Proportional Controller

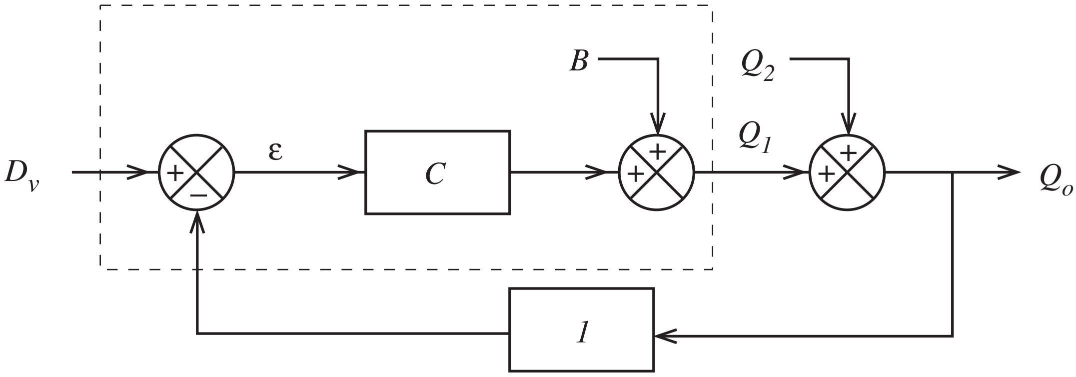

FIG. 9

We will now derive an expression for the steady state value of Q_o.

$$Q_o = Q_2 + Q_1 \quad \dots\dots\dots\dots\dots\dots\dots \quad (1)$$

$$Q_1 = B + \varepsilon K \quad \dots\dots\dots\dots\dots\dots\dots \quad (2)$$

where K is the controller gain and B is the bias signal.

Substitute equation (2) into equation (1) for Q_1, to give:

$$Q_o = Q_2 + B + \varepsilon K \quad \dots\dots\dots\dots\dots \quad (3)$$

also $$\varepsilon = D_V - Q_o \quad \dots\dots\dots\dots\dots\dots\dots \quad (4)$$

Substitute equation (4) into equation (3) for ε:

$$Q_o = Q_2 + B + K(D_V - Q_o)$$

$$Q_o = Q_2 + B + KD_V - KQ_o$$

$$Q_o + KQ_o = Q_2 + B + KD_V$$

$$Q_o(1 + K) = Q_2 + B + KD_V$$

$$Q_o = \frac{Q_2 + B + KD_V}{(1 + K)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Let's look at the values of the variables in this equation.

We already know that under normal operating conditions $Q_2 = 1000$ m^3 h^{-1}, $Q_o = 2000$ m^3 h^{-1} and $D_V = 2000$ m^3 h^{-1}.

If the error signal is zero then the bias signal, B, must be 1000 m^3 h^{-1} so that $Q_1 = 1000$ m^3 h^{-1}.

The last value we require is the controller gain K. Initially we'll assume K to equal 1.0.

If we substitute these values into equation (5) we can check that Q_o does equal 2000 m^3 h^{-1}.

If we apply a load change to this system by altering the flow Q_2 we should see the resulting offset. Note that a load change is either a change in a supply to a control system or a change in a demand on a control system.