

Robot Elements

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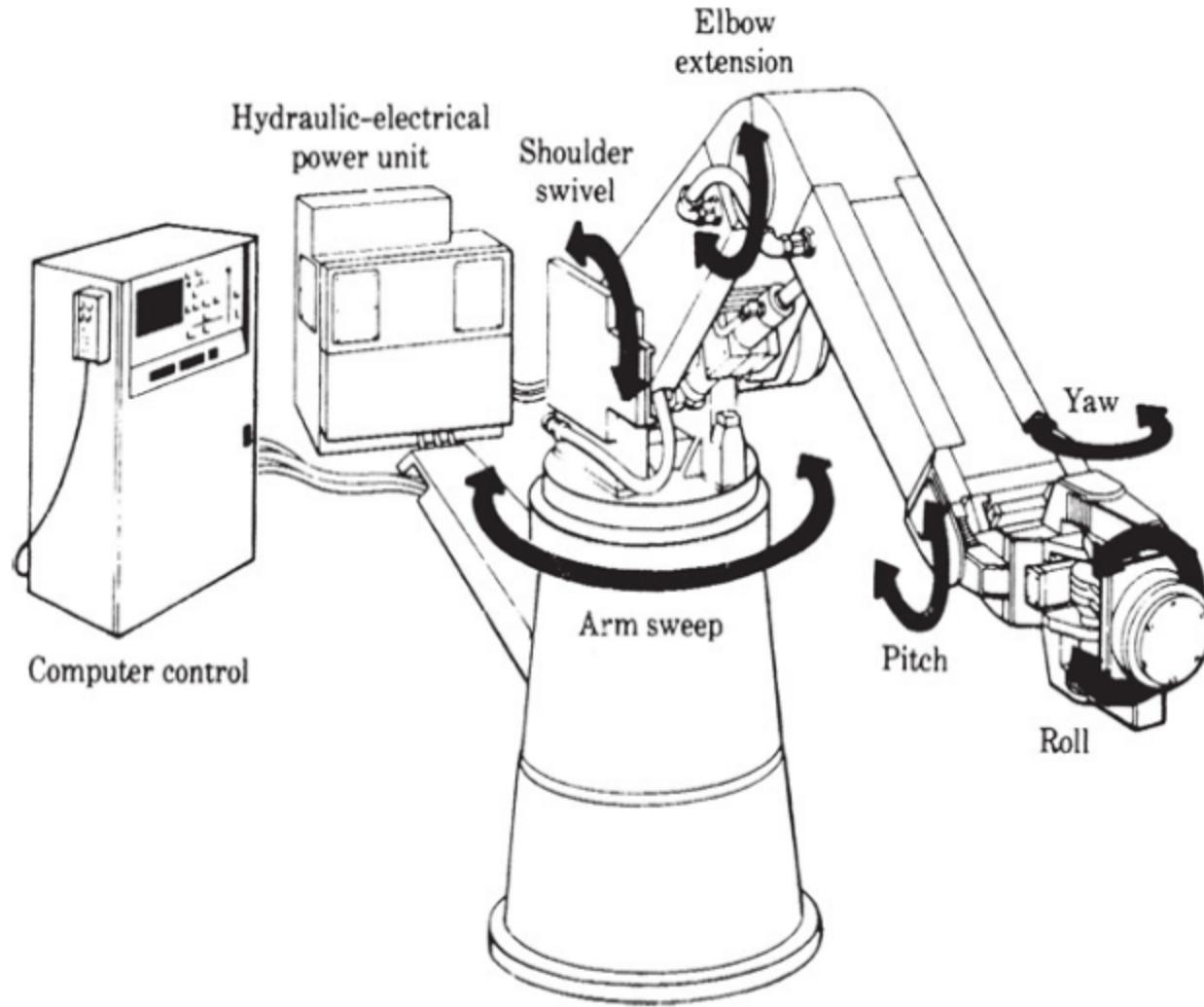


FIGURE 1-1 Complete industrial robot system. (*Courtesy of Cincinnati Milacron.*)

