Chamfer-roller tool

Why gears require a rolling operation

Gears require a rolling operation after chamfering due to the plastic deformation caused by this operation and to eliminate the “burs” or swellings that form on the material (see figure N°1).

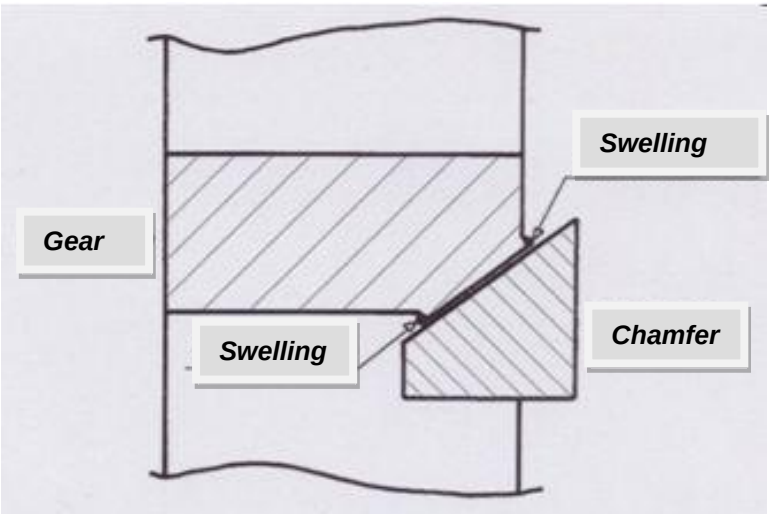

Figure N°1

Whilst burs on the gear face may be removed by deburring tool, those on the lead remain. These burs, usually in the range of 0,05 – 0,07 mm, cause problems in subsequent grinding phases and actually put the grinding wheel at risk.
At this point a rolling operation on the gears becomes necessary.
Although there is no doubt that burs must be eliminated when the gear is to be finished by grinding, it has not been demonstrated that the requirement arises when the subsequent operation is shaving. But of course the bur inside of the tooth cannot be helpful.

Traditional rolling methods

Up until today the method used for rolling gears required a machine with two work heads. The first one for fitting a chamfering tool and the second for a two-in one rolling and deburring tool, like in figure N°3.
This kind of solution cannot always be used since it is not suitable for tooth root filet, shaft gears or gears with sloping faces (see figure N°2)

