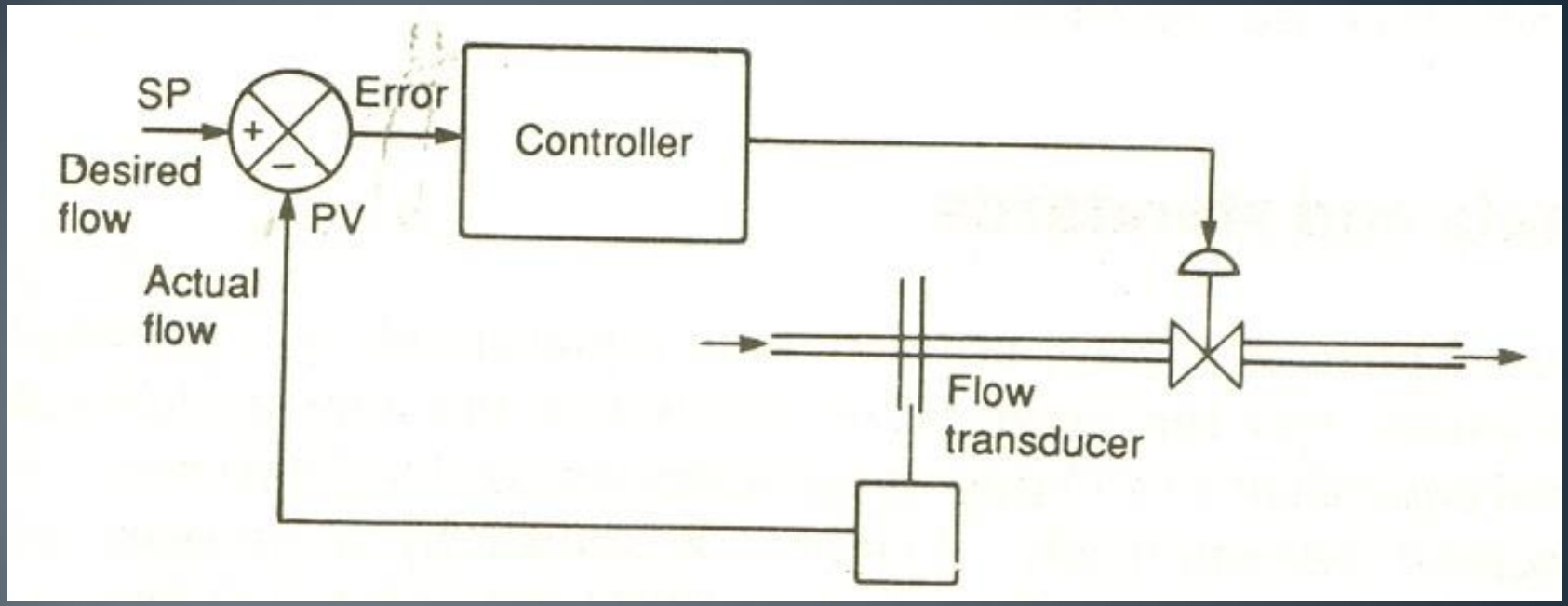
PNEUMATIC CONTROLLERS

Introduction

- Pneumatic controls are powered by compressed air.
- Pneumatic Process control are safer than Electronic and controller's, when used in Explosive atmosphere like Chemical or Petrochemical plats.

