5.3 The Geometric Parameter and Size of Bevel Gear

5.3.1 Types of Bevel Gear and Tooth Taper.

Bevel Gear

Bevel gear refers to gear whose reference surface is conical surface. Generally, it can be divided into straight bevel gear, helical bevel gear and spiral bevel gear.

Bevel gears can be used to form bevel gear pair, hypoid gear pair and spiroid gear pair. It often refers to gear that can compose to bevel gear pair and hypoid gear pair. See Figure 5-71.

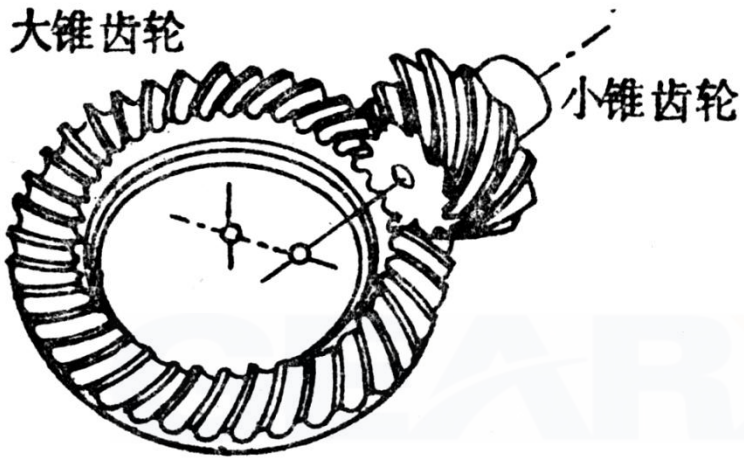


图 5-71

Straight Bevel Gear

Straight bevel gear refers to the bevel gear whose tooth trace is overlapped with the generatrix of reference bevel, or overlapped with its radial line on the imaginary crown gear. See figure 5-72.

The general characteristics of straight bevel gear are: it takes standard tapered tooth and radial tooth trace. It can be processed into crowned tooth; the tooth profile is an involute; radial and tooth-thickness modification tooth form can be taken applied; it is generated by generating gear or processed under forming method; the basic tooth profile and module are selected based on the national standard. There is no big difference between the national standard and the foreign existing standard, the only differences come to tooth profile angle and the bottom clearance. Gear grinding process is tough in this kind of gear.

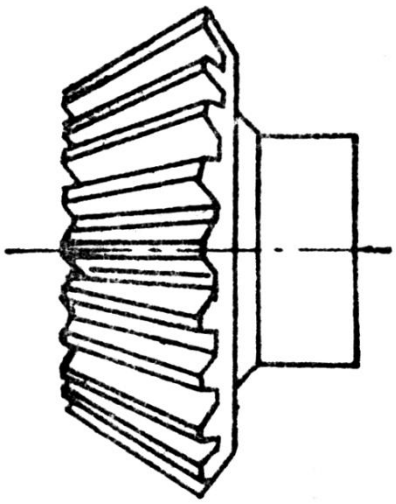


图 5-72

Skew Bevel Gears, Helical Bevel Gear

There is a helix angle β between tooth trance and reference bevel generatrix. On its imaginary crown gear, skew bevel gear has a tooth trace that makes a tangent on a fixed circle and the tooth trace is a straight line. See Figure 5-73.

The main characteristics of skew bevel gear are: tapered tooth are taken; the tooth trace is a tangent straight line; generally, the tooth profile is an involute; it can be applied in various long-and-short addendum system and x-zero gear; it can be generated and processed by straight generating gear. Similar to straight bevel gear, it has many types of gear tooth systems; most of them are used in bevel gear with larger size.

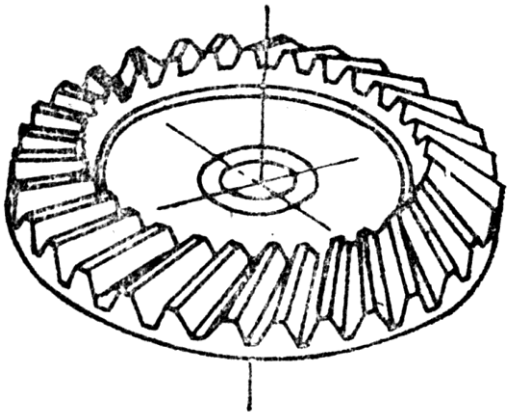


图 5-73

Curved Tooth Bevel Gears

Tooth trace presents as spiral line in reference bevel and curve in an imaginary crown gear. See Figure 5-74. This kind of bevel gear have many types, they are called curved tooth bevel gears in general.

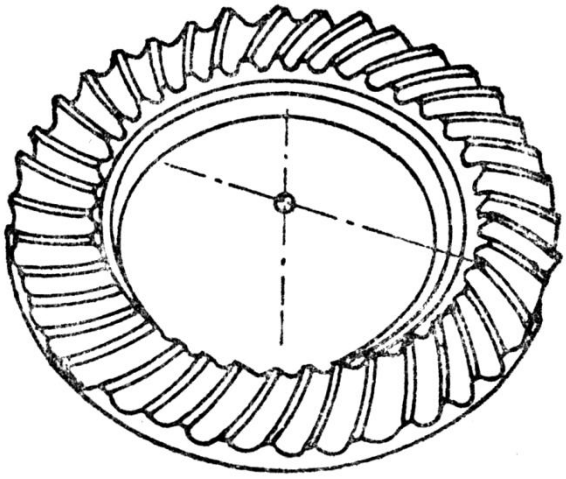


图 5-74

Spiral Bevel Gears

The tooth trace of generating crown gear is curved bevel gear of circular arc. See Figure 5-75. The main characteristics of spiral bevel gear are: the tooth trace on imaginary crown gear of equal-addendum toothed spiral bevel gear is a circular arc; tooth trace on the imaginary crown gear of spiral bevel gear with tapered tooth is a circular arc; the tooth profile is an involute (except spherical tooth-profile spiral bevel gear); generally, addendum modification and tooth-thickness modification will be applied; it is generated and processed by generating crown gear; the tooth can be grinded and precise tooth can be gained. Three kinds of spiral angle (small, medium and large) can be used. It is one of the most widely used curved tooth bevel gears.

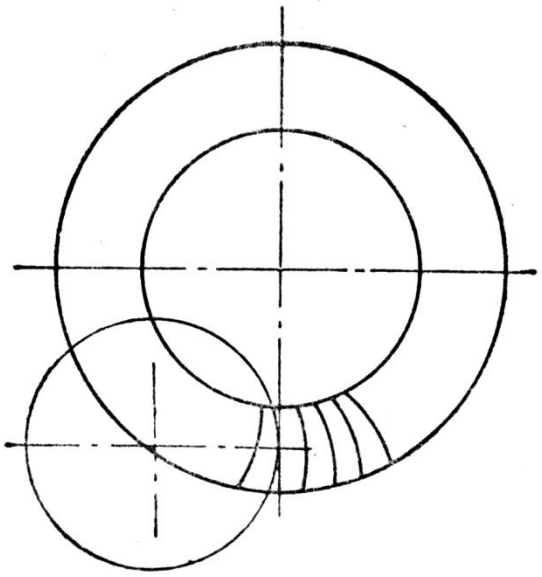


图 5-75

Hypoid Gear

Gear with double reference surface is called hypoid gear.

Palloid Gear

Palloid gear refers to spiral bevel gear whose tooth trace of imaginary crown gear is similar to involutes. See Figure 5-76.

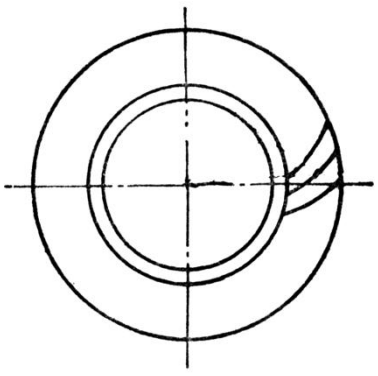


图 5-76

Epicycloid Gear，Prolate Gear，Eloid Gear

Epicycloid gear refers to gear whose tooth trace of imaginary crown gear is cycloid. See Figure 5-77. Epicycloid gears' main characteristics are: it is only applied in equal-addendum tooth; the tooth trace of imaginary crown gear is prelate epicycloids; the tooth profile is involutes; generally, it applies combination modified

system and its main manufacturing methods contain Oerlikon and Fiae. This kind of gear is not likely to be easily abraded and it is simple to calculate and adjust.

What needs to be mentioned here is that Eloid tooth processing machine made by Clingelnberg Corporation can manufacture cycloid bevel gear with hard tooth flank, larger diameter and module, and it is a leading company.

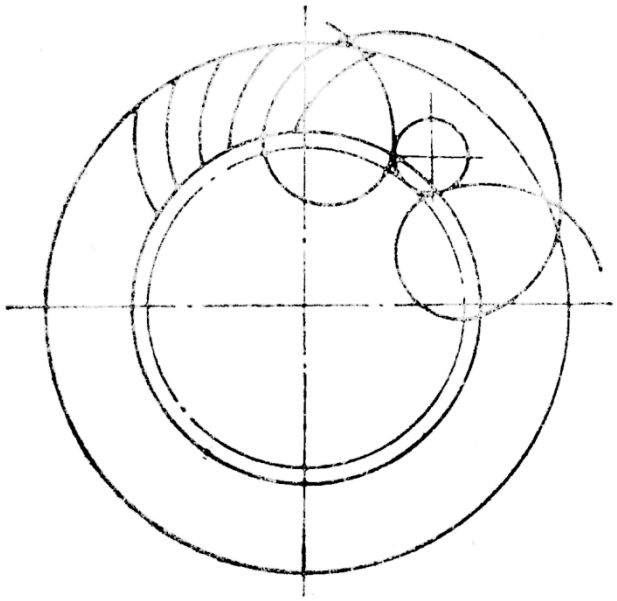


图 5-77

Face gear，Contrate Gear

Face gear refers to the bevel gear whose tip angle δα 、and bottom angle δf are all 90°. See Figure 5-78. Face gear is a kind of equal-addendum bevel gear and can be matched with common cylindrical gear into cylindrical face gear pair.