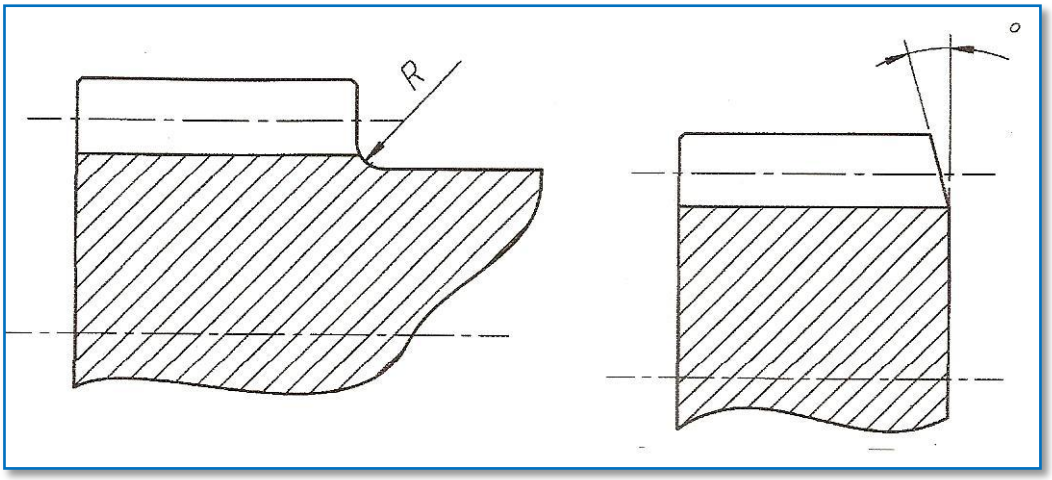

Figure N°2- *Gear with inclined face and face with radius*

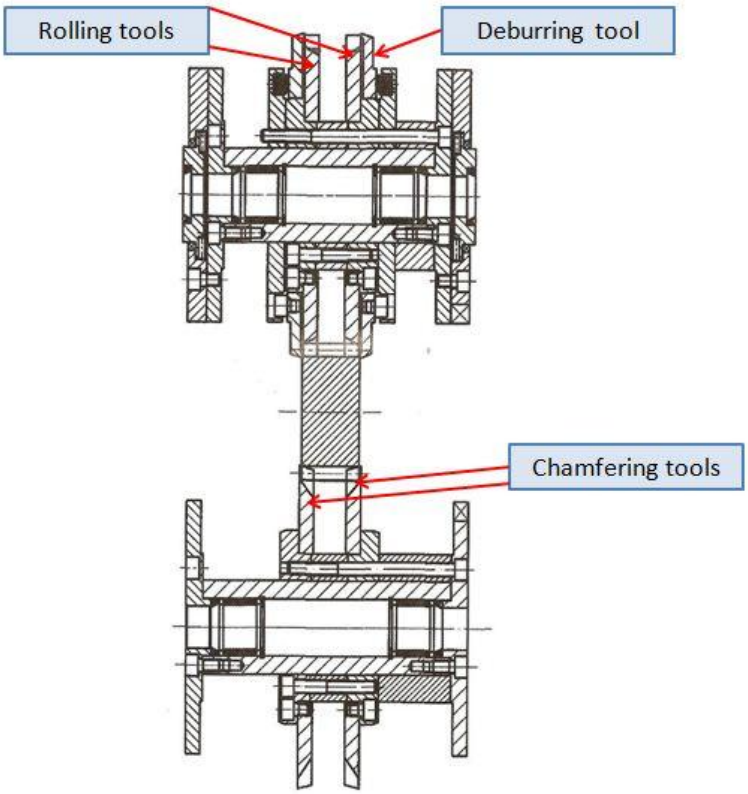

Figure N°3- *Group of chamfering tools and head with rolling an deburring tools*

Samputensili method

With the Samputensili chamfer-roller tool there is a more practical solution where the chamfering and rolling operations are carried out with a single tool fitted to one of the machine's two work heads. Deburring will then be carried out by another tool fitted to the second heads (figure N°4).

