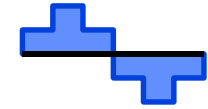


Types of Adjustable Speed Drives

Introduction

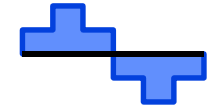
- Speed adjustment techniques have been used in transmitting mechanical power to machinery since the earliest use of powered machinery.
 - Before electric motors were invented, mechanical speed changers were used to control the mechanical power provided by water wheels and steam engines.
 - When electric motors came into use, means of controlling their speed were developed almost immediately.
 - Today, various types of mechanical drives, hydraulic drives and electric drives compete with one another in the industrial drives market.



Types of Adjustable Speed Drives

Mechanical drives

- There are two types of mechanical drives
 - Variable pitch drives
 - Traction drives.

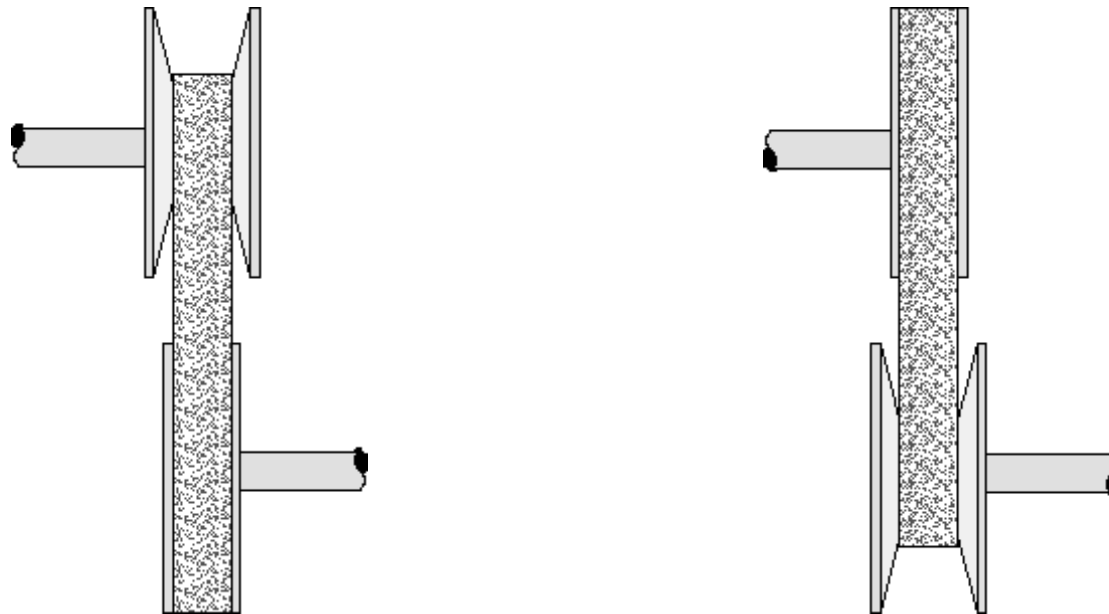


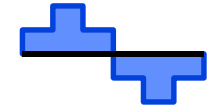
Types of Adjustable Speed Drives

Mechanical drives

■ Variable Pitch Drives

- Variable pitch drives are pulley and belt drives in which the pitch diameter of one or both pulleys can be adjusted.



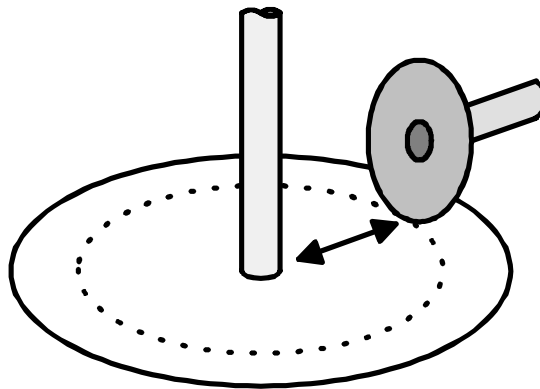


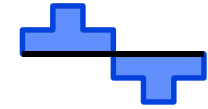
Types of Adjustable Speed Drives

Mechanical drives

■ Traction Drives

- Traction drives transmit power through metal rollers running against mating metal rollers.
- The input/output speed ratio is adjusted by moving the rollers to change the diameters of the contact path.
- Many different roller shapes and mechanical designs have been used.

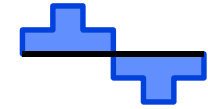




Types of Adjustable Speed Drives

Hydraulic Drives

- There are three types of hydraulic drives
 - Hydrostatic drives
 - Hydrodynamic drives
 - Hydroviscous drives.