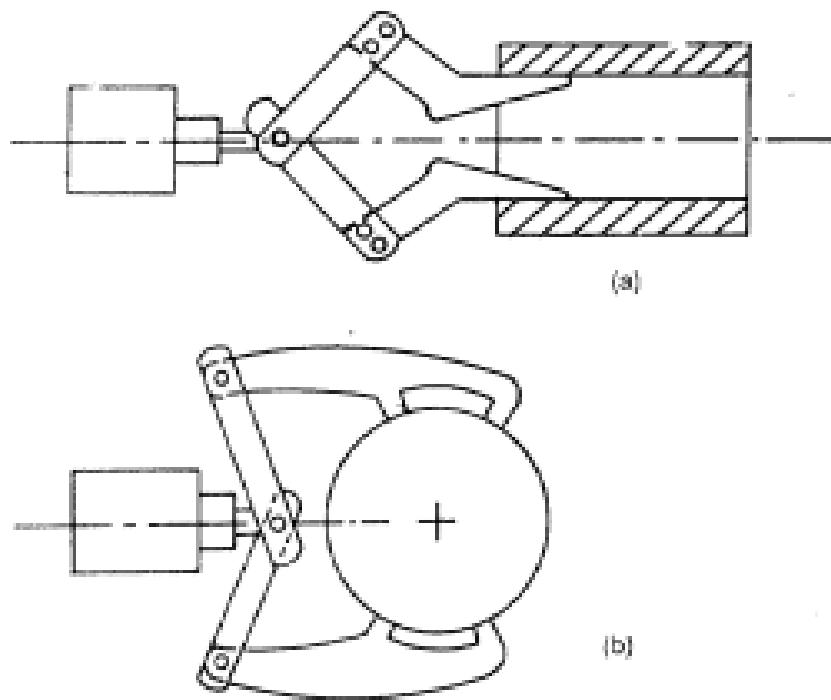
Grippers

- Grippers are end effectors used to grasp and hold objects

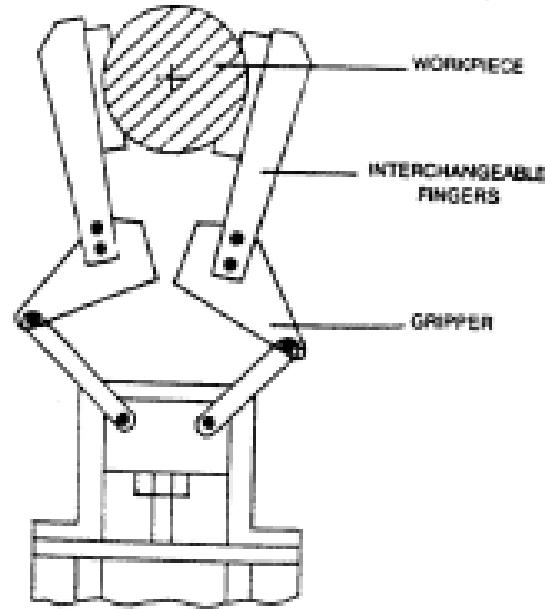
Classification of Grippers

- Mechanical
- Magnetic
- Vacuum
- Adhesive
- Miscellaneous Devices

External/Internal Grippers



Mechanical Gripper



Mechanical Grippers

- Linkage Actuation
- Gear and Rack Actuation
- Cam Actuation

Linkage Actuation

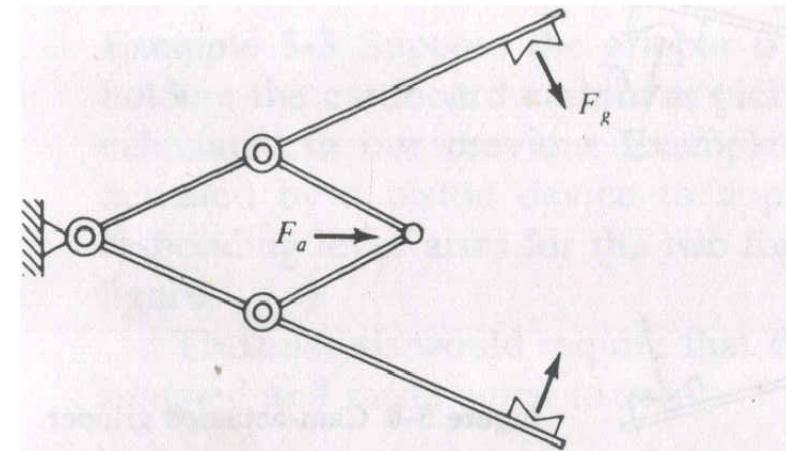
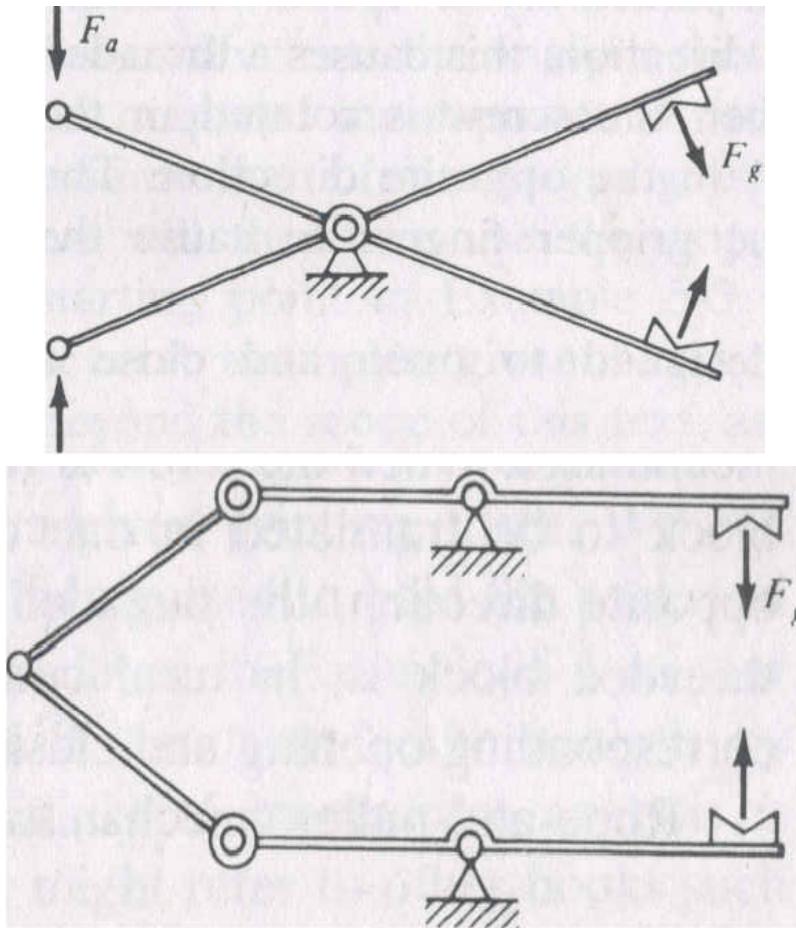
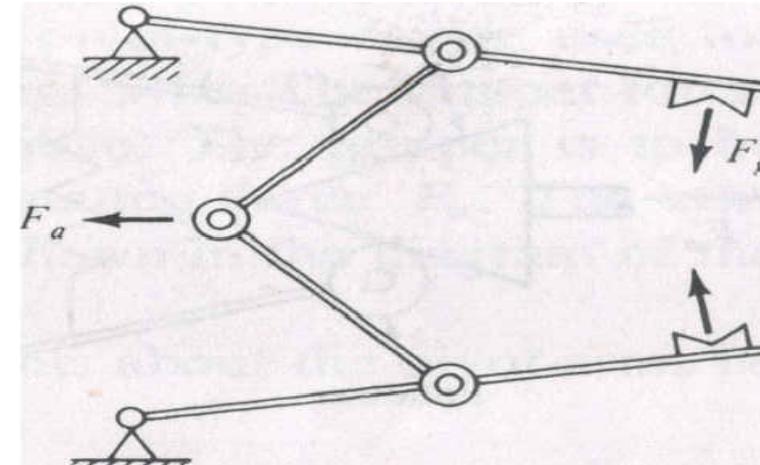
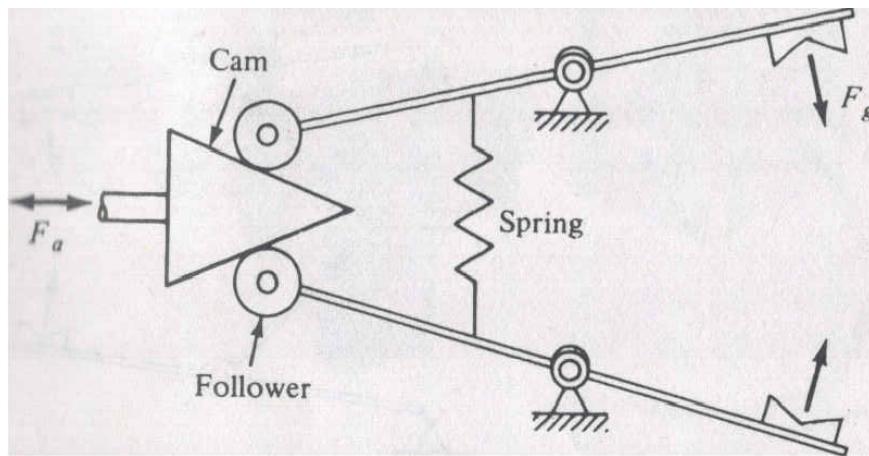
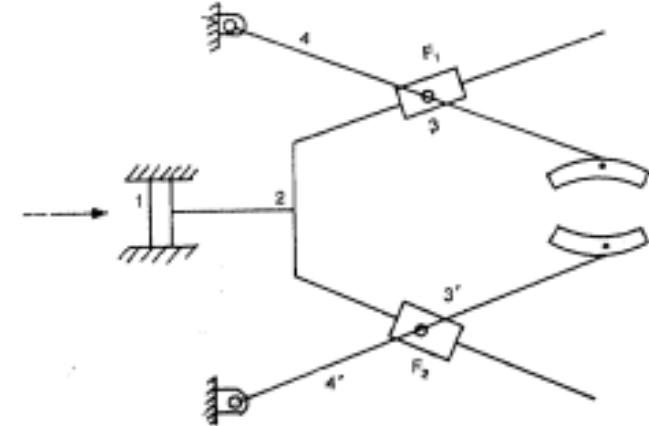
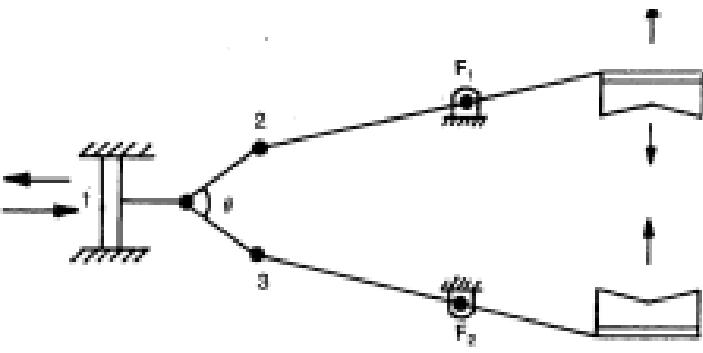


Figure 5-6 Some possible linkages for robot grippers.



