

Whether you're building a windmill, weathervane or toy airplane, the propeller can be very tricky. I have learned some nice details over the years that make the job easier and more precise. These directions cover propellers for weathervanes but are easily adapted for windmills and toys.

I hope this section helps make it easier for you.

### **Supplies needed:**

3/4" planking, larger than the hub  
1 good, 2' long knot free, clear 2" x 4" (for the blades)  
1/4" metal rod, 3" long with one end threaded about 1-1/2" in.  
2ea 1/4" nuts  
2ea 1/4" flat washers  
Small 1/2" brads  
1ea 1/4" brass sleeve or roller bearing.

### **Special equipment needed:**

Wood lathe with a drill chuck or jaws.  
Band saw, miter saw, or incredible skill with hand saws.  
Protractor.

### **Construction:**

You must first decide on how many blades you want/need on the propeller.

For weathervanes, I think five are by far the best looking but this is certainly the hardest to build with precision.

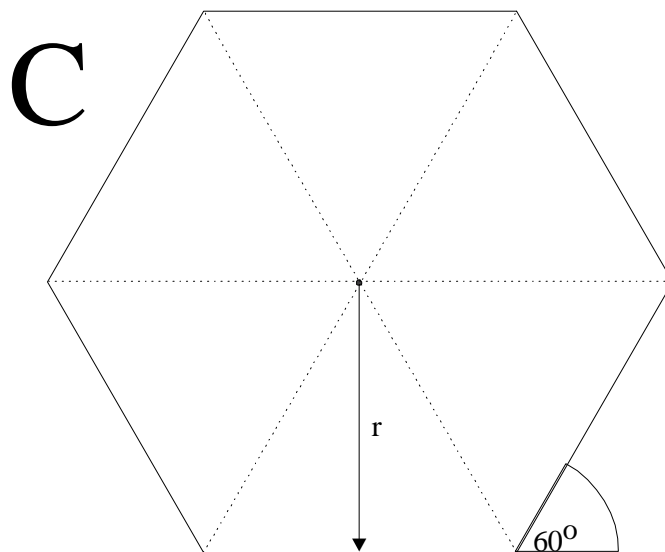
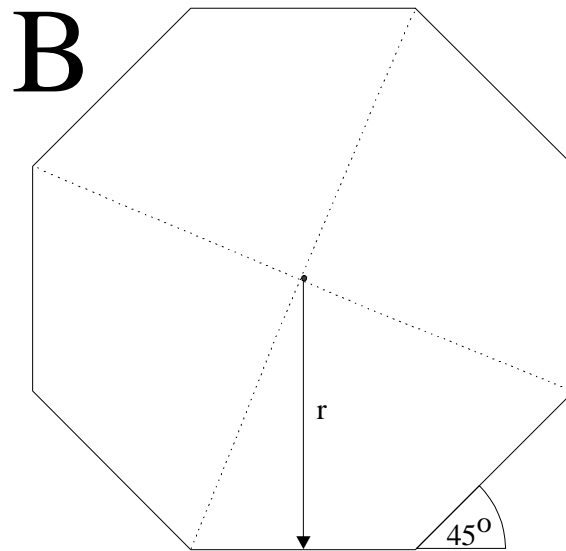
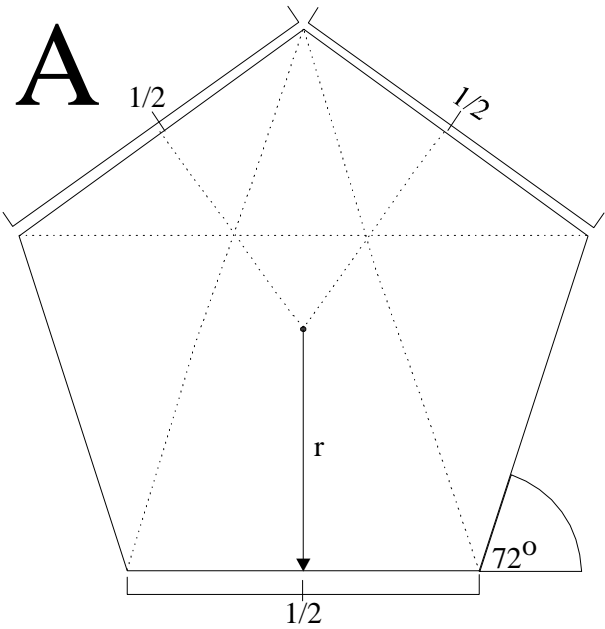
For the greatest power, use the eight blade propeller.