Closed Lop Control



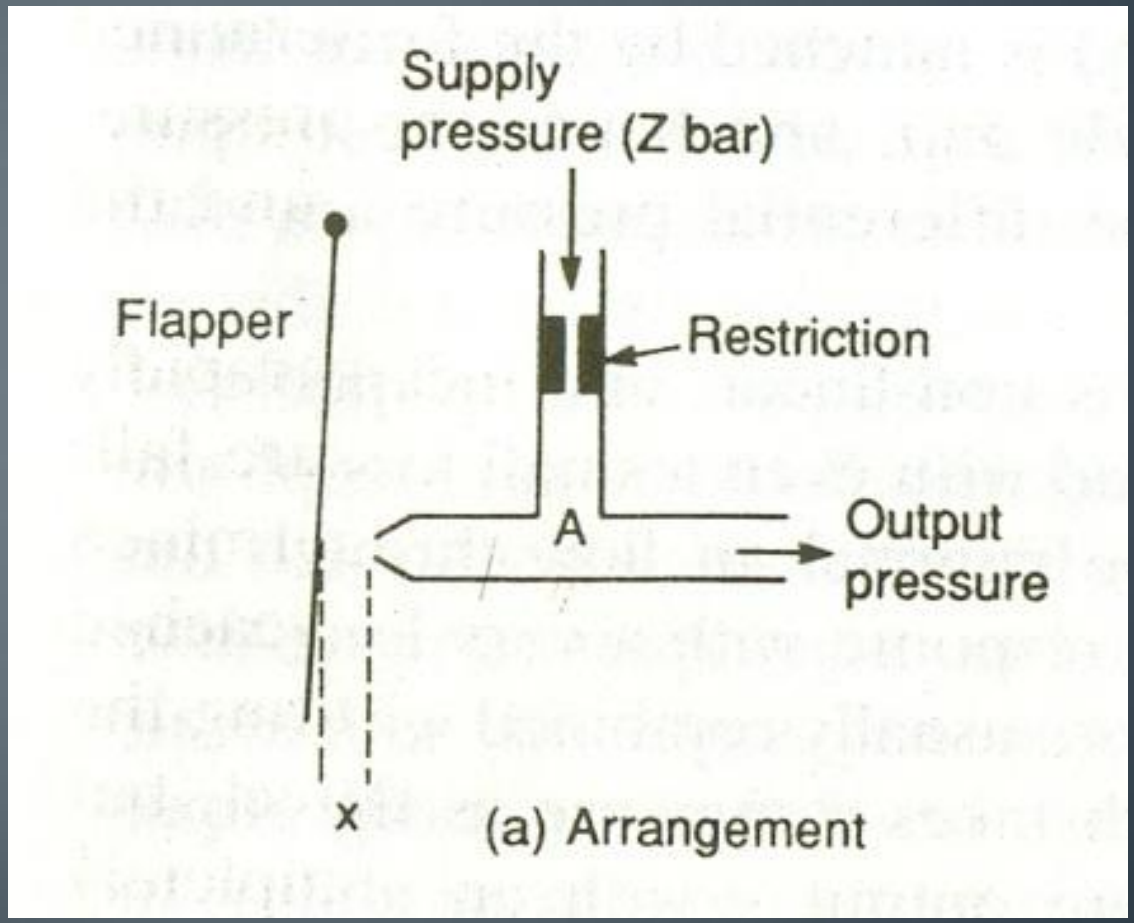
1. Controller
2. Actuator
3. Measuring Device

(SP-Set Point, PV= Process variable)