Linkage Actuation



Linkage Actuation

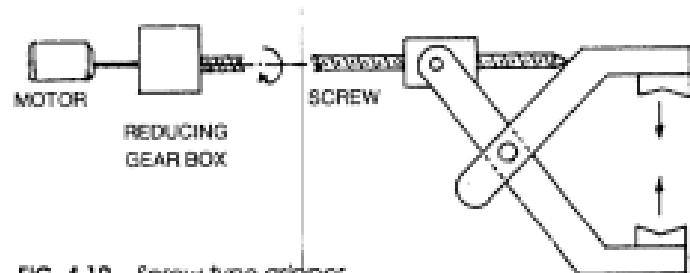


FIG. 4.10 Screw type gripper

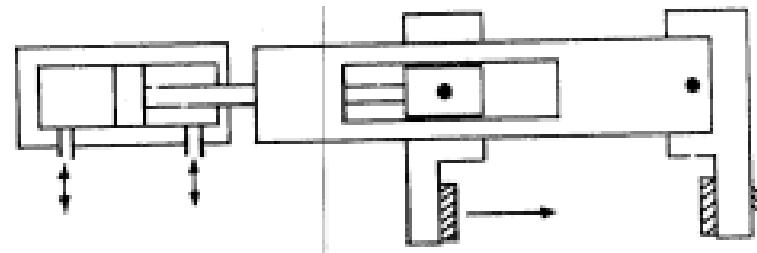


FIG. 4.11 Translational gripper using cylinder piston

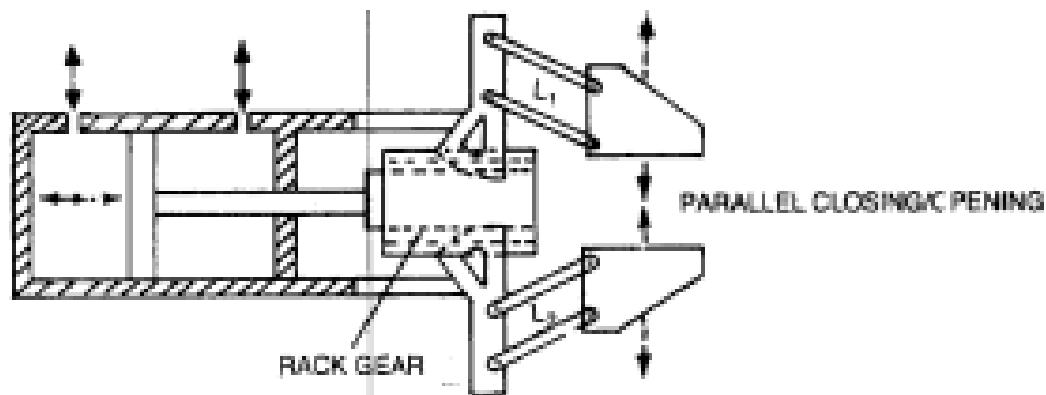


FIG. 4.12 Translational gripper using parallel bar linkages

Gripper Actuations

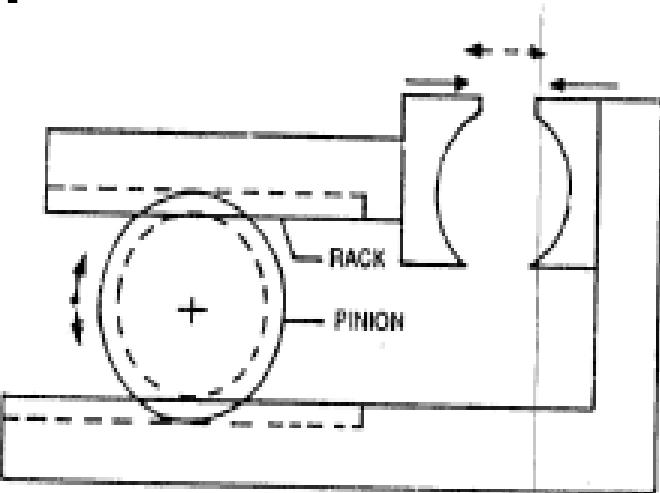


FIG. 4.13 Translational gripper using rotary actuators

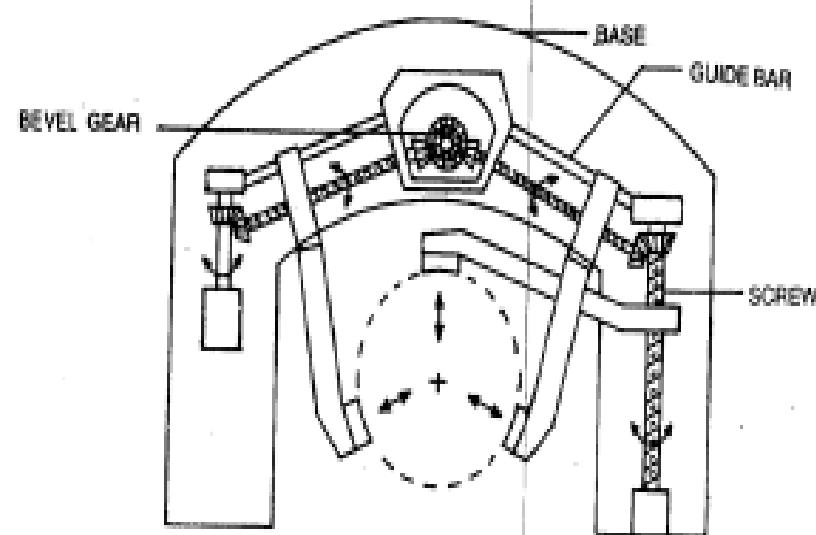
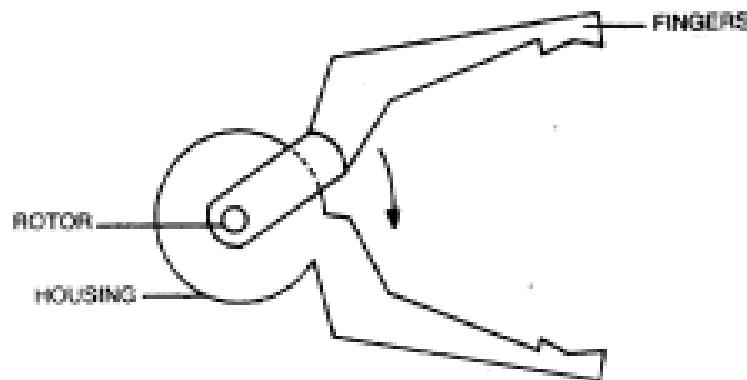
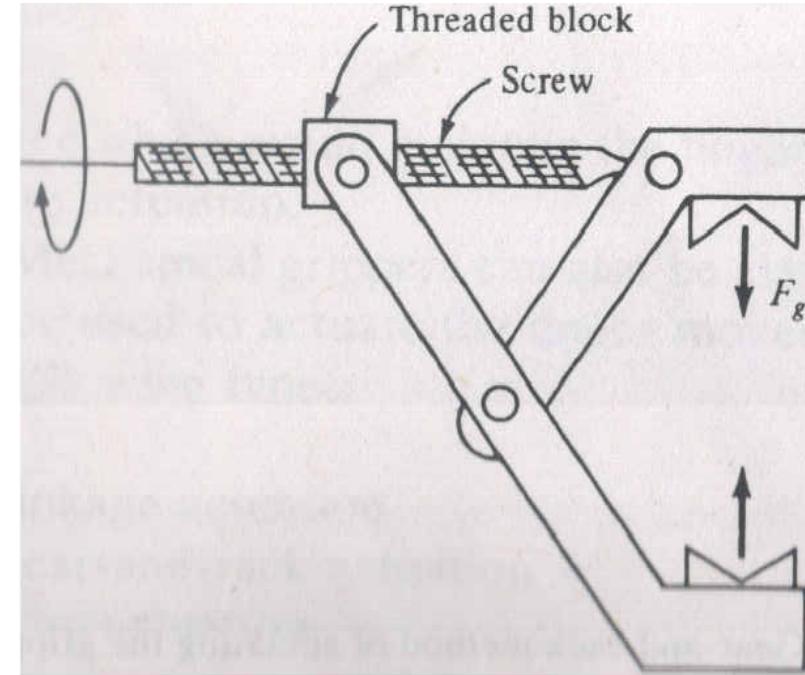
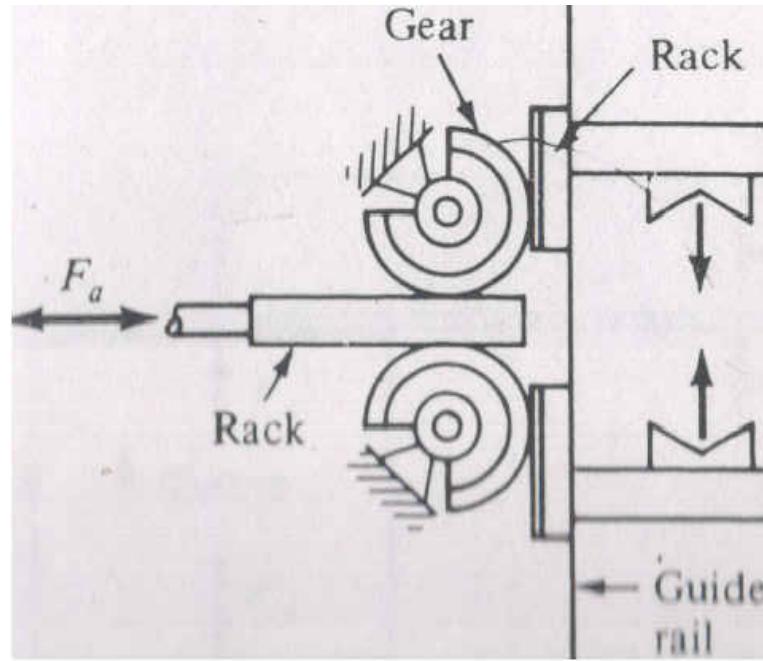
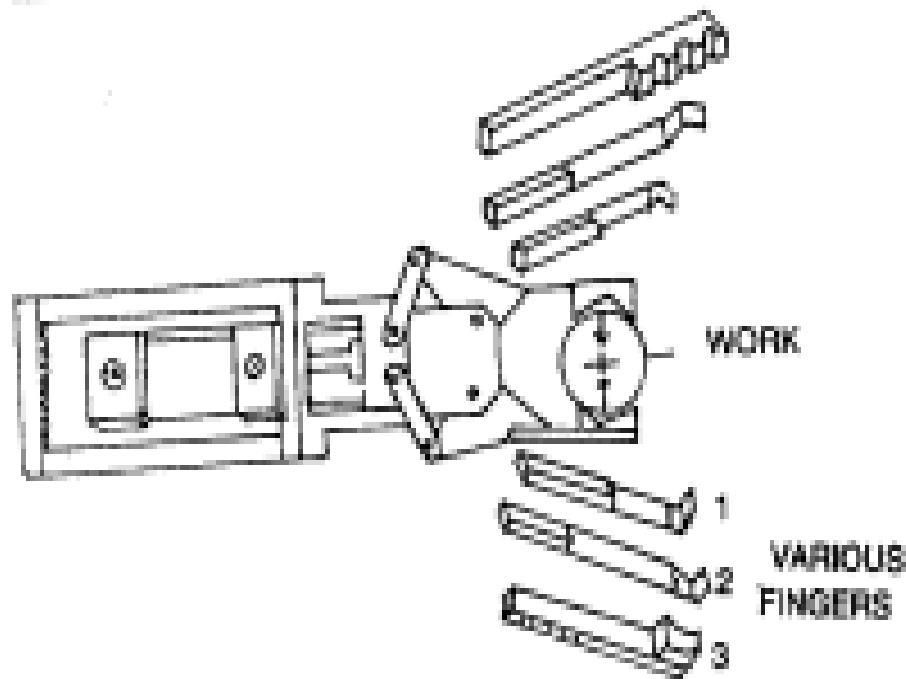


