SLIP CLUTCHES & BRAKES

For ordering information see page A-7.

SLIP CLUTCHES, BRAKES AND CLUTCH/BRAKE MODULES

Electroid offers two lines of electromagnetic devices designed for controlled "slip" applications: its EP Magnetic Particle Series, and its TS "friction type" Series.

The EP Series are completely enclosed magnetic particle devices, described in greater detail on page G-3. Magnetic particle devices have very linear torque/slip speed characteristics (see Figure 1).

Electroid's new TS Series of friction type clutches and brakes are designed as an economical alternative to hysteresis type devices. In addition, the TS series offers modular construction, lower drag torque (improved low level control), zero cogging (improved low speed control), and smooth electrically controllable torque.

Electroid's application engineers will be happy to assist you in choosing the right design for your application.

MAGNETIC PARTICLE TYPE

OPERATING PRINCIPLE

A magnetic field causes magnetic particles to form "chains" that mechanically link an inner and an outer rotating member. Strength of linkage is a function of coil current.

ADVANTAGES

Fast response and smooth operation. Torque independent of slip speed. High torque-to-signal linearity over a wide control range. No wear adjustments required.

LIMITATIONS

More expensive than friction type units.

INDUSTRIAL APPLICATIONS

Tension and position control, printing equipment, machine tools, conveyors.

FRICTION TYPE

OPERATING PRINCIPLE

A metallic disc is drawn or forced axially into engagement with a ring of friction material.

ADVANTAGES

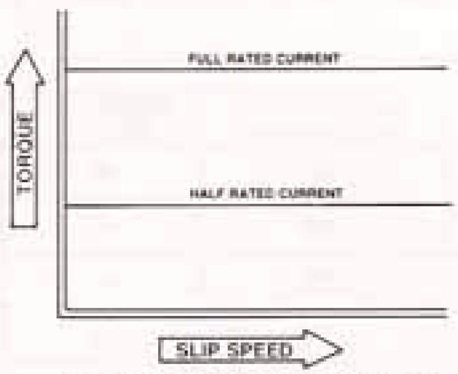
Versatile, fast-acting device is low in cost. Torque is controlled by adjusting coil current. Available in wide range of sizes with numerous mounting arrangements.

LIMITATIONS

Friction surfaces eventually wear to a point requiring adjustment or replacement. Units must be derated to operate in continuous slip mode.

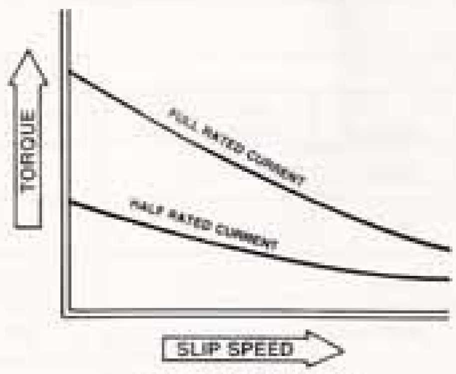
INDUSTRIAL APPLICATION

Machine tools, robotics (failsafe brakes), textile, packaging equipment, material handling equipment.



MAGNETIC PARTICLE TYPE

EP SERIES



FRICTION TYPE

TS SERIES

FIG. 1

SLIP CLUTCHES & BRAKES

MAGNETIC PARTICLE CLUTCHES
EPC Series

MAGNETIC PARTICLE BRAKES
EPB Series

MAGNETIC PARTICLE CLUTCH/BRAKE MODULES
EPCB Series

TS SERIES CLUTCHES

TS SERIES BRAKES

SLIP CLUTCHES & BRAKES

UNDERSTANDING MAGNETIC PARTICLE CLUTCHES & BRAKES

Figure 1 shows a cutaway of a magnetic particle clutch. The input shaft is rigidly coupled to a rotor. The output shaft is attached to a disk that can rotate within the rotor's gap **filled with ferrous particles**. As soon as the coil is energized, the particles form "chains" along the magnetic force lines, thus "freezing" the input and output shafts. The output shaft starts to rotate with the input shaft.

The degree of coupling is **linearly proportional** to the coil current, see Fig. 2a. Herein lies the exceptional ability of a magnetic particle clutch to provide infinitely variable slippage between the input and output shafts.

