Advantages of an Epicyclic Gear

1. Envelope size (smaller than parallel shaft for same power)
2. Low weight
3. Lower Pitch Line Velocity for comparable parallel shaft unit
4. Coaxial Shafts (in line system) resulting in more compact installation
5. low cost for entire train layout

One of the most important considerations for an epicyclic gear is to assure uniform load distribution among the planets. This is made possible in a 3 or more planet arrangement. A basic example is a single-stage gear unit with three fixed-planets and a rotating carrier know as a star epicyclic gear. Upon applying a torque, equal distribution of torque takes place between the sun pinion and its planets. With the absence of any pinion bearings the pinion is free to float and with the applied load immediately centers itself on the pitch circle resulting in equal load sharing among the planets. To assure the load is further equally transmitted to the annulus or ring gear the planet carrier must be very stiff in design and structure thereby minimizing elastic deflections through the planet bearing pins. The gearbox can be mounted and supported by the turbine structure. For example with a MAAG PF3 design for use with an Allison turbine drive, the sun pinion spline mates with the internal spline of the turbine. The output shaft is rigidly connected with the rotating annulus which is furnished with an integral flange to which a Maag gear type shear pin design coupling can be mounted. Also, a dry diaphragm coupling (shear pin design) can be provided based on the service requirement.

Maag had built both single helical and spur epicyclic hardened and ground gears. Maag determined that there are significant advantages in the use of spur gears in an epicyclic gear for driving a generator. Spur gear teeth produce no axial force on the geared elements. This is extremely important to optimize the load distribution in the meshing of the planets. The Maag design utilizes carburized and ground spur gears. Profile corrections are designed into the final grinding process. These profile corrections produce a tooth form which results in a contact ratio, under operating conditions, of 1.6 between the pinion and the planets and 1.8 between the planets and the annulus. This is in comparison to normal spur gears without modifications that have a contact ratio of 1 and single helical gears of approximately 2. However with helical gears, the axial forces generated in the mesh between the planet and sun pinion and the planets and the annulus oppose each other. These forces act as a moment in the radial plane of the bearing and produce an unequal tilting bearing load, which has an adverse effect on the tooth meshing pattern. For gears running at constant torque, a longitudinal tooth correction can be applied to reduce this effect. However, for a generator drive with large variations in torque, the spur gear has a distinctive advantage of not producing axial forces in the gear mesh. Double helical gears as spur gears avoid this characteristic however extra care must be given to assure perfect apex alignment over the number of meshes particularly with load variations to maintain designed load sharing.

The Maag modified spur gear closely approaches the advantages of the helical gearing (that is, smooth transfer of loads) without the detrimental effects of axial forces and axial vibrations. Furthermore spur gears of the advantages of a simple design with least number of components; elimination of axial vibrations (no axial forces); low noise due to high gear accuracy and optimized tooth flank correction achieved by tooth grinding.