FIG. 4.14 Gripper using three point chuck mechanism

Gear & Rack & Cam Actuation



Modular Mechanical Gripper



Vacuum Cups

- Vacuum surfaces are just an extension of the vacuum cup principle. In some material-handling applications the product to be lifted is not ridged enough for vacuum cups to be effective.
- To lift such material as cloth, paper, and plastic into place, a vacuum surface is used.
- The vacuum gripper consists of a flat surface with tiny holes that forms one side of a vacuum chamber.
- Each hole in the vacuum surface provides a small lifting force so that the flexible cloth, paper, or plastic would be held into place against the vacuum surface from many points.



- Vacuum grippers are usually venturi devices, applying Bernoulli's principle to create suction by using compressed air.
- The vacuum generator and venturi block (miniature vacuum pump) are two common devices used for this purpose.
- The vacuum generator is a piston-operated or vane-driven device powered by an electric motor, and it is capable of creating a relative high vacuum.
- The venturi on the other hand is a simple device, as shown in Figure.

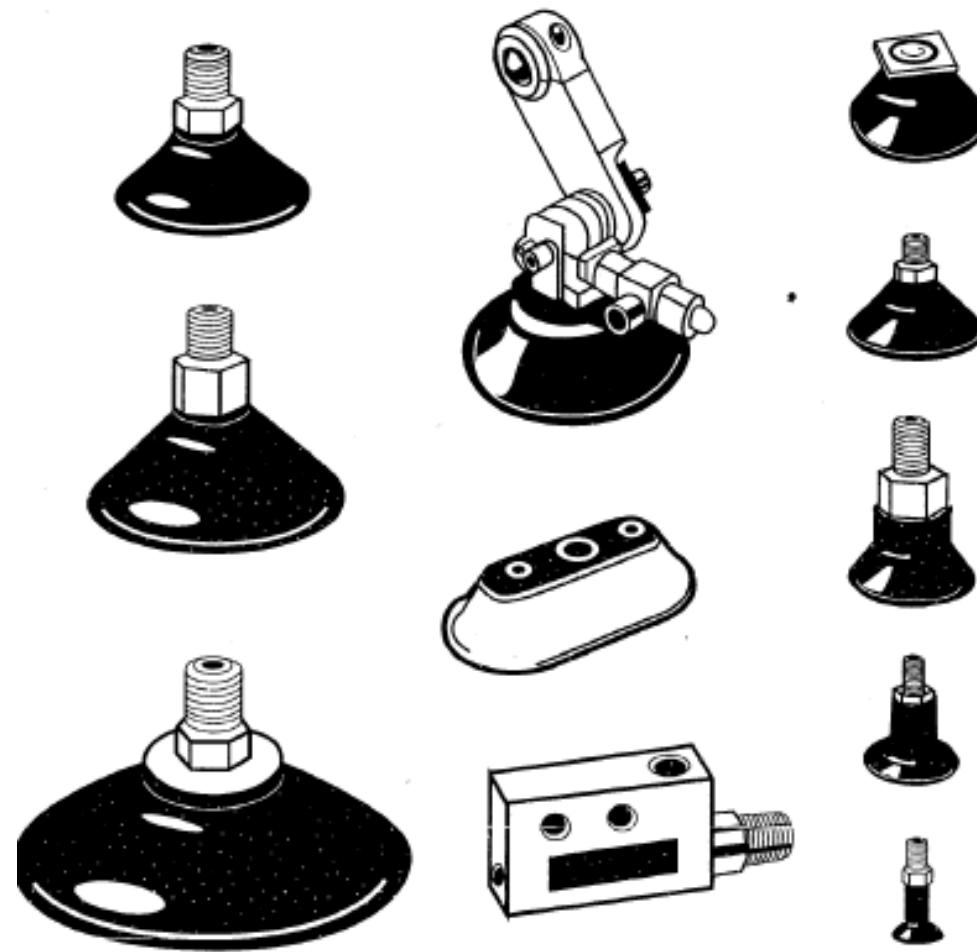


Suction cup

The advantages for using suction cup grippers are:

1. They require only one surface for grasping the part.
2. They apply a uniform pressure on the surface of the part.
3. They require a relatively lightweight gripper.
4. They are applicable to a variety of different materials.
5. They have a significantly low cost.