You must also decide the diameters of the hub (at least 2") and the overall propeller you want.

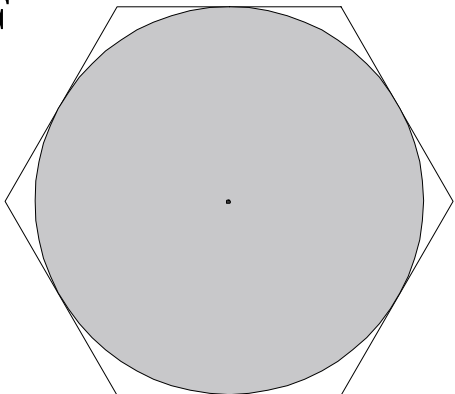
The blades should be either 1/8" to 3/16" thick. Thinner blades may warp but thicker ones are harder for the wind to turn.

1. Using 3/4" wood, cut out a square equal to exactly twice the radius (r) of the hub. See figures A,B, & C. (pg. 3)
2. Locate the exact center of this cube by drawing pencil lines from corner to corner.
3. Drill a 1/8" pilot hole in the EXACT center of the square.
4. Using trig, and the formulas shown on page 4, determine the length of each side of the hub for the shape you have chosen.  
\*\*\*\*\* If you are not good at trig, you can make sample cuts to find this dimension or \*\*\*\*\*  
\*\*\*\*\* shrink the templates from pages 8-10, to the size you want. \*\*\*\*\*
5. Using a protractor, carefully draw pencil lines (at the given angle) on the square to precisely locate all the cuts.
6. Cut the angles as indicated in figures A, B, & C. (pg. 3)
7. Cut out a sample blade as a guide for the thickness.
8. Next determine the angle needed for the blade recess as shown in figure E. (See pg. 4)  
You will need to 'test' this dimension by holding the sample blade to the edges.  
Mark the best position with a pencil.
9. Adjust your saw to cut this angle. (See pg. 5)  
Tilt the table if using a band saw. Cut a wedge to feed through with the hub if using a table saw.
10. Cut the groove for the blades in each flat edge of the hub to a depth of 3/8" to 1/2" and to the thickness of the blades.  
You may need multiple cuts for this. The blades should fit tightly in the grooves.
11. If you do not have a lathe, you can use a circle cutter on your bandsaw to round the hub.
12. For the lathe, drill a 1/4" hole in the hub center.
13. Place a nut on the 1/4" bolt and thread it down far enough for the hub, washers and other nut to fit on the rod..
14. Place a washer on the 1/4" bolt and insert it through the hole. (See figure E, pg. 4)
15. Place a washer on the back of the bolt and secure it with a nut.
16. Mount the hub in the headstock and turn it down until it is just round.
17. Remove the hub from the lathe.
18. Cut all the blades from a single piece of wood to keep the density of the wood as uniform as possible.
19. Shape and sand the blades before assembly. (See templates, pg. 11)
20. Position and glue the blades into the hub. (See figures G & H, pgs. 6 & 7)
21. Lie the hub upside-down and flat on a level surface. Make sure all the blade tips are even.
22. Nail the blades into the hub with very small brads.
23. Be sure to dull the brad tips by tapping them with your hammer to prevent cracking the thin wood.
24. Allow the glue to dry before proceeding.
25. Using a scrap piece of lumber, mount your sleeve or bearing in a vise and slip the propeller into it. Oil as needed.
26. Mark the bottom blade with a pencil.

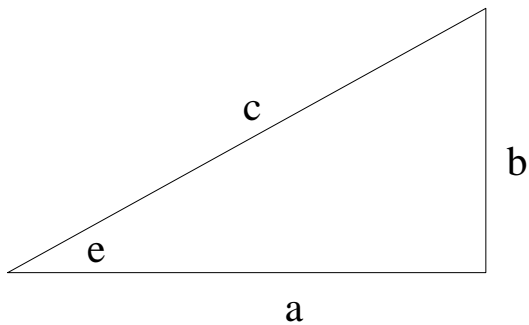
27. Test the balance of the propeller by spinning it. If it always stops with the same blade down, that blade is heavy.
28. Cautiously sand a little from the heavy blade and test again. Also, placing small brads in the tip of the opposite blade may help.
29. When reasonable balance is found, seal and paint the entire propeller then test for balance again.
30. Add another coat of paint to the lightest blade to help balance it.
31. Insert the propeller into your final project.