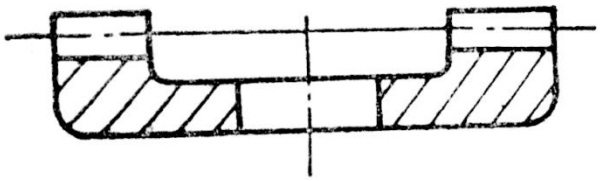


图 5-78

Gear with 90° face angle

When the tip angle of bevel gear δα=90° , it is called top-flat gear. See Figure 5-79.

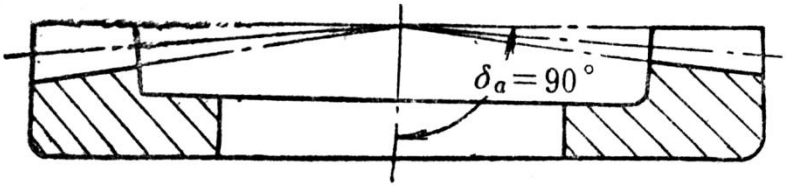


图 5-79

Crown Gear

Crown gear refers to the bevel gear whose reference angle δ=90°. See Figure 5-80. Taking the distance $\overline{OP}$ from cone apex (O) to the pitch (P) as radius to make a spherical surface, which help form an imaginary circular face gear whose module, tooth profile angle are totally the same with the corresponding bevel gear. It is an imaginary rack which takes pitch cone plane as its plane and has infinite virtual number of teeth. The meshing of gear pair composed of crown gear and matched bevel gear can be seen as the engagement of bevel gear and the master rack. It is a basic rack that is used to study the meshing, movement and processing characteristics of bevel gear pair. It also refers to generating gear whose crown gear is bevel gear.

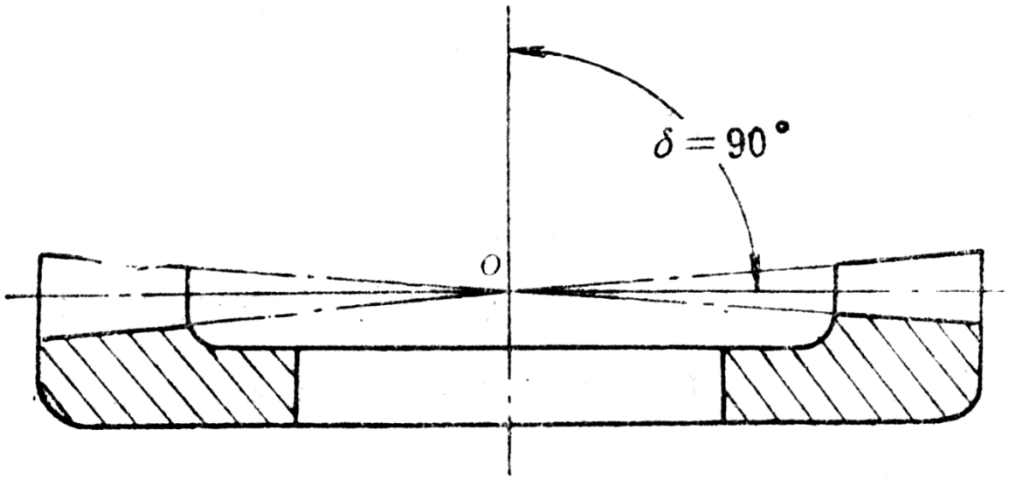


图 5-80

Zero Bevel Gear

Zero bevel gear refers to a kind of spiral bevel gear which is located in the imaginary crown gear and its helix angle at the central point of tooth profile β_m=0 or β_m＜10°. See Figure 5-81. Zero bevel gears belong to spiral bevel gear with small

spiral angle. It contains the common features of spiral bevel gear.

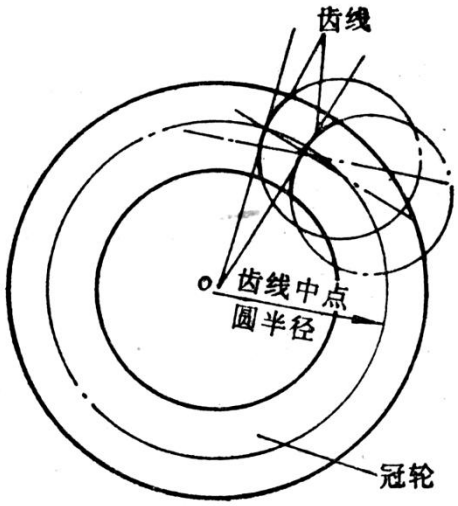


图 5-81

Octoid Gear

When the tooth shape of generating crown gear is plane, this kind of bevel gear is called octoid gear. The theoretical meshing line on spherical plane of bevel gear pair composed by this kind of gear is a complete “8-shaped”closed curve. See Figure 5-82.

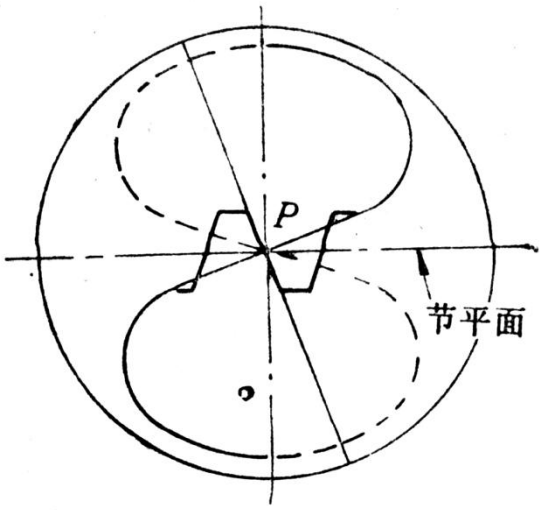


图 5-82

Gleason bevel gear

Gleason bevel gear is put forward by Gleason Corporation in US.

Oerlikon Curved Tooth Bevel Gears

Oerlikon Curved Tooth Bevel Gears is put forward by Oerlikon Corporation in Switzerland. This kind of gear belongs to extended epicycloid bevel gear, which means to suppose the tooth trace of crown gear being extended epicloid and the tooth profile being involutes equal-addendum tooth.

Klingenberg Curved Tooth Bevel Gears

Klingenberg curved tooth bevel gears is put forward by Klingenberg Corporation in Germany. It is curved bevel gear generated by bevel gear hob. The tooth profile of Klingenberg curved tooth bevel gears is involute; the tooth trace of Klingenberg curved tooth bevel gears is involute.

Archimedes Spiral Bevel Gear

It is supposed that the tooth trace of the imaginary crown tooth is archimedes spiral bevel gear. See Figure 5-83.

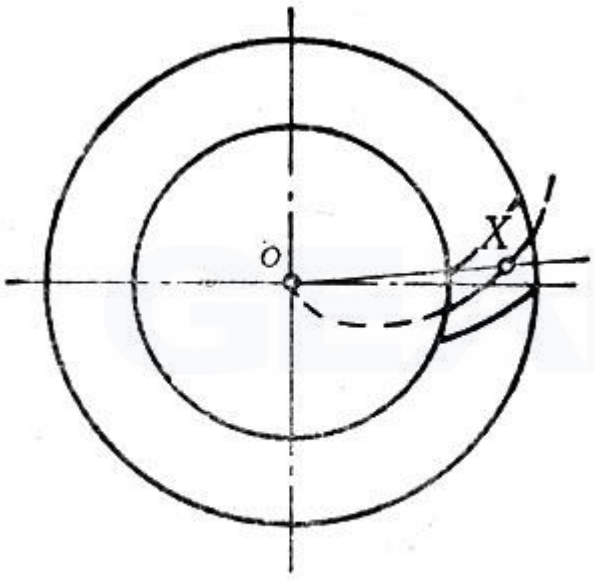


图 5-83

Bevel Gear of Convex-arc Profile

Bevel gear of convex-arc profile refers to the bevel gear whose normal tooth profile is convex arc. Except pinion of circular arc point meshing bevel gear pair, this kind of gear is processed under broach milling method. It also has convex circular arc tooth profile.

Bevel Gear of Variable Involute Profile

Bevel gear of variable involute profile refers to bevel gear whose normal tooth profile is variable involute.

Bevel Gear with Straight Tooth Profile

Bevel gear with straight tooth profile refers to bevel gear whose normal tooth profile is straight line, such as the bull gear in antithesis tooth profile of spiral bevel gear pair.

Episinoid Bevel Gear

Sinusoidal bevel gear refers to curved bevel gear whose tooth trace is supposed to be similar with sinusoidal curve. See Figure 5-48.

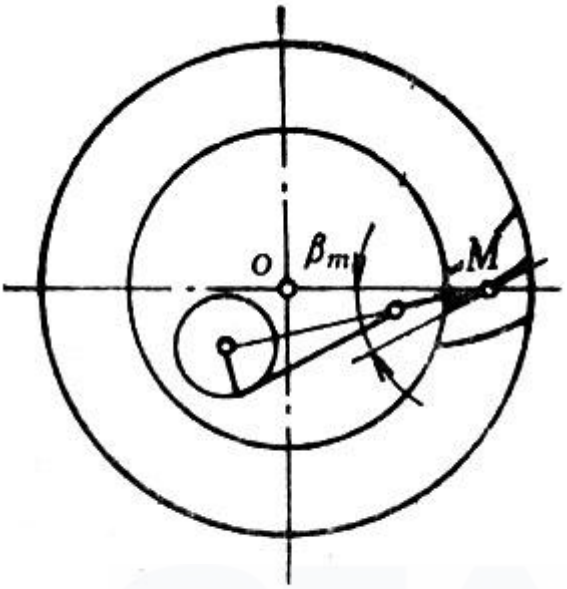


图 5-84

Involute Profile Bevel Gear

Involute profile bevel gear refers to those whose normal tooth profile is involute. It is one of the most commonly seen tooth profile in bevel gear, such as common spur bevel gear, spiral bevel gear, epicycloid spiral bevel gear, episinoid bevel gear, etc.

Crowned Tooth Straight Bevel Gear

On bevel gear cutter or bevel gear grinding machine, modify the crown teeth along the tooth length direction in generating method and make it into crowned gear. This kind of gear is called crowned tooth straight bevel gear.

Herringbone Bevel Gear

Herringbone bevel gear refers to the inverse herringbone line composed by two segment of Archimedes spiral line starting from the central point on the imaginary crown gear of bevel gear. If the two lines composed to tooth traces are conversely staring from the central point, then it is called spur herringbone bevel gear. See Figure 5-85.

