TECHNOLOGICAL DESIGN
Introduction to Engineering

CONTROL TECHNOLOGY

What is Control Technology?

Control Technology covers all areas of **automation.** The way buildings function is becoming more and more automated. The opening and closing of curtains, the dimming of lights, and temperature or even humidity levels can be adjusted according to human presence for optimum efficiency. When a person leaves a room, the room automatically goes into conserve mode and cools down and/or dims. This function can only be accomplished by using PLC **or Programmable Logic Circuits.** PLC use **and/or** statements and continuous loops to search for answers to questions it keeps asking itself about its environment (also known as Boolean Logic).

Automation in factories has been around for a long time, but has become efficient only recently when PLC have been integrated with servo-motor and pneumatic controls.

A **servo-motor is** simply an electric motor that has hundreds of electronic steps for each rotation of the spindle. Hence, it is often called a stepper motor.

Pneumatics is the use of compressed air to drive pistons, valves, and switches. A typical bank machine uses a combination of Pneumatics and servo-motors to give you money.

Hydraulics is the use of a liquid to create motion. The liquid needs some sort of force acted upon it in order to create motion. Liquids are not compressible so that you gain an equal amount of motion for a given force. In a car's braking system, you gain a mechanical advantage using small diameter tubing to transfer the liquid. Using a vacuum diaphragm will amplify the amount of force put on the liquid. Compressed air stores a lot of energy and can be used to push on a liquid- Car hoists use compressed air to drive liquids in order to raise a car. Large construction equipment also use hydraulics to create motion.

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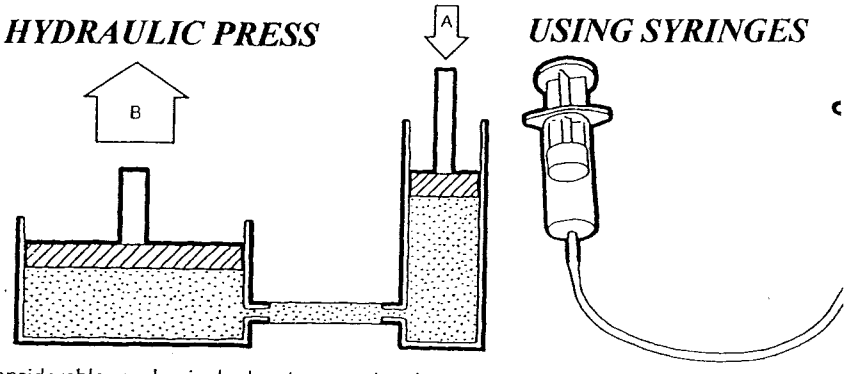
APPLYING PNEUMATICS/ HYDRAULICS

Below is an example of a hydraulic press. When pressure is applied to piston A (the driver piston), it will push a larger piston B (the driven piston). The larger and smaller syringes (pistons) illustrate the same action.

Why is piston A able to support a load of 3 times that of piston B?

_____

Which piston will travel a greater distance?_____ How much?_____



A considerable mechanical advantage can be obtained if two different diameter piston/cylinder units are connected. Ignoring any friction, if an effort of 1 N is applied to piston A, it will support a load of 3 N at B. This is because the pressure produced by piston A is acting on three times the area at B. Piston B, though, will move only one third of the distance of A

just the FACTS French mathematician Blaise Pascal (1623–1662) determined the principle behind hydraulics. He stated that pressure exerted upon a liquid is transmitted equally in all directions. This principle has become known as Pascal's law. Blaise Pascal invented the syringe and the hydraulic press.

