1.13 External Helical Gears

Helical gears are used to transmit power or motion between parallel shafts. The helix angle must be the same in degrees on each member, but the hand of the helix on the pinion is opposite to that on the gear. (A RH pinion meshes with a LH gear, and a LH pinion meshes with a RH gear.)

Single helical gears impose both thrust and radial load on their bearings. Double helical gears develop equal and opposite thrust reactions which have the effect of canceling out the thrust load. Usually double helical gears have a gap between helices to permit a runout clearance for the hob, grinding wheel, or other cutting tool. One kind of gear shaper has been developed that permits double helical teeth to be made *continuous* (no gap between helices).

Helical-gear teeth are usually made with an involute profile in the *transverse* section (the transverse section is a cross section perpendicular to the gear axis). Small changes in center distance do not affect the action of helical gears.

Helical-gear teeth may be made by hobbing, shaping, milling, or casting. Sintering has been used with limited success. Helical teeth may be finished by grinding, shaving, rolling, lapping, or burnishing.

The size of helical-gear teeth is specified by module for the metric system and by diametral pitch for the English system. The helical tooth will frequently have some of its dimensions given in the *normal section* and others given in the *transverse section.* Thus standard cutting tools could be specified for either section—but not for *both* sections. If the helical gear is small (less than 1 meter pitch diameter), most designers will use the same pressure angle and standard tooth size in the normal section of the helical gear as they would use for spur gears. This makes it possible to hob helical gears with standard spur gear hobs. (It is not possible, though, to cut helical gears with standard spur-gear shaper-cutters.)

Helical gears often use 20° as the standard pressure angle in the normal section. However, higher pressure angles, like $22\frac{1}{2}°$ or 25°, may be used to get extra load-carrying capacity.

Figure 1.19 shows the terminology of a helical gear and a helical rack. In the transverse plane, the elements of a helical gear are the same as those of a spur gear. Equations (1.1) to (1.7) apply just as well to the transverse plane of a helical gear as they do to a spur gear. Additional general formulas for helical gears are:

$$\text{Normal circ. pitch} = \text{circ. pitch} \times \text{cosine helix angle} \quad (1.8)$$

$$\text{Normal module} = \text{transverse module} \times \text{cosine helix angle} \quad (1.9)$$

$$\text{Normal diam. pitch} = \text{trans. diam. pitch} \div \text{cosine helix angle} \quad (1.10)$$

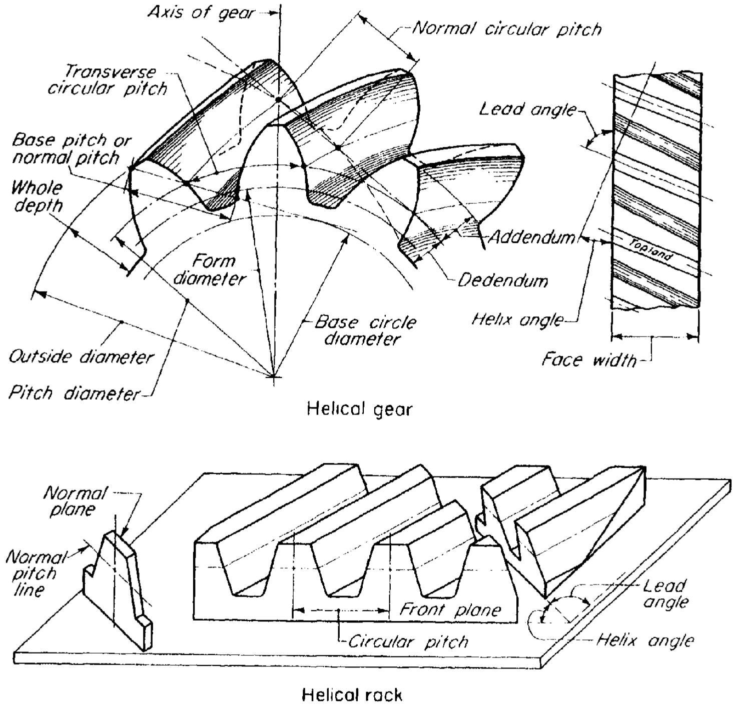

FIG. 1.19 Helical-gear and rack terminology.

$$\text{Axial pitch} = \text{circ. pitch} \div \text{tangent helix angle} \quad (1.11)$$

$$= \text{norm. circ. pitch} \div \text{sine helix angle} \quad (1.12)$$

1.14 Internal Gears

Two internal gears will not mesh with each other, but an external gear may be meshed with an internal gear. The external gear must not be larger than about two-thirds the pitch diameter of the internal gear when full-depth 20° pressure angle teeth are used. The axes on which the gears are mounted must be parallel.

Internal gears may be either spur or helical. Even double helical internal gears are used occasionally.

An internal gear is a necessity in an epicyclic type of gear arrangement. The short center distance of an internal gearset makes it desirable in some applications where space is very limited. The shape of an internal gear forms