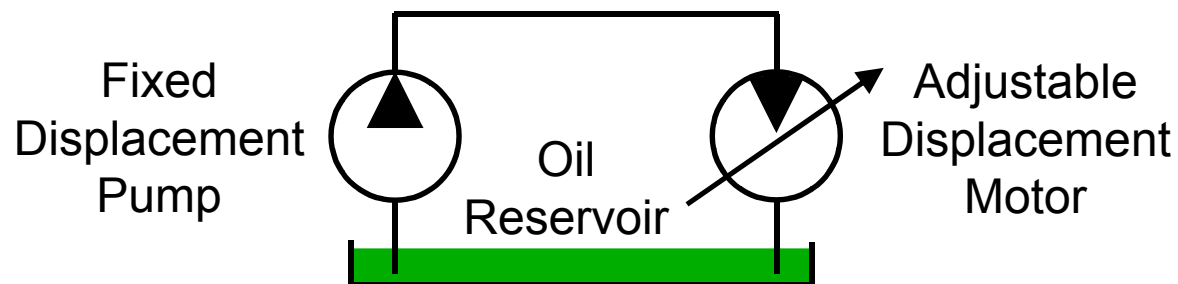


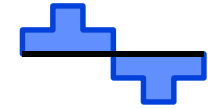
Types of Adjustable Speed Drives

Hydraulic Drives

■ Hydrostatic Drives

- Hydrostatic drives consist of a hydraulic pump and a hydraulic motor.
- Since positive displacement pumps and motors are used, one revolution of the pump or motor corresponds to a fixed volume of fluid flow regardless of speed or torque.
- Speed is regulated by regulating the fluid flow with a valve or by changing the displacement of the pump or motor.
- Many different design variations have been used.



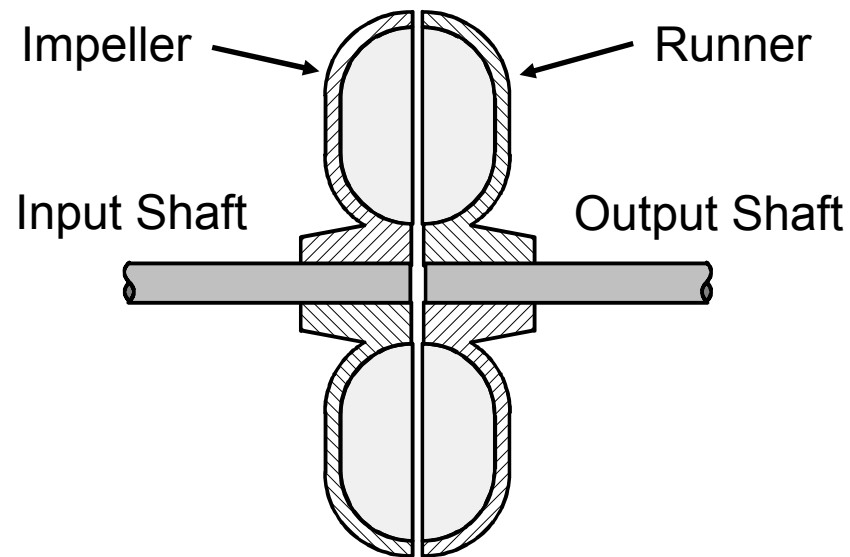


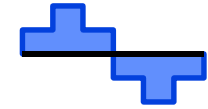
Types of Adjustable Speed Drives

Hydraulic Drives

■ Hydrodynamic Drives

- Hydrodynamic drives use oil to transmit torque between an impeller on the constant-speed input shaft and a rotor on the adjustable-speed output shaft.
- The torque converter in the automatic transmission of a car is a hydrodynamic drive.