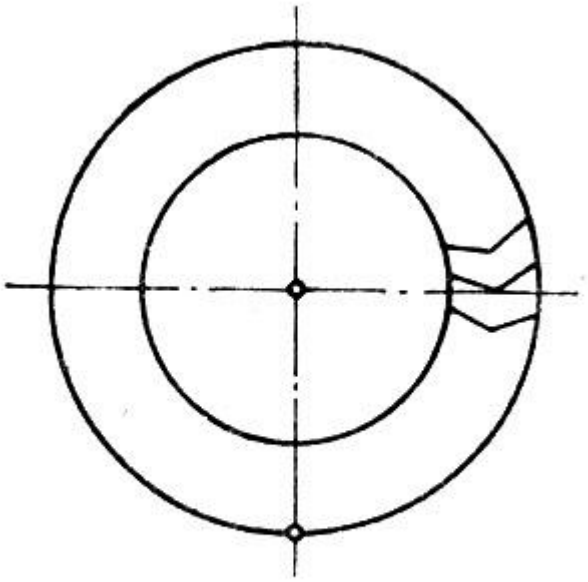


图 5-85

Bevel Gear

Bevel gear refers to the shrinkage spiral bevel gear with the average spiral angle being β_m = 25 °～40 °（generally β_m=35 °）

Generating Crown Gear

In the process of manufacturing bevel gear with generating method, generating crown gear serves as an imaginary mating crown gear meshed by cutter tool and the manufactured bevel gear.

Equal-height Tooth Bevel Gear

The teeth of bevel gear with equal depth of teeth from the big end to the small end, with equal tip angle, reference cone angle and root angle and un-overlapping conical point, gear with this character is called equal-height tooth bevel gear. See Figure 5-86. When processing this kind of gear, it is convenient to adjust machine tool and the calculation work is simple. But undercut and addendum sharpen may occur on the smaller end, so it has limitation on tooth-width coefficient and tooth number. Currently, equal-height tooth is widely used in cycloid bevel gear and spiral bevel gear.

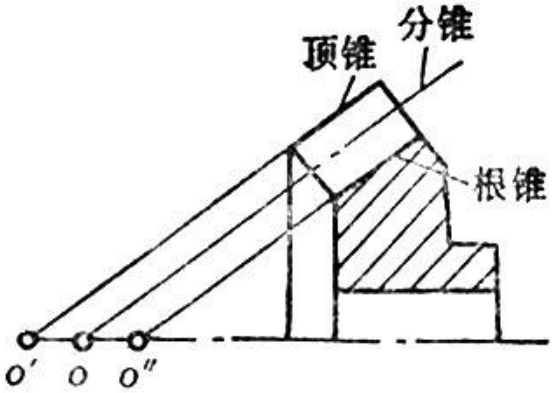


图 5-86

Tooth Taper

For the tooth of bevel gear, from big end to small end, the size change of tooth depth or tooth top width is called tooth taper. It can be divided into common taper, natural taper, double taper, equal-height and converse taper, etc. The difference of tooth-height or top tooth width between the big end and the small end show the change of taper's size.

Standard Tapered Tooth Bevel Gear

Form the big end to the small end of bevel gear, tooth depth gradually reduces and the top of tip cone, reference cone and root cone are overlapping. This kind of gear is called standard tapered tooth bevel gear. See Figure 5-87. The bottom clearance of bevel gear pair composed by standard tapered tooth bevel gear is also gradually taped from the big end to small end. Standard tapered tooth bevel gear was once widely applied in spur bevel gear, but recently it has the tendency to be replaced by bottom clearance tapered tooth gear.

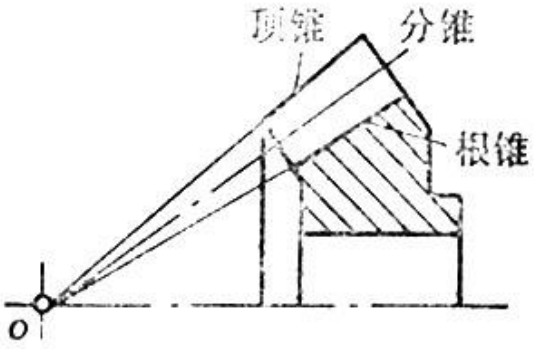


图 5-87

Natural Taper

In general, the space width at the big end of bevel gear tooth is wider than that at the small end. This kind of gear tooth is called natural taper.

Tip Cone Contracting Bevel Gear

The contracting of tip cone makes the cone vertex set inside the vertex of reference cone and root cone. Tip cone contracting bevel gear can be composed into bottom clearance bevel gear pair. See Figure 5-88.

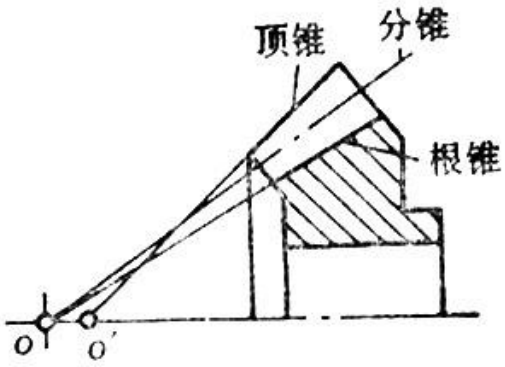


图 5-88

Tilted Root Line

Tooth contracting of bevel gear or double curve gear is called tilted root line. Tilted root line change the dedendum angle of bull gear and make the root cone and the axle of bull gear not intersect in the cone centre. Tilted root line is generally used in normal slot width pinch in which the sum of the vertex distance of tough cutter and the top width of doubled precise cutter is smaller than the largest slot width.

Duplex Tapered Tooth Bevel Gear

The tooth depth of bevel gear taper dramatically from the big end to small end, and the vertex of tip cone, reference cone and the root cone do not overlapped with each other. That means the tip angle increase dramatically and then root angle decreased dramatically, then the vertex of tip cone and the vertex of root cone fall inside and outside of the vertex of reference cone, respectively. See Figure 5-89.

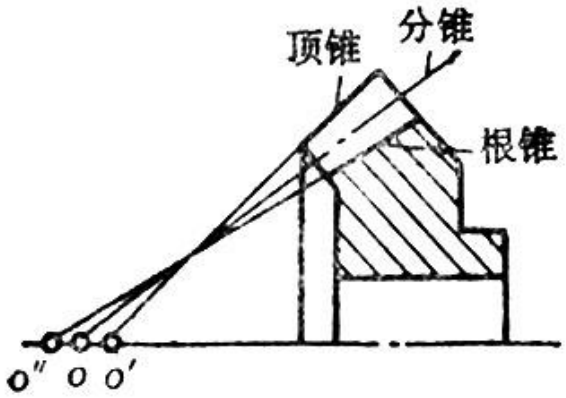


图 5-89

Reverse Taper

The tooth space of tooth of bevel gear increase rather than decrease, namely, the tooth width of small end is wider than that of the big end. This kind of taper is called reverse taper. See Figure 5-90.

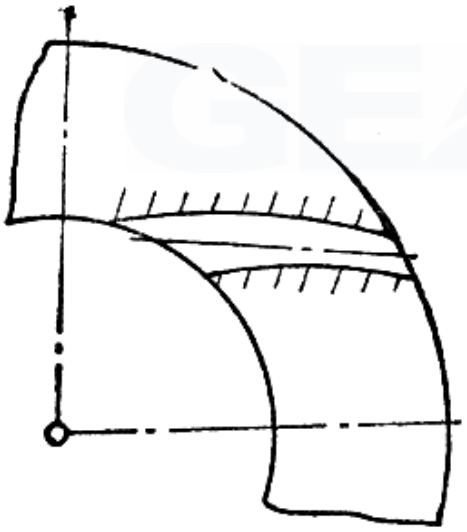


图 5-90

Tooth Crown

Excessive reverse taper occurs on the tooth of bevel gear and make the tooth at the big end sharper. This phenomenon is called tooth crown.

External Bevel Gear

When the cone angle of reference bevel flank is $0<\delta<90°$, this kind of bevel gear is called external bevel gear. See Figure 5-91. External bevel gear is the most

widely used bevel gear.

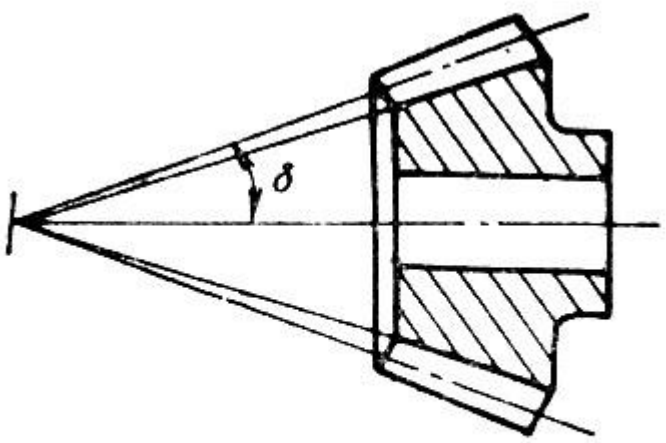


图 5-91

Annular Bevel Gear

Bevel gear whose reference bevel flank being 180°>δ>90°is called annular bevel gear. Currently, annular bevel gear has been used in some fields. See Figure 5-92.

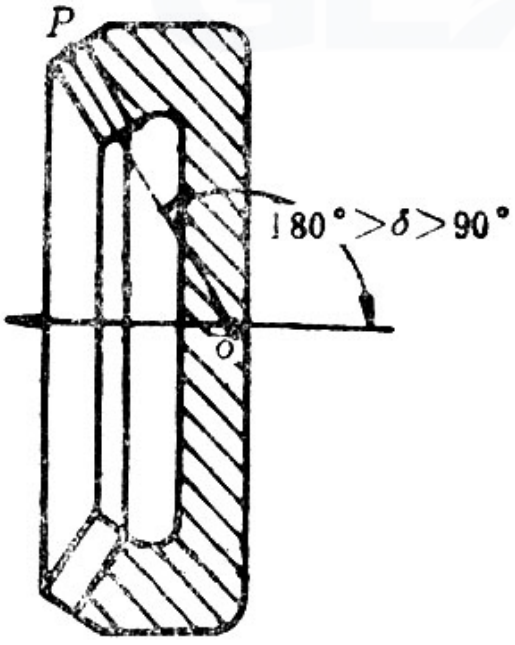


图 5-92

Virtual Cylindrical Gear of Bevel Gear

Imaginary cylindrical gear taking the back cone distance of bevel gear as radius of reference circle, with its transverse module, transverse pressure angle equal to those of bevel gear. This kind of imaginary cylindrical gear is called virtual cylindrical gear of bevel gear, which is abbreviated as virtual gear of bevel gear. See Figure 5-93. Points along the direction of tooth width have different back cone distance, so the virtual gear has various types.