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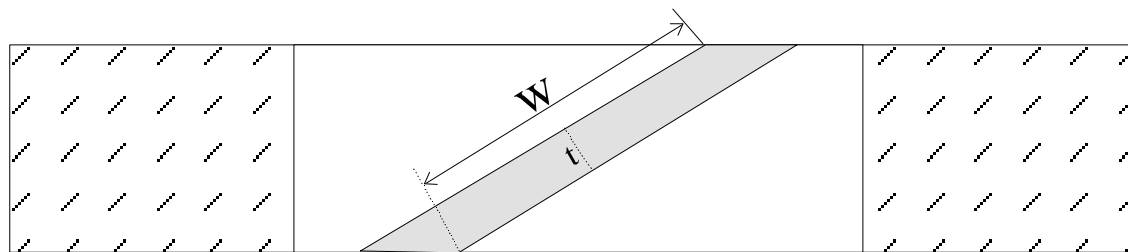
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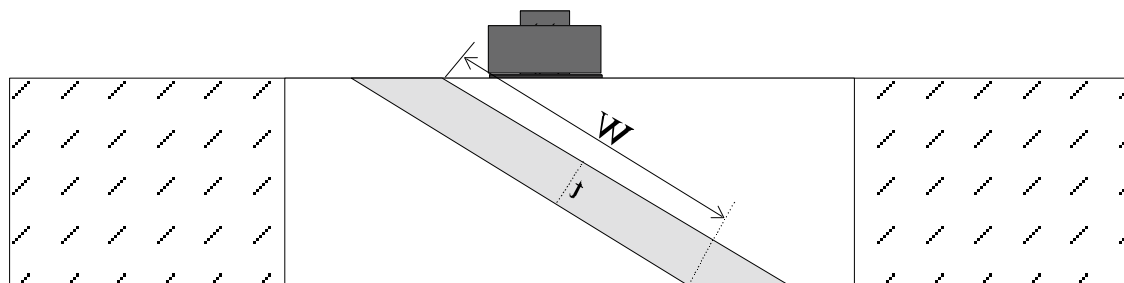
$$a^2 + b^2 = c^2$$