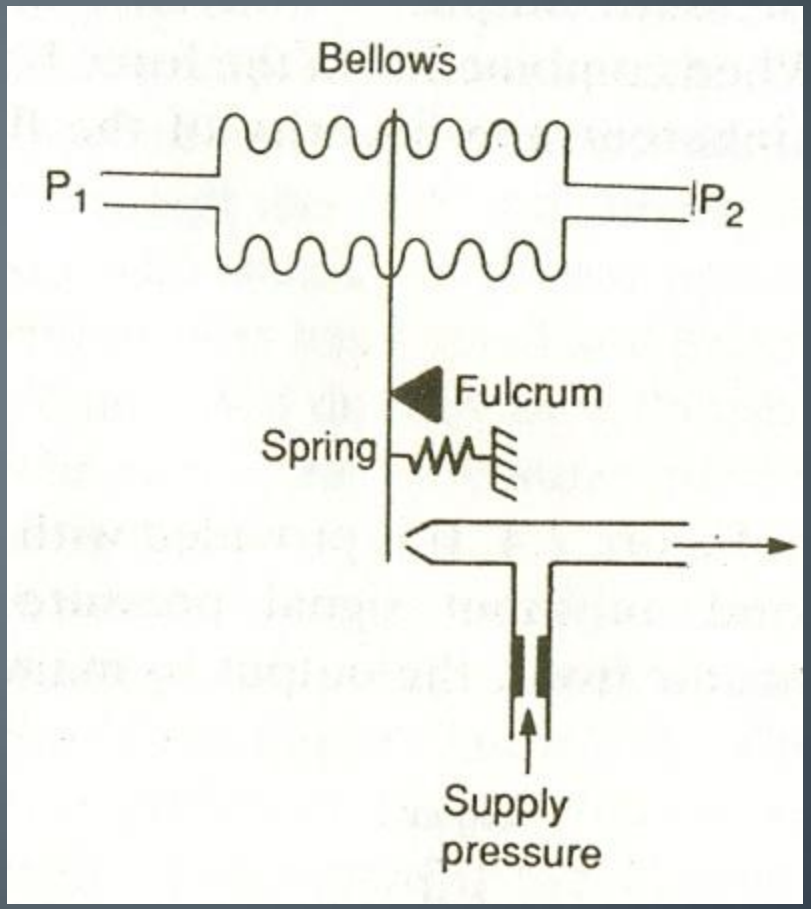
Pneumatic Controllers

- 1. Flapper Nozzle
- 2. Volume Booster
- 3. Force Balance Principle

1. Flapper Nozzle

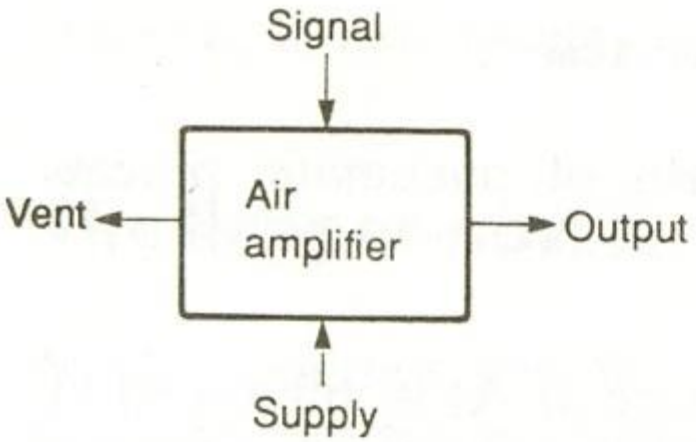


- The heart of all pneumatic process control devices is a device to convert a small displacement into a pressure change.
- This displacement is based on the Flapper Nozzle.

