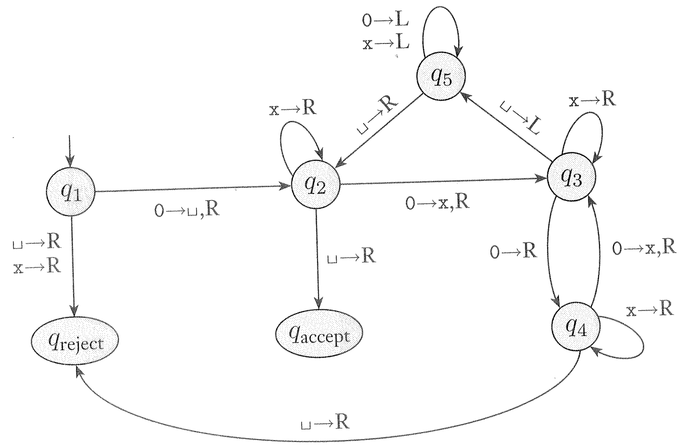

FIGURE 3.4
State diagram for Turing machine M_2

A sample run of M_2 on input 0000:

$q_1$0000	␣q_5x0x␣	␣x$q_5$xx␣
␣$q_2$000	q_5␣x0x␣	␣$q_5$xxx␣
␣x$q_3$00	␣q_2x0x␣	q_5␣xxx␣
␣x0$q_4$0	␣x$q_2$0x␣	␣$q_2$xxx␣
␣x0xq_3␣	␣xxq_3x␣	␣x$q_2$xx␣
␣x0q_5x␣	␣xxxq_3␣	␣xxq_2x␣
␣x$q_5$0x␣	␣xxq_5x␣	␣xxxq_2␣
		␣xxx␣q_{accept}

EXAMPLE 3.5

The following is a formal description of $M_1 = (Q, \Sigma, \Gamma, \delta, q_1, q_{accept}, q_{reject})$, the Turing machine that we informally described on page 127 for deciding the language $B = \{w\#w|\ w \in \{0,1\}^*\}$.

- $Q = \{q_1, \ldots, q_{14}, q_{accept}, q_{reject}\}$,
- $\Sigma = \{0,1,\#\}$, and $\Gamma = \{0,1,\#,x,␣\}$.
- We describe δ with a state diagram (see Figure 3.5).
- The start, accept, and reject states are q_1, q_{accept}, and q_{reject}.

In Figure 3.5 depicting the state diagram of TM M_1, you will find the label 0,1 → R on the transition going from q_3 to itself. That label means that the machine stays in q_3 and moves to the right when it reads a 0 or a 1 in state q_3. It doesn't change the symbol on the tape.

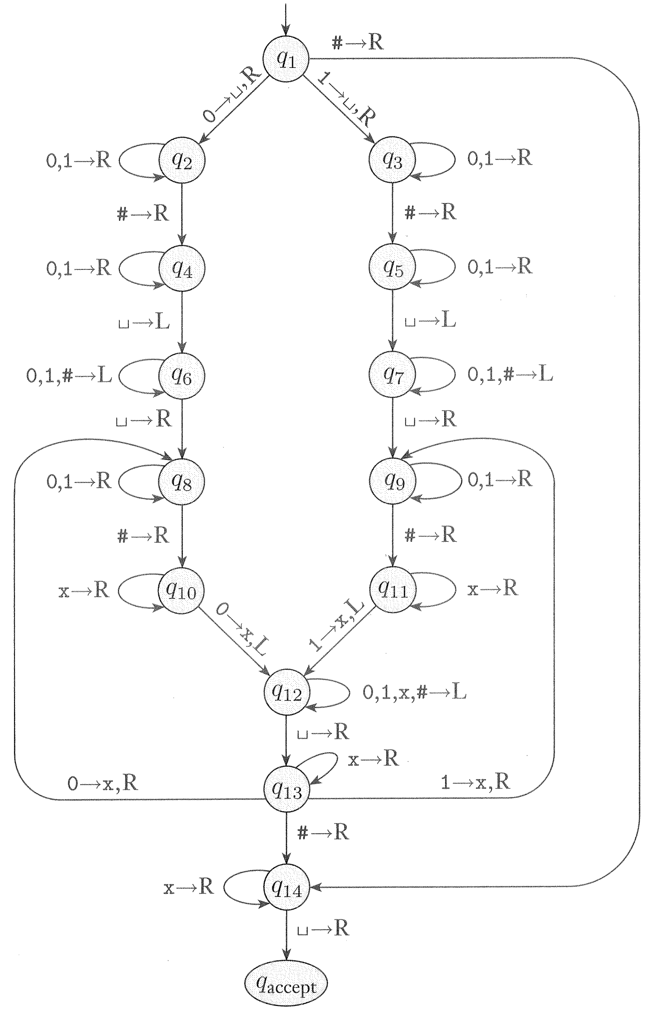

FIGURE 3.5
State diagram for Turing machine M_1

As in Example 3.4, the machine starts by writing a blank symbol to delimit the left-hand edge of the tape. This time it may overwrite a 0 or a 1 when doing so, and it remembers the overwritten symbol by using the finite control.

Stage 1 is implemented by states q_1 through q_7, and stages 2 and 3 by the remaining states. To simplify the figure, we don't show the reject state or the transitions going to the reject state. Those transitions occur implicitly whenever a state lacks an outgoing transition for a particular symbol. Thus, because in state q_5 no outgoing arrow with a # is present, if a # occurs under the head when the machine is in state q_5, it goes to state q_{reject}.