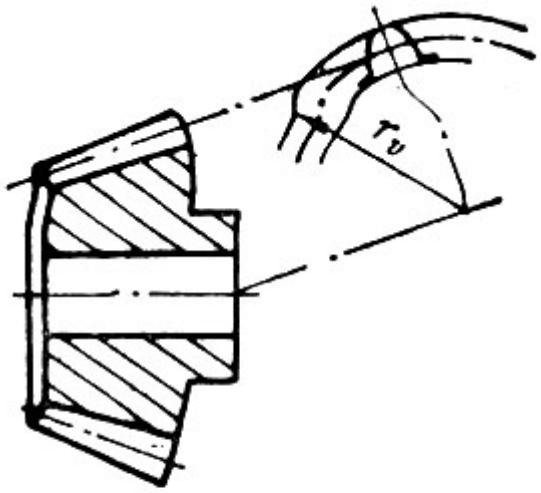


图 5-93

Virtual Gear of Curved Tooth Bevel Gear

Curved bevel gear, as imaginary cylindrical gear formed by taking back cone distance as reference radius, is a kind of helical-spur gear, which is called virtual helical gear of curved tooth bevel gear. This virtual spur gear of virtual helical gear is called virtual spur gear of curved tooth bevel gear, for short, virtual gear of curved tooth bevel gear.

Angular Bevel Gear

Any bevel gear constituting angular bevel gear pair is called angular bevel gear.

Left-hand Spiral Bevel Gear

Bevel gear with left-hand tooth flank is called left-hand spiral bevel gear. See “Left-hand Gear”.

Right-hand Spiral Bevel Gear

Bevel gear with right-hand tooth flank is called right-hand spiral bevel gear. See “right-hand Gear”.

5.3.2 Tooth Trace and Flank Profile of Bevel Gear

Tooth Trace of Bevel Gear

Tooth trace of bevel gear refers to the intersection line between reference cone and tooth flank. Tooth trace of bevel gear can be shown as straight line, oblique line or curved line. Generally, the type and character of tooth trace are presented by the tooth trace on crown gear.

Radial Tooth Trace

On the imaginary crown wheel of bevel gear, tooth trace overlapped with the radial direction of crown wheel is called radial tooth trace. Radial tooth trace also refers to the tooth trace coinciding with the generatrix of reference cone. It is the simplest and widely used tooth trace. See Figure 5-94.

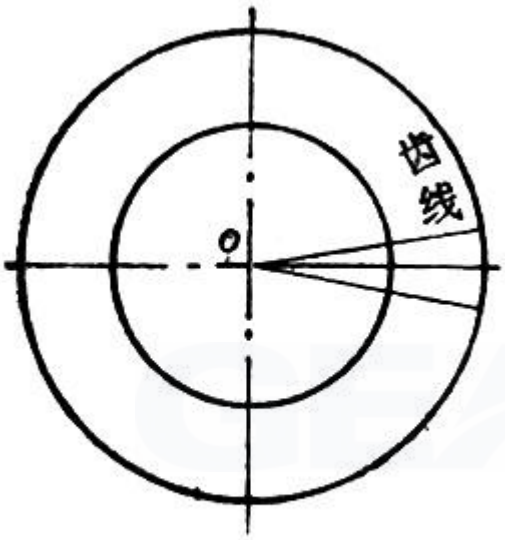


图 5-94

Tangential Tooth Trace

On the crown wheel of bevel gear, tooth trace that is tangent to the circle concentric with crown wheel is called tangential tooth trace, namely, the tooth trace of angular bevel gear. The tooth trace angle β is shown in the Figure 5-95.

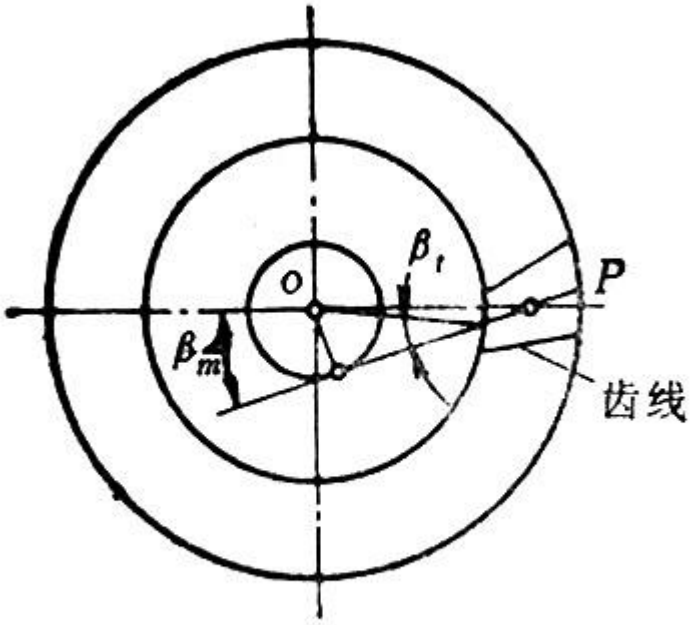


图 5-95

Zero Tooth Trace

Tooth traces whose spiral angle βm = 0 is called zero tooth trace. Let oM⊥MA, then the central curvature of tooth trace at the central point M will fall on the line （MA）. See Figure 5-96.

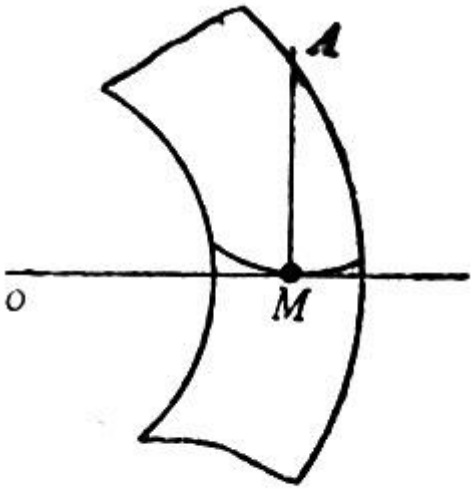


图 5-96

Herringbone Tooth Trace of Bevel Gear

Herringbone tooth trace of bevel gear belongs to zero tooth trace. But half of its tooth width is increasing angle tooth trace, and half of its width its reduced angle tooth trace. See Figure 5-85.

Tooth Trace of Increasing Angle of Bevel Gear

In the imaginary crown wheel of curved tooth bevel gear, if the difference of spiral angle$\Delta\beta = \beta - \beta$ 小>0, then the tooth trace of this bevel gear is called tooth trace of increasing angle (see Figure 5-97). Alternatively, at the central point(M) of tooth trace, if oM⊥MA, ∠oMA=90°, and the point M is at the center of curvature and fall in ∠oMA, then the tooth trace of this curved tooth bevel gear is called tooth trace of increasing angle.

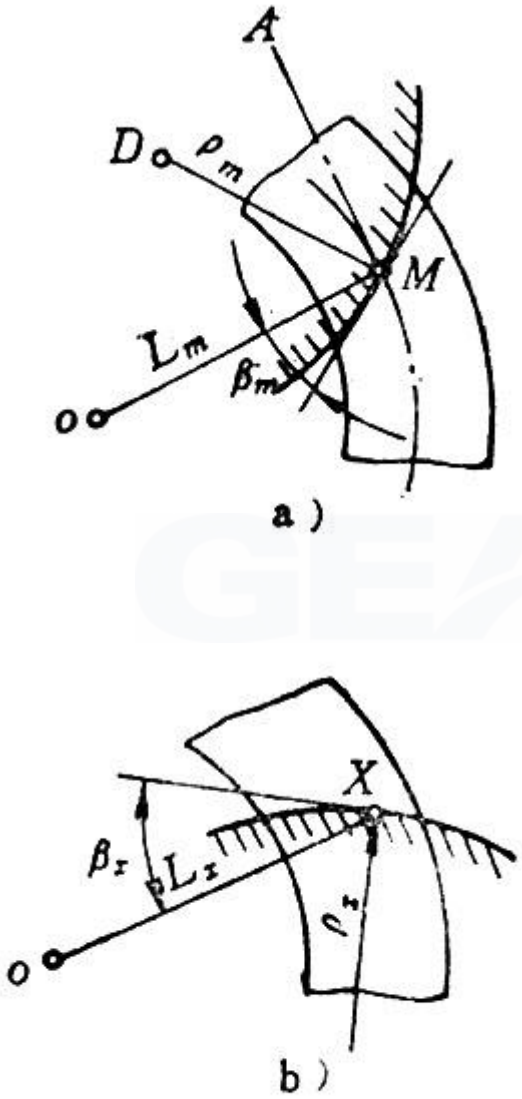
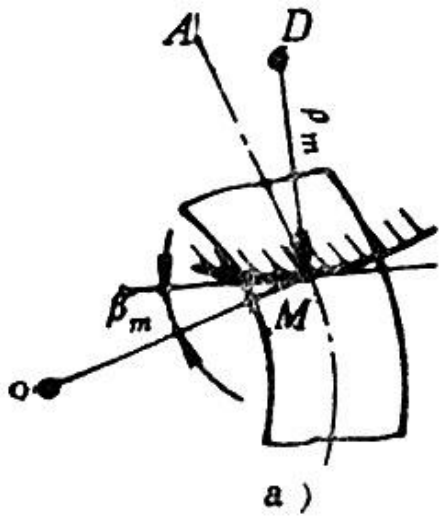


图 5-97

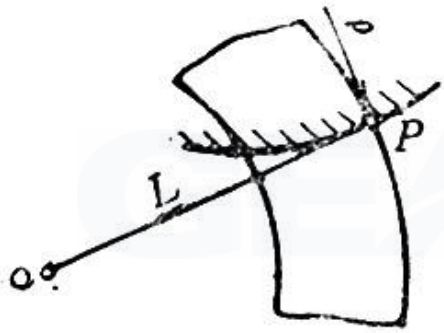
Tooth Trace of Reduced Angle of Bevel Gear

In the imaginary crown wheel of curved tooth bevel gear, if the difference of tooth trace spiral angle$\Delta\beta = \beta - \beta$ 小∠0, this tooth trace is called tooth trace of reduced angle. Alternatively, at the center (M) of tooth trace, making oM⊥MA and

let $\angle oMA = \angle\sigma = 90°$, then when the center of tooth trace curvature fall outside $\angle\sigma$,this kind of tooth trace is called reduced angle tooth trace. See Figure 5-98.



a)



b)

图 5-98

Tooth Trace of Constant Angle of Bevel Gear

On the imaginary crown wheel or bevel gear, if the difference of spiral angle of tooth trace $\Delta\beta = 0$, then the tooth trace of this curved tooth bevel gear is called tooth trace of constant angle. At the midpoint (M) of tooth trace, let $oM \perp MA \angle oMA = \angle\sigma = 90°$, then the condition of being tooth trace of constant angle can also be met when the curvature center of tooth trace fall on the MA line. See Figure 5-99.