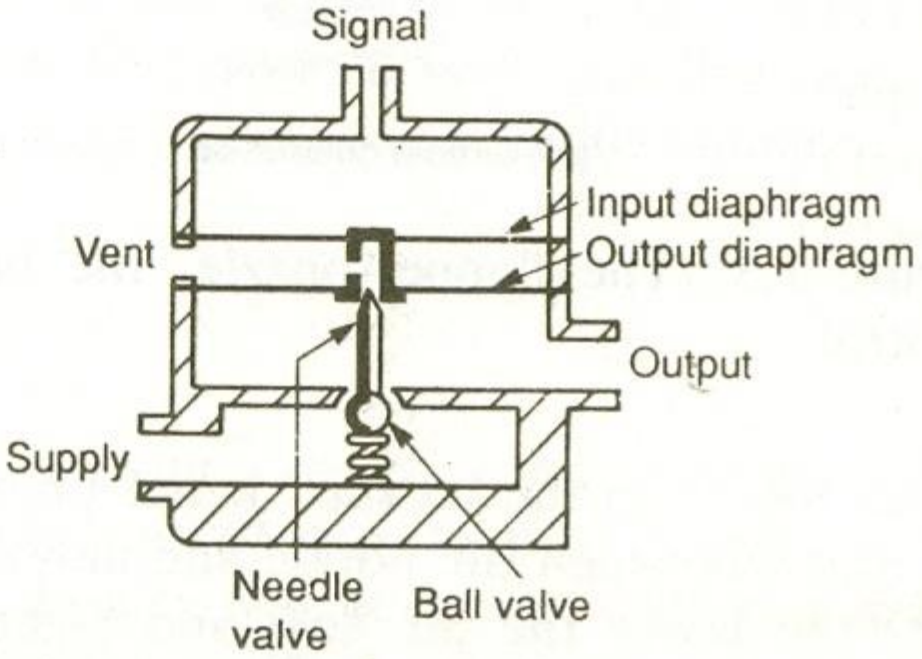


Simple Differential Pressure Transducer

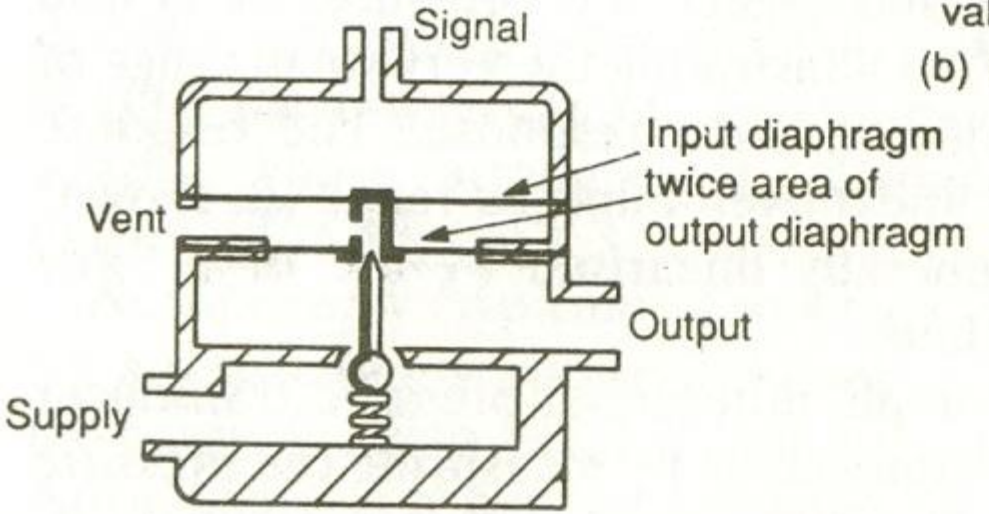
• 2. Volume Booster



(a) Block diagram



(b) Unity gain