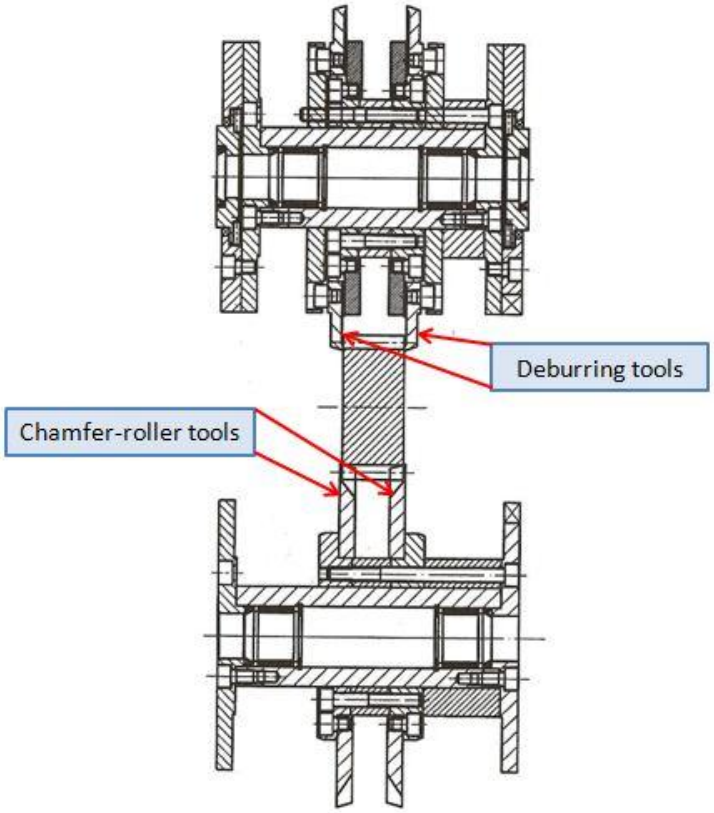

Figure N°4- *Head with chamfer-roller tool and head with deburring tool alone*

In this way the gear teeth not longer present typical chamfering burs along the lead.
The burs shown in the upper part of diagram of figure N°5 are without rolling operation. In the bottom part of diagram we can see that the burs are disappeared.

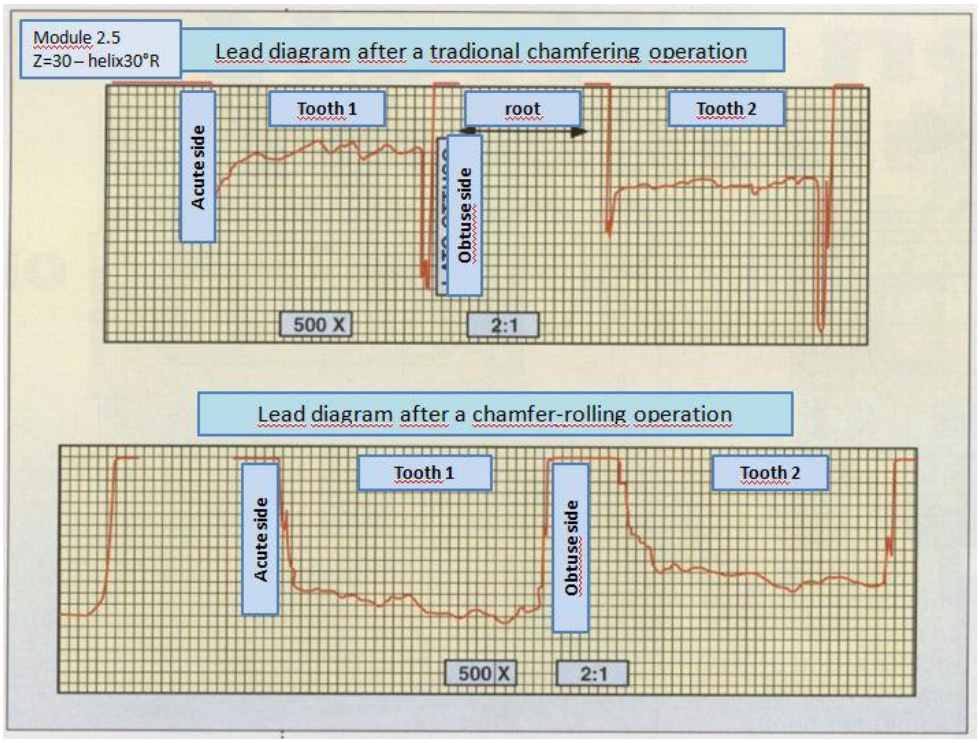

Figure N°5-*Lead diagrams without an with rolling operation*

The Samputensili chamfer-roller tool is composed of two sectors each of 180°.
In one sector we have chamfering teeth and in the other rolling teeth and in both sectors each tooth works simultaneously on both gear flanks.
This solution is far easier than another suggested in which the chamfering and rolling teeth alternate along the entire 360° tool circumference. The figure N°6 shown the schematic drawing of this tool and the figure N°7 shown a picture of the chamfer-roller tool.