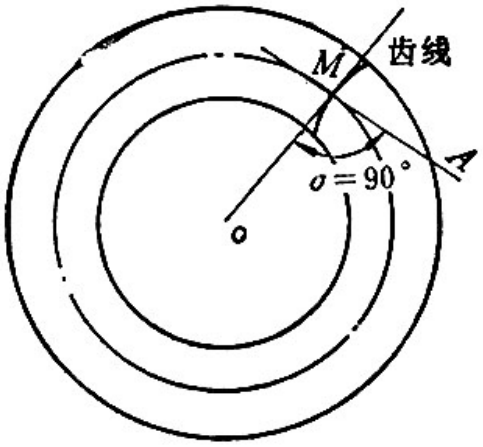


图 5-99

Hands of Tooth Trace of Curved Tooth Bevel Gear

Looking towards the top surface of bevel gear, the hands of tooth trace from the midpoint of tooth width to its big end being anti-clockwise is right-hand teeth (See Figure 5-100a) while that of clockwise is left-hand teeth (See Figure 5-100b).

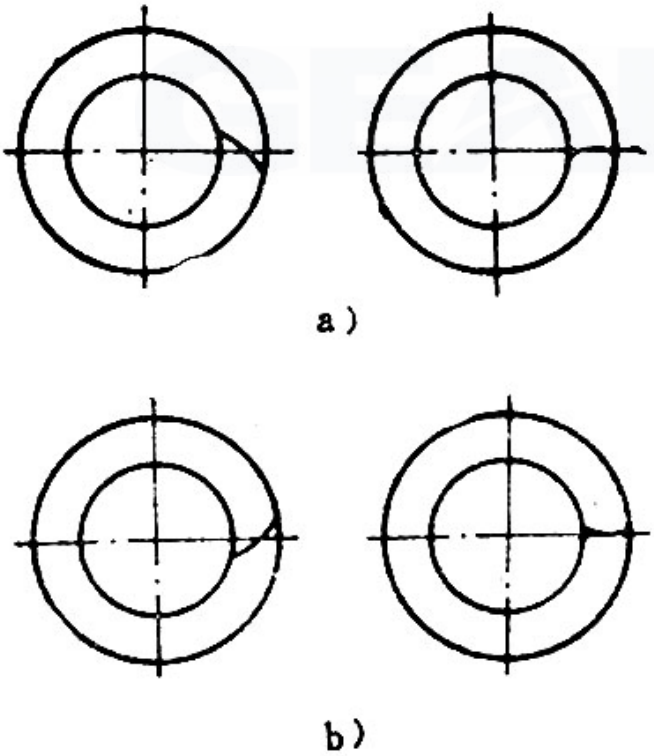


图 5-100

Offset of Tooth Trace

The distance from the tooth trace of imaginary crown wheel (generating crown gear) of helical bevel gear to the conical point is called offset of tooth trace. The circle drawn taking offset as radius and taking conical point as its center is called formed circle (See Figure 5-101).

图 5-101

Spiral Angle of Bevel Gear

The acute angle (β) formed between the tangents of tooth trace crossing a point which is also crossed by the cone generatrix is called spiral angle of bevel gear. See Figure 5-102.

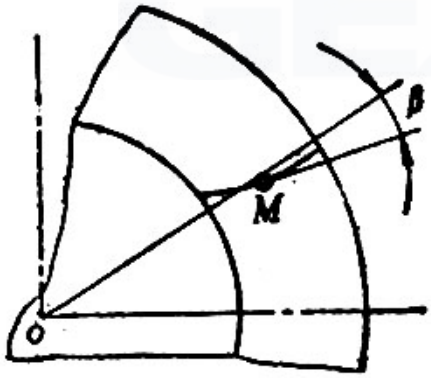


图 5-102

Mean Spiral Angle

The spiral angle (β_{mo}) at the center point of tooth trace of the imaginary crown wheel of curved tooth bevel gear or the spiral angle of tooth trace at the midpoint of tooth width is called mean spiral angle. See Figure 5-103.

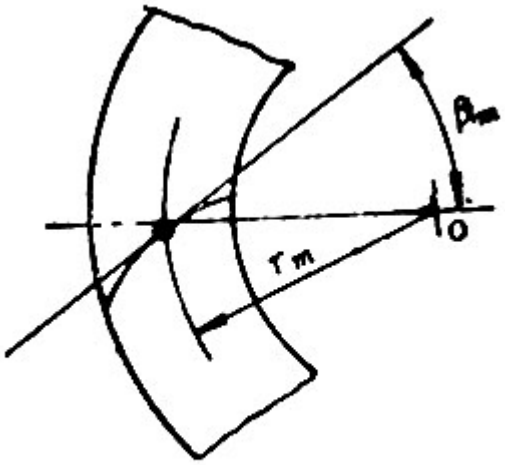


图 5-103

Spiral Angle of Curved Tooth Bevel Gear

Spiral angle is an important parameter for curved tooth bevel gear. Spiral angle refers to that at the midpoint of tooth trace.

If the spiral angle increases, the contact radio increases. This can make the gear operation more steady, lower noisiness and avoid undercutting. But the grow value of β m would increase the axial force.

The general value of spiral angle and direction is: the standard spiral angle of shrinkage tooth of equal clearance β_m=35°, the equal-addendum tooth β_m=10°～35°. When choosing spiral angle, one must assure that$\varepsilon\beta \geq 1.25$ and try to make it reach $\varepsilon\beta$ ＝1.5～2. The choosing principle of spiral direction: when the change direction of axis is confirmed, we should try our best to make the axial force of bell gear and driven gear running at opposite direction.

Outer Spiral Angle

On the imaginary crown gear of curved tooth bevel gear, the spiral angle (β) at the outside of tooth trace is called outer spiral angle (Figure 5-104). Outer spiral angle also refers to the spiral angle of tooth trace of bevel gear at the large end of the gear teeth.

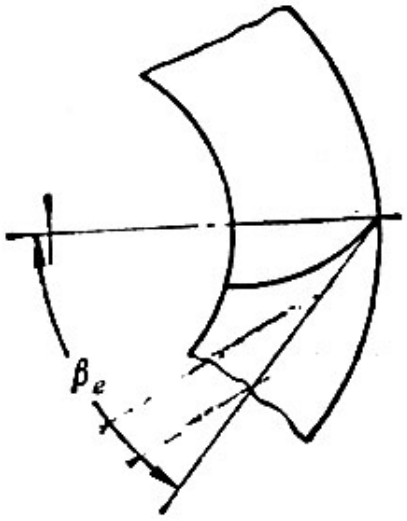


图 5-104

Inner Spiral Angle

On the imaginary crown of curved tooth bevel gear, the spiral angle β_i (Figure 5-105) of tooth trace at the inner end is called inner spiral angle. Inner spiral angle also refers to the spiral angle of tooth trace of bevel gear at the small end of gear teeth.

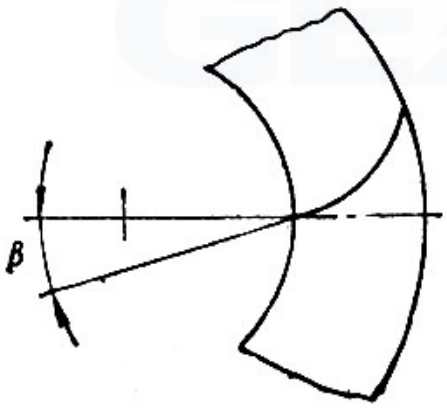


图 5-105

Spiral Angle at A Point

On the curved tooth bevel gear or its imaginary crown wheel, the acute angle between the tangent of tooth trace at a point and the generatrix crossing this point is called spiral angle at a point.

Difference of Tooth Trace Spiral Angle of Curved Tooth Bevel Gear

On the tooth trace of imaginary wheel of curved tooth bevel gear, the spiral angle β at various points is different from one another. Let the spiral angle at the big end

being β and the spiral angle at the small end being β_i, their difference $\Delta\beta=\beta-\beta i$, which is called difference of tooth trace spiral angle of curved tooth bevel gear.

Basic Rack Tooth Profile of Straight Bevel Gear and Skew Bevel Gear

Basic rack tooth profile of straight bevel gear and skew bevel gear refers to the imaginary tooth profile of octoid gear at the normal plane of big end gear teeth. Parameters of basic tooth profile shown in Figure 5-106 are normal value. The working addendum is a straight line. National standard stipulate these parameters' value: the basic tooth profile angle α＝20°, addendum h_a=m, working depth h_ω=2m, tooth pitch ρ=πm. the tooth thickness is equal to the tooth width on the neutral line; radial clearance c=0.2m; the fillet radius r=0.3m; the fillet radius should be selected as large as possible, it can be r=0.3m; α=14.5°and α＝25℃an also be used based on one's needs.

