Types of gears

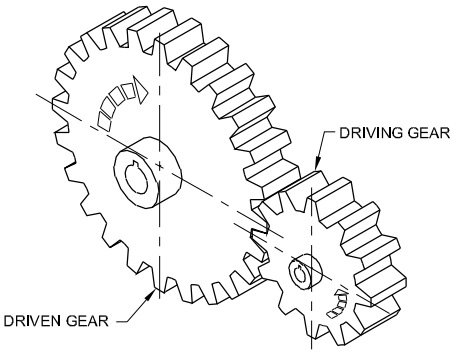
Objectives : At the end of this lesson you shall be able to
- **state the purpose of gears**
- **name the most common forms of gears and state their uses**
- **determine the velocity ratio of a gear train**
- **state the care and maintenance of gears.**

Purpose of gears

Gears are used to transmit torque/motion from the driving shaft to the driven/follower shaft:

- to change the velocity ratio
- to change the direction of rotation. (Fig 1)
- to get a positive drive.

Fig 1



Gears are made from cast iron, steel, non-ferrous, plastic or fibre material.

Types

Spur gear

The teeth are cut parallel to the axis of rotation. The spur gears are used to transmit power between two parallel shafts.

Fig 2 shows two spur gears mating each other and Fig 3 illustrates the application of gears in the centre lathe to transmit motion from the main spindle to the lead screw.

Helical gear

In a helical gear, the teeth are cut at an angle to the axis of rotation. It may be used to transmit power between two parallel shafts. Helical gears run more silently than a spur gear.

Fig 4 shows a set of helical gears mounted on two parallel shafts. These are widely used in automobile vehicles. The application of helical gears in an oil pump is illustrated in Fig 5.

Fig 2

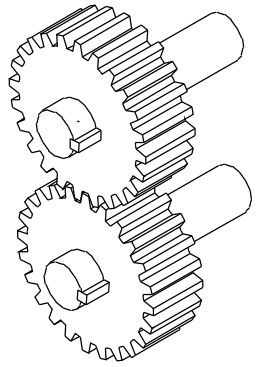


Fig 3

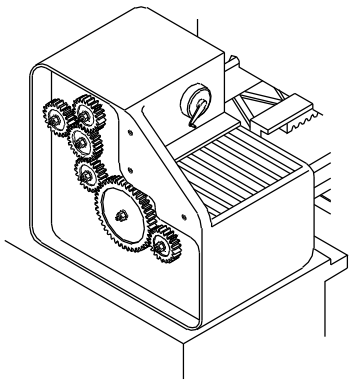


Fig 4

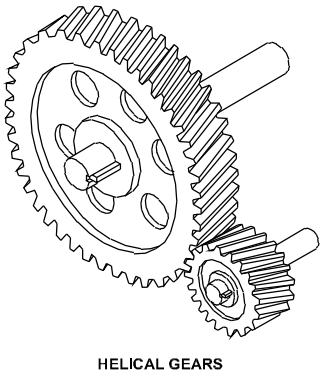
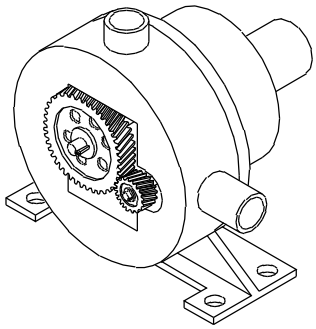


Fig 5



HELICAL GEARS

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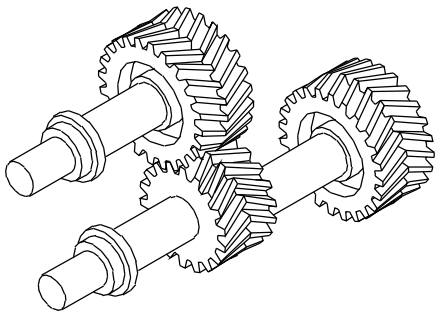
The end thrust is exerted by the driving and driven gears in the case of helical gears and the thrust may be eliminated by using double helical gears. These gears are called herring-bone gears. (Fig 6)

Fig 6



HERRING BONE GEARS

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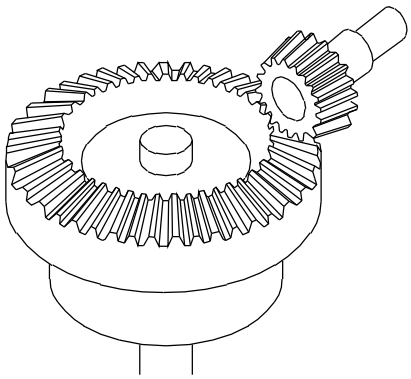
Bevel gear

The bevel gears shown in Fig 7 are used to transmit motion between shafts at various angles to each other. The teeth profile may be straight or spiral.

