APPARATUS FOR HOLDING SUBSTANTIALLY CYLINDRICALLY SHAPED ELEMENTS

Abstract: A self-adjusting apparatus is provided for clamping and supporting a substantially cylindrical element. When an element is placed in the self-adjusting apparatus, the element is supported at about 90° from the surface on which the apparatus sits. This is achieved with an integrated clamping mechanism and, preferably, with a self-centering mechanism comprising flexure springs and a retaining-center pin. The clamping mechanism applies a substantially radial force on the element that is directly proportional to the substantially cylindrical element's weight, and can be less than the weight of the element, preventing damage to the element. The present invention can include a liquid management system for when the apparatus supports a tree trunk. The liquid management system can include a reservoir, a funnel for filling the reservoir, a capillary wick and mat that provides water to the tree even when it is above the level of water in the reservoir.
1. A self-adjusting apparatus for holding a substantially cylindrical element in a substantially vertical position with respect to a surface of reference, the self-adjusting apparatus comprising:
   a base for placement on the surface of reference;
   a receiving chamber attached to and extending upwardly from the base to define a receiving area for receiving the substantially cylindrical element, the receiving chamber defining an opening at an upper edge thereof;
   a retaining member for retaining a lower portion of the substantially cylindrical element within the receiving area, the retaining member disposed within the receiving area and below the opening and being vertically movable in response to receiving the substantially cylindrical element;
   a plurality of clamping mechanisms, each clamping mechanism coupled to the receiving chamber, and including:
   a clamping arm moveable along a radial axis, the axis being below the opening and above the retaining member; and
   a cable system operatively connecting the clamping arm to the retaining member to automatically move the clamping arm along the radial axis from a rest position to a clamping position in response to downward vertical displacement of the retaining member, to clamp the substantially cylindrical element in the substantially vertical position.

2. The self-adjusting apparatus according to claim 1, wherein, in the absence of an externally applied force, the clamping arm exerts a clamping force on the substantially cylindrical element that is directly proportional to the weight of the substantially cylindrical element.

3. The self-adjusting apparatus according to claim 1, wherein, in the absence of an externally applied force and for a given weight of the substantially cylindrical element, the clamping arm exerts a substantially constant clamping force on the substantially cylindrical element irrespective of the clamping position.
4. The self-adjusting apparatus according to claim 2, wherein the clamping force is less than or equal to a downward force due to the weight of the substantially cylindrical element on the retaining member.

5. The self-adjusting apparatus according to claim 2, wherein the clamping force is between about 0.002 and about 0.6 times the weight of the substantially cylindrical element on the retaining member.

6. The self-adjusting apparatus according to claim 1, wherein the clamping mechanism includes two cooperating elements exerting a variable frictional force on each other to prevent the clamping mechanism from unclamping in response to a substantially horizontal external force applied to the substantially cylindrical element.

7. The self-adjusting apparatus according to claim 6, wherein the clamping arm is a threaded clamping arm and the clamping mechanism further includes a threaded cylinder, the frictional force being between the threaded clamping arm and the threaded cylinder.

8. The self-adjusting apparatus according to claim 7, wherein the cable system includes a cable under tension and the frictional force prevents the external force from affecting the magnitude of tension in the cable.

9. The self-adjusting apparatus according to claim 6, wherein: the clamping arm is an unthreaded clamping arm; the cable system includes a cable and a fixed pulley; and the frictional force is between the cable and the fixed pulley.

10. The self-adjusting apparatus according to claim 9, wherein: the cable system further includes a first tension (T1) in the portion of the cable between the unthreaded clamping arm and the fixed pulley; a second tension (T2) in the portion of the cable between the fixed pulley and the retaining member; and the ratio between the first tension and second tension (T1/T2) is between about 0.08 and about 0.00008.

11. The self-adjusting apparatus according to claim 1, wherein the clamping mechanism further comprises a geared transmission to achieve a desired amount of radial displacement.
of the clamping arm as a function of the amount of vertical displacement of the retaining member.

12. The self-adjusting apparatus according to claim 11, wherein the desired amount of radial displacement of the clamping arm is between about 0.8 and about 1.2 times the vertical displacement of the retaining member.

13. The self-adjusting apparatus according to claim 1, further comprising a flexure spring mechanism attached to the retaining member to center the substantially cylindrical element within the opening.

14. The self-adjusting apparatus according to claim 13, wherein the flexure spring mechanism is a single ring-type member.

15. The self-adjusting apparatus according to claim 13, wherein the flexure spring mechanism has at least two flexure springs.

16. The self-adjusting apparatus according to claim 1, wherein the retaining member further comprises a center pin located substantially in the center of the retaining member.

17. The self-adjusting apparatus according to claim 1, wherein the clamping arms are radially spaced substantially equally around the perimeter of the receiving chamber and define a substantially circular opening whose radius is greater than the radius of the substantially cylindrical element.

18. The self-adjusting apparatus according to claim 1 comprising three clamping arms.

19. The self-adjusting apparatus according to claim 1 comprising four clamping arms.

20. The self-adjusting apparatus according to claim 1 wherein the self-adjusting apparatus further comprises a liquid management system including a reservoir disposed below the opening and within the receiving area.
21. The self-adjusting apparatus according to claim 20, further comprising a funnel in liquid communication with the reservoir for filling the reservoir with liquid.

