is possible to order the torque limiter pre-set in the factory for only a small surcharge.

Mounting at low speeds

Application of friction torque limiters is best done at lower speeds, for example the output of a gearbox. This means that prolonged slipping is possible without significant wear. However in some machines it is not practical to limit on the output shaft. This may be due to physical constraints, or sometimes the associated high level of torque makes low speed mounting uneconomic. Maximum speeds for friction torque limiters are actually high. For example at 4-pole motor speed torques can be up to 8000Nm. As powers at higher speeds rise, the potential problem of overheating occurs unless the drive is promptly turned off after an overload. Speed sensing is recommended or there are alternative mechanical variants that allow overloads to be detected by proximity switch.

Friction torque limiters work equally well for both directions of torque transmission, meaning that the input and output can be reversed. Often they will be used for an offset right-angle drive with a chainwheel. However other sprockets, gears and pulleys can also be fitted. Where an in-line

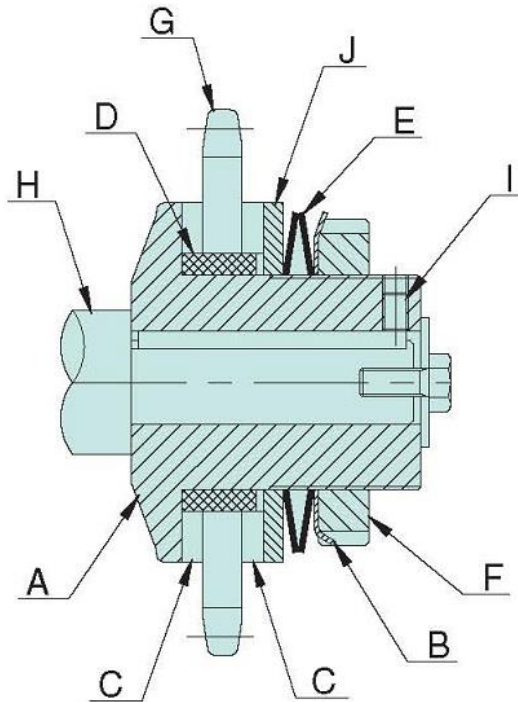
connection is required, the torque limiter should be combined with a flexible coupling. In the past chain couplings have commonly been used where a duplex ring of chain connects from a chainwheel in the torque limiter to a separate hub on the second shaft. Lubrication of the chain ring is not necessary and this helps to avoid contamination of the friction rings. Alternative rubber-based coupling connections are available that are maintenance free.

Chainwheels are often used for an offset drive because they are readily available and low cost. They are also known as platewheels and sprockets, and can be simplex, duplex or triplex. Equally gears and pulleys can be used with proviso that the material is steel. Whatever element is used, the bore needs to be toleranced to suit the plain bearing in the torque limiter. The width of the element should suit the range offered by the model of torque limiter. If there is not a match, alternatives are to turn down the face of the element or select a variant of torque limiter with a longer hub. A limited range of simplex chainwheels is available as an ex-stock option for all sizes of friction torque limiters.

A wide range of options

Surface finish for the steel parts of ComInTec friction torque limiters is black phosphated which suits the majority of applications. Higher protection against rust is possible and electroless nickel plating is an effective option at a lower cost than stainless steel construction. Note that the springs cannot be made in stainless steel. There are options for long life with extended slipping times on the friction rings. Low wear versions can give a five times increase in lifetime or even 150 times with the penalty of reduced torque levels. Where particularly sensitive torque adjustment is needed, the disc springs can be replaced by a coil spring around the central hub. This makes the body longer but gives fine adjustment for lower torques.

Friction torque limiters are at the lower end of the torque limiter market offering simplicity and economy. Other designs often using ball and roller torque transmission step up in performance and cost. Designers might look for a ball or roller alternative if the environment is particularly wet or oily. Such models can easily give a signal to indicate overload, can be set to the required torque more accurately and are capable of synchronising input to output. At the top end of the market torque limiters with pneumatic actuation allow the release torque to be varied across the machine cycle. There are many options and full documentation and advice is available for the ComInTec range through Techdrives.



Friction torque limiter with a simplex chainwheel



Range of friction torque limiters (high res image being sent from Italy)



Friction torque limiter with chainwheel



Friction torque limiter with chain coupling

(1342 words)

About Techdrives

Techdrives is a division of Lenze Ltd offering products that are essential for machine building. These quality products come from manufacturers where Lenze has a long relationship and they are supported by Engineers with strong product and application experience.

About Lenze Ltd

Established 45 years ago in Bedford, Lenze Ltd now has 55 employees and achieves sales of about £20M in power transmission equipment from the Lenze factories and other quality suppliers. Services to UK customers include application engineering, software writing, training, commissioning and service

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