```
        begin
1.          T ← ∅;
2.          VS ← ∅:
3.          construct a priority queue Q containing all edges in E;
4.          for each vertex v ∈ V do add {v} to VS;
5.          while ‖VS‖ > 1 do
                begin
6.                  choose (v, w), an edge in Q of lowest cost;
7.                  delete (v, w) from Q;
8.                  if v and w are in different sets W1 and W2 in VS then
                        begin
9.                          replace W1 and W2 in VS by W1 ∪ W2;
10.                         add (v, w) to T
                        end
                end
        end
```

Fig. 5.2. Minimum-cost spanning tree algorithm.

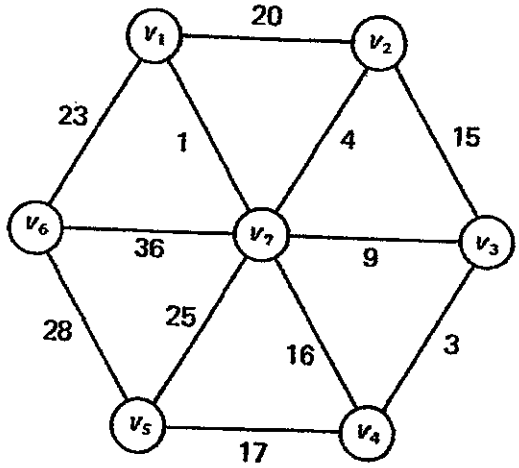

Fig. 5.3 An undirected graph with costs on edges.

Edge	Action	Sets in VS (connected components)
(v_1, v_7)	Add	$\{v_1, v_7\}, \{v_2\}, \{v_3\}, \{v_4\}, \{v_5\}, \{v_6\}$
(v_3, v_4)	Add	$\{v_1, v_7\}, \{v_2\}, \{v_3, v_4\}, \{v_5\}, \{v_6\}$
(v_2, v_7)	Add	$\{v_1, v_2, v_7\}, \{v_3, v_4\}, \{v_5\}, \{v_6\}$
(v_3, v_7)	Add	$\{v_1, v_2, v_3, v_4, v_7\}, \{v_5\}, \{v_6\}$
(v_2, v_3)	Reject	
(v_4, v_7)	Reject	
(v_4, v_5)	Add	$\{v_1, v_2, v_3, v_4, v_5, v_7\}, \{v_6\}$
(v_1, v_2)	Reject	
(v_1, v_6)	Add	$\{v_1, \ldots, v_7\}$

Fig. 5.4. Sequence of steps for constructing a spanning tree.

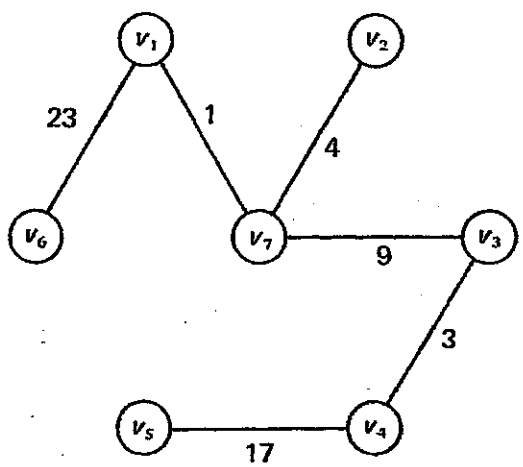

Fig. 5.5 A minimum-cost spanning tree.

```
     procedure SEARCH(v):
     begin
1.       mark v "old";
2.       for each vertex w on L[v] do
3.           if w is marked "new" then
                 begin
4.                   add (v, w) to T;
5.                   SEARCH(w)
                 end
     end
```

Fig. 5.6. Depth-first search.

```
     begin
6.       T ← ∅;
7.       for all v in V do mark v "new";
8.       while there exists a vertex v in V marked "new" do
9.         SEARCH(v)
     end
```