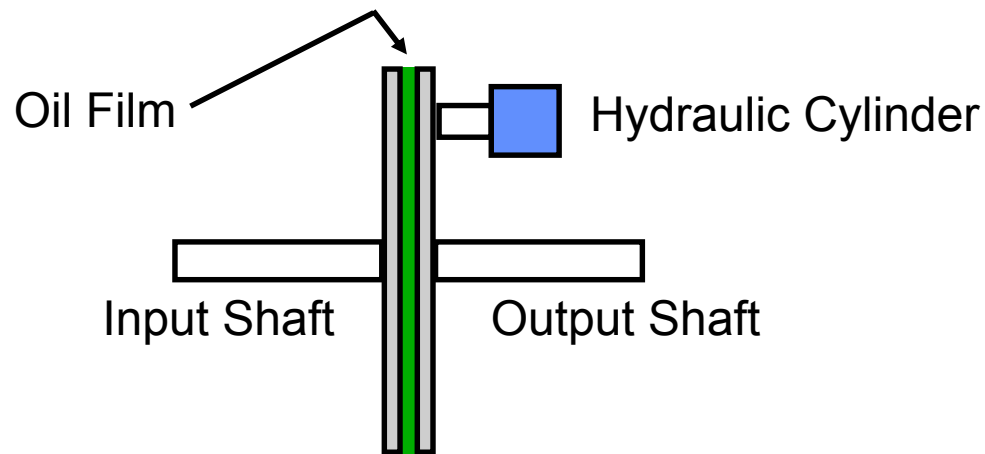


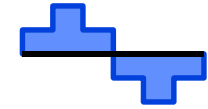
Types of Adjustable Speed Drives

Hydraulic Drives

■ Hydroviscous Drives

- Hydroviscous drives discs connected to the input shaft pressed against similar discs connected to the output shaft.
- Torque is transmitted from the input shaft to the output shaft through an oil film between the discs.
- The transmitted torque is proportional to the pressure exerted by a hydraulic cylinder that presses the discs together.

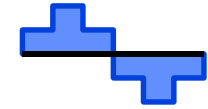




Types of Adjustable Speed Drives

Electrical Drives

- There are three types of electric drives
 - DC Motor Drives
 - Eddy Current Drives
 - AC Motor Drives

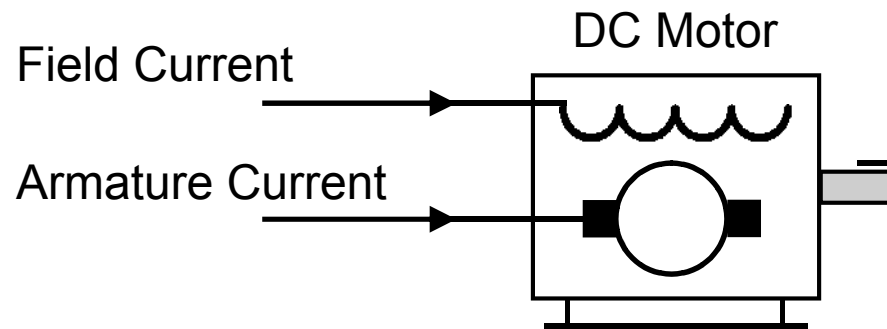


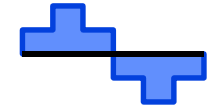
Types of Adjustable Speed Drives

Electrical Drives

■ DC Drives

- Since the speed of a DC motor is directly proportional to armature voltage and inversely proportional to field current, either armature voltage or field current can be used to control speed.



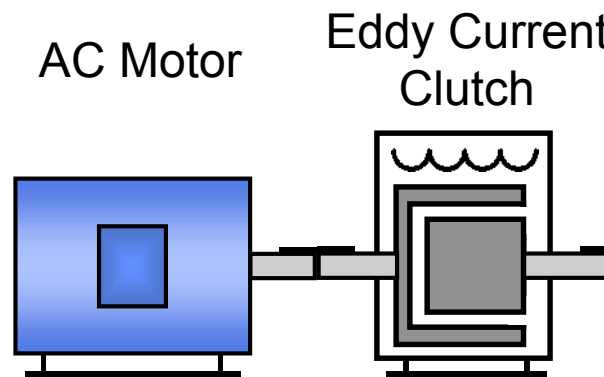


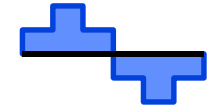
Types of Adjustable Speed Drives

Electrical Drives

■ Eddy Current Drives

- An eddy current drive consists of a fixed speed motor and an eddy current clutch.
- The clutch contains a fixed speed rotor and an adjustable speed rotor separated by a small air gap.
- A DC current in a field coil produces a magnetic field that determines the torque transmitted from the input rotor to the output rotor.



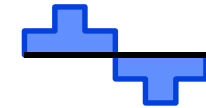


Types of Adjustable Speed Drives

Electrical Drives

■ AC Drives

- The speed of an induction motor can be controlled by changing:
 - ≡ The motor's synchronous speed.
 - ≡ The motor's slip
- An AC motor's *synchronous speed* is the motor's operating speed with no load connected to the motor.
- An AC motor's *slip* is the reduction in speed below synchronous speed that occurs when a load is connected to the motor.

