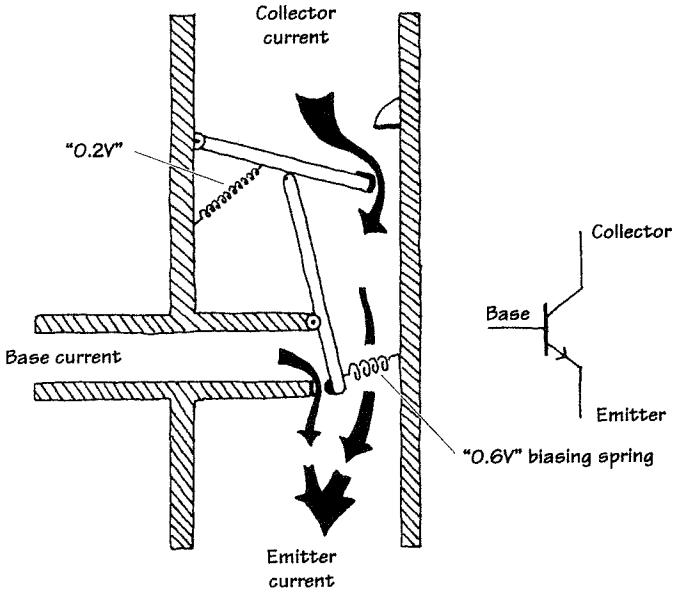
NPN WATER ANALOGY



The base of the *npn* water transistor represents the smaller tube entering the main device from the left side. The collector is represented by the upper portion of the vertical tube, while the emitter is represented by the lower portion of the vertical tube. When no pressure or current is applied through the "base" tube (analogous to an *npn* transistor's base being open circuited), the lower lever arm remains vertical while the top of this arm holds the upper main door shut. This state is analogous to a real bipolar *npn* transistor off state. In the water analogy, when a small current and pressure are applied to the base tube, the vertical lever is pushed by the entering current and swings counterclockwise. When this lever arm swings, the upper main door is permitted to swing open a certain amount that is dependent on the amount of swing of the lever arm. In this state, water can make its way from the collector tube to the emitter tube, provided there is enough pressure to overcome the force of the spring holding the door shut. This spring force is analogous to the 0.6 V biasing voltage needed to allow current through the collector-emitter channel. Notice that in this analogy, the small base water current combines with the collector current.

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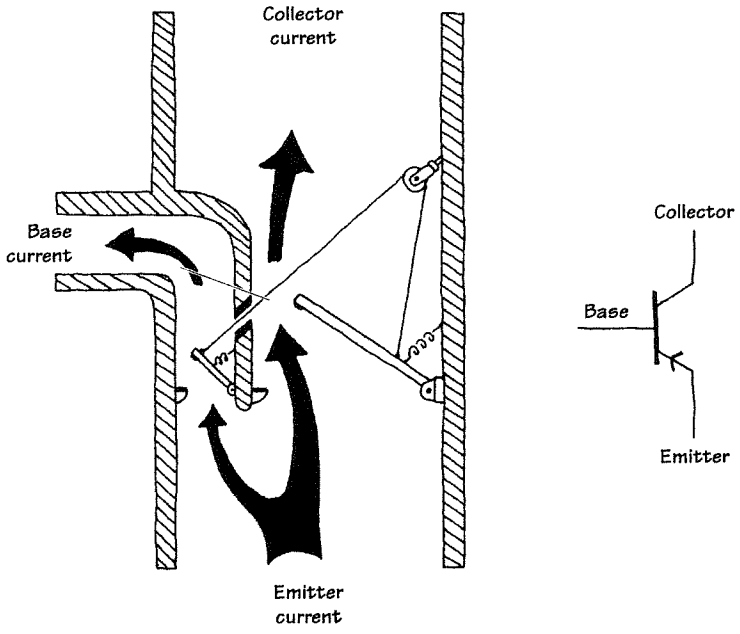

The main feature to note here is the need for a lower pressure at the base for the *pnp* water transistor to turn on. By allowing current to flow out the base tube, the lever moves, allowing the emitter-collector door to open. The degree of openness varies with the amount of swing in the lever arm, which corresponds to the amount of current escaping through the base tube. Again, note the 0.6 V biasing spring.

FIGURE 4.52