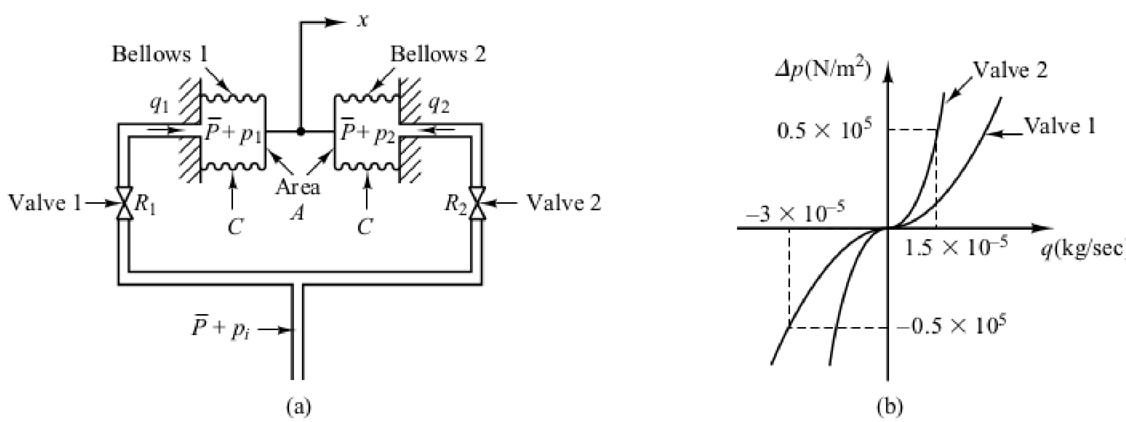
Control y Sistemas

Trabajo práctico: Modelado de sistemas neumáticos

Resuelva los siguientes ejercicios en Simscape.

1)

A–4–4. In the pneumatic pressure system of Figure 4–29(a), assume that, for $t < 0$, the system is at steady state and that the pressure of the entire system is $\bar{P}$. Also, assume that the two bellows are identical. At $t = 0$, the input pressure is changed from $\bar{P}$ to $\bar{P} + p_i$. Then the pressures in bellows 1 and 2 will change from $\bar{P}$ to $\bar{P} + p_1$ and from $\bar{P}$ to $\bar{P} + p_2$, respectively. The capacity (volume) of each bellows is $5 \times 10^{-4}\ \mathrm{m}^3$, and the operating-pressure difference Δp (difference between p_i and p_1 or difference between p_i and p_2) is between $-0.5 \times 10^5\ \mathrm{N/m^2}$ and $0.5 \times 10^5\ \mathrm{N/m^2}$. The corresponding mass flow rates (kg/sec) through the valves are shown in Figure 4–29(b). Assume that the bellows expand or contract linearly with the air pressures applied to them, that the equivalent spring constant of the bellows system is $k = 1 \times 10^5\ \mathrm{N/m}$, and that each bellows has area $A = 15 \times 10^{-4}\ \mathrm{m}^2$.

