Shaft, Keys, Keyways and Splines.