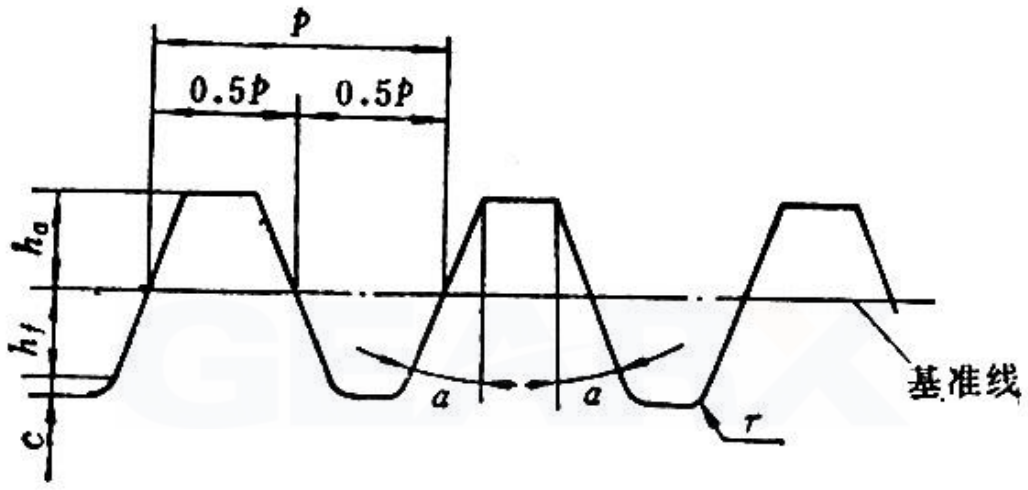


图 5-106

Standard Basic Rack Tooth Profile of Bevel Gears

The standard basic rack tooth profile of equivalent cylindrical gear of bevel gear is called standard basic rack tooth profile of bevel gears.

Back Cone Tooth Profile

The transversal cut by back cone curved surface or the tooth profile of virtual gear of bevel gear is called back cone tooth profile. Back cone tooth profile is a special term used in bevel gear. See Figure 5-107.

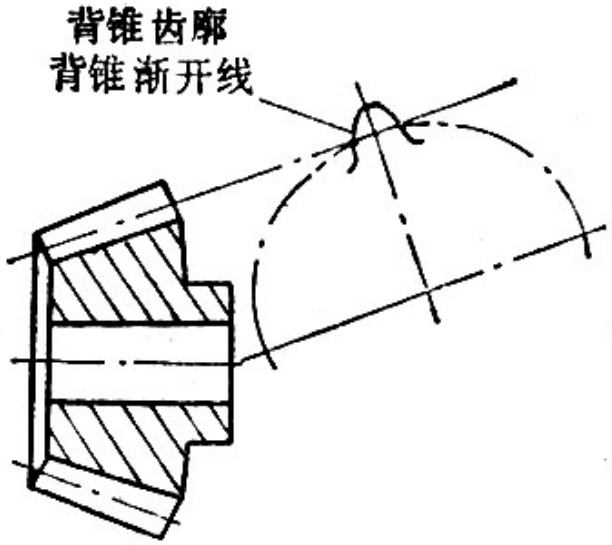


图 5-107

Back Cone Involute

Back cone involute refers to the tooth profile curve of virtual gear of straight bevel gear. In accordance with the forming principium of flank of straight bevel gear, the tooth profile of back cone involute is spherical involute. In practice, spherical involute is always replaced by similar back cone involute, and this similar tooth profile curve of straight bevel gear is called back cone involute. It is the tooth profile curve of virtual gear. See Figure 5-107.

5.3.3 The Imaginary Conical Surface, Cone Angle, Cone Distance and Mounting Distance of Bevel Gear.

Reference Cone

The reference surface of bevel gear is a cone, so this reference surface is called reference cone (see Figure 5-108).

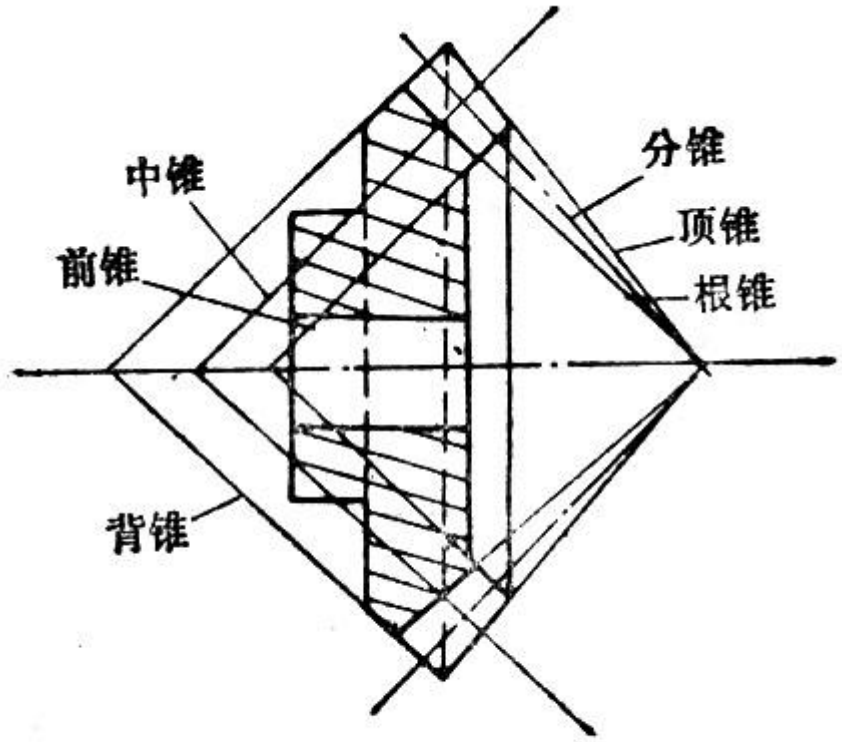


图 5-108

Face Cone， Tip Cone

The tip surface of bevel gear is a conical face. This tip surface is called face cone. See Figure 5-108. Face cone includes all conical faces of top surface of gear teeth.

Root Cone

The root surface of bevel gear is a conical face. This root surface is called root cone. Root cone includes all the conical surface of bottom land. See Figure 5-108.

Middle Cone

Middle cone refers to an imaginary conical face on bevel gear, whose generatrix is passing through the center point of tooth width and intersecting with the reference cone. In fact, middle cone is an imaginary back cone at the center point of tooth width. See Figure 5-108.

Back Cone

An imaginary conical surface of bevel gear, whose axial line is overlapped with that of bevel gear and whose cone apex is quite opposite to that of bevel gear and whose generatrix is vertically intersecting with the reference surface of bevel gear, is called the back cone of bevel gear. See Figure 5-108.

Front Cone， Inner Cone

Front cone refers to an imaginary conical face on bevel gear. The generatrix of front cone is located at the small end of gear teeth and vertically intersected with the reference cone. See Figure 5-108.

Inner Cone Distance

The distance between the apex of reference cone of bevel gear and the front cone crossing the generatrix is called inner cone distance. See Figure 5-109.

Mean Cone Distance

Mean cone distance refers to the distance from the apex of reference cone of bevel gear to the center point of tooth width of gear teeth calculating along with the generatrix. See Figure 5-109.

Outer Cone Distance

The distance between the apex of reference cone of bevel gear and the big end of gear teeth calculating along with the generatrix of reference cone is called outer cone distance. Outer cone distance is a basic size of bevel gear. See Figure 5-109.

Back Cone Distance

Back cone distance refers to the distance between the apex of back cone and the reference cone calculating along with the generatrix of back cone. See Figure 5-109.

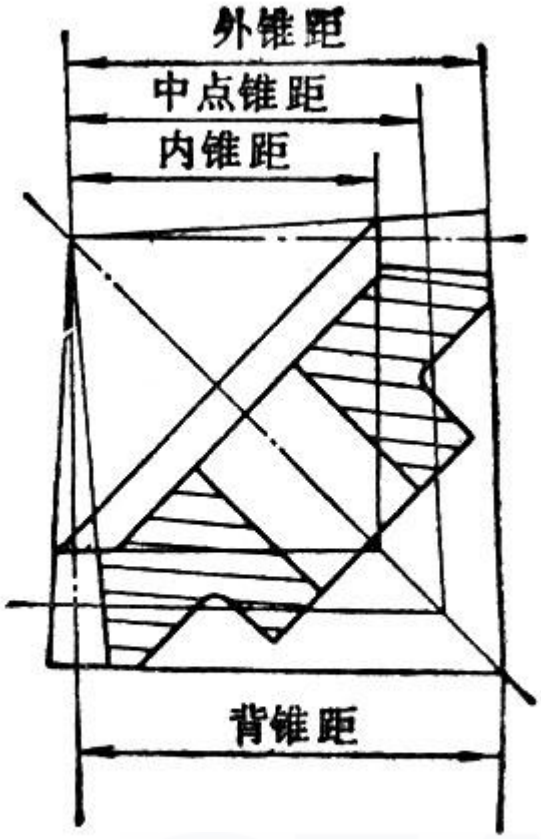


图 5-109

Cone Angle

Taking the apex of reference cone as the initial point, the axial line of bevel gear as axial line and making the direction pointing to the cone apex of back cone being positive (see Figure 5-110), then rotating the positive axis based on the initial point and make it overlapped with the generatrix of conical face, then the minimum angle formed by rotating the axis is called the cone angle of this conical face. For the internal bevel gear, cone refers to the supplement of the above mentioned minimum angle.

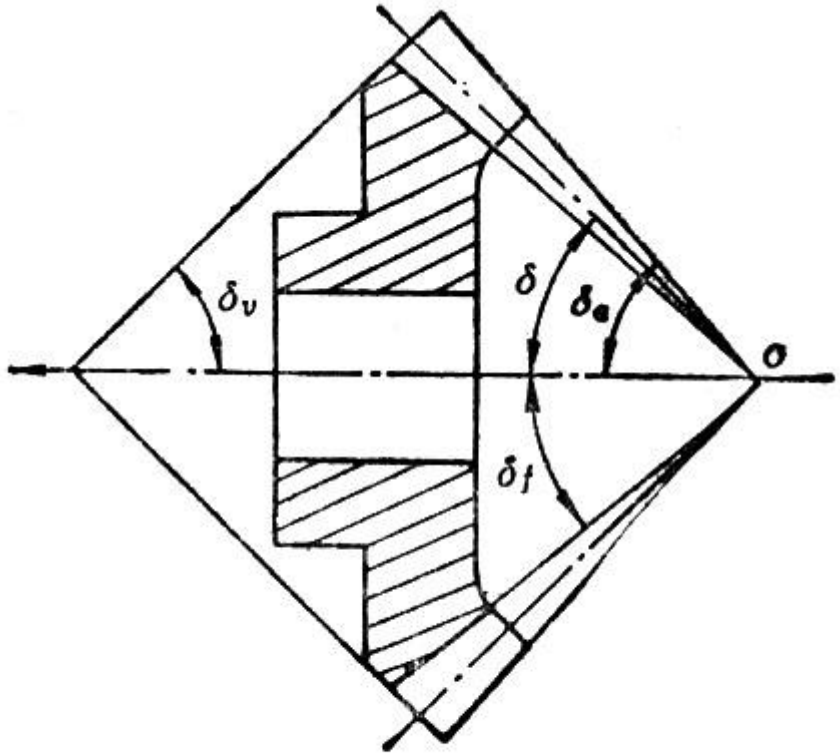


图 5-110

Reference Cone Angle

Acute angle formed between the axial line of bevel gear and its generatrix of reference cone is called reference cone angle. The generatrix of root cone is inside of this angle. See Figure 5-110.