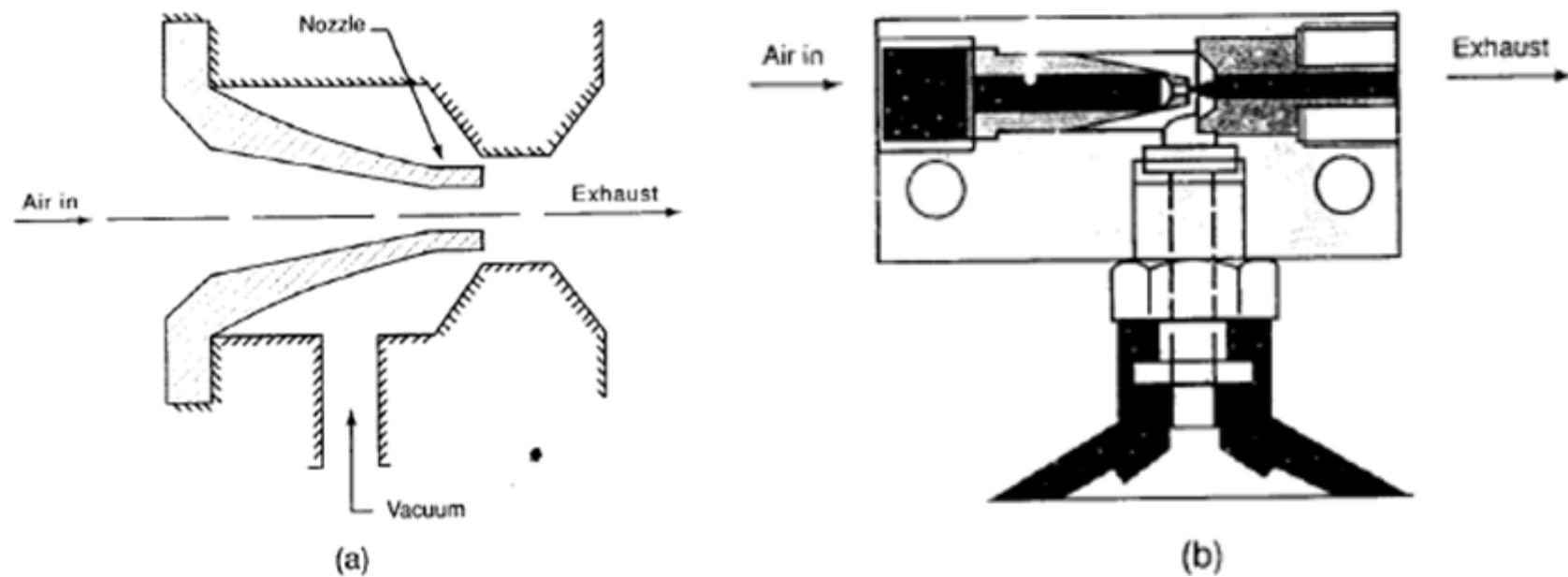
Vacuum Cups



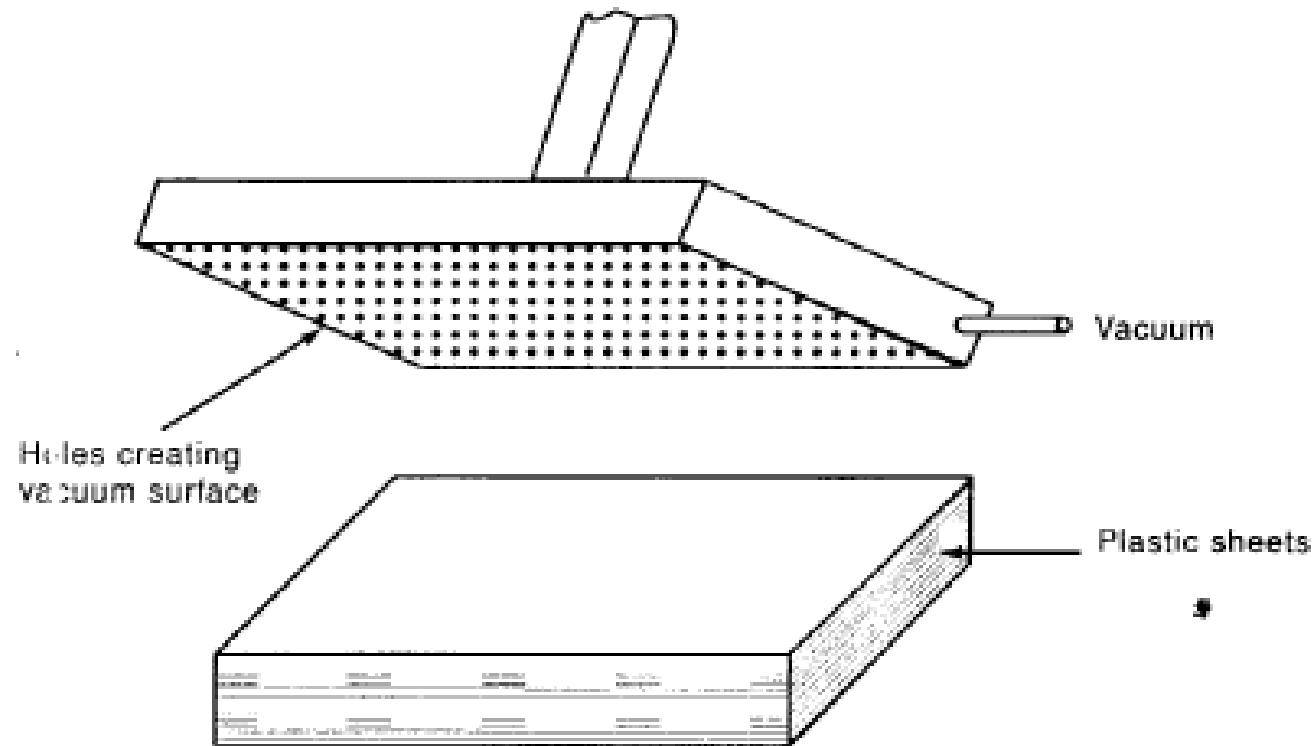
Vacuum Cups



Vacuum Cup with Venturi device



Vacuum Gripper



Vacuum Gripper

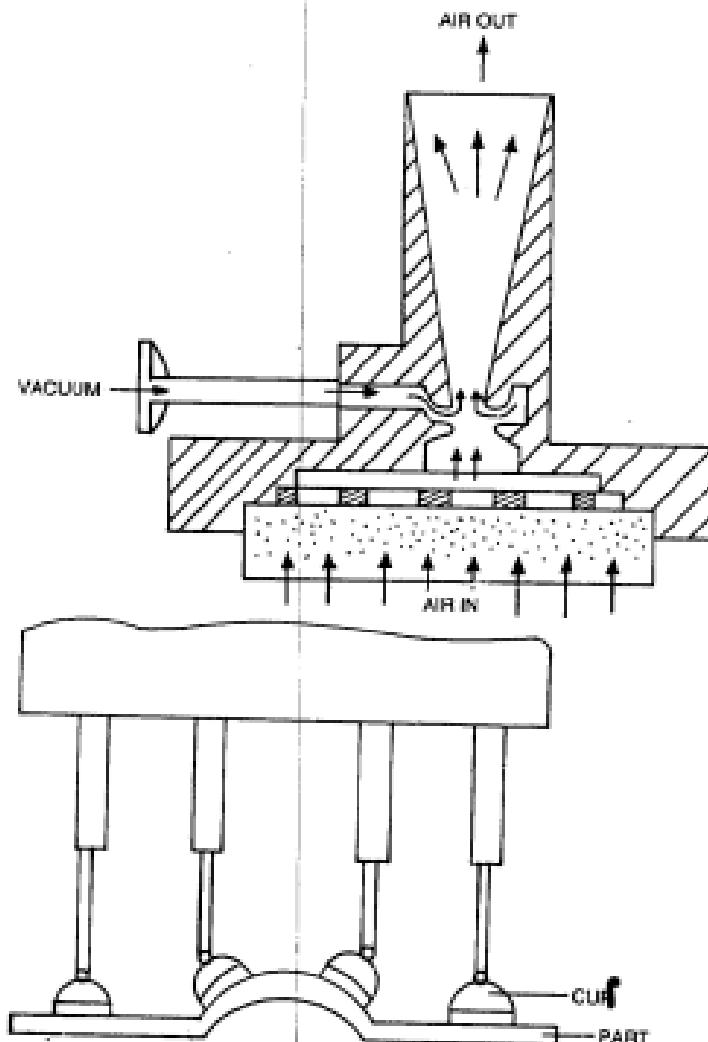


FIG. 4.16 Vacuum gripper (a) Venturi device for flat surface gripping
(b) Gripper for contoured surface