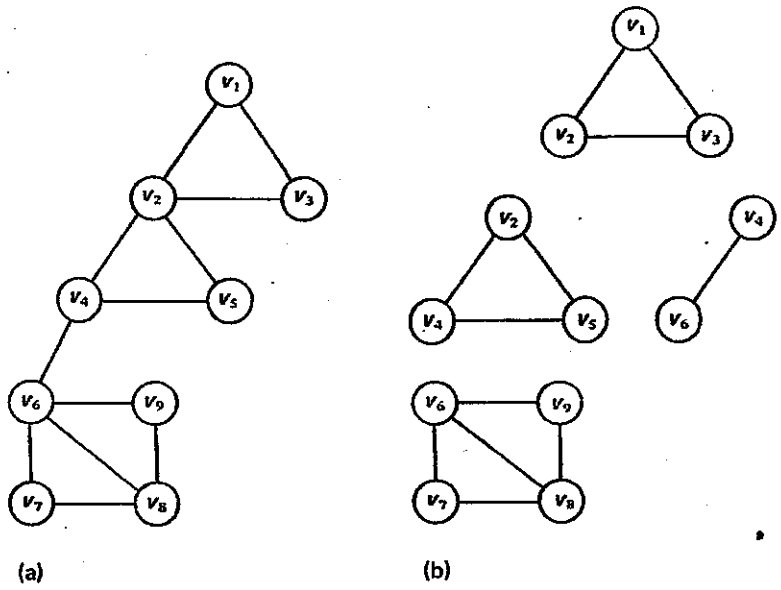

Fig. 5.8 (a) An undirected graph and (b) its biconnected components.

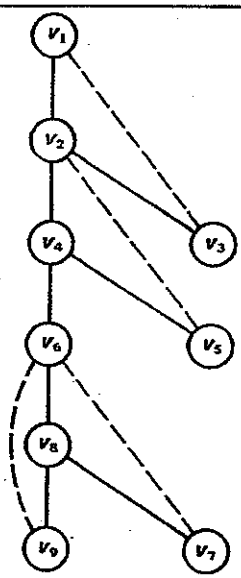

Fig. 5.9 A depth-first spanning tree.

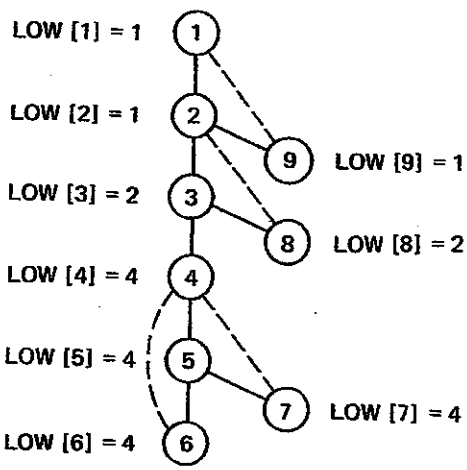

Fig. 5.12 Spanning tree of Fig. 5.9, with values of LOW.

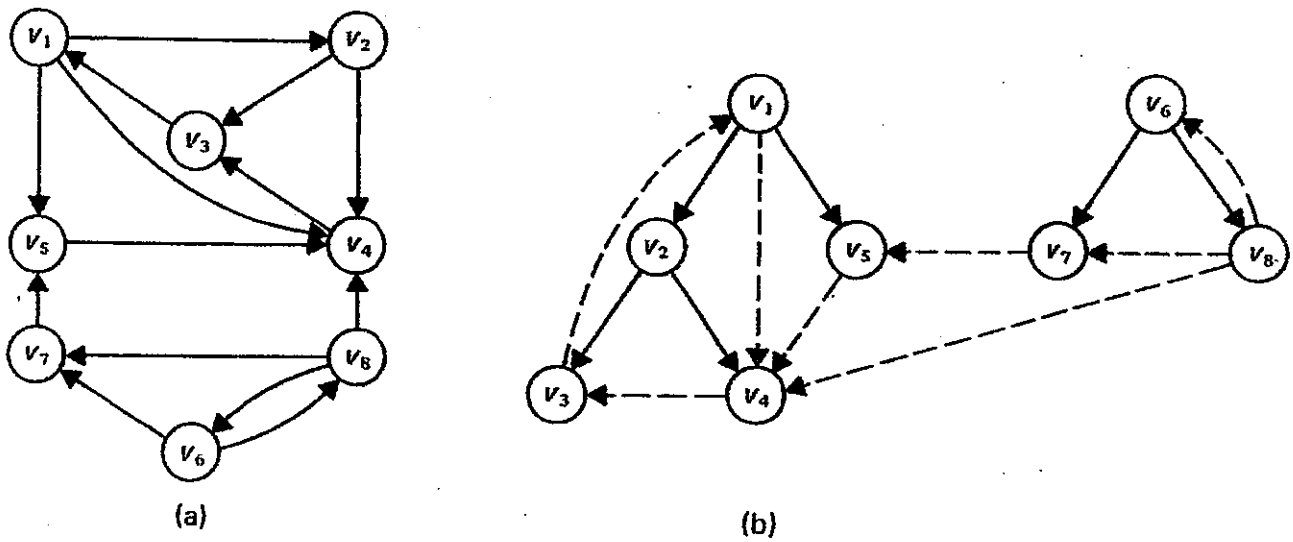

Fig. 5.13 Depth-first search of a directed graph: (a) directed graph; (b) spanning forest.