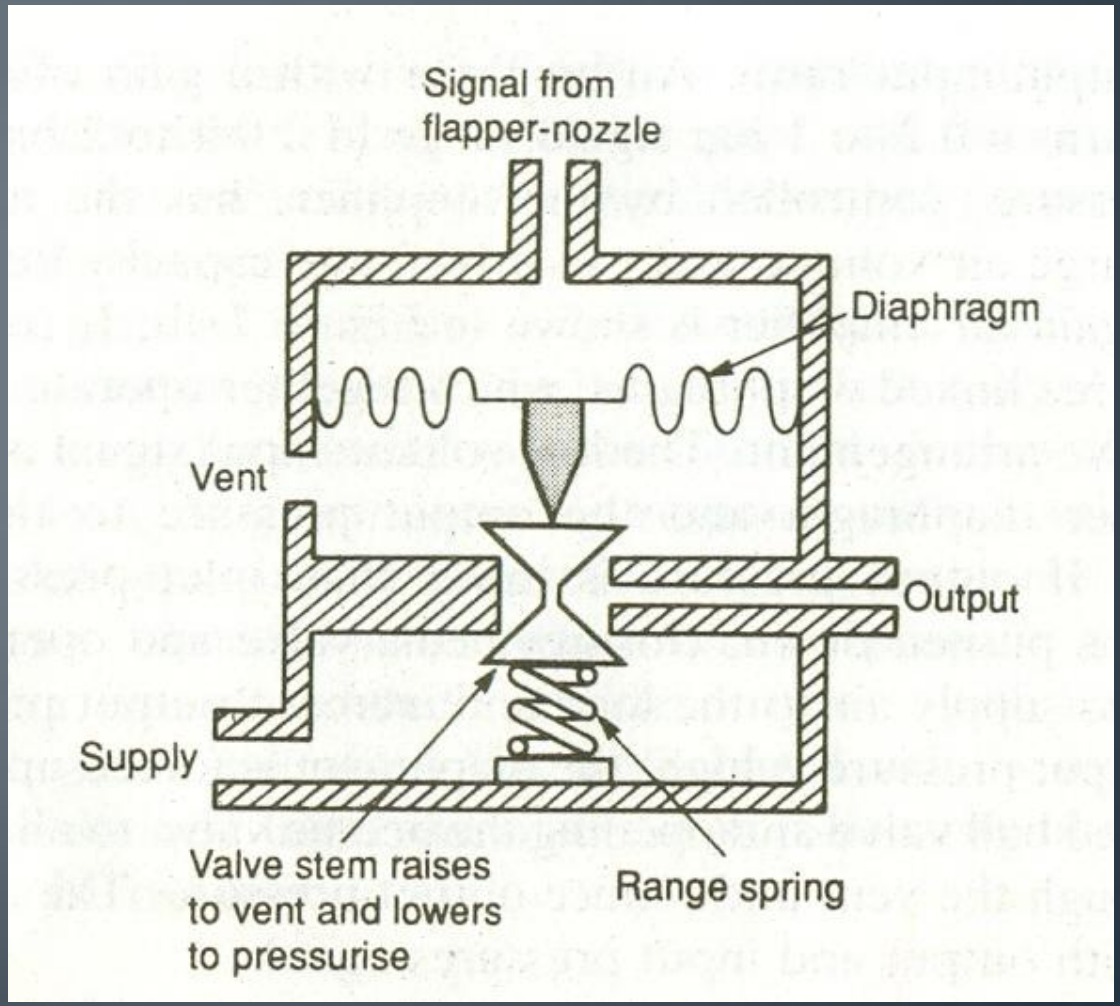
(c) Gain x 2

2. Volume Booster

- When Pressure given as input then linearly related pressure as output is obtained with an ability to supply a large volume of air.