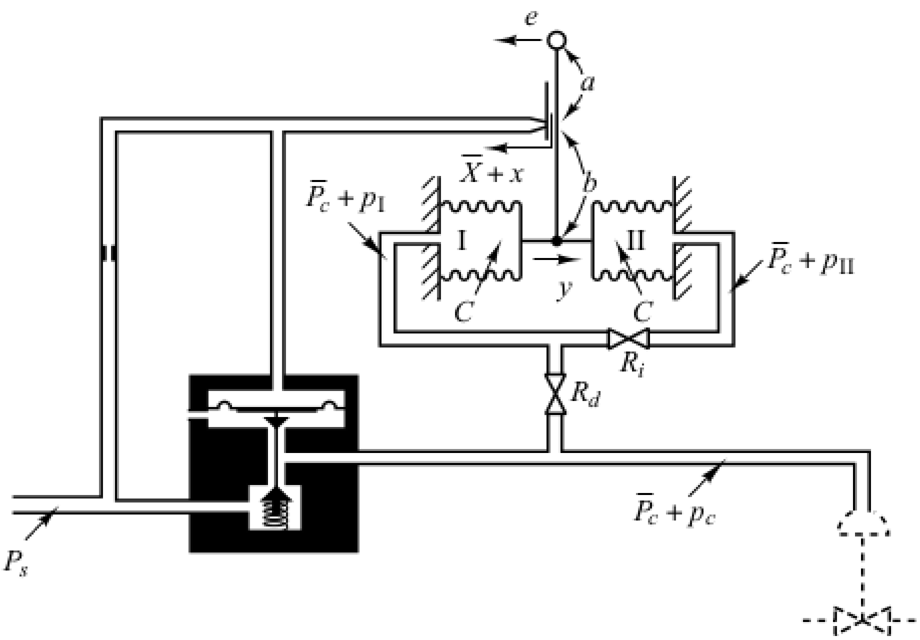


Defining the displacement of the midpoint of the rod that connects two bellows as x, find the transfer function $X(s)/P_i(s)$. Assume that the expansion process is isothermal and that the temperature of the entire system stays at 30°C. Assume also that the polytropic exponent n is 1.

2)

A–4–5. Draw a block diagram of the pneumatic controller shown in Figure 4–30. Then derive the transfer function of this controller. Assume that $R_d \ll R_i$. Assume also that the two bellows are identical.

If the resistance R_d is removed (replaced by the line-sized tubing), what control action do we get? If the resistance R_i is removed (replaced by the line-sized tubing), what control action do we get?



3)

B–4–4. Figure 4–45 shows a pneumatic controller. The pneumatic relay has the characteristic that $p_c = K p_b$, where $K > 0$. What kind of control action does this controller produce? Derive the transfer function $P_c(s)/E(s)$.

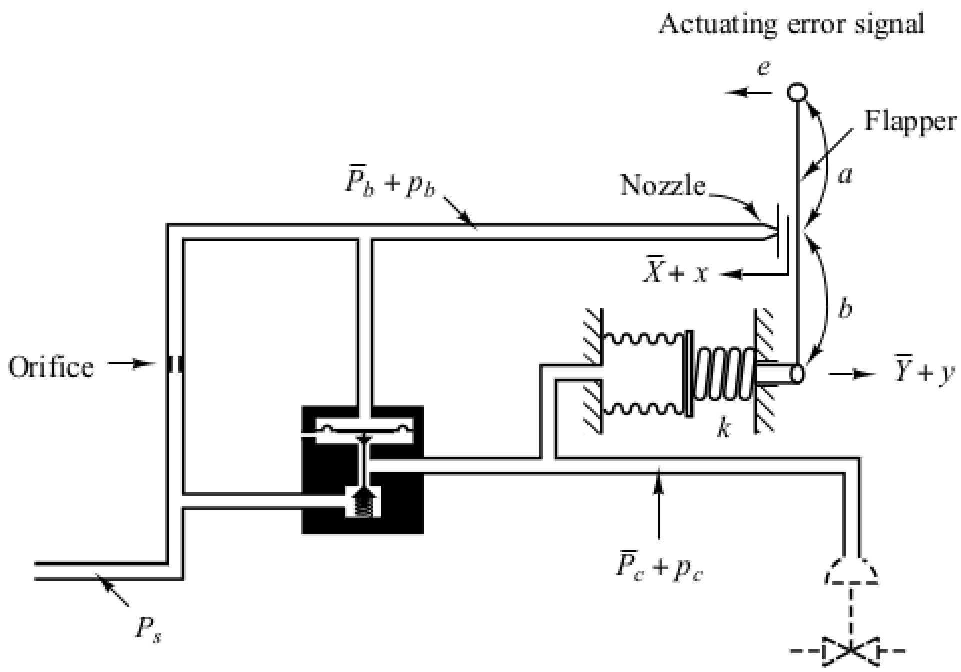


Figure 4–45
Pneumatic controller.