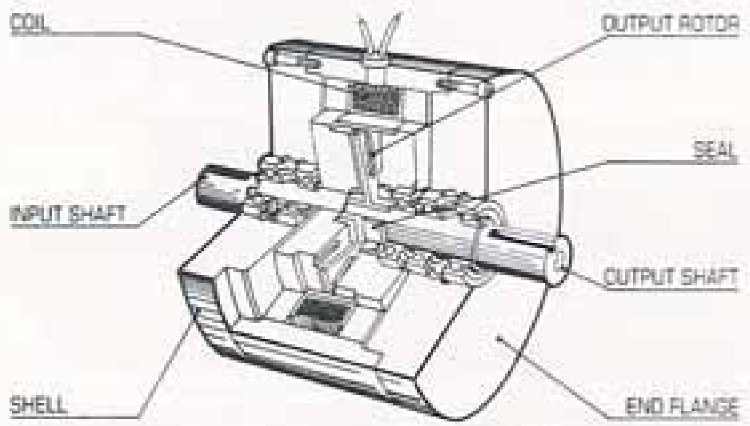
That is to say, the amount of torque transmitted by a magnetic particle clutch is also directly proportional to the coil current.

What is even more important from the point of view of a tensioning control system, is the fact that torque transmitted by a magnetic particle clutch (or brake) is independent of slippage speed. This makes this type of clutch ideally suited for tensioning control.

Still another highly important characteristic of a magnetic particle clutch is that, unlike a conventional friction type clutch, it does not appreciably wear while providing this controlled slippage.

Thus, the amount of slippage depends on the degree of coupling between the ferrous particles, and not on the coefficient of friction between two rubbing surfaces.

Therefore, in a tensioning system, a magnetic particle brake placed at the unwind reel provided the required amount of restraining torque, thus maintaining the desired tension in the transported medium. On the other hand, at the take-up reel, a clutch is used to transmit the torque required to maintain the desired speed and tension in the medium.



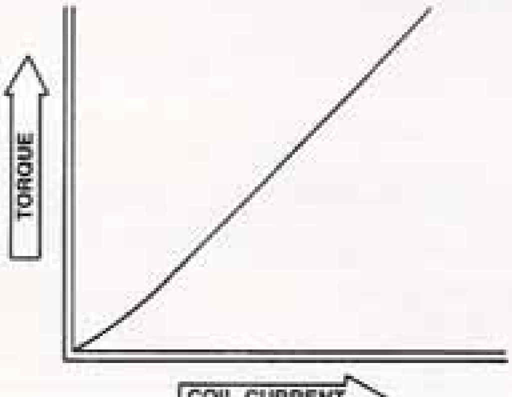


FIG. 2A

SELECTING SLIP CLUTCHES & BRAKES

To properly specify an Electroid Clutch or Brake for a controlled "slip" application, several parameters must be considered:

- Projected slip speed (in RPM)
- Maximum torque required (in ft.-lbs.)
- Slippage dissipation capacity (in watts)

It should be noted that in applications where the slippage (heat) dissipation exceeds listed values, we recommend either an increase in unit size, or forced air cooling to insure long life.

The following are examples of selecting the proper slip clutch and brake for a tension control system:

SELECTING A BRAKE FOR A UNWIND STATION

The purpose of a tension control system for an unwind station is to maintain some desired web tension and velocity. For example:

Tension, t_e = 2 lbs.
Web Velocity, V_w = 150 feet/minute
Initial Roll Radius, R_r = 1 foot

This data can be used to determine the required brake parameters employing the following relationships:

Maximum brake torque,
$T_m = t_e R_r$ = (2) x (1) = 2 ft. - lbs. (1)
Roll rpm, 150/2 x 3.14 x 1
$R_{rpm} = V_w/2 \pi R$ = 23.88 rpm (2)
Slippage dissipation, =
$T_m R_{rpm}/7$ = (2) 23.87 = 6.8 watts (3)

Checking the availability brake specifications, we can recommend Model TS-BEC-42B.

SELECTING A CLUTCH FOR A WIND STATION

To size the clutch required at the take-up reel for the following conditions:

Tension, t_e = 2 lbs.
Web Velocity, V_w = 150 feet/minute
Core Diameter, D_c = 2/3 foot
Full Roll Radius, R_r = 1 foot max.

We proceed as follows:

Torque, $T_m = t_e R_r$ = (2) x (1) = 2 ft. - lbs.
Clutch input RPM,
$S_{in} = V_w/[\pi D_c]$ =
150/[(3.14)(2/3)] = 72 rpm
Clutch Output RPM,
$S_{out} = V_w/[\pi (2 \times R_r)]$ =
150/[(3.14)(2)(1)] = 24 rpm
Slip speed, $S_s = S_{in} - S_{out}$ = 48 rpm
Slippage dissipation =
$T_m S_s/7$ = [(2) x (48)]/7 = 14 watts

Looking up the available clutch specifications, we can recommend Model TS-BEC-42C to do the job.