Because of the size of the components, endurance tests were not executed. No the total about the increase of the faitigue strength are available therefore. The residual compressive stress characteristic served as judgment criterion for the selection of the optimal machining parameters.

5.2 Turbine disks

Turbine disks of steam turbines partially become exposed to hot steam contaminated with critical chemicals. Especially chloride however also other materials cause stress corrosion cracking but only under the influence of tension stresses. So, elimination of these stresses avoids stress corrosion cracking.

These disks run under a high tangential and radial tension stresses evoked through the centrifugal. These operation conditions can lead to the sudden destruction of the material, by stress corrosion cracking. Research results show that residual compressive stresses in the top layer avoid the stress corrosion by the absence of tensional stresses.

Fig. 5-2: turbine wheel

The disks (Fig. 5-2), show a contour existing of a flat cone with subsequent transition radiuses, that lead in to the cylindrical hub diameter inside and to the outer collar at the opposite side.

This contour deep rolled with the hydrostatic tool HG13-9E270° (Fig. 5-3), in four sections. The division of the sections is determined by the maximum alteration of the contact angle from + / - 35° between tool and workpiece surface.

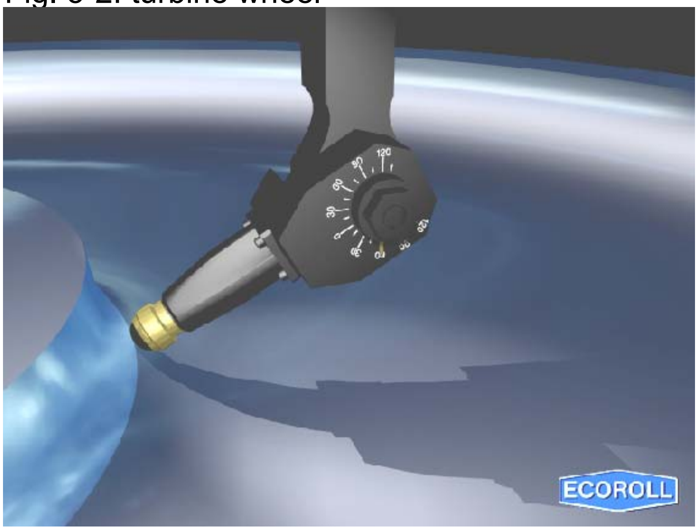

Fig. 5-3: deep rolling turbine wheel with HG13

After finishing of one section, the process is interrupted, the tool dug out and set manually on the new angular position for the next section. The adjustment is possible in steps of 15°. A delayed pressure built-up on the beginning of each treatment zone as well as the delayed pressure relief avoids any inhomogeneity of the residual compressive stresses. Through a connection with the CNC-control with the hydraulic unit can be switched on and off program-controlled over M-functions.

The criterion for the optimization of the treatment parameters was the attainable compressive stress characteristic. The following parameters where chosen:

Parameter	Unit	Selected	Possible range
Circumferential speed	[m/min]	100	0 to 200
Pressure / Rolling force	[bar] / [kN]	200 / 2	0 to 700 / 0 to 7
Pressure / Rolling force	[PSI] / [lbf]	2900 / 450	0 to 10200 / 1600
Feed rate	[mm/U]	0,44	0,1 to 0,8

The achieved compressive stress characteristic is shown in Fig. 5-4. Deep rolling replaced shot peening due to better performance. The costly transportation of the turbine disks and the difficult handling of the parts were eliminated. The shot peening plant could dismantled and workshop space was free for other use.

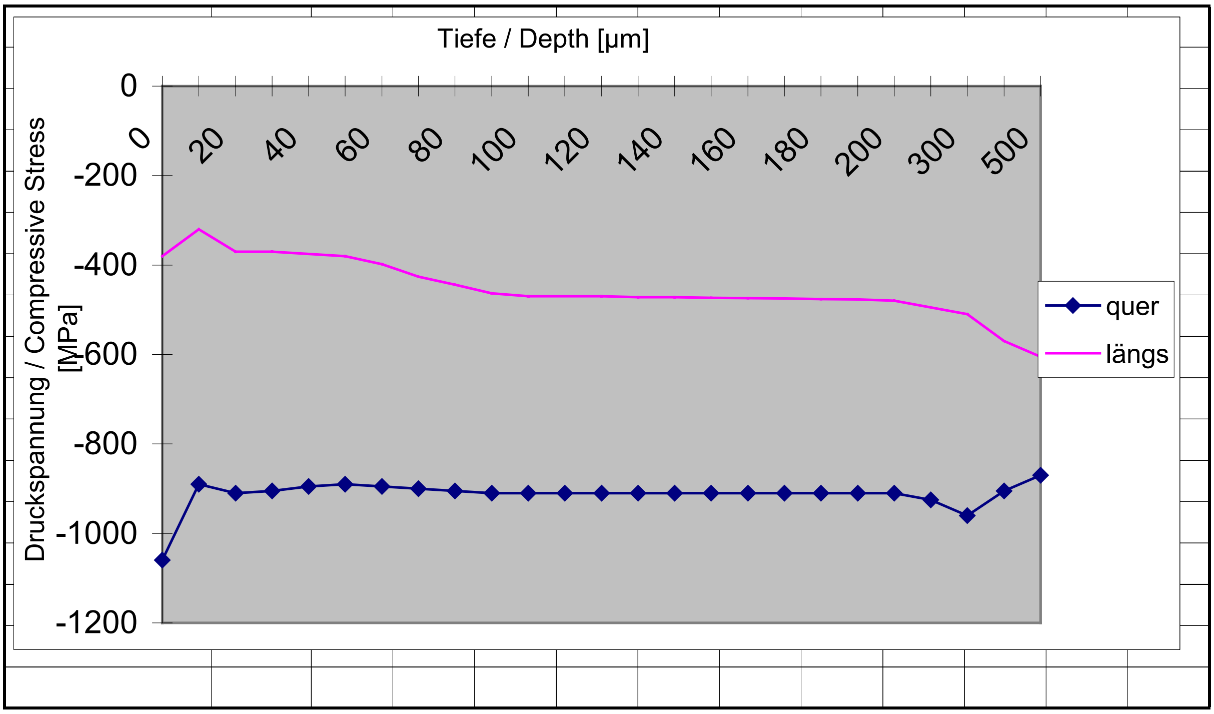

Fig.5-4: Residual compressive stress characteristic achieved with HG13
p = 200 bar (2900 PSI); f = 0,44 mm/rev; v = 100 m/min

Similar applications are known on turbine disks and housings of gas turbines. Also in this case is, the working parameters were laid out so that a compressive stress characteristic according to specification was reached.

High operational stresses are generated by dynamic loads in the dovetail slots. Simultaneously, the geometrical form of the slots causes a distinctive notch effect. Therefore, the danger of material fatigue is high in this area. Hydrostatic deep rolling tools are therefore used for this application since 1992 . The more particular description of this application follows in chapter 5.4.