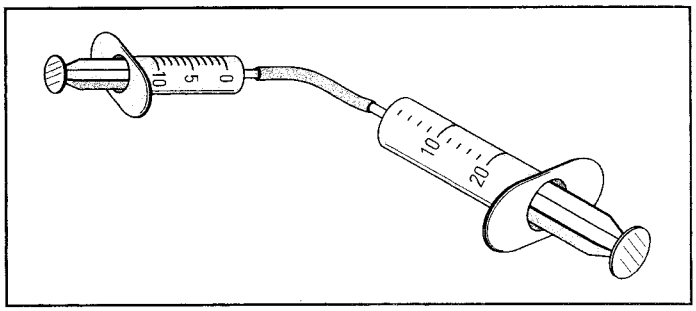
research

At the library or on the Internet, research hydraulics and pneumatics. Explain how hydraulic and pneumatic systems are similar, and how they are different. (Key Search Words: "fluid power + definitions") ▲

Hydraulic Principles

When two syringes of different sizes are connected, **Pascal's law** states that the **pressure** on the small plunger is the same as the pressure on the large plunger. The equation for the relationship between force and pressure is force = pressure × area. The area of the larger plunger is greater than the area of the smaller plunger. So, the fluid exerts a greater **force** on the larger plunger than on the smaller one.

In devices such as hydraulic presses or car jacks, applying a relatively small force to the **piston** of the small **input (master) cylinder** exerts a much greater force on the piston of the larger **output (slave) cylinder**. However, the small piston must move correspondingly farther than the large one.



▲ **FIGURE D.3-5** Which plunger is easier to move?

Pascal's law: the principle that pressure exerted upon a liquid is transmitted equally in all directions

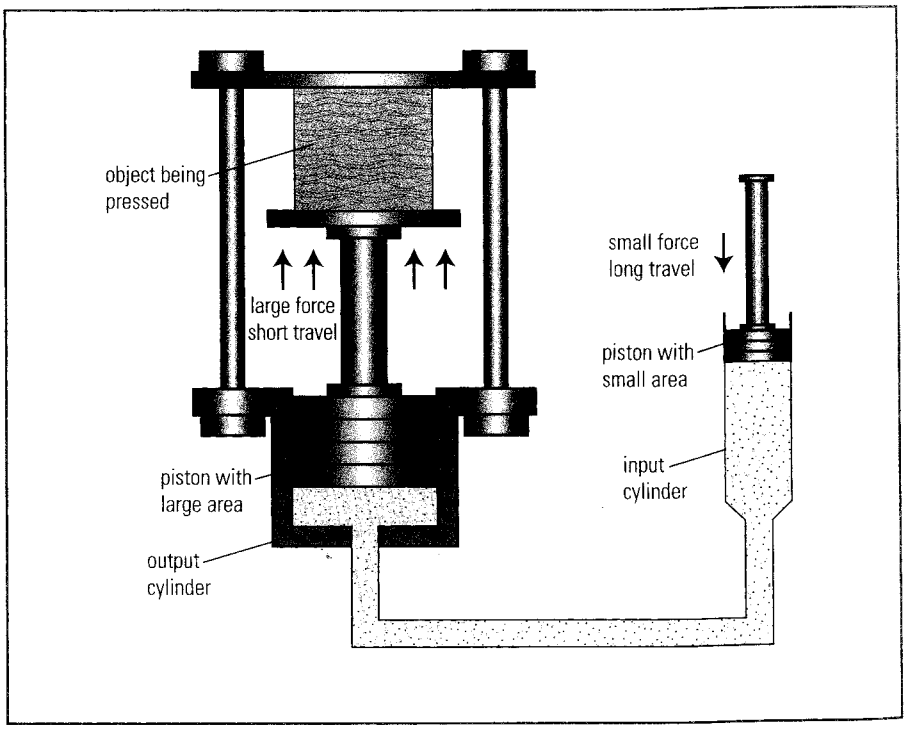
Pressure: force per unit area, that is, the force acting on a surface divided by the area of the surface

Force: a push or pull exerted on an object

Piston: a cylinder that fits tightly inside a tube or hollow cylinder and either moves a fluid or is moved by a fluid

Input (master) cylinder: the control cylinder that is used to initiate movement in a hydraulic system

Output (slave) cylinder: a cylinder with a piston that moves in response to the input cylinder



▲ **FIGURE D.3-6** The principle of the hydraulic press