Control y Sistemas
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4)

B–4–5. Consider the pneumatic controller shown in Figure 4–46. Assuming that the pneumatic relay has the characteristics that $p_c = K p_b$ (where $K > 0$), determine the control action of this controller. The input to the controller is e and the output is p_c.

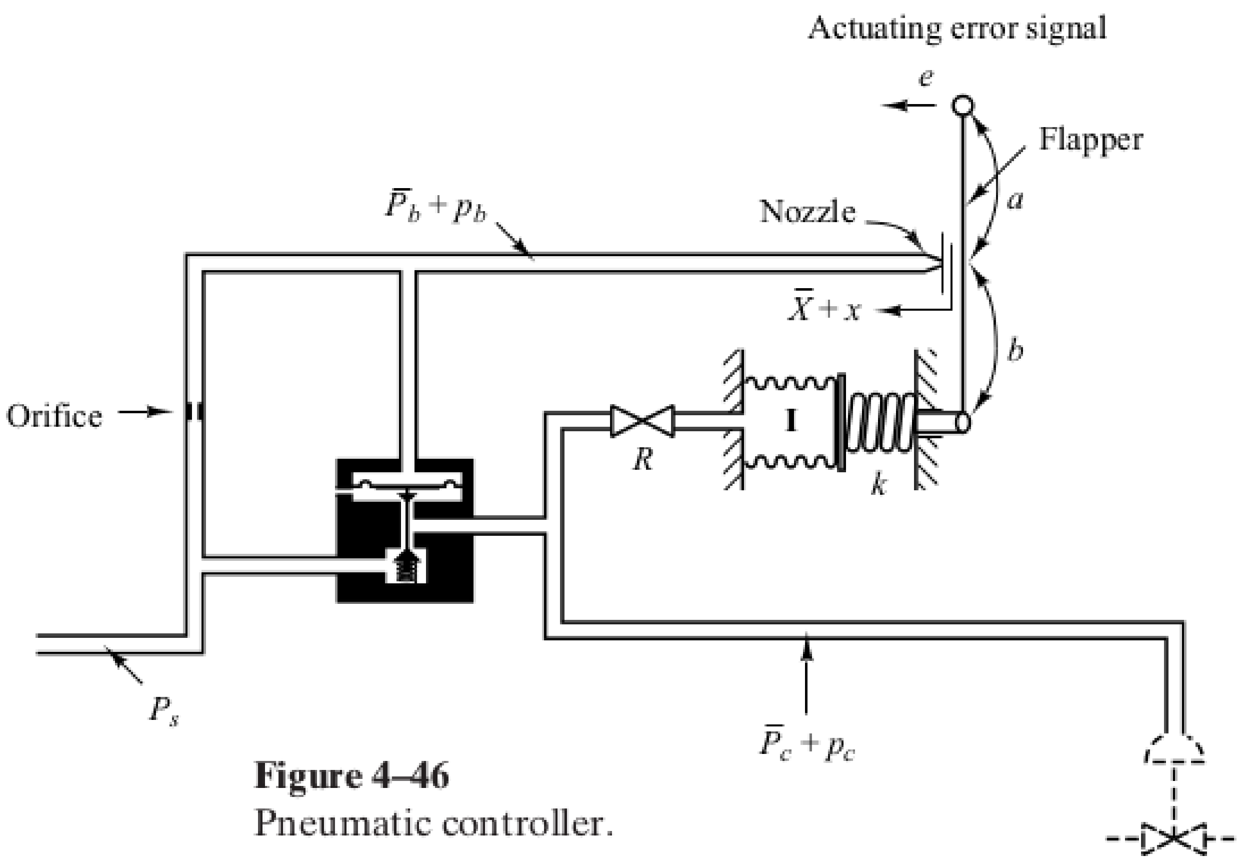

Figure 4–46
Pneumatic controller.