$$b^2 / a^2 = \sin^2(e)$$

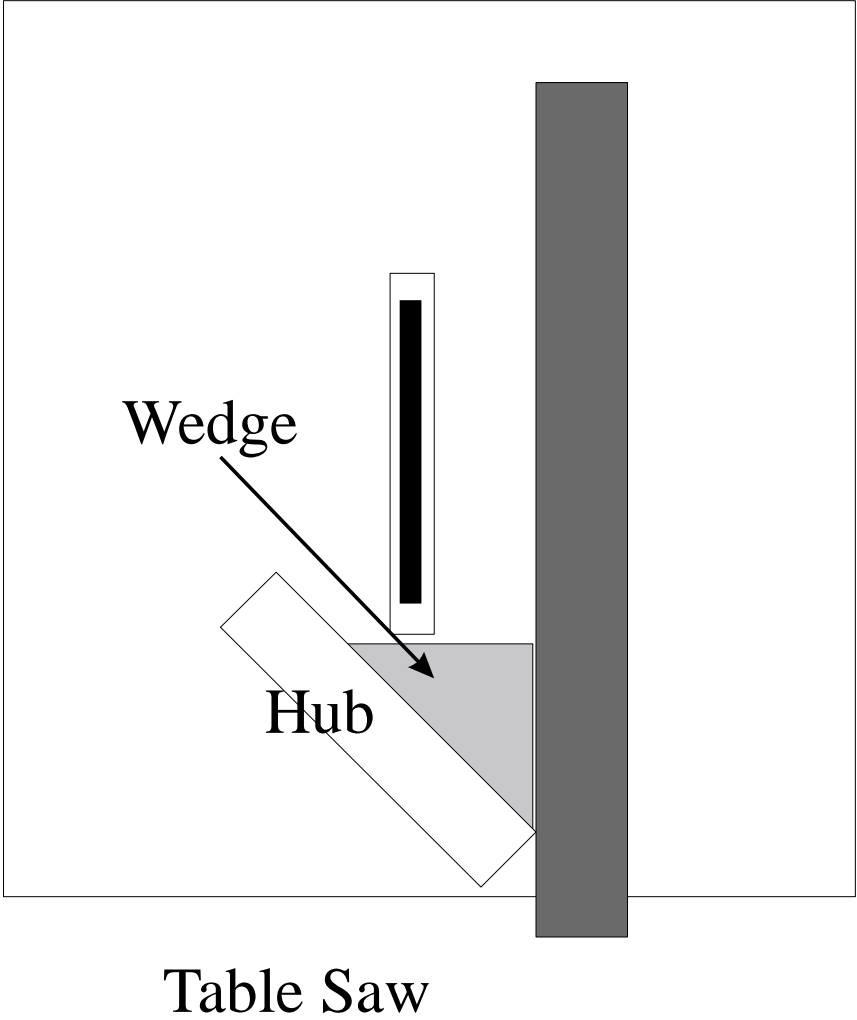
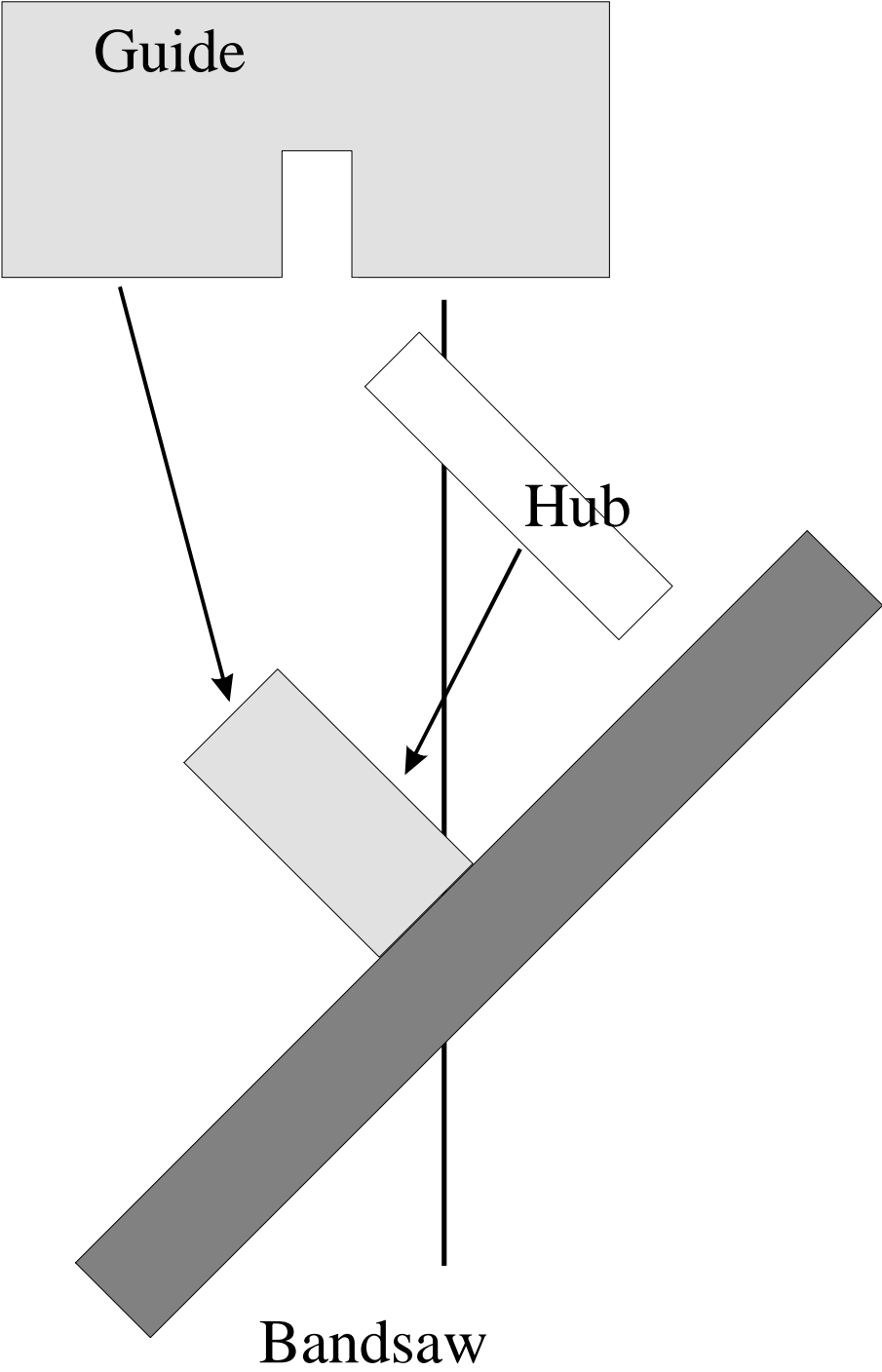
E