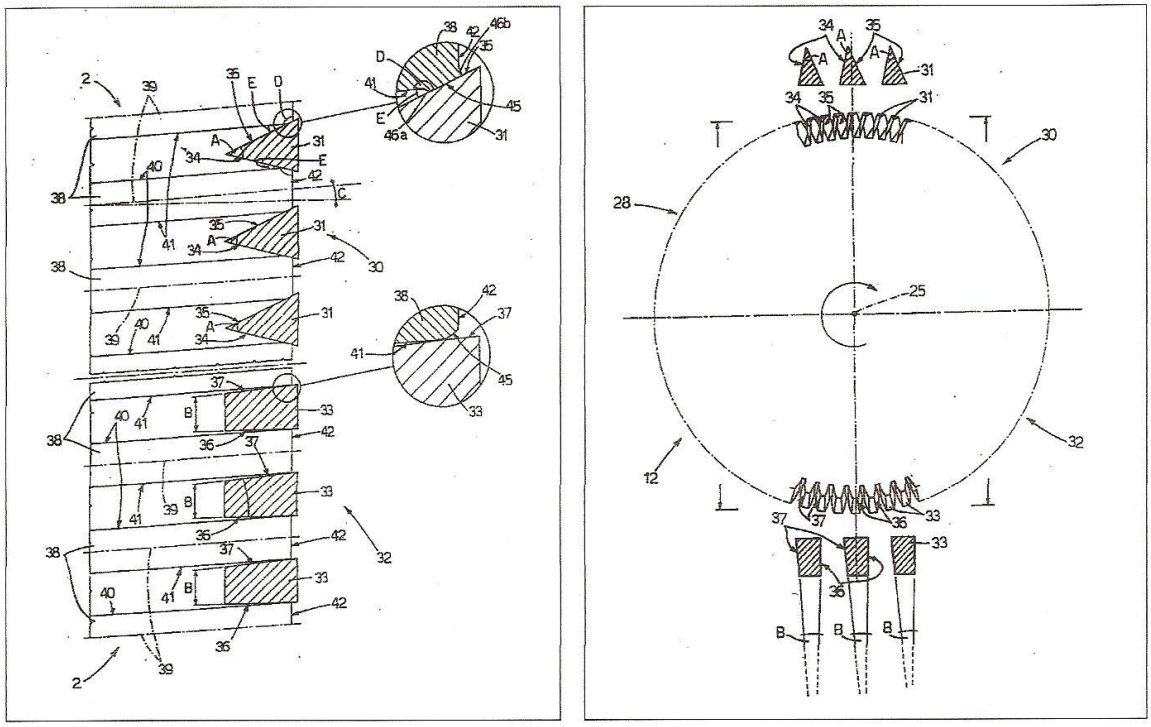

Figure N°6 – *Schematic drawing of chamfer-roller patented by Samputensili*

Figure N° 7 – *Picture of a Samputensili chamfer-roller tool*

Advantage and disadvantage of this solution

Unlike other more traditional methods this process makes it possible to camfer, roll and deburr gears with special geometry, what is more, for gear with parallel or without shoulders, it is possible to use just one work head.
With the chamfer-roller tool it is possible to use just one work station to chamfer, roll and deburr shaft with two set of teeth and use the same tool to process gear with different lead angle in a range of 2°.
Finally, by merging two tools in one, we may envisage a reduction in overall tooling costs that would otherwise be required for three operation.
Any increase of the cycle times brought about by the lower number of chamfering teeth is negligible as on the whole chamfering is not a bottleneck area of gear production.
On the contrary, hobbing machine do not guarantee a level of productivity that saturates chamfering machine.
The main handicap of this solution is the difficult or even impossibility of regrinding the tool. Just a simple regrind will alter tool pitch. In reality the problem is not so great with the chamfer-roller tool since it is subjected to a super-finishing process that produces a very high level of hardness.
Thus, in term of cost, the incidence of tool replacement compared to regrinding is not important.
The rolling operation generates a work hardening in the deformation area, but it is yet to be demonstrated whether this has positive or negative consequences on subsequent grinding or shaving operation.