Fig 7



BEVEL GEAR

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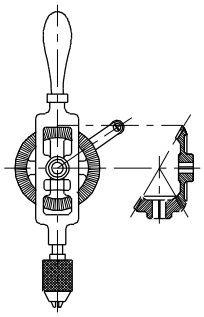
In a hand driller, the bevel gears transmit motion when the shafts are at right angles to each other. (Fig 8)

Fig 8



BEVEL GEAR

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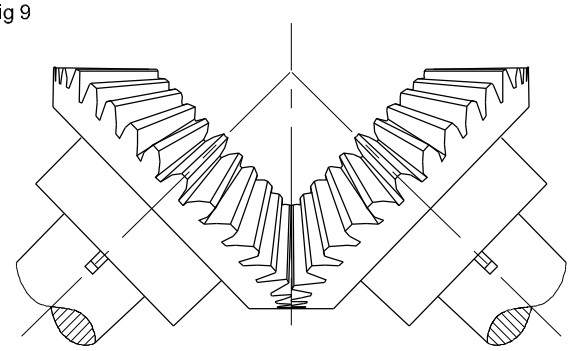
Mitre gears

If two bevel gears are symmetrical to each other and transmit motion at right angles, such gears may be called ‘mitre gears’. (Fig 9)

Fig 9



MITRE GEARING

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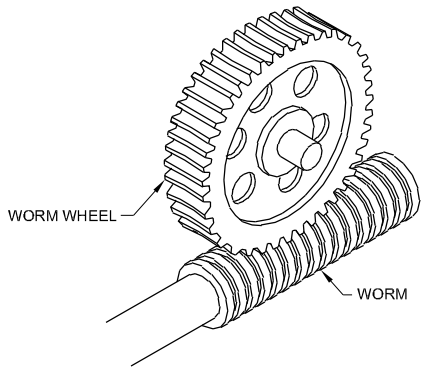
Worm shaft and worm gear

The worm shaft has spiral teeth cut on the shaft and the worm wheel is a special form of gear teeth cut to mesh with the worm shaft. (Fig 10)

Fig 10



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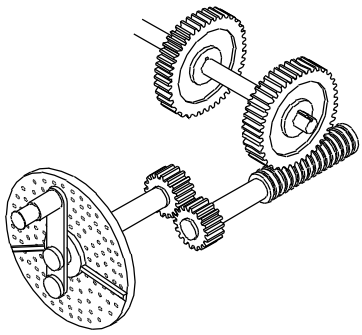
These are widely used for speed reduction purpose.

The application of worm and worm gear in the index-head gear mechanism is shown in Fig 11.

Fig 11



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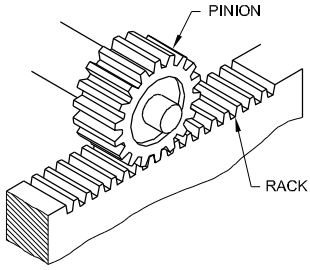
This system transmits motion at right angles to the axis of motion at different planes.

Rack and pinion

The rack and pinion can change rotary into linear movement and vice versa. (Fig 12)

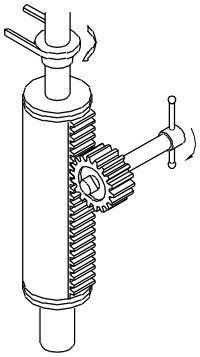
Fig 12



FIN421691C

This mechanism is used in drilling machines as illustrated in Fig 13.

Fig 13

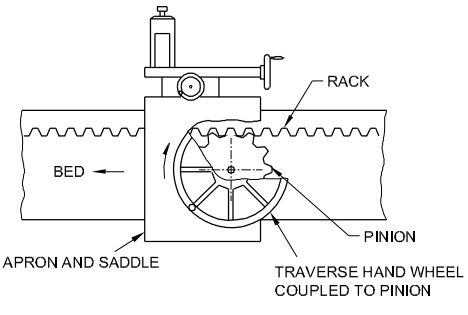


DRILLER

FIN421691D

Fig 14 shows the application of the rack and pinion in lathe traverse mechanism.