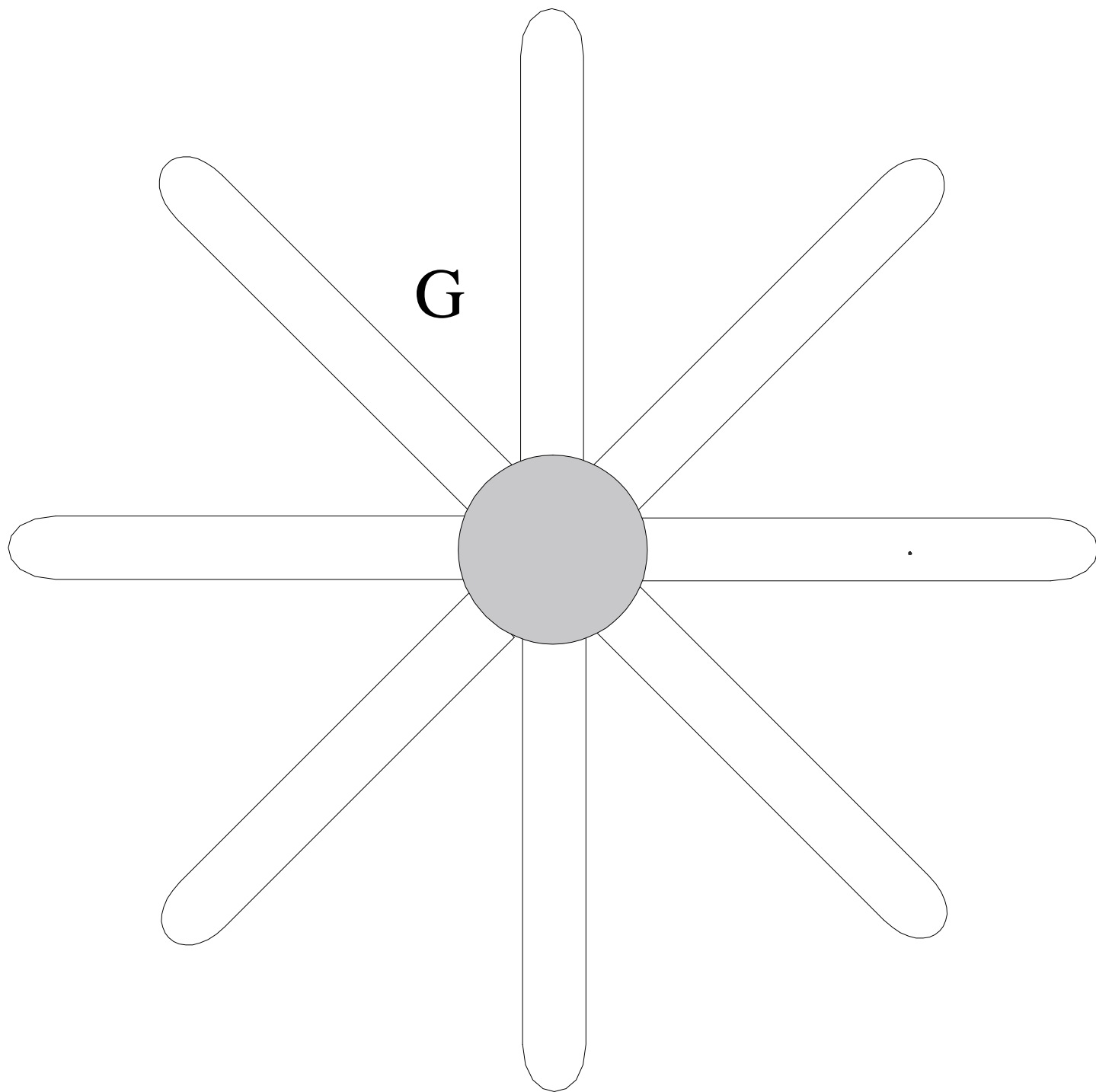