22. The self-adjusting apparatus according to claim 20, further comprising a means for indicating the level of liquid in the reservoir.

23. The self-adjusting apparatus according to claim 20, further comprising a capillary system for drawing liquid from a lower portion of the reservoir up to a portion of the reservoir above the retaining member when the level of liquid in the reservoir is below the retaining member.

24. A self-adjusting apparatus for holding a substantially cylindrical element in a substantially vertical position with respect to a surface of reference, the self-adjusting apparatus comprising:
   a base for placement on the surface of reference;
   a plurality of posts, each post attached to and extending upwardly from the base to define a receiving area for receiving the substantially cylindrical element, the receiving area defining an opening between upper ends of the plurality of posts;
   a retaining member for retaining a lower portion of the substantially cylindrical element within the receiving area, the retaining member disposed within the receiving area and below the opening and being vertically movable in response to receiving the substantially cylindrical element;
   a plurality of clamping mechanisms, each clamping mechanism coupled to one of the plurality of posts, and including:
      a clamping arm moveable along a radial axis, the axis being below the opening and above the retaining member; and
      a cable system operatively connecting the clamping arm to the retaining member to automatically move the clamping arm along the radial axis from a rest position to a clamping position in response to downward vertical displacement of the retaining member, to clamp the substantially cylindrical element in the substantially vertical position.
25. The self-adjusting apparatus according to claim 24, wherein the number of clamping mechanisms is equal to the number of posts, and each post has one clamping mechanism coupled thereto.

26. The self-adjusting apparatus according to claim 24, wherein each clamping arm is integral with the post to which it is coupled.

27. The self-adjusting apparatus according to claim 24, further comprising a receiving chamber, the plurality of posts being integral with the receiving chamber.

28. A self-adjusting apparatus for holding a substantially cylindrical element in a substantially vertical position with respect to a surface of reference, the self-adjusting apparatus comprising:
   a base for placement on the surface of reference;
   a receiving chamber attached to and extending upwardly from the base to define a receiving area for receiving the substantially cylindrical element, the receiving chamber defining an opening at an upper edge thereof;
   a retaining member for retaining a lower portion of the substantially cylindrical element within the receiving area, the retaining member disposed within the receiving area and below the opening and being vertically movable in response to receiving the substantially cylindrical element;
   a plurality of clamping mechanisms each having a clamping arm moveable along a radial axis, the axis being below the opening and above the retaining member, each clamping mechanism coupled to the receiving chamber and operatively connecting the clamping arm to the retaining member to automatically move the clamping arm along the radial axis from a rest position to a clamping position in response to downward vertical displacement of the retaining member, to clamp the substantially cylindrical element in the substantially vertical position, and, in the absence of an externally applied force, the clamping arm exerts a clamping force on the substantially cylindrical element that is directly proportional to the weight of the substantially cylindrical element.
29. A self-adjusting apparatus for holding a substantially cylindrical element in a substantially vertical position with respect to a surface of reference, the self-adjusting apparatus comprising:
   a base for placement on the surface of reference;
   a receiving chamber attached to and extending upwardly from the base to define a receiving area for receiving the substantially cylindrical element, the receiving chamber defining an opening at an upper edge thereof;
   a retaining member for retaining a lower portion of the substantially cylindrical element within the receiving area, the retaining member disposed within the receiving area and below the opening and being vertically movable in response to receiving the substantially cylindrical element;
   a plurality of clamping mechanisms, each clamping mechanism coupled to the receiving chamber, and including:
      a clamping arm above the retaining member; and
      a cable system operatively connecting the clamping arm to the retaining member to automatically move the clamping arm from a rest position to a clamping position in response to downward vertical displacement of the retaining member, to clamp the substantially cylindrical element in the substantially vertical position.

30. The self-adjusting apparatus according to claim 29, wherein at least one clamping mechanism further comprises:
      at least one fixed element in physical communication with, and exerting a frictional force on, the cable system;
      wherein the clamping arm exerts a clamping force, which is reduced by the frictional force, on the substantially cylindrical element, the clamping force being proportional to the downward force of the substantially cylindrical element on the retaining member, the downward force being due to the weight of the substantially cylindrical element.

31. The self-adjusting apparatus according to claim 30, wherein the fixed element is a fixed pulley.
32. The self-adjusting apparatus according to claim 30, wherein the clamping force is reduced to between about 0.002 and about 0.6 times the weight of the substantially cylindrical element on the retaining member.

33. The self-adjusting apparatus according to claim 30, wherein the fixed element exerts a variable frictional force on the cable system.

34. The self-adjusting apparatus according to claim 30, wherein the clamping arm is an unthreaded clamping arm; the cable system includes a cable and a fixed pulley; and the frictional force is between the cable and the fixed pulley.

35. The self-adjusting apparatus according to claim 29, further comprising a flexure spring mechanism to center the substantially cylindrical element within the opening.

36. The self-adjusting apparatus according to claim 1, further comprising a flexure spring mechanism disposed within the receiving area and below the opening to center the substantially cylindrical element within the opening.