Pineapples, Corncobs & Other Hobbing Matters

William L. Janninck

Question: I have worked in the gear manufacturing department for over 15 years, and just recently someone told me about a pineapple hob. I wonder just what kind of tool this is and what it does.

"Pineapple hob" is the rather picturesque name the shop people have given to what really should be called a tapered-end, tangential-feed, worm gear hob. It is used to produce throated worm gears on a hobber equipped with a special feed slide which moves the hob tangentially to the gear, rather than in the usual axial feed motion. Standing on its big end, this multiple-start, high-lead-angle hob with its helical flutes and long slow taper, immediately reminds one of a pineapple. Hence, the name.

A lot of the names given to hobs, such as gear hob, involute spline hob, parallel key spline hob, herringbone gear hob, camshaft hob, ring gear hob, ratchet hob, or skiving hob, are properly indicative of their purpose and use. But many have other pictorially descriptive second names. For example, the term "pancake hob" usually means any narrow-faced hob where the width is much less than the diameter. A camshaft hob, which is used to cut the integral gear on an engine camshaft, can also be called a pancake hob.

What about a fly cutter? It is a tool used on a tangential feed hobber to cut or fly-out worm gear teeth. Basically, it is a hob with all but one tooth removed. Usually this cutter is composed of a body with an adjustable blade clamped in place. If it is multiple-start and has only one tooth left per start, it may also be called a pancake hob. If the hob has five or six starts and, thus, has only five or six teeth or points, it may be called a star hob. An earlier name for carbide-tipped fly cutters with only one tooth is the snail back cutter, an allusion to the long, rounded-off tooth used to back up the carbide.

The tapered end hob, the tapered hob, and the tapered root hob have similar names, but very different functions. The first is a hob with a short, tapered end used to cut helical gears. This feature is used to spread the chip load over a broadened area to reduce the danger of hob tooth overload, wear, and failure. The next is a hob tapered over its entire form and used on a hobber with oblique or diagonal feed capability to cut tapered forms, such as tapered serrations or splines. A tapered root hob has a tapered outside diameter, but the form itself is not tapered. It is used on an oblique hobber to generate parallel or involute splines where the root of the spline is conical instead of cylindrical.

"Corncob hob" is another coined name for extra long, but rather small diameter gear hobs. These were developed as part of a plan to increase gear productivity in high-speed hobbing by increasing hob rotational and indexing speed and by having a long useable hob face for long in-machine time. They are usually coated with bright yellow titanium nitride. A quick

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glance immediately reveals the corncob connection.

Some hob names, such as "convolute hob", are not exactly descriptive. This name is applied to a single convolution hob that is used for cutting face gears and face-serrated couplings.

The thread hob and rack hob are not hobs at all, but are form milling, nongenerating cutters used for machining screw threads or rack gear segments. Their names are derived from their appearance. From a short distance they look just like gear hobs.

Question: When setting up a gear hobbing machine, we on the shop floor are told to be sure to set the hob swivel angle as exactly as we can. Does this setting really have to be so precise? What happens if it is off a bit, say some 15 or 20 minutes? We are sure we have run some hobs that were off on this setting, and we never seemed to have any subsequent problems.

The answer depends on whether you're cutting cylindrical gears or worm gears.

Cylindrical gears are much more common. These can be separated into two discrete types, spur and helical.

The hobs for gears will have a lead angle marked on the hub end or body for set-up purposes. When cutting a spur gear, the hob swivel is set to this angle, so the thread of the hob will line up with the gear tooth normal section. On a spur gear the teeth are parallel to the gear axis. On many manual machines, the best one can set the machine is plus or minus about five minutes, based on a vernier scale. Of course, on occasion the true zero setting on the machine should be verified for alignment by use of master arbors and swing indicators.

Regardless of the accuracy of the setting angle, the hob still performs well as a cutting tool, properly forming chips and producing gear teeth. Adjusting the swing angle will not change the profile produced; the involute cut will be correct even with an incorrect setting angle.

To prove this, we conducted tests, supported by mathematical computer analysis, using a 4DP 20 PA Class A hob, where we cut five test gears using the same hob. The hob swivel was first set at the proper angle, and a gear cut and then offset by 1-degree intervals up to 4-degree swivel angle error. All five gears checked correctly on the involute produced, with the exception that the fillet radius became larger as the set error went up, and the radius to the involute starting point also went up. Since we maintained the center distance between hob and gears (that is, we kept a constant gear root diameter) we found that the hob swept out a wider space and reduced the gear tooth thickness by .005 inches per one degree of swivel setting error. Backwards interpolation implies that a swivel setting error of five to ten minutes in general is sufficiently close.

When considering the cutting of helical gears, the same results apply. However, the correct swivel angle for like-hand hobs and gears is the gear helix minus the hob lead angle. But one must be careful if a short lead hob is used, since in this circumstance, the hob setting is the helix at the generating circle minus the hob lead angle. Since short lead hobs are usually single-purpose, the hob lead angle as well as the proper swivel setting angle are both marked on the hob.

On occasion a slight swivel angle adjustment is used on purpose to make a hob cut a slightly wider space than the hob was designed for and yet hold the over-pin measurement and root diameter relative.

When considering the cutting of throated worm gears, the swivel setting angle is of much higher importance, and this is especially so on the higher lead angle jobs, heavily loaded drives, or precision sets. Typically these sets will use hobs with smaller oversize, and the

less the oversize, the more sensitive the setting angle. However, most single-start sets tolerate more oversize and are less sensitive than multiple starts. On many of the sensitive sets, five minutes of accuracy in the set angle may be insufficient, and a pin-and-dial indicator may be used to make positive small adjustments. Although a correct zero point is not necessary, because you can make moves relative to the last position, a correct zero point is recommended. On worm gears, where the contact pattern and the gear set axis angle is measured on a separate inspection machine, the information is fed back to the gear hobber as small swivel adjustment using the dial indicator.

Some time ago, we were assigned to design the hobs necessary for a new style of very simple spur gear hobber. Besides cutting only spurs and moderate pitches, it was to have no hob swivel, and the table was to be fixed at a zero angle, thereby eliminating all the extra components involved. This complicated design procedure for the hob was required in order that a zero set angle would be maintained. We were successful on the tooling for a few parts which were tested, but the inability to design tools to meet certain other part specifications caused the project to be stopped. ■

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