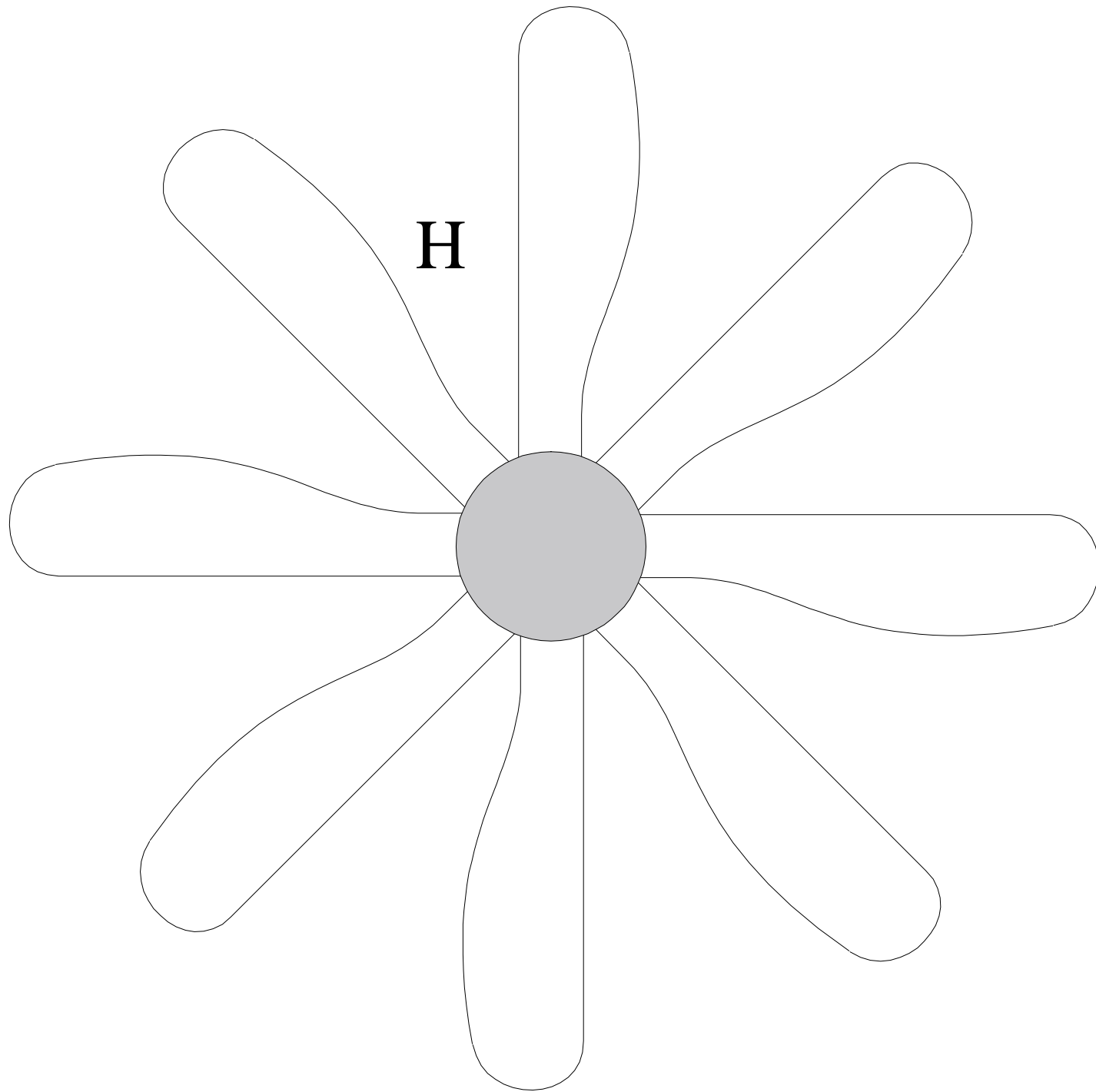
CCW rotation



CW rotation







H