Vacuum Cups



Flat Short & Bellows Pad

For work pieces with inclined adsorption surface

Multistage bellows type

With/without lock ring



Heavy-duty oval pad

For heavy or large work pieces

Pad material: **Nitrile (NBR)**, FKM, Chloroprene rubber
silicone rubber



Pad materials include: NBR, silicon rubber, urethane rubber, FKM, conductive NBR, conductive silicon rubber, mark-free NBR, NBR+stuck fluororesin, fluororubber+stuck fluororesin, PEEK, conductive PEEK, conductive CR, Chloroprene rubber (CR), EPR

Pad types: flat, heavy duty flat with ribs, sponge, flat with ribs, thin flat, thin flat with ribs, bellows, heavy duty bellows, oval, heavy duty oval, nozzle, thin flat (skirt), thin flat (w/groove), multistage bellows

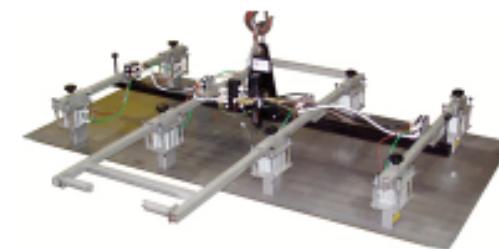
Magnetic Gripper



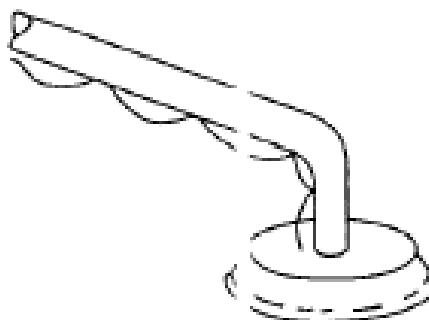
Magnetic Grippers

Advantages:

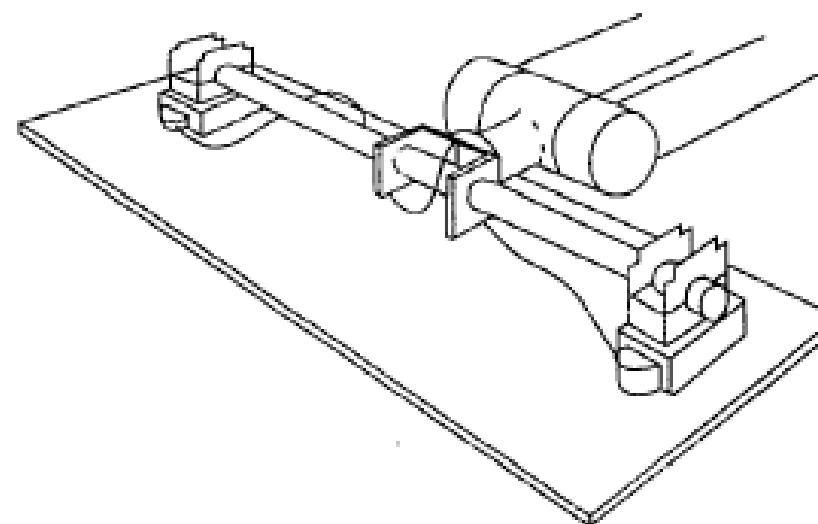
- Decreased air cost
- Grasps odd or non-uniform parts
- Outlasts most vacuum parts
- Won't drop materials during power outage or air loss
- Low maintenance cost



Magnetic Gripper

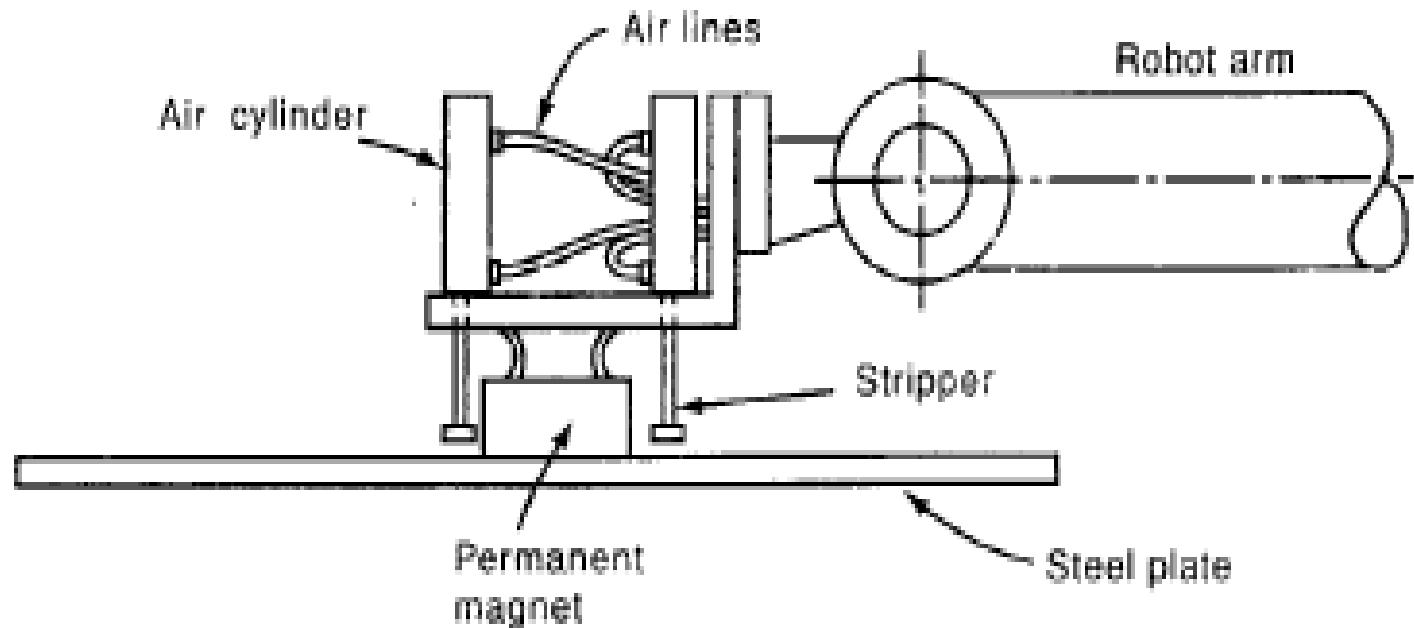


(a)



(b)