5)

B–4–6. Figure 4–47 shows a pneumatic controller. The signal e is the input and the change in the control pressure p_c is the output. Obtain the transfer function $P_c(s)/E(s)$. Assume that the pneumatic relay has the characteristics that $p_c = Kp_b$, where $K > 0$.

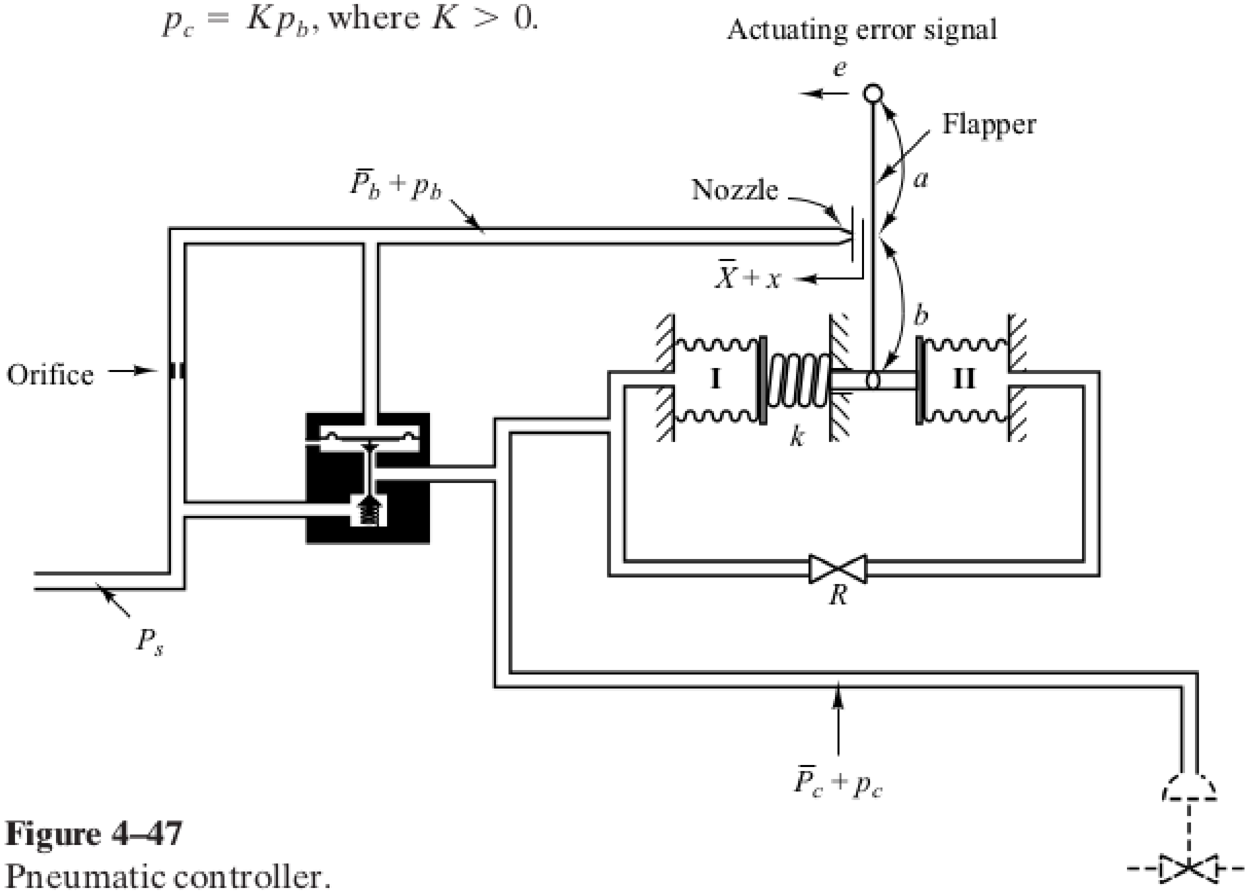

Figure 4–47
Pneumatic controller.

