Cam Fundamentals

With emphasis on Ornamental Lathe and Rose Engine applications.

My name is Vern West. I have operated lathes since I was 12, and have been paid to operate them from 1967 thru 2008. Nearly all of this was turning metal. I have been exploring metal spinning, wood turning and Ornamental turning (modified MDF Rose) since 2007. My hands-on work with cams occurred from 1981 thru 1985. Note: throughout this article you may substitute the word rosette for the word cam.

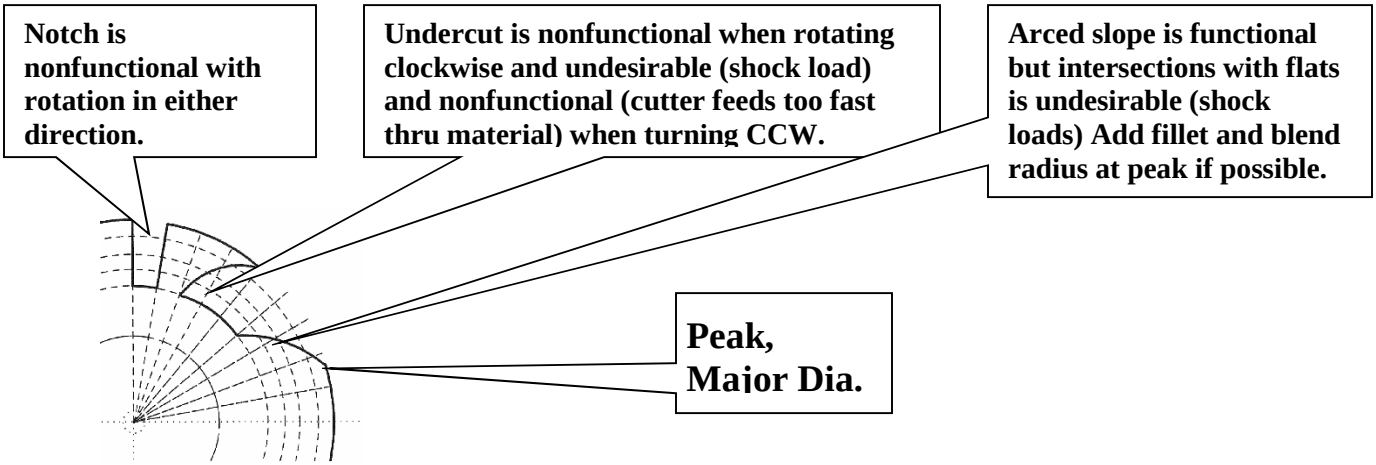
Increased knowledge of cam fundamentals will be useful in assessing if cams designed by others will be useable or useful for your application and will help avoid unusable or undesirable situations if you venture into designing or producing your own cams.