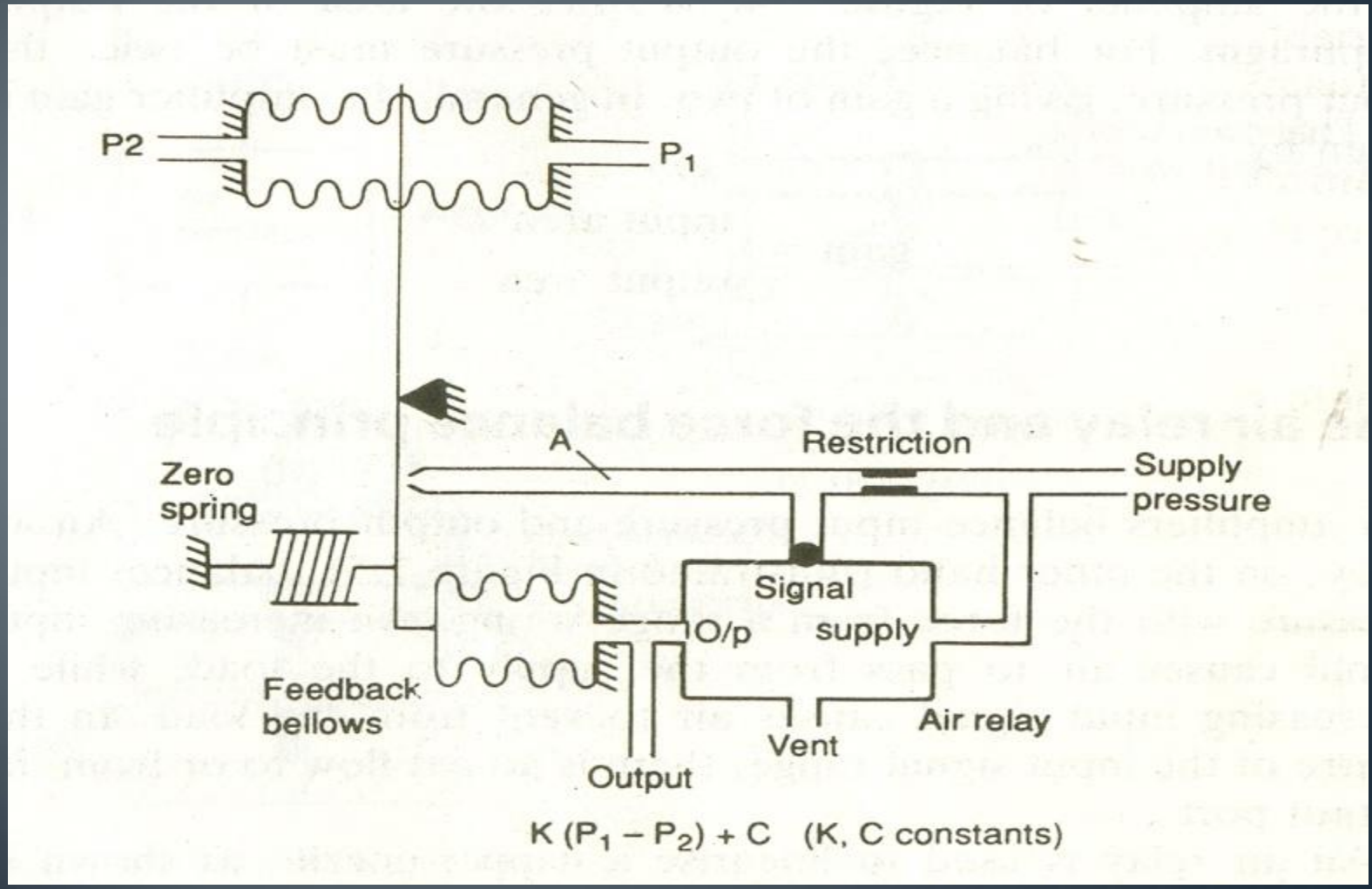
3. Force Balance Principle

1. Air Relay



- An increase in input signal cause air to pas from the supply to the load, while a decreasing input signal cause air to vent from the load.

2. Balance Principle



- The force from the feedback bellows match the force from the input signal bellows and output pressure directly proportional to (P1-P2)