6)

B–4–7. Consider the pneumatic controller shown in Figure 4–48. What control action does this controller produce? Assume that the pneumatic relay has the characteristics that $p_c = Kp_b$, where $K > 0$.

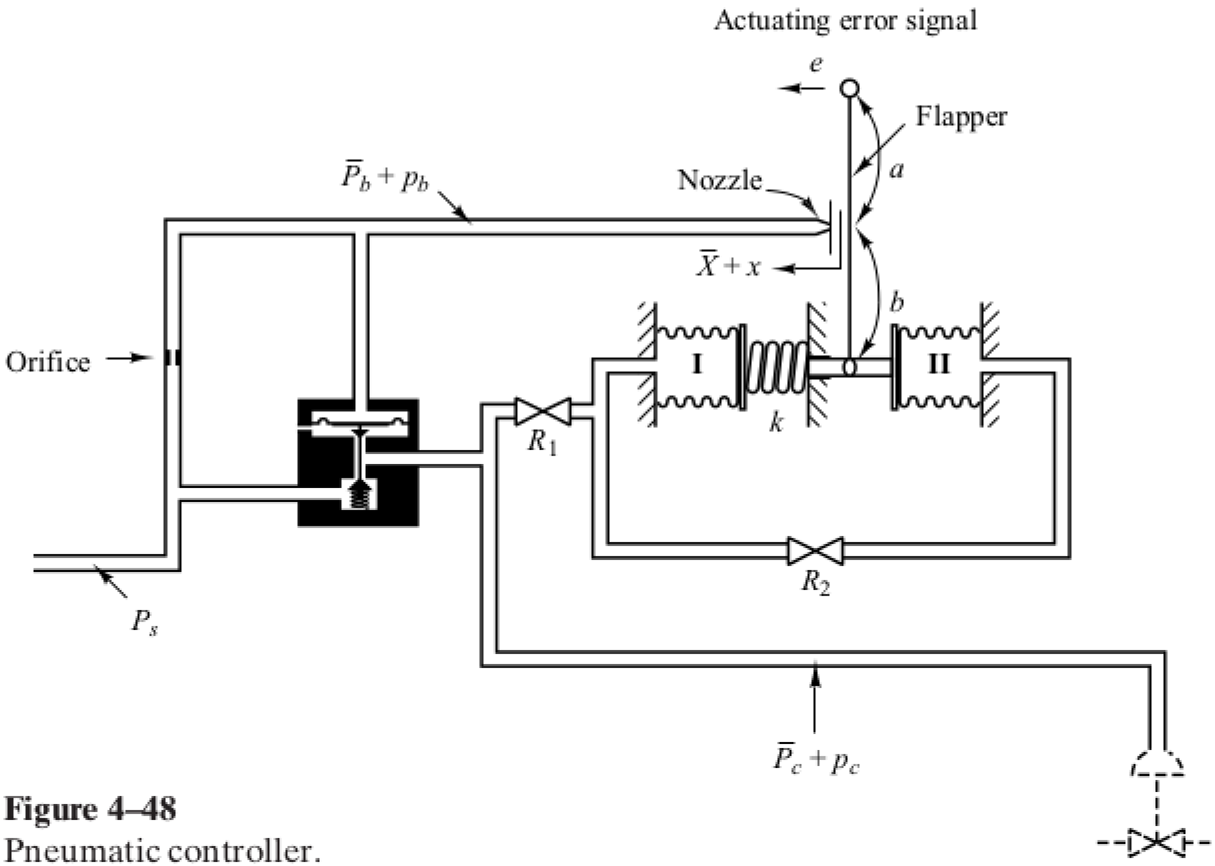

Figure 4–48
Pneumatic controller.