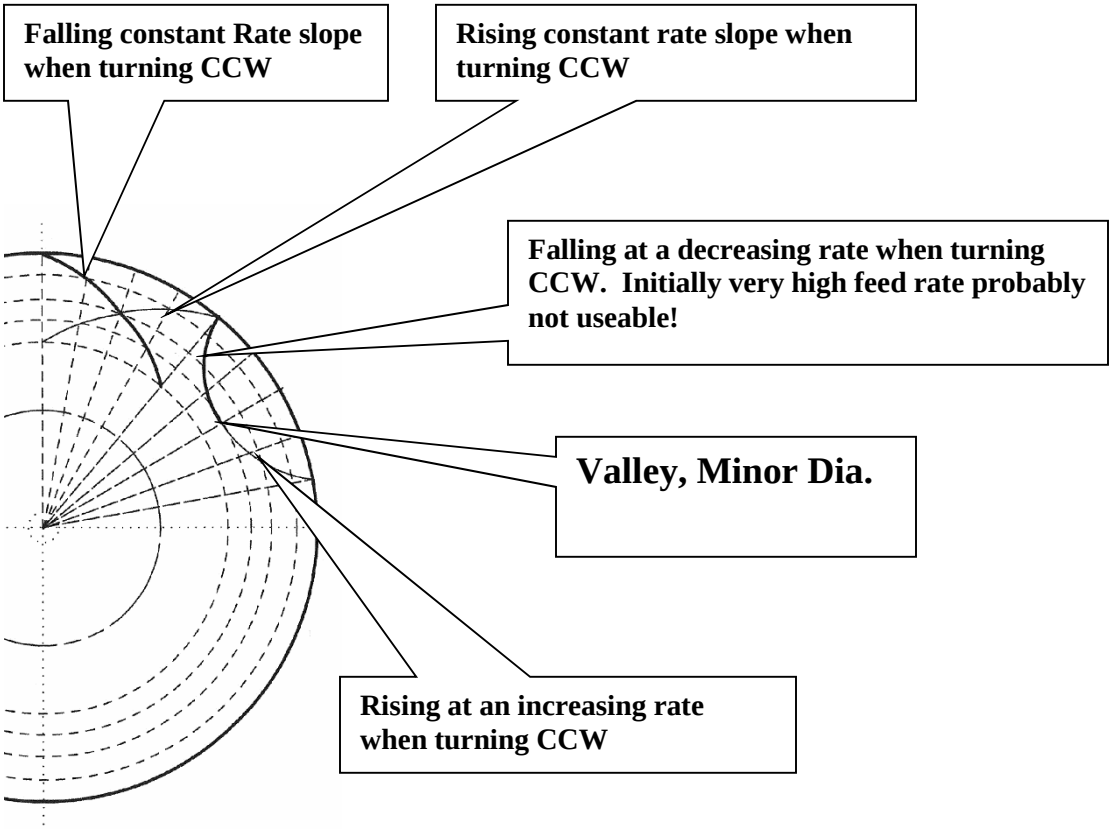
I plan on showing examples and using the following terms with respect to cams.
Major Dia., Minor Dia., Peak, Valley, Flat, Slope, Reversible, Rise, Fall, Constant, Increasing, Decreasing. I will show examples of undesirable and non functional elements as well as useable forms. I will not show or try to establish the limits between what is useable vs. unusable or between undesirable and functional. There are many factors that bear on individual situations. I will make some general observations. Cam Followers may be divided into two categories: Rubbers and Rollers. I recommend Rollers for any use where they will allow the detail required or desired. They will obviously not follow into narrow Valleys.

Cams may be produced in a number of forms. The disk, bell and combination forms are used on Ornamental and Rose Engine applications. I do not have pumping capability on my Rose Engine nor do I have the computer skills to generate drawings of the bell form.

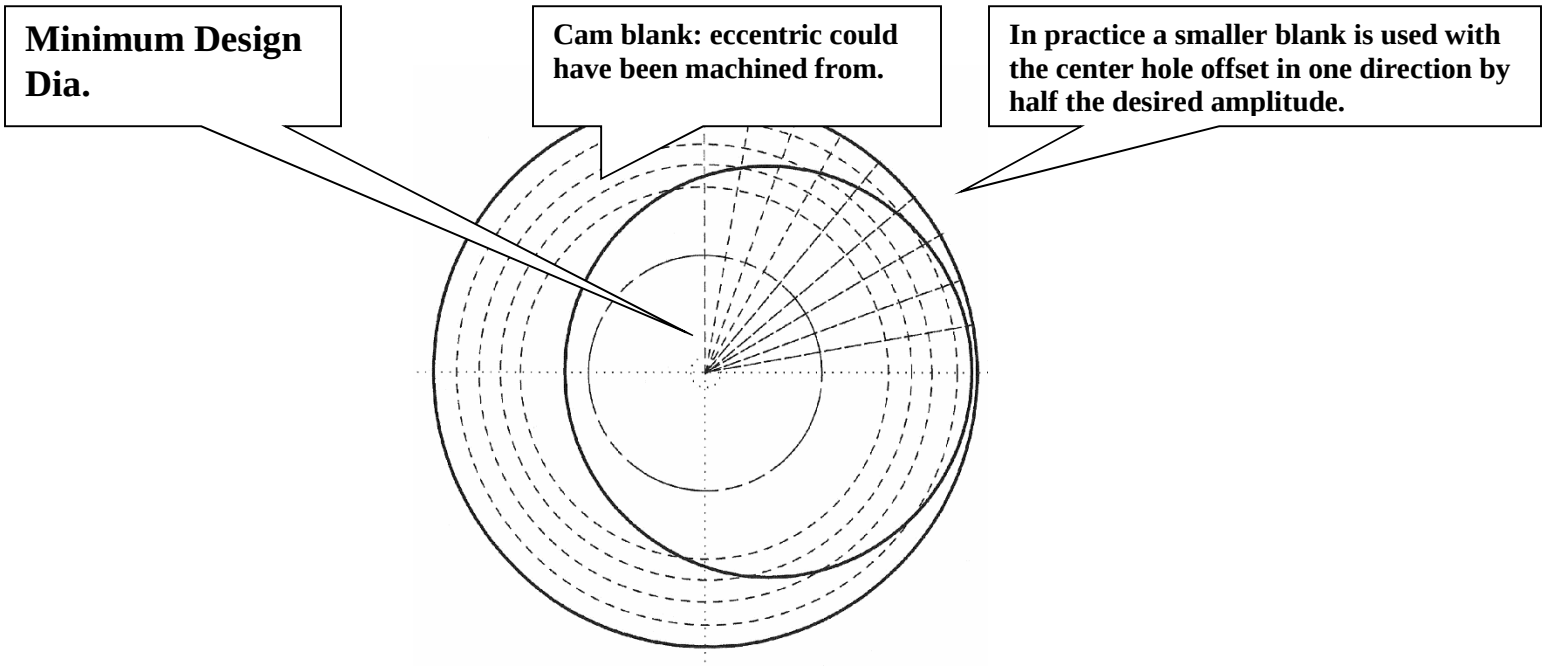
Cam Design Limitations:

