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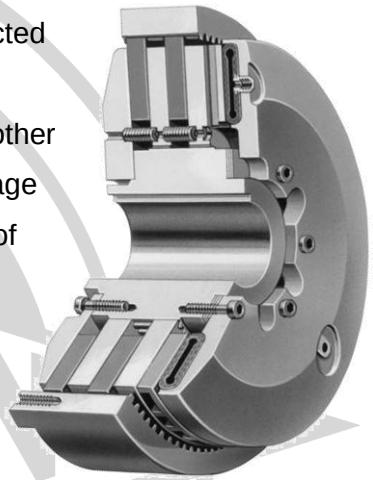
What is a Clutch?

A clutch is a device that transmits power between two mechanisms (usually rotating) selectively. When the clutch is engaged, it “slips” until the two mechanisms rotate at the same speed and power is transmitted. When the clutch is disengaged, the two mechanisms are decoupled and allowed to rotate at different speeds. Power is not transmitted. Clutches are similar in principle to brakes. In a brake, the driven mechanism would be connected to a fixed frame.

The basic operation of a clutch relies on two discs or other circular components rotating coaxially but not rigidly connected to each other. One disc is connected to the driving mechanism, and the other disc is connected to the driven mechanism. To engage the clutch, the two discs are pressed against each other to generate a frictional force that causes them to rotate together. To disengage the clutch, the discs are pulled apart so that they may rotate independently of each other. Some designs use multiple discs for increased torque capacity. The engagement / disengagement mechanisms vary depending on the application and can be spring-applied, mechanical, electromagnetic, pneumatic, or hydraulic. In a manual transmission car for example, the clutch is engaged via spring pressure and disengaged mechanically by a thrust or throw-out bearing actuated by the clutch pedal.



If the input torque exceeds the capacity of the clutch, then the clutch will continue to slip and will not transfer all of the torque and motion to the output. This is desirable in some situations such as in web handling applications where constant tension is required. Clutch slippage generates heat so a tension / slip clutch should be designed with extra heat dissipation capability (fins or liquid cooling for example) to deal with continuous slip operation.

A tooth clutch substitutes disc-to-disc friction with interlocking teeth. The positive engagement provides much greater torque capacity in a smaller package but at the expense of low engagement speeds (engaging at higher speeds would damage the teeth).

Some electromagnetically actuated clutches use powder cavities or hysteresis instead of disc-to-disc friction to transmit power. These designs provide very accurate control of torque, making them ideally suited for use as tension / slip clutches.

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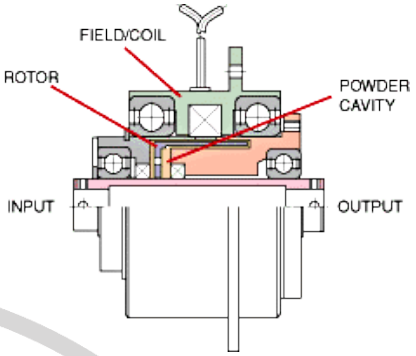
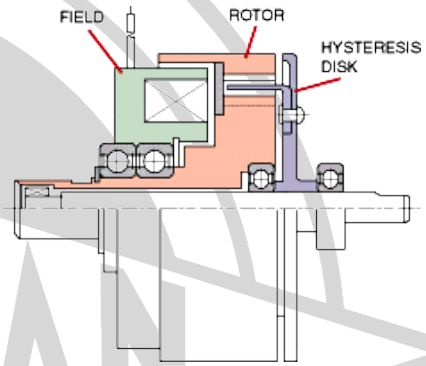


In an electromagnetic particle clutch, an energized coil applies magnetic flux to magnetic particles in a powder cavity causing them to bind together. The binding of the particles causes the driving (rotor) and driven (armature) components to experience drag which causes torque to be transmitted from one to the other via the particles. The strength of the binding (and accordingly, the deceleration torque generated) can be finely controlled by the varying the amount of current provided to the coil.



In a hysteresis clutch, an energized coil applies magnetic flux to the rotor and a hysteresis disc attached to the driven mechanism. The hysteresis disk becomes magnetized and is attracted to the rotor, causing it to rotate with the rotor. The rotor and disc do not make physical contact. Like the magnetic particle clutch, varying the amount of current provided to the coil controls the amount of torque transmitted.