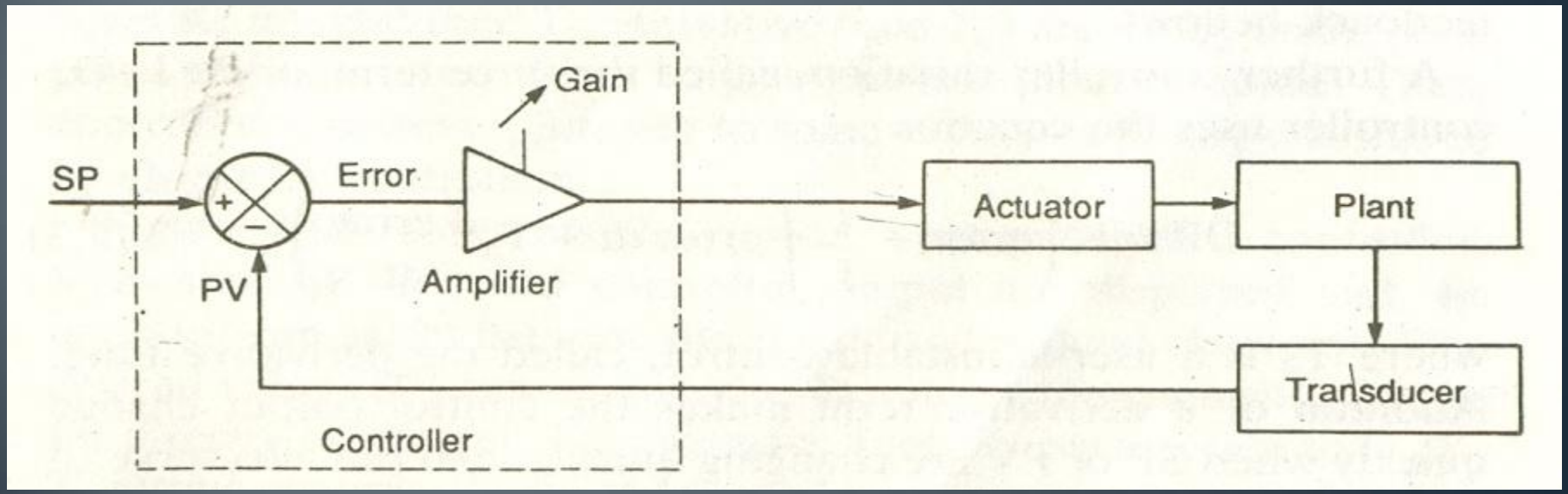
PNEUMATIC CONTROLLER

From the figure 1, closed loop control

$$OP = K \times ERROR$$

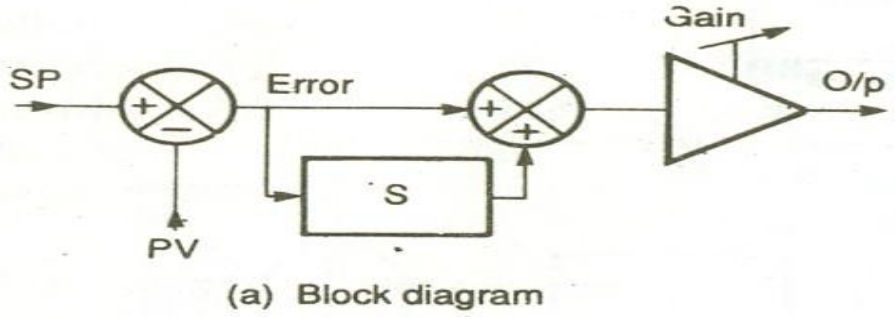
$$= K \times (SP - PV)$$

(where K is Gain)

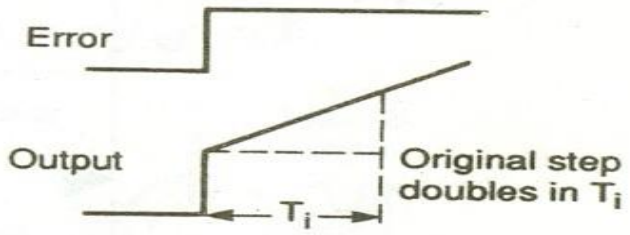


Proportional only Controller (Simplest Pneumatic Controller)

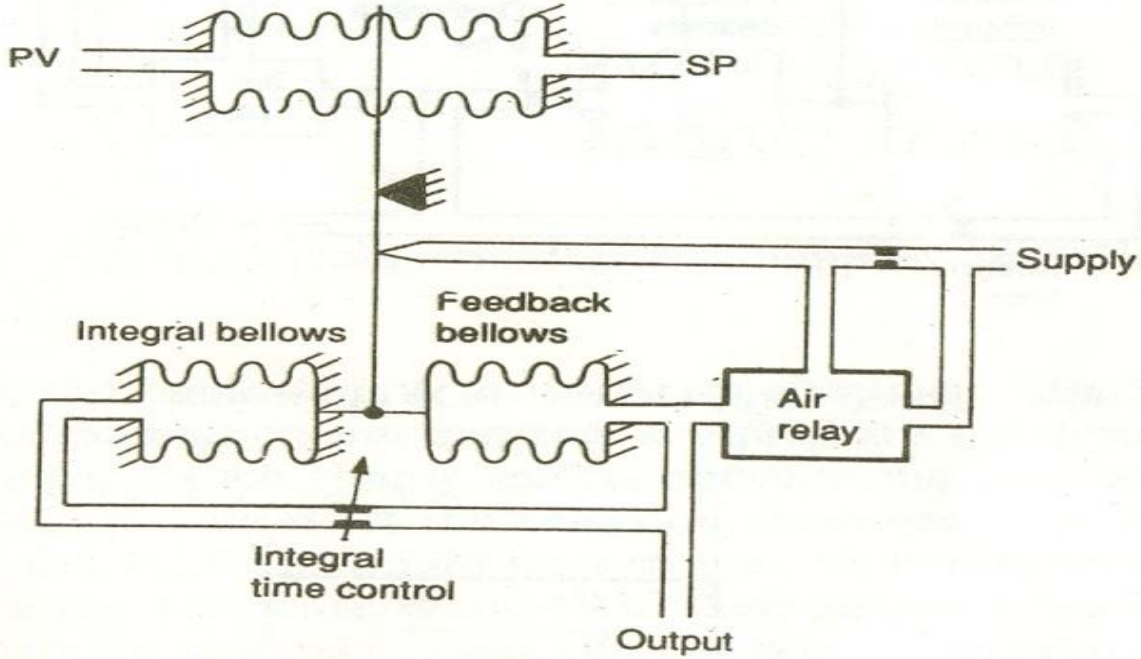
1. Proportional plus Integral controller (P + I)



