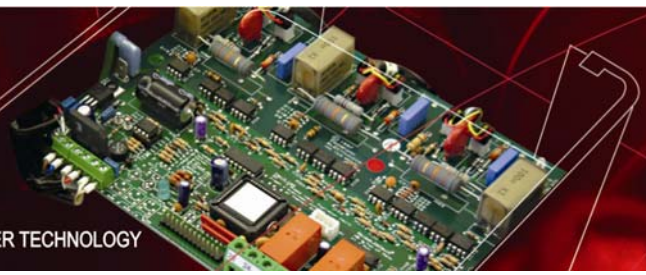


REPLACING HYDRAULIC COUPLINGS & CENTRIFUGAL CLUTCHES

Centrifugal clutching systems and hydraulic couplings have been used in industry for many years particularly where sensitive loads need to be protected from the shock of the normal electromechanical induction motor starting process, or where difficult starting conditions prevail.

Although the principle of allowing an input shaft to impart its energy to a hydraulic fluid or a variable-rate mechanism which in turn drives an output shaft is fairly straightforward, the mechanical realisation is always bulky, requires careful alignment, and in the case of fluid couplings, is prone to leaking.

Since electronic soft starters reproduce many of the features of these slip coupling systems, increasing consideration is being given to using soft starters as replacements or substitutes due to their lower first cost, greater reliability and most significantly for hydraulic couplings, lower running costs. However, despite these advantages, some soft starter installations have failed through a misunderstanding of the relationships between a motor, the coupling and soft starter and this paper is intended to highlight these interactions and show where soft starters can successfully replace fluid and centrifugal couplings.

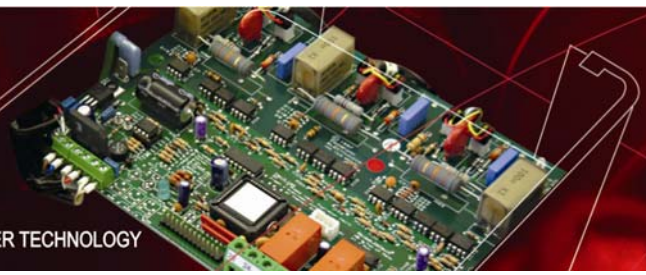
The Application of Slip Coupling Systems.

a) Smooth starting

Most couplings are installed in order to give a load a smooth, progressive acceleration from standstill to full speed. With traditional electromechanical starting methods, direct-on-line, star-delta etc, induction motors usually produce far too much torque at start-up with the result that gearboxes, transmission systems and even the loads themselves, suffer considerable wear and tear which results in premature replacement and unscheduled shut-downs.

b) Torque “magnification”

Occasionally, slip couplings are used in the special situation where a load breakaway torque exceeds the motor locked rotor torque, Ms/Mn. In this case the motor is allowed to accelerate to a speed where it's torque becomes greater than the load standstill torque, at which point the load itself begins to accelerate. This action is known as "torque magnification", because the motor torque is effectively magnified or increased to match that of the load starting torque.



c) Motor heating reduction

Electromechanical switching systems such as direct-on-line or star-delta, do not allow any control over the current flowing into the motor either during starting or the running conditions: the motor current is wholly dependent on the supply and motor characteristics. Because of this, a long ramp time can cause a motor to overheat due to the high currents flowing while it is running slowly.

Certain applications such as directly-coupled centrifuges often have a very high inertia and frequently require very long ramp up times to accelerate them to full speed. Acceleration times of 2 - 3 minutes are not uncommon and, as stated above, a slowly-rotating motor will experience considerable heating. However, if a slip coupling is fitted, the motor acceleration time, as opposed to the load acceleration time, may be reduced due to the slip effect. In this case, the motor is allowed to run up to full speed relatively quickly while the load is still accelerating. While motor overheating may be reduced, the coupling often experiences considerable heat gain.

Using a Soft Starter to Replace a Slip Coupling.

Using a correctly-sized soft starter with a current limit control has a number of advantages:-

In most applications it will remove the need for a slip coupling. Taking away a hydraulic coupling in particular has the immediate effect of lowering the amount of energy needed during the process because the slip loss in the coupling (about 5% of motor rating) is eliminated. Clearly this reduces process costs because less electricity is consumed during the run phase. Capital and maintenance costs are also reduced.

Fairford Electronics' QFE/XFE ranges of soft starters is supplied with an automatic energy optimising feature, which, when the load is small compared with the motor output, will add to the lowering operating costs by approximately a further 2% of motor rated power.

Practical Considerations of Using Fairford Electronics' Soft Starters

Replacing a direct-on-line or star-delta starter but keeping the slip coupling, a soft starter can be fitted simply on a size-for-size basis. Where a star-delta starter exists, it would be necessary to re-arrange starter to a simple direct-on-line type and place the soft starter electrically ahead of the motor. The motor must be connected in delta only.

When a slip coupling is to be removed from a torque magnification type of application, it is essential that the motor is replaced with one with sufficient Ms/Mn to overcome the load breakaway torque. Remember that conveyor belts, centrifuges etc, normally, do not have high breakaway torques except when they are started in the loaded condition, and the static friction load is increased as a result. Care must be taken to include the start-under-load condition when selecting the motor characteristic. Because of the first high cost of a slip coupling mechanism, it is frequently economical to replace a coupling with a motor and soft starter combination - even without considering the reduced maintenance and operating costs. Except in the most special of circumstances it is not normally a viable proposition to fit a slip coupling to a new installation.

Where a slip coupling is used to relieve the motor thermal stresses, it may be necessary to take into account the thermal effects on the soft starter of the extended ramp time, the frequency of starting (starts/hour) and the ambient temperature. For instance, the soft starter rating may need to be increased by a size just in order to cater for the increased thermal stresses. The motor however, should be able to withstand it's increased thermal stresses (provided it is rotating) because the current can be restricted to a lower level by means of the current limit feature.

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