POWER CLAMPING

• A number of clamps can be operated simultaneously by power clamping.
• It is classified as
  1. Fluid power clamping:
     a. Pneumatic actuation clamping
     b. Hydraulic actuation clamping
     c. Air to hydraulic booster circuit clamping
  2. Vacuum clamping
  3. Magnetic clamping
  4. Electrostatic clamping
FLUID POWER CLAMPING

• Actuated by cylinders.
• Clamping fixtures is clamping nut attached to cylinder ram.
• Pressurized fluid pulls ram and clamps against work piece.
• Unclamping, port connected to unpressurized discharge line.
• For clamping and unclamping we use three way direction control valve, lever and pedal.
Fluid power clamping
MULTIPLE CLAMPING

- Single direction control valve can actuate number of clamps through number of cylinders to pressure or discharge lines.
- Clamping pressure is varied by regulating pressure of fluid.
- High pressure – heavy roughing cut
  Low pressure – light finish cut.
- A risk of sudden pressure drop in event of power failure can be countered by provision of non return valve in pressure supply line.
Multiple clamping by fluid power
RACK AND PINION ACTUATED FLUID POWER CLAMPING

• Rarely positive rack and pinion non-return mechanism between clamp and cylinder is used.
• Fluid power is used to position the clamp.
• Clamp remains in its position even if cylinder is depressurized due to power failure.
Rack and pinion actuated fluid power clamping
PNEUMATIC ACTUATION CLAMPING

• Compressed air is used for power transmission
• Depressurized air is exhausted directly into atmosphere.
• As load resistance increases speed of a pneumatic devices drops and vice versa.
• Moisture in air causes rusting of pneumatic cylinders and valves which can be minimized by using lubricator.
• Pressure regulator can be used to vary system pressure.
AIR ASSISTED HYDRAULIC WORK HOLDING

• It is divided into three groups of components.
• First group of component, the shop air system (6-12bar) provides power, in the form of pneumatic pressure.
• Shop air (pressurized air) system consists of air inlet, filter/regulator/lubricator device, the safety valve/release valve.
• The second group of component is hydraulic booster consists of booster, check valve, and manifold.
• The final group is clamping system- hold, position, and support work piece.
Figure 15-3 The layout and components of a typical air-assisted hydraulic workholding system.
• Shop air is just used for boosting.
• In addition electric booster and hydraulic pump are used to air-operated booster system.
• Hydraulic pump is used for larger applications.
• Drawback – no hydraulic pressure - no clamping pressure.
• Accumulator is installed between clamps and power source which maintain the necessary pressure when power is disconnected.
Figure 15-4 A pallet-decoupler unit uses an accumulator charged with either fluid or gas to maintain hydraulic pressure when the power source is removed (Courtesy of Carr Lane Manufacturing Company).
Figure 15-5 These hydraulic clamps are made with an internal locking device that mechanically locks the clamps against the workpiece when the power source is removed (Courtesy of Jergens, Inc.).
Figure 15-6 The basic principle behind these mechanically locked hydraulic clamps is the locking angle machined on the piston and locking pin (Courtesy of Jergens, Inc.).
PNEUMATIC WORK HOLDING SYSTEMS

• Air operated work holding system is another form of power work holding system.
• Typically used for light machining, inspection, assembly and similar operations.
• Draw back is size of ram needed to generate holding forces and air itself which will compress by hydraulic fluid won’t.
BASIC OPERATION OF POWER WORKHOLDING SYSTEMS

- General functions of any power work holding systems are a. position b. support c. clamp.
- Positioning devices are used to hold the work piece against a locator.
- Supporting elements are used below the part to support to resist any cutting forces.
- The clamping devices are designed to lock the part.
- Power work holding system for any particular part is dependent on part itself.
ADVANTAGES OF PNEUMATIC POWER WORKHOLDING SYSTEMS

• Apart from increased production speed and productivity it has advantages like.
• Consistent and repeatable operation
• Controlled clamping forces
• Automatically adjusting work supports
• Remote clamp operation
• Automatic sequencing
CONSISTENT AND REPEATABLE OPERATION

• Clamps controlled by power source.
• Consistent clamping pressure, safety allows much higher machining feed rates.
• Self positioning clamp.
• Once properly set it performs the same throughout the complete production run.
CONTROLLED CLAMPING FORCES

• The clamping force of a power system can be adjusted to suit work piece requirements.