Face Angle, Tip Angle

Face angle refers to the acute angle formed between the axial line of bevel gear and the generatrix of face cone. Face angle is the maximum cone angle of external cone gear, namely, δ a＞δ ＞δ f. See Figure 5-110.

Dedendum Angle

In the axial plane of bevel gear, the acute angle formed between the generatrix of reference cone and that of root cone is called dedendum angle. It also refers to the difference of reference cone angle and root cone angle. See Figure 5-110.

Back Angle

Back angle refers to the angle formed between then axial line of bevel gear and the generatrix of its back cone. See Figure 5-110.

Locating Distance Apex to Hack

Locating distance refers to the axial distance from reference cone apex to the

locating surface. See Figure 5-111.

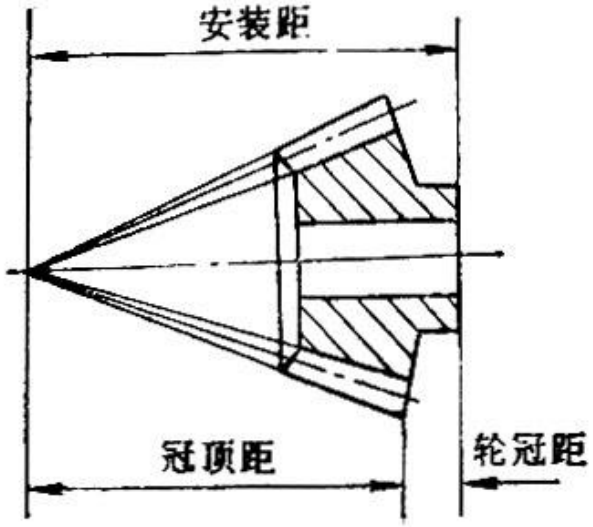


图 5-111

Tip Distance Crown to Back

Tip distance crown to back refers to the distance from plane which addendum circle is located in to the locating surface. See Figure 5-111.

Apex to Crown

Apex to crown refers to the distance between reference cone apex and the plane where the addendum circle is located in. See Figure 5-111.

5.3.4 The Imaginary Circle and Diameter of Bevel Gear

Reference Circle

The intersecting line between the reference cone of bevel gear and its transverse plane is called reference circle. See Figure 5-112. Reference circle also refers to the intersection between reference cone and back cone. Bevel gear has different reference circle within different transverse plane. Generally, the reference circle of bevel gear refers that at the big end of bevel gear. The pitch is a given value on this circle.

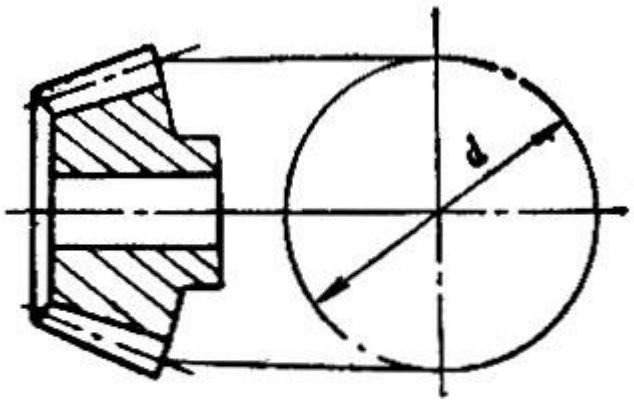


图 5-112

Reference Diameter

The reference diameter of bevel gear can be seen in the Figure 5-112.

Addendum Circle，Tip Circle

Addendum circle refers to the intersection between the tip cone and transverse plane of bevel gear. See Figure 5-113. It also refers to the intersection between tip cone and back cone. Within different transverse plane, the addendum circle holds various sizes. Addendum circle, in general, refers to that at the big end.

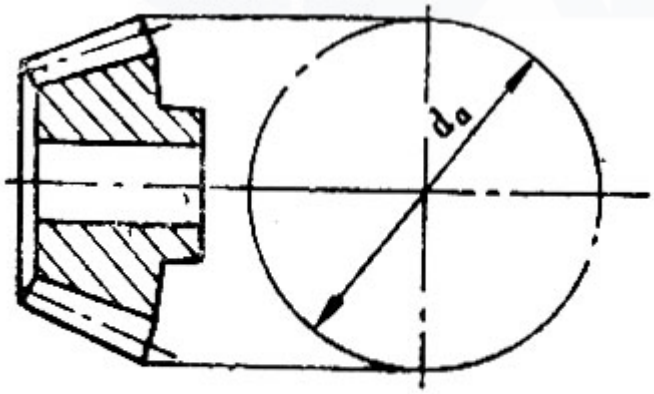


图 5-113

Tip Diameter of Bevel Gear

The tip diameter of bevel gear can be seen from the Figure 5-113.

Root Circle

Root circle refers to the intersection between root cone and transverse plane of bevel gear; it also refers to the intersecting line between root cone and back cone. The

size of root circle is different in different transverse plane. Generally, it refers to the root circle at the big end. See Figure 5-114.

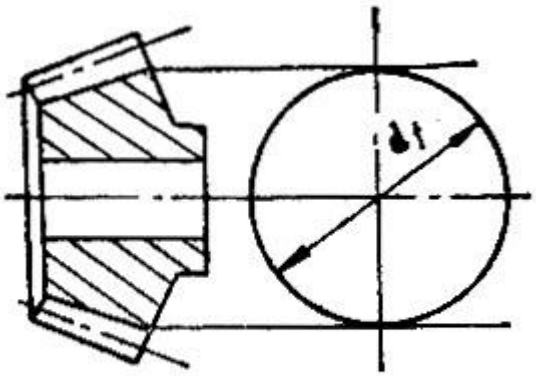


图 5-114

Root Diameter

The root diameter of bevel gear can be seen from the Figure 5-114.

Formation Circle of Skew Bevel Gear

The circle drawn taking offset of tooth trace of skew bevel gear as radius and taking the apex of imaginary crown wheel of skew bevel gear as the center of this circle is called formation circle of skew bevel gear. All the tooth trace of skew bevel gear is tangent to the formation circle. See Figure 5-115.

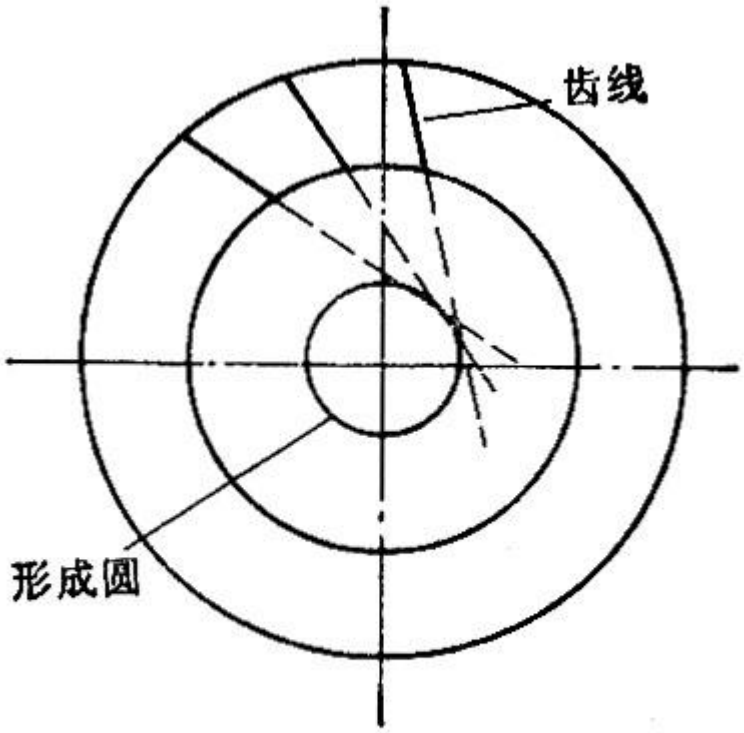


图 5-115

5.3.5 Apex, Tooth Depth, Tooth Width, Tooth Thickness and Tooth Flank of Bevel Gear

Apexes and Crossing Points

Apexes and crossing points refers to the intersecting point between the generatrix of various cone and its axis or the apex of cone is called apexes and crossing points. For example: reference apex, tip cone apex, root cone apex, middle cone apex, back cone apex and front cone apex, etc. The reference apex, tip cone apex and root cone apex may be overlapped or not, which is determined by the contracting nature of gear teeth of the bevel gear. See Figure 5-116.

