NASA TECH BRIEF

Lyndon B. Johnson Space Center

Magnetic Particle Clutch Controls Servo System

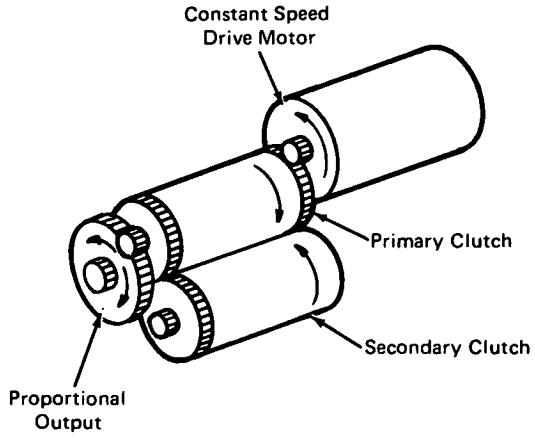
Magnetic particle clutches provide an alternate means of driving low-power rate or positioning servo systems (up to 0.2 kW for intermediate duty cycles). There are several advantages in the use of a magnetic clutch as compared to the more commonly employed servo motors.

Magnetic clutches may be used over a wide variety of input speeds, 1000 to 10,000 rpm, and are of use for many slip speed ranges. The torque-to-current response remains constant over a wide range of clutch input speeds. This constant torque response is extremely useful when operating at reduced primary drive speeds, as might occur when emergency conditions in an aircraft cause reduced motor voltages. Another important feature of a magnetic clutch in a servo system is its comparatively low weight. Clutches have been designed to weigh as little as 0.675 kg (1.5 lbs) for a 0.2 kW unit.

The power drain is very good with an overall motor/clutch efficiency greater than 50%, and the gain of the clutch is close to linear, following the hysteresis curve of the core and rotor material. With the proper selection of core and rotor material, hysteresis may be kept to within 4 or 5% of the saturation level.

The figure shows how a magnetic clutch can be used in a typical rotary positioning servo. In a magnetic particle clutch, a current is applied to a coil winding to produce a magnetic field that aligns the particles in a chain. Through this chain, an output torque is developed in proportion to the applied current.

To design the proper clutch for a given servo system, one must know the appropriate electrical-mechanical transfer function and heating profile for the clutch over the desired operating range. Information is available on these and other factors of interest in the design of mechanical particle clutches for servo systems.



TYPICAL DRIVE TRAIN

The two counter-rotating clutches provide two-directional control. The drive motor powers the counter rotating clutches, whose output provides proportional control to the common output gear.

Note:

Requests for further information may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

Source: Phillip B. Fow of
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