• In case of either light or heavy clamping forces are needed to hold work piece.
AUTOMATICALLY ADJUSTING WORK SUPPORTS

- Work piece must be supported to prevent distortion or deflection by auto adjustment of work supports are well suited.
- In below example, has a step that requires the supports to make contact with the surface at two different heights.
Hydraulic work supports are used to prevent part distortion during machining.
REMOTE CLAMP OPERATION

• Usually a large work piece might need more clamps (>6) to completely hold the part and takes lot of time for fixture.

• The single remote operating point greatly reduces the time and expense of manually positioning and clamping each clamp.
AUTOMATIC SEQUENCING

• Systems can provide the sequencing function with a sequencing valve installed in hydraulic circuit.
• Activates the clamps and other devices at proper time.
• Hence power-sequencing arrangement is much faster and more reliable than manually operated clamps.
FLUID POWER CLAMPING

- Milling Cutters
- Clamp
- Workpiece
- Cylinder ram
- Pressurised fluid
- Cylinders

Diagram shows a fluid power clamping mechanism with components labeled.
• The above figure shows a clamping fixture with the clamping nut attached to the cylinder ram. Feeding of the pressurised fluid is the factor that pulls the ram downwards and presses the clamp against the workpiece.

• Unclamping done by connecting to an unpressurised discharge line.

• For clamping and unclamping a 3 way direction control valve is used
Hydraulic clamping

FIGURE 1.85 Pneumatic or hydraulic work supports are used to prevent part distortion during machining.
Air to hydraulic power booster circuit clamping

**Diagram:**
- Air valve
- To plant air supply, 6.85 bar
- 6.85 bar chamber pressure
- Area of piston = 64.5 cm²
- Area of ram = 6.45 cm²
- Hydraulic oil, 68.5 bar
- Retractable short-stroke piston
- Hydraulic clamping mechanism
- Work
- Machine table

**Figure 1.86 AIR-TO-HYDRAULIC BOOSTER CIRCUIT**
• The above fig shows a typical hydraulic power clamping circuit

• The principle

• If air-cylinder piston is subjected to 6.85 bar pressure, and area of piston is 64.5 sq.cm, then a force of 4450N is placed upon ram. If the ram area is 6045 sq.cm the pressure upon hydraulic oil must be 4450N.

• Thus hydraulic pressure of 68.5 bar is obtained for an air pressure of 6.85 bar.

• The ratio of area of air piston to the area of driven ram gives the idea regarding output pressure
Vaccum clamping

0.025 mm Deep vacuum grooves

Workpiece

Seal

Vacuum pump

Figure. 1.88 Vacuum Clamping
• Convenient for securing thin flat sheets as heavy clamping forces causes distortion
• Clamping provided with 0.025mm deep grooves which create a vaccum all over the face. the seal in the ground segregates the clamping vaccum area from the space around the seal.
• Vaccum pressure limited to 1 bar
Magnetic clamping

Figure 1.89 Magnetic Clamping
Electrostatic clamping

• The workpiece is charged with static electricity with polarity opposite to the polarity of the chuck face developing the clamping force.
• Workpiece and chucks are separated using insulating dielectric fluids
• The clamping force depends on amount of static electric charge
Non-mechanical clamping

To hold parts that cannot be held practically in other devices because of shape, size or possibility of distortion
Magnetic chucks

Figure 1.90 Magnetic Chucks and Accessories
• Magnetic chucks are used mainly for ferrous materials
• Available in different shapes
• The permanent magnetic chuck has a series of magnetic inserts that are constantly polarized, meaning they have permanent poles and constantly pull on the part. Another type is the electromagnetic chuck, which is engaged only while the electrical current is on. This chuck has the advantage of being able to turn the magnetic pull off, releasing the workpiece quickly and easily. The disadvantage of this chuck is that it releases the workpiece when the electrical current is stopped, often putting the worker at risk of injury if it happens during a work process.
Vaccum chucks

Figure 1.91 Vacuum Chuck

- Sealed Open
- Atmospheric pressure up to 12 lbs P.S.I
- Atmospheric ports
- Side rail
- To vacuum pump
- Vacuum gauge
- Push valve to release part
- Adjust knurled nut to vary holding power
- Chucked part
- Top plate stop
- Ring seals in vacuum
- Side rail
- Seals out coolant
- Mounting tongue
- Cast iron chuck body
• A vacuum chuck is a container that has negative air pressure in it. We can utilize that air pressure to hold work pieces on the open end of that container.

• By removing the atmosphere inside our container the atmosphere outside our container will push the bowl against the open end of the chuck. How hard it pushes depends on how much we remove from our container.