Permanent Magnet Gripper



Magnetic grippers

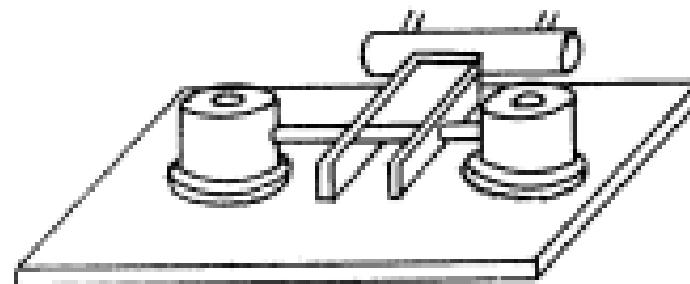
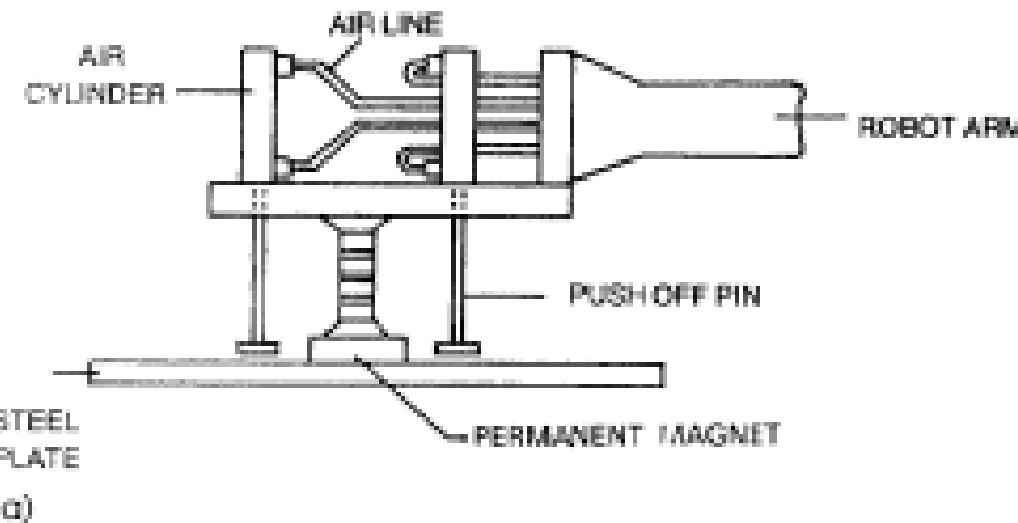
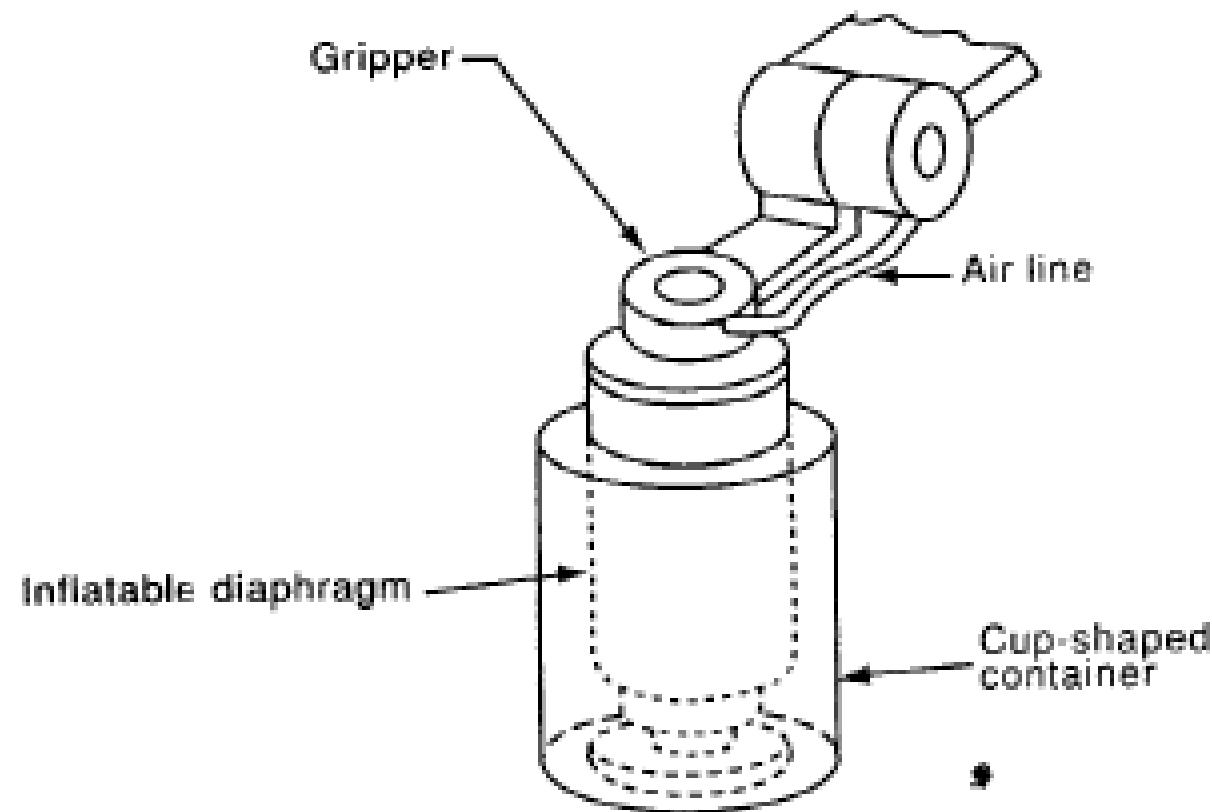


FIG. 4.15 Magnetic grippers (a) Permanent magnet type (b) Electro-

Inflatable Gripper

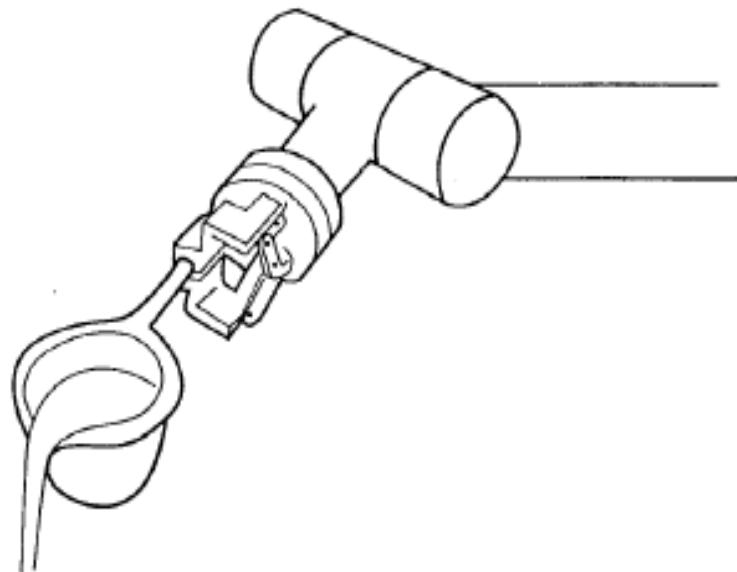


SPECIAL-PURPOSE GRIPPERS

- Hook grippers can be used to handle containers of parts and to load and unload them from overhead conveyors, Obviously, the items must have some sort of handle to enable the hook to hold it.
- Scoop and ladle grippers can be used to handle certain materials in liquid or powder form.
- A tool for ladling hot material. such as molded metal, is shown in Figure.
- One of this method's limitations is that the amount of material being scooped by the robot is sometimes difficult to control.



Scoop and ladle



- Collet grippers are used to pick and place cylindrical parts that are uniform in size.
- They obtain 360 degree of clamping contact with strong force for rapid part transfer.
- They are used for grinding and deburring operations.
- Collet grippers are available in round, square, or hex shapes.

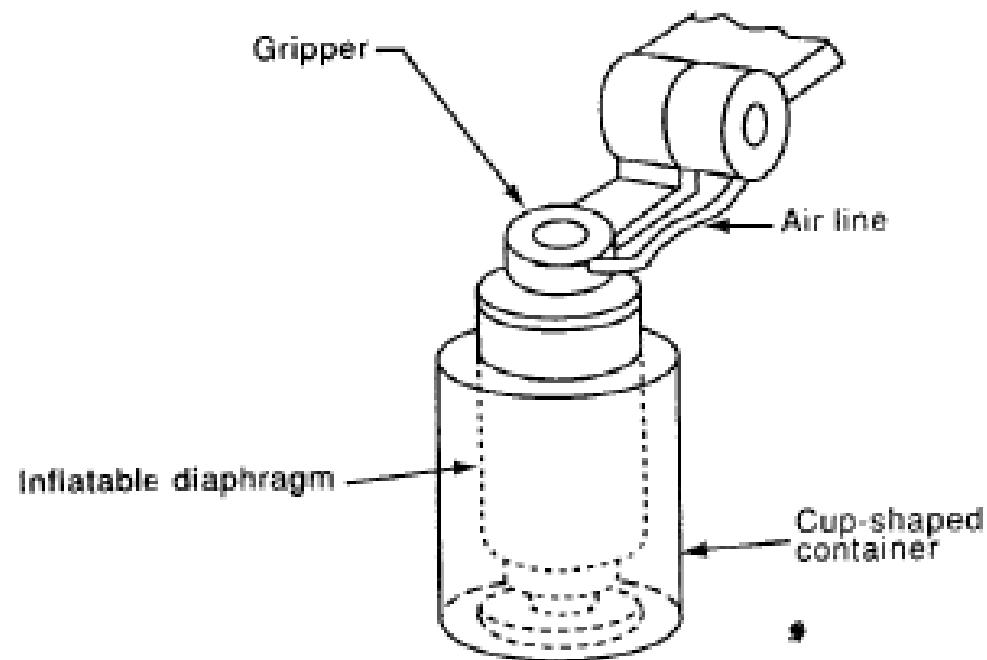


Inflatable grippers

- Inflatable grippers have an inflatable diaphragm that expands to grasp the object.
- The inflatable diaphragm is fabricated out of rubber or other elastic material, which makes it appropriate for gripping fragile objects.
- The gripper applies a uniform grasping pressure against the surface of the object rather than a concentrated force typical of a mechanical gripper.
- Figure shows an inflatable diaphragm grasping the inside diameter of a cup-shaped container.