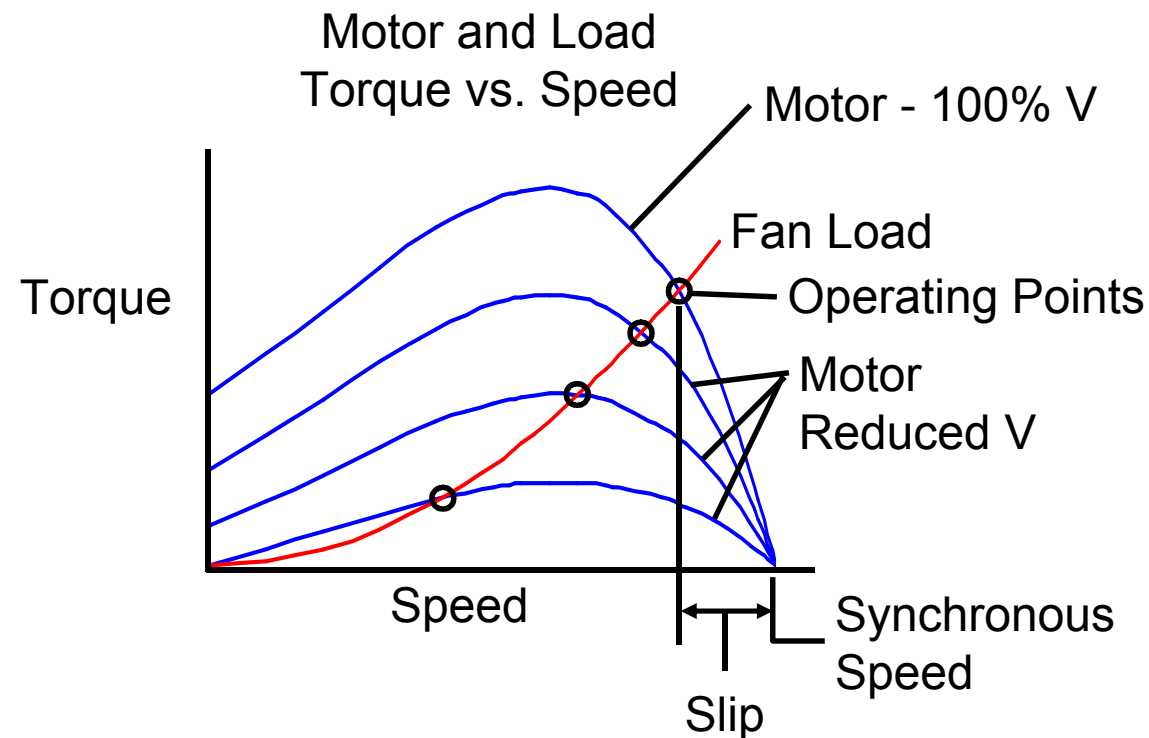


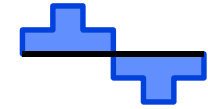
Types of Adjustable Speed Drives

Electrical Drives

■ AC Drives - Slip Control

- Primary voltage control changes the motor slip by changing the stator voltage to change the shape of the motor's torque-speed curve.