A. Minimum Design Dia. Each cam will have a Minimum Design Dia. This minimum will be affected by the shaft dia. It rides on, the location on the shaft and any requirement and limitation of clamping, phasing, or follower extension.
B. Maximum Dia. Each cam will have a maximum design dia. (Obstructions that must be cleared to allow the cam to turn). Cam blanks are often stocked at this size and occasionally at other smaller sizes. Maximum Dia. should be labeled as two times the largest radius. (Some cams have an odd number of peaks).
C. Maximum Number of Peaks. A cams maximum number of peaks is limited by the cam followers nose radius, the Amplitude, the maximum rise and fall angles, and the Maximum Design Dia.
D. Max Amplitude. Can't be larger than one half of the difference between Maximum Design Dia. And the Minimum Design Dia. In practice it is often desirable to have a cam Maximum Design Amplitude similar to the travel available to the cutter or head travel.
E. Maximum Rate of Rise. Desirable machining conditions and functionality both limit the maximum rate of rise.
F. Maximum Rate of fall. Desirable machining conditions and protecting the machine from heavy shocks both limit the maximum rate of fall for all O.T. and Rose Engine applications.





The eccentric circle makes the simplest cam and an example of a reversible cam as well. It can be run both CW and CCW. It has one Peak and one valley, though one must be thinking cams to see either. If you divide the eccentric circle into quarters with one axis perpendicular to the direction of the offset from the cam axis of rotation you will get arc segments with rising and falling slopes. And arc segments with increasing and decreasing rate slopes. Their location depends on which way the cam is turning. The amplitude of this cam is twice the amount the eccentric is offset from the cam axis. Think about how you can
make this cam with various amplitudes in fixed increments or fully adjustable within a fixed range (for example from 0 to ¾").



Cam complexity (amount of detail) is limited by the maximum rise & fall rates and the radius of the cam follower. Using cam followers with a smaller nose radius or larger Dia. cam will allow more detail to be produced. Larger cams will create lower rise and fall angles and a lower tendency to over drive the spindle (undesirable jerky motion) and allow the use of larger cam followers. Increasing a cams size in relation to the parts produced will decrease part defects due to the leverage involved. If you cannot increase the cam size keep the parts small.

All of the cams available from two manufacturers of Rose Engine accessories are reversible, but they do not have to be to function. Articles have been written and devices constructed to translate irregular cross sectional plans into cam shapes capable of reproducing the original, (for example a silhouette of a famous person). Heart and shamrock shaped cams are available.

The Interaction of cam elements with tool slides and resulting part form and finish is quite varied and can often be unacceptable. An understanding of these interactions will lead to more useful cams. Part shape or generated pattern are often the main concerns when selecting a cam for O.T., but the variable speed of advance of the cutter into the work piece will frequently need to be considered. Manually operated Rose Engines are Likely superior for their ability to adjust the rate of spindle rotation over preset speeds or even electrical variable speeds. Computer controlled spindle speeds could be equal or superior but then you would not be controlling any other motion with cams! When using lathes with preset- able speeds or variable speeds fewer cam forms are suitable. Likewise, material choices will be restricted further as well. I did not get an easier machine to operate when I incorporated **a powered spindle into an O.T. set up.**