Inflatable grippers



Expandable grippers

- Expandable grippers are similar to inflatable grippers but with a two- or three-finger design.
- Primarily, they are used to clamp an irregular-shaped workpiece.
- There are two types of expandable grippers: one that surrounds objects, gripping them from the outside, and one that grips hollow objects from the inside.
- In both cases, they make use of a hollow rubber envelope or other plastic material that expands when pressurized.
- Expandable grippers are distributing even pressure on the part and are ideal for handling fragile parts or parts that vary a great deal in size.



GRIPPER SELECTION AND DESIGN

1. The part surface to be grasped must be reachable.
2. The size variation of the part must be accounted for because this might influence the accuracy of locating the part.
3. The gripper design must accommodate the change in size that occurs between part loading and unloading.



4. Consideration must be given to the potential problem of scratching and distorting the part during gripping.
5. If there is a choice between two different dimensions on the part, the larger dimension should be selected for grasping.
6. Gripper fingers can be designed to conform to the part shape by using resilient pads or self-aligning fingers.



- 7.The important factors that determine the required grasping force are:
- a. The weight of the object
 - b. The speed and acceleration with which the robot arm moves, and the orientational relationship
 - c. The physical constriction or friction that is used to hold the part
 - d. The coefficient of friction between the object and the gripper fingers

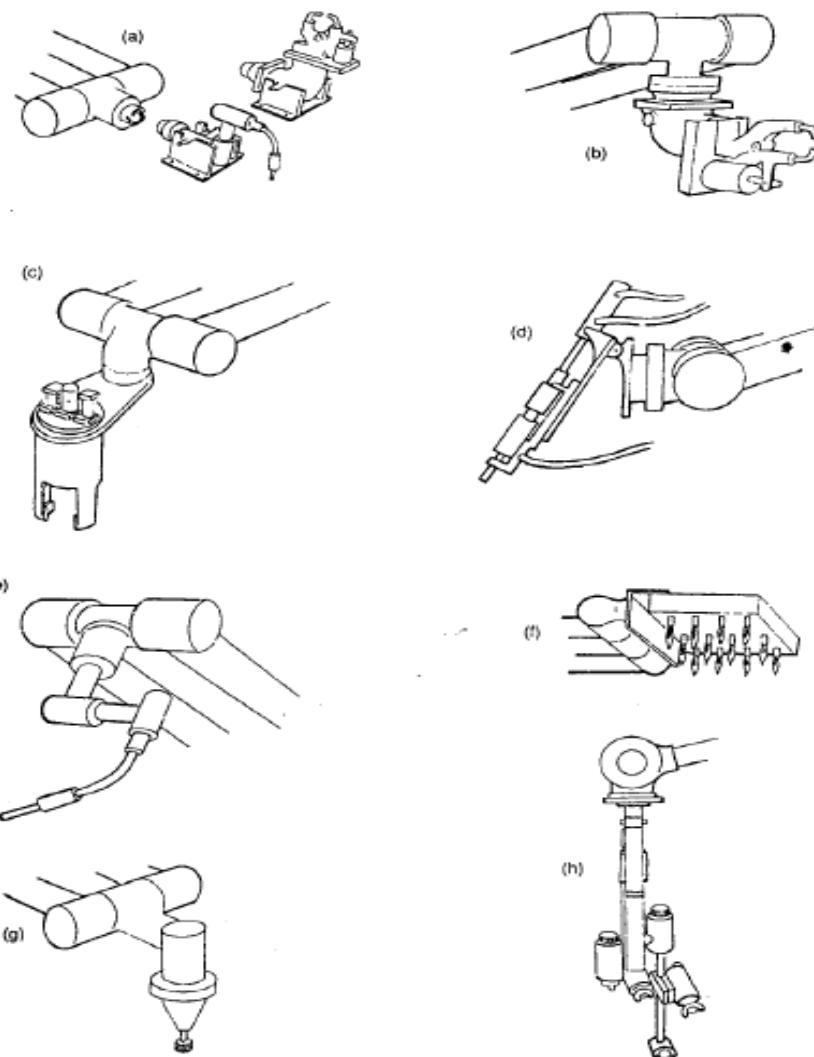


PROCESS TOOLING

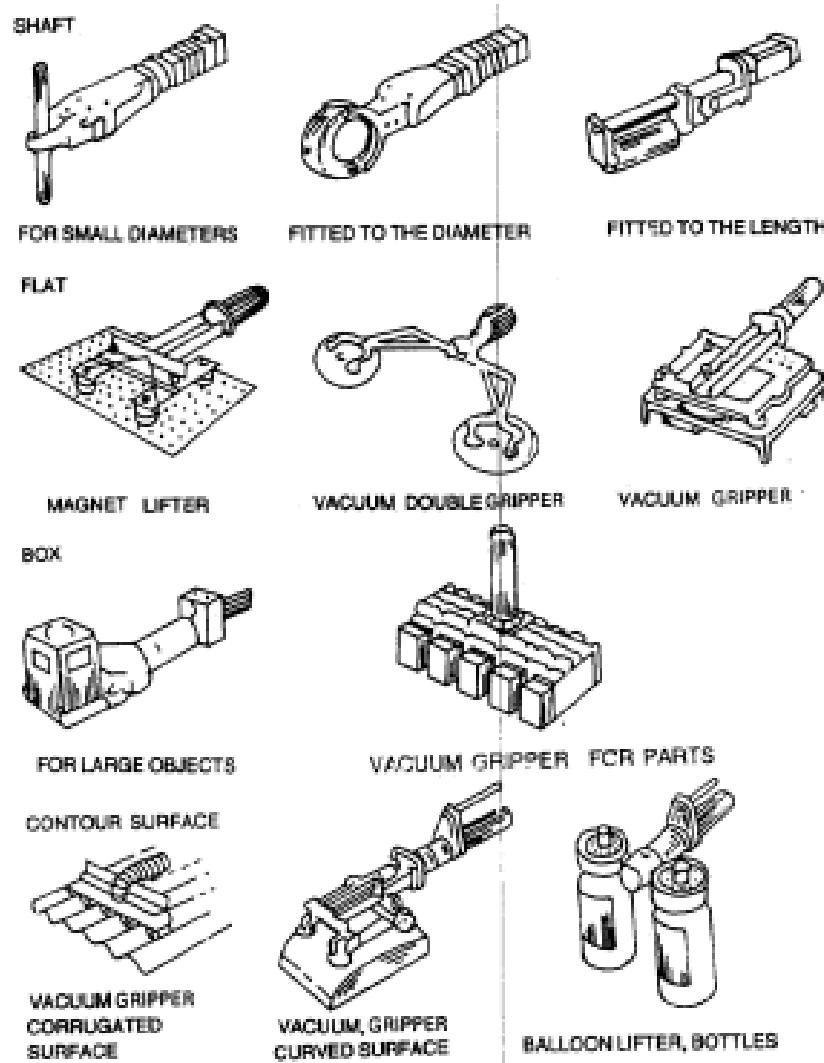
- Process tooling is an end effector designed to perform work rather than to pick and place a work part.
- In a limited number of applications, the process tooling is a gripper that is designed to grasp and handle the tool.
- The reason for using a gripper in these applications is that there may be more than one tool to be used by the robot in the work cycle.
- Process tooling refers to the general class of special end effectors that may be attached to the robot wrist.



Toolings



Toolings



https://www.youtube.com/watch?v=sZ_-yb-TN9M

<https://www.youtube.com/watch?v=NR32ULxbjYc>

https://www.youtube.com/watch?v=8vIT2da6N_o



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