circuit may have both types of outputs. The two models of a sequential circuit are commonly referred to as a *finite state machine*, abbreviated FSM. The Mealy model of a sequential circuit is referred to as a Mealy FSM or Mealy machine. The Moore model is referred to as a Moore FSM or Moore machine.
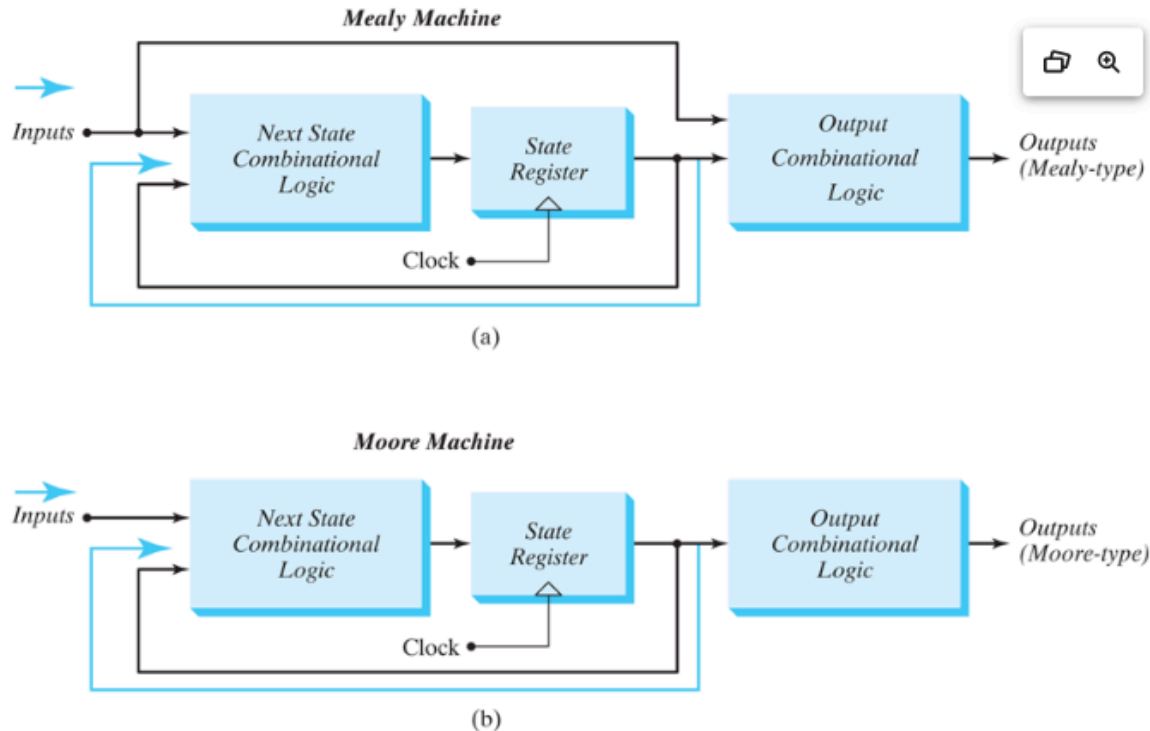

FIGURE 5.21
Block diagrams of Mealy and Moore state machines

Practice Exercise 5.8

What determines the next state of a *T*-type flip-flop?

Answer: If the *T* input is asserted, the next state is the complement of the present state (output) at the synchronizing edge of the clock. If *T* is not asserted, the state remains fixed.

The circuit presented previously in **Fig. 5.15** 🔲 is an example of a Mealy machine. Output *y* is a function of both input *x* and the present state of *A* and *B*. The corresponding state diagram in **Fig. 5.16** 🔲 shows both the input and output values, separated by a slash along the directed lines between the states.

An example of a Moore model is given in **Fig. 5.18** 🔲. Here, the output is a function of the present state only. The corresponding state diagram in **Fig. 5.19** 🔲 has only inputs marked along the directed lines. The outputs are the flip-flop states marked inside the circles. Another example of a Moore model is the sequential circuit of **Fig. 5.20** 🔲. The output depends only on flip-flop values, and that makes it a function of the present state only. The input value in the state diagram is labeled along the directed line, whereas the output value is indicated inside the circle together with the present state.

In a Moore model, the outputs of the sequential circuit are synchronized with the clock, because they depend only on flip-flop outputs, which are synchronized with the clock. In a Mealy model, the outputs may change if the inputs change during the clock cycle. Moreover, the outputs may have momentary false values because of the delay encountered from the time that the inputs change and the time that the flip-flop outputs change to their final values. In order to synchronize a Mealy-type circuit, the inputs of the sequential circuit must be synchronized with the clock and the outputs must be sampled immediately before the clock edge. The inputs are changed at the inactive edge of the clock to ensure that the inputs to the flip-flops stabilize before the active edge of the clock occurs. Thus, **the output of the Mealy machine is the value that**