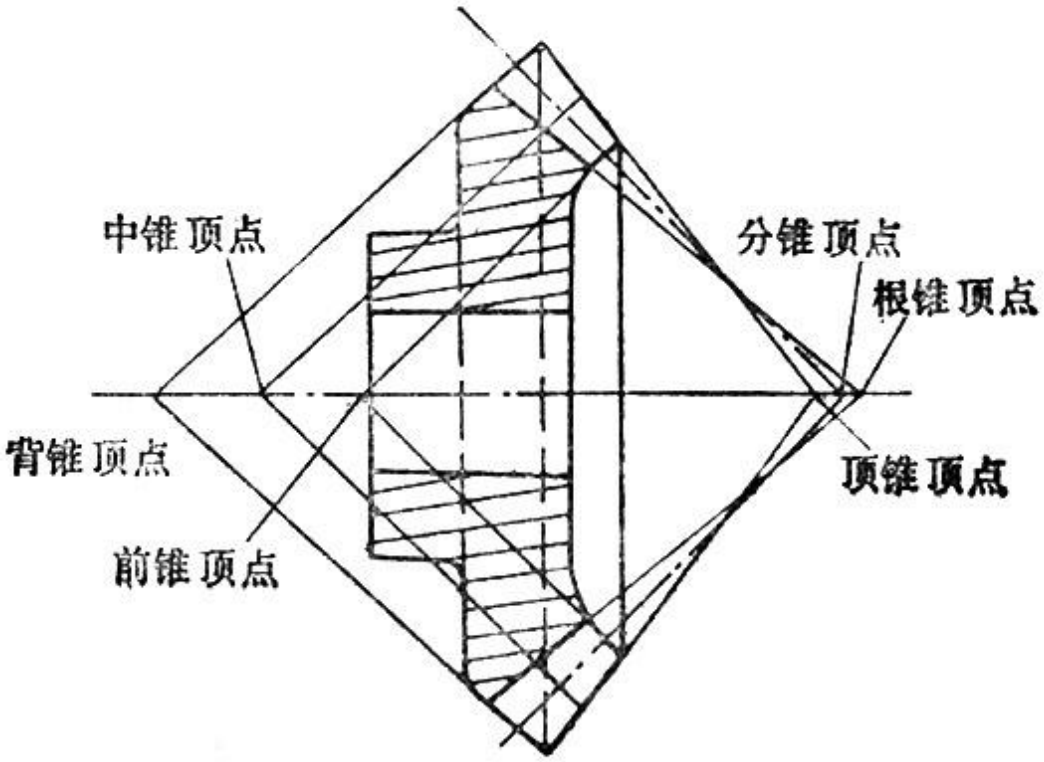


图 5-116

Tooth Depth

Tooth depth refers to the distance between tip cone and root cone calculating along with the direction of back cone generatrix, which also refers to the tooth depth of virtual gear.

Addendum

The distance between tip cone and reference cone measuring along with the back cone generatrix is called addendum. This is the addendum of virtual gear. See Figure 5-116.

Dedendum

Dedendum refers to the distance between reference cone and root cone measuring along with the back cone generatrix. This is also the dedendum of virtual gear. See Figure 5-116.

Working Depth

In the meshing course of bevel gear pair, the addendum circle of two gears and the public generatrix of the two back cone have an intersecting point each, then the distance between the two intersecting points is called working depth of bevel gear , namely, the working depth of virtual gear.

Addendum Angle

On the axial plane of bevel gear, the acute angle formed between the tip cone generatrix and reference cone generatrix is called addendum angle, namely, the difference between tip cone angle and reference cone angle. See Figure 5-117.

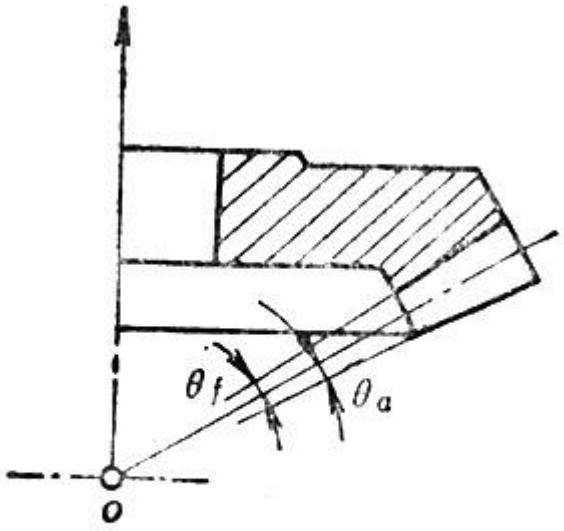


图 5-117

Dedendum Angle

The difference between reference cone angle and root cone angle is called dedendum angle. That also refers to the acute angle formed between reference cone generatrix and root cone generatrix on the axial plane. See Figure 5-117.

Facewidth of Bevel Gear

Facewidth of bevel gear refers to the width of gear teeth measured along the reference cone generatrix. See Figure 5-118.

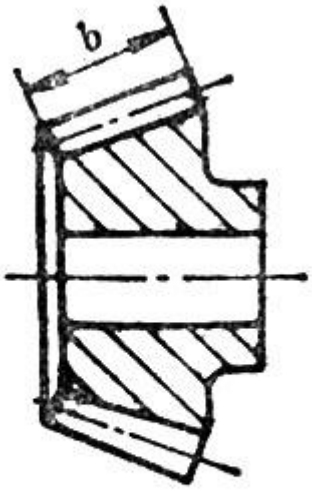


图 5-118

Crown

On the axial cross section of bevel gear, the intersecting point of tip cone and back cone is called crown. See Figure 5-119.

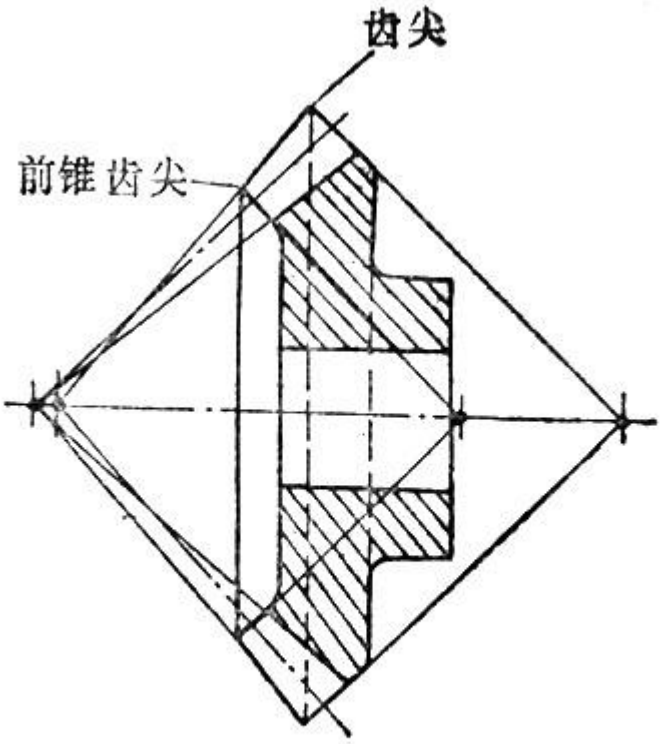


图 5-119

Front Crown

On the axial plane of bevel gear, the intersecting point of tip cone and front cone generatrix is called front crown. See Figure 5-119.

Tooth Angle

Tooth angle refers to an adjusting angle on double-plane iron gear shaping machine, the value is equal to half of the angle formed by pitch-cone generatrix on two flanks of a tooth. See Figure 5-120.

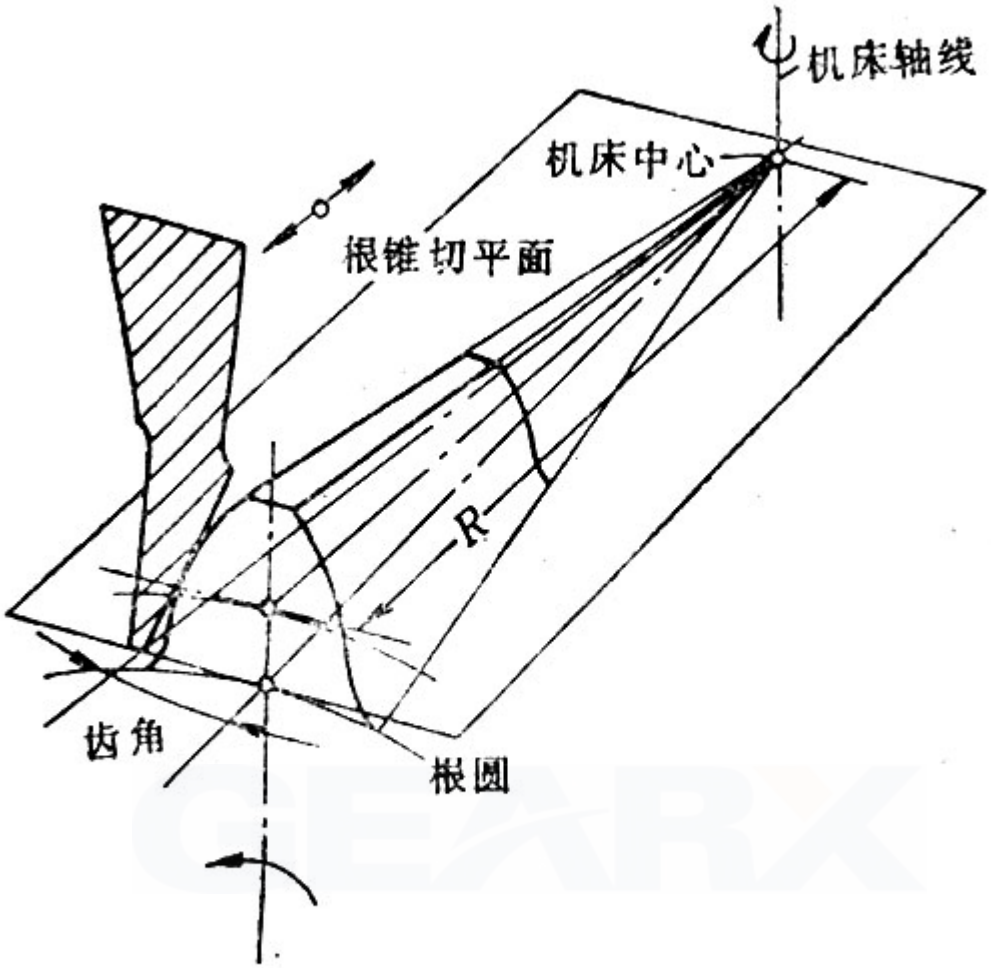


图 5-120

Convex Side

Convex side is a flank of gear tooth of curved tooth bevel gear. Convex side is a tooth flank cut by hobbing teeth inside of a facer. This flank has a shape of convex along the tooth length direction. See Figure 5-121.

图 5-121

Concave Side

Concave side is the lateral tooth surface of gear teeth of curved tooth bevel gear. Concave side is a flank cut by the external milling cutter of a facer. The shape of this flank along the tooth length direction is concave. See Figure 5-121.

Heel of Tooth

The teeth of bevel gear locating at the big end is called heel of tooth. See Figure 5-121.

Toe of Tooth

The teeth of bevel gear locating at the small end is called toe of tooth. See Figure 5-121.