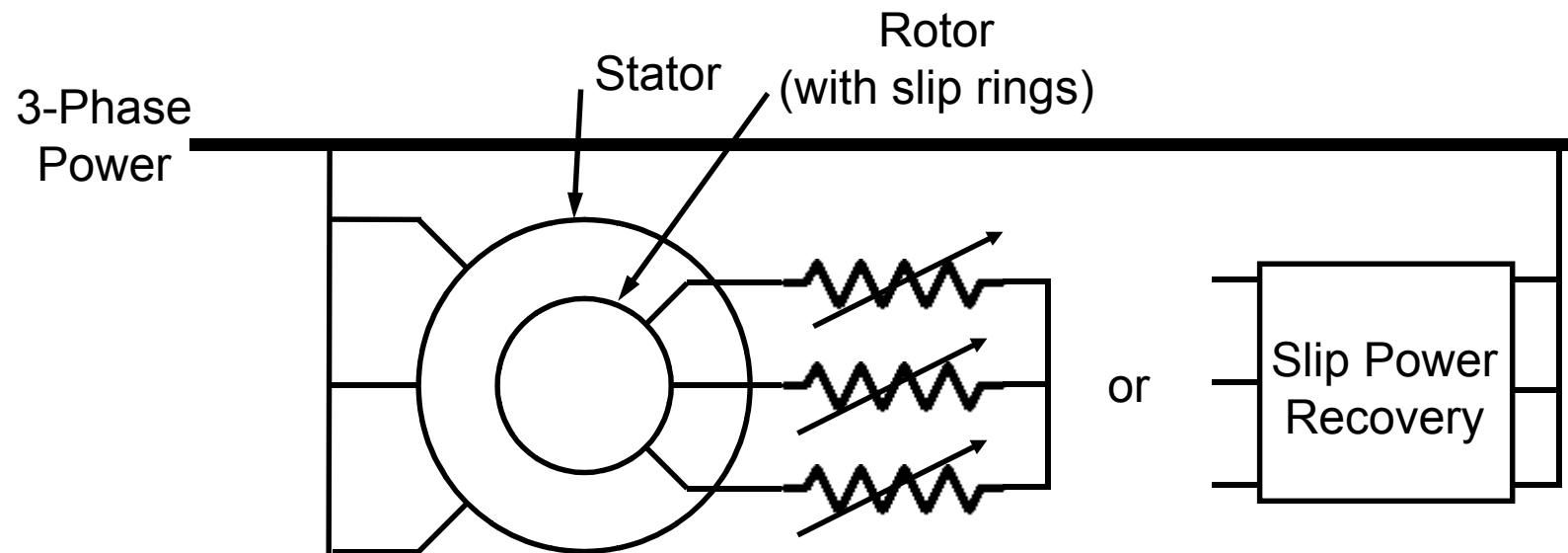
Types of Adjustable Speed Drives

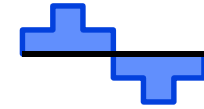
Electrical Drives

■ AC Drives - Slip Control

- Rotor resistance control changes the motor slip by changing the resistance in the rotor circuit to change the motor's torque-speed curve.

≡ To avoid dissipating slip energy in the rotor resistors, energy recovery circuitry can be used instead of resistors.



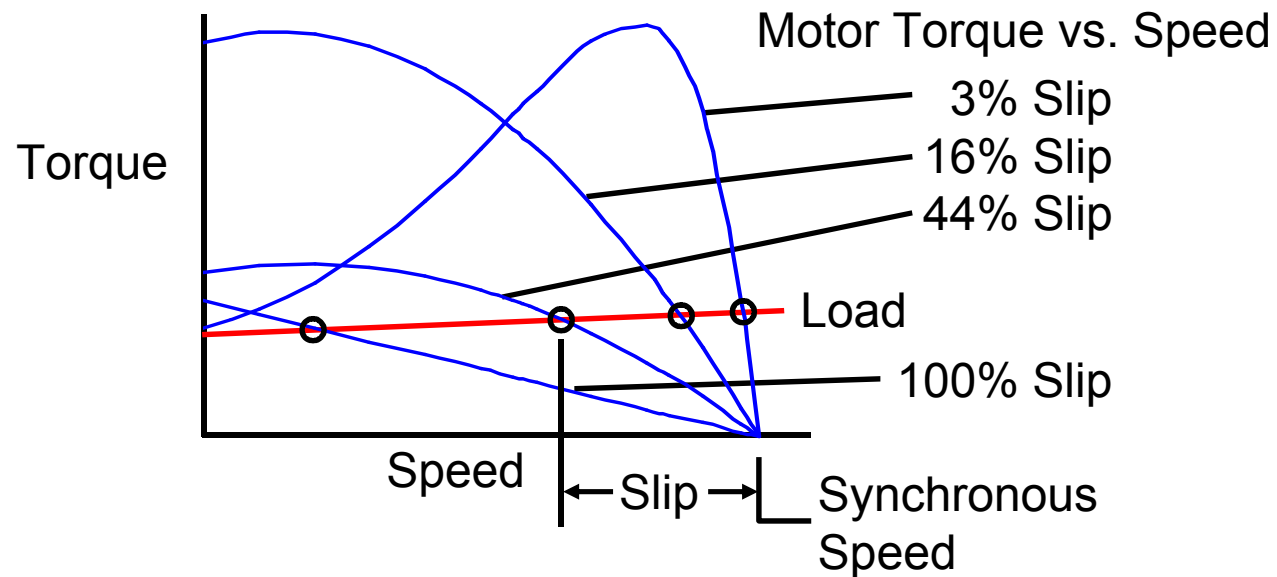


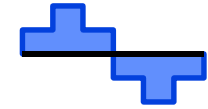
Types of Adjustable Speed Drives

Electrical Drives

■ AC Drives - Slip Control

- Rotor resistance control torque - speed curves.





Types of Adjustable Speed Drives

Electrical Drives

■ AC Drives - Frequency Control

- Adjustable frequency control changes the frequency of the power supply to change the motor's synchronous speed.
- With adjustable frequency control, the motor's torque-speed curve is moved along the speed axis, but the shape of the curve is not changed.