Fig 14



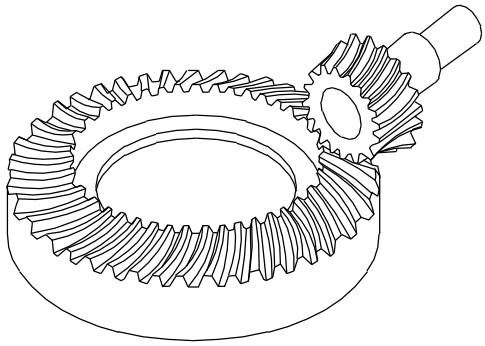
RACK AND PINION
(LATHE TRAVERSE MECHANISM)

FIN421691E

Hypoid gears

The hypoid gears are used in automotive differential gearboxes. A pair of hypoid gears (illustrated in Fig 15) is similar to the spiral bevel gear but with the shafts offset. The tooth action between each gear is a combination of rolling and sliding action along a straight line. The pitch surfaces are hyperboloids of revolution; as such the gears are called hypoid gears.

Fig 15



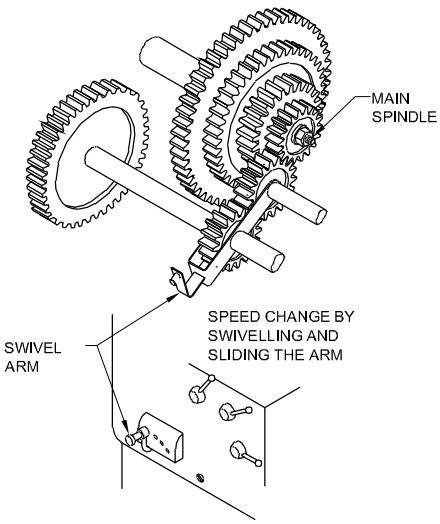
FIN421691F

Velocity ratio of gear train

The gear train transmits motion without slip.

Different speeds can be obtained byshifting gear position in the gear- box. Fig 16 shows the feed change by swivelling and sliding the swivel arm in the Norton gearbox of lathes.

Fig 16



FIN421691G

Velocity ratio of worm gear

It is the ratio of number of turns of the worm to 1 turn of the worm wheel.

$$\text{Speed ratio} = \frac{z2}{z1}$$

Where z2 = Number of teeth on the worm wheel.

Z1 = Number of starts on the worm.

Methods of machining worm

– On a centre lathe

– On a worm milling machine

– On a gear hobbing machine

Methods of machining a wormwheel

– On a milling machine

– On a hobbing machine

Repair broken gear tooth (Dovetail blank method)

Objective: At the end of this lesson you shall be able to

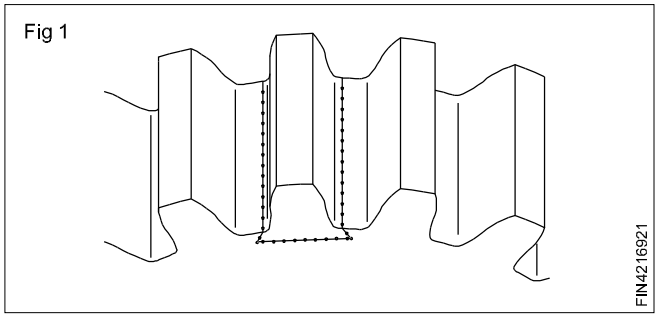
• repair broken gear tooth by dovetail method.

Support the gear against a Vee block and clamp it by parallel camp.

Mark the dovetail groove on the gear wheel form both sides using a venier height gauge and vernier bevel protractor.

Punch the marking lines.(Fig 1)

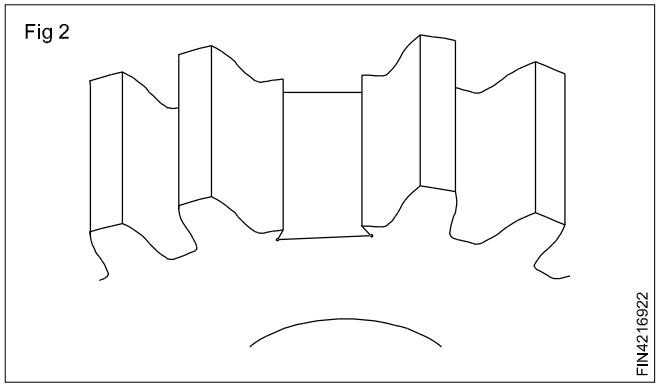
Fig 1



Drill 3mm dia. relief holes one each on the corner of the dovetail.

Remove material from the gear to shape and size of dovetail as per marking. (Fig 2)

Fig 2



File the blank to the profile of the gear tooth as per punch mark.

File the dovetail portion of the blank.

Fit the blank into the dovetail groove of the gear wheel. If necessary,file the blank till it fits in.

Apply Prussian blue on the dovetail groove to check the high spots in the blank piece.

Remove the high spots and make a snug fit in the dovetail groove.

Drill 5.9mm dia. -2 holes up to a depth of 33 mm on the blank and gear wheel in assembled condition.

Ream the holes using a hand reamer.

Dismantle the assemlby and remove the chips from the holes of the gear and the blank.

Assemble again and fit the dowel pins in the holes by a slight tapping.

File the profile of the gear tooth to the correct shape.

Use a template to check the profile.

File on the sides of the blank,flush with the gear.

Repair broken gear tooth (Welding method)

Objective: At the end of this lesson you shall be able to

• repair broken gear tooth using the welding method.

File the broken tooth surface flat. (Fig 1)

Mark for four holes on the surface with 10 mm centre distance between the holes.

Punch the centres for drill holes. (Fig 2)

Drill 5mm dia. holes on the centres to a depth of 9 mm. (Fig 3)

Remove the chips from the holes.

Fig 1

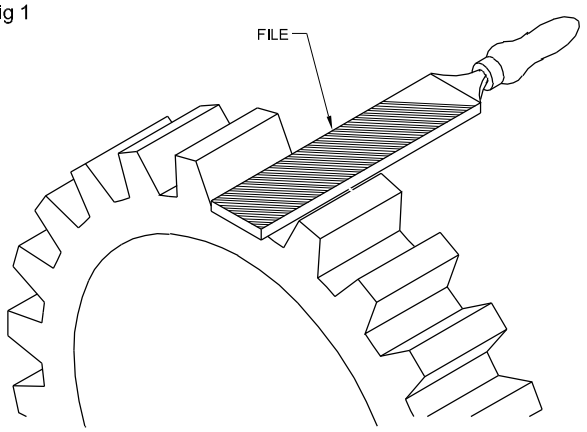


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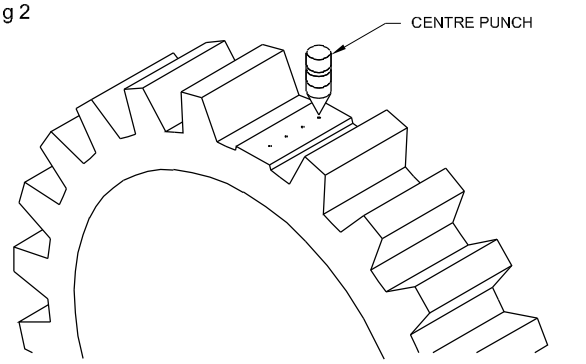
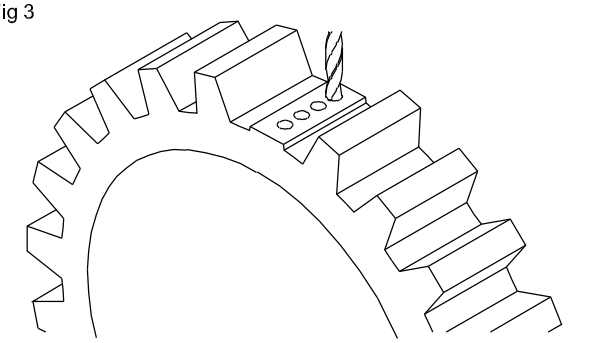
Fig 2



FIN42 16932

Drill the holes of ϕ 5 mm for M6 tap(Fig 3)

Fig 3



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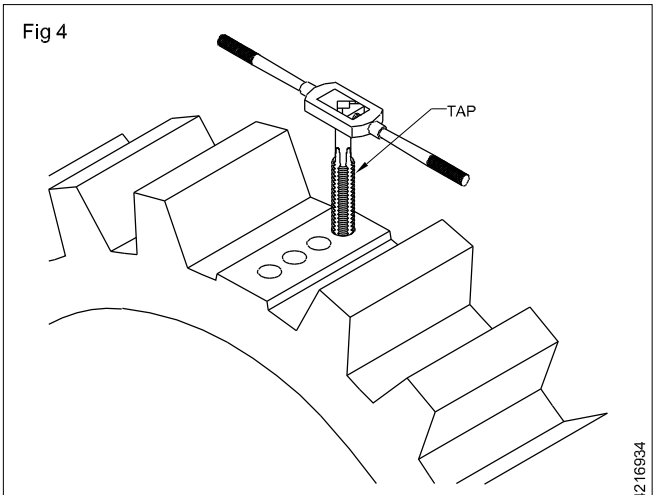
Tap the holes using a M6 hand tap. (Fig 4)

Fig 4



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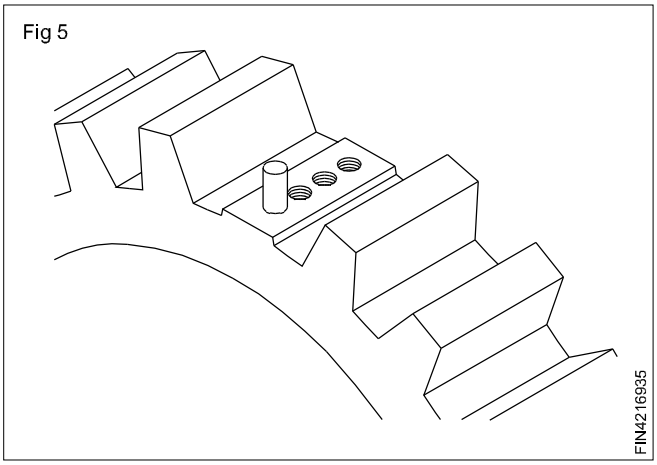
Remove the chips and clean the tapped holes.

Fix up four hexagonal headed M6 bolts into the tapped holes and tighten them securely. (Fig 5)

Fig 5



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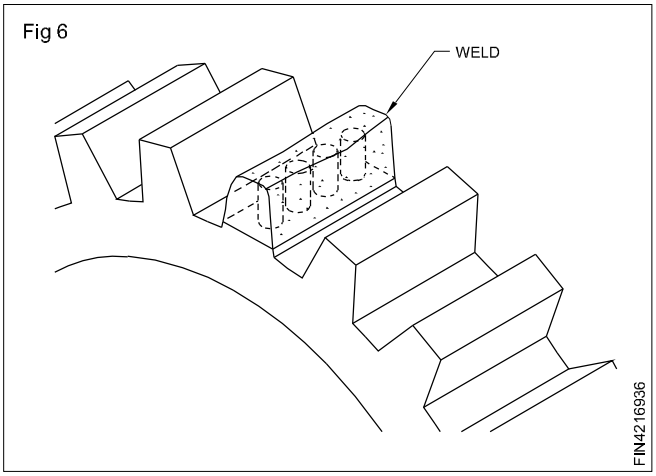
Cut off the haxagonal head of the bolts by hacksawing.

Build up maerial by welding enough to make the tooth profile by filing. (Fig 6)

Fig 6



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File the built up material to tooth profile. Use a template frequently to check the profile to have correct shape and pitch. (Figs 7 & 8)

Fig 7

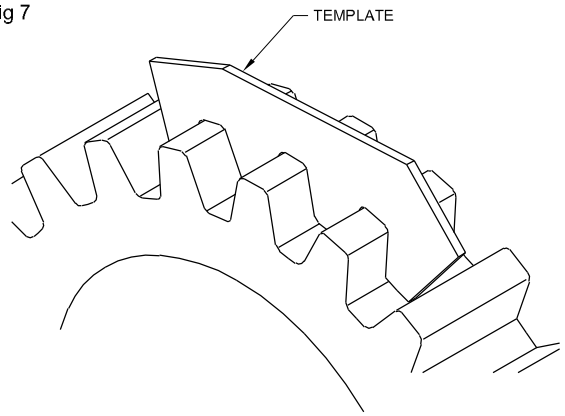

Fig 8