New Concepts in CNC Gear Shaping

When is a gear shaper not a gear shaper?

Klaus Felten
Michael Johnston

On today's economy, when purchasing a new state-of-the-art gear shaper means a significant capital investment, common sense alone dictates that you develop strategies to get the most for your money. One of the best ways to do this is to take advantage of the sophistication of the machine to make it more than just a single-purpose tool.

With the right machine adjustments, cutting tools and auxiliary attachments, a modern gear shaper can produce a variety of parts beyond a simple circular gear. It can make variants of square external profiles, splines, spur couplings with straight-sided teeth, face gears with non-parallel axes, sector steering gears and racks, parts for hydraulic motors and pumps and elliptical gears. It can also perform more than one operation in a single setup.

Following are six examples of the kinds of applications a modern gear shaper can do.

External Gear Machined in One Setup

The task is to machine an external gear with face width bigger than the stroking length of a given machine and specific runout conditions. This is done with a gear shaper with a sliding cutter head and special SSM software.

Requirements

- Cutter head slide machine with high accuracy
- Special back-off cam
- Special software
- Dialogue programming
- Special cutter holder

Possible Applications

- Production of extended stroking length
- Shaping parts with limited runout, dependent on pre-set stroking length
- Shaping of parts without runout
- Optimizing shaping conditions

Machine Data

- According to customer requirements

Conveyor Units (Gate Parts)
Pump Gear for Conveying of Granulates
The task here is to shape all outer contours; no teeth. The required surface finish is Rz = 16µm = 400 µinch (finish shaping).

The Specific CNC Programs Used

- Main Program: Positioning data and signals for tool changer
  Cutting data with number of cuts
  Stroking speed and radial infeed
- Sub-Program: Track data, turning direction

Machine Data

- Two-cut operation (roughing/finishing)
- Cutting speed – 25 m/min
- Total cycle time – 113 min
- Peripheral length – 800 mm

Cutting Tool
Two disc-type cutters, ASP 60 (different diameter, positioned on one cutter holder), one for concave and one for the convex section.

Hydromotor
The task is shaping of internal and external non-circular gears. Three major steps are necessary to produce the a.m. components.

1. Calculation of the generating curves
2. Calculation of the geometry of the gear
3. Calculation according to the collision diagram

Machine Requirements

- Highly precise rotation axes C and D
- Highly precise X-axis with extremely low backlash for forward and backward movement
- High-speed CNC control and dialogue programming as well as software for manufacturing non-circular gears

The complex geometry of the internal involute gear requires that the cutting tool will be mounted eccentrically and that a special back-off cam is available.

Pedal Arm for Bicycle Polygon Internal Profile
The task here is to cut a tapered internal square.

Machine Data

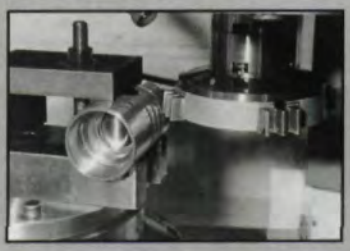
- Special back-off cam for taper cutting
- Face Width: 14.5 mm
- Number of Cuts: 2
- Feed Method: Generating
- Cycle Time: 1.05 min

Cutting Tool

- Shank-type cutter, polygon, TiN-coated

Dr. Klaus Felten
is director of research and development for Liebherr/Lorenz, Ettlingen, Germany.

Michael Johnston
is product manager for Liebherr America, Saline, MI.



Steering Segment and Steering Rack

The task is to shape a steering gear with three teeth. The thickness of the center tooth is different and will be varied by moving the X-axis during shaping. A steering rack with two teeth (three spaces) must also be shaped.

Machine Data

- Number of cuts – 2-3
- Feed method – Plunging without generating motion
- Machining method – Generating of axes C and D and interpolation of X-axis
- Cycle time –
  1. Steering segment – 0.7 min., column inclination for taper cutting 4", special back-off cam for the steering segment
  2. Steering rack – 1.5 min

Cutting Tool

1. Disc-type cutter with segments, 36/12 teeth for the steering rack
2. Disc-type cutter with 35 teeth for the steering segment (shaft)

Both made of ASP 30 material + TiN.

Variable Valve Timing Unit

The task is to cut the cam shaft part. This involves finish-shaping of two position-oriented helical gears, each with a block tooth, in one setup. The complete unit consists of three parts:

1. *The Chain Wheel*
   internal helical gear* — shaped
   chain wheel for sprocket chain — hobbed

2. *Shaft Cam*
   internal* and external* gear — shaped (see picture)

3. *Flange Case*
   external* gear

* Each of these gears had a block tooth and was shaped with the same cutter.

Number of Teeth

- Internal – 20, external – 29

Machine Data

- Number of cuts – 2
- Feed method – plunging without generating motion
- Cycle time – 3.35 min

Cutting Tool

- Solid wafer, ASP 30 + TiN, 14 teeth

Positioning of the cutter and the size of the gears are controlled and monitored by the machine by an electronic measurement device via tool data stored in the cutter adapter (E-Prom).

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