(a) Block diagram



(b) Step response

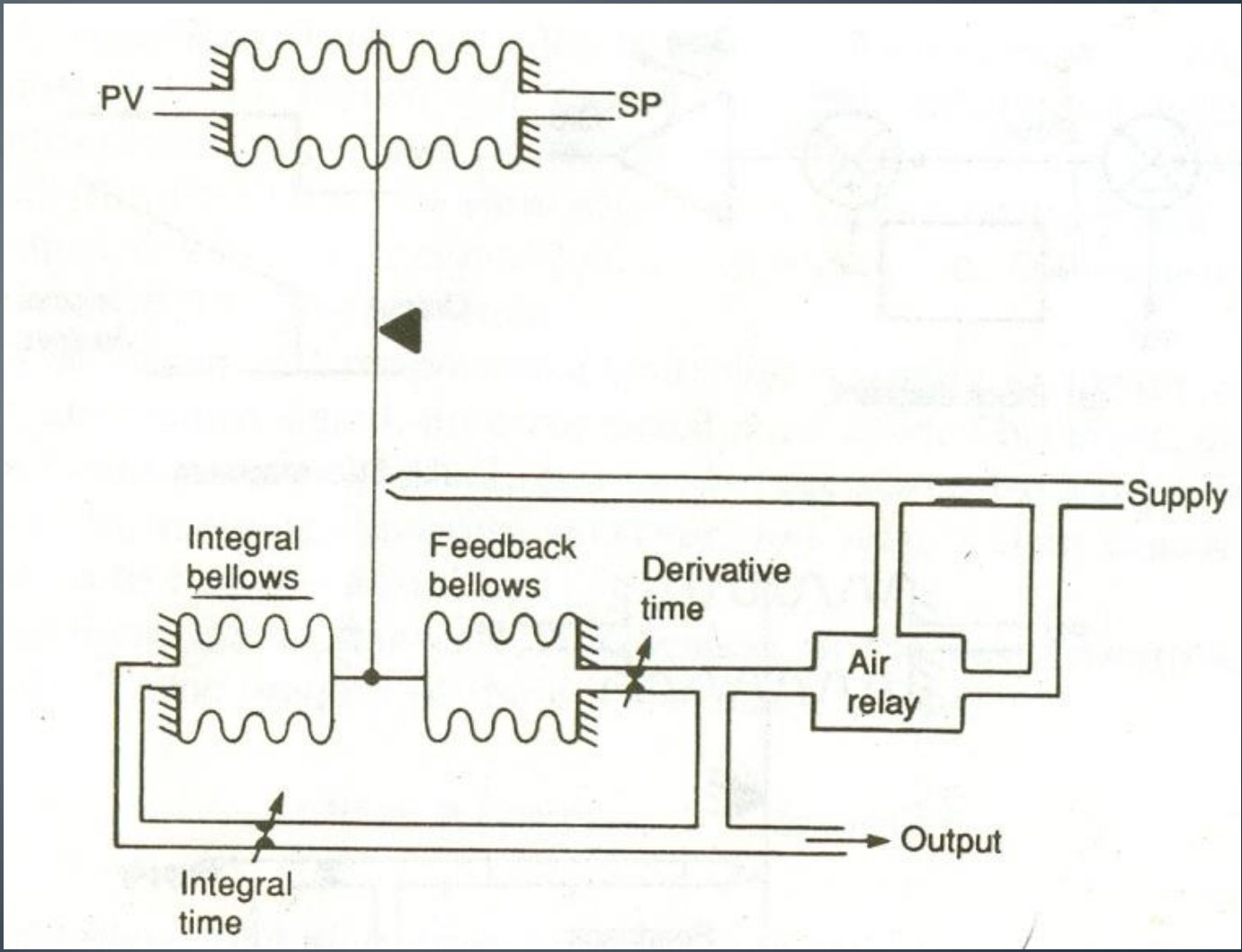


(c) Construction

- Any output signal an error exist this error is called Offset Error.

$$OP = K\left(\text{error} + \frac{1}{T}\int \text{error}\, dt\right)$$

Proportional plus Integral controller plus Derivative Time(P + I + D)



$$OP = K\left(\text{error} + \frac{1}{T_i}\int \text{error}\, dt + T_d \frac{d\ \text{error}}{dt}\right)$$

Where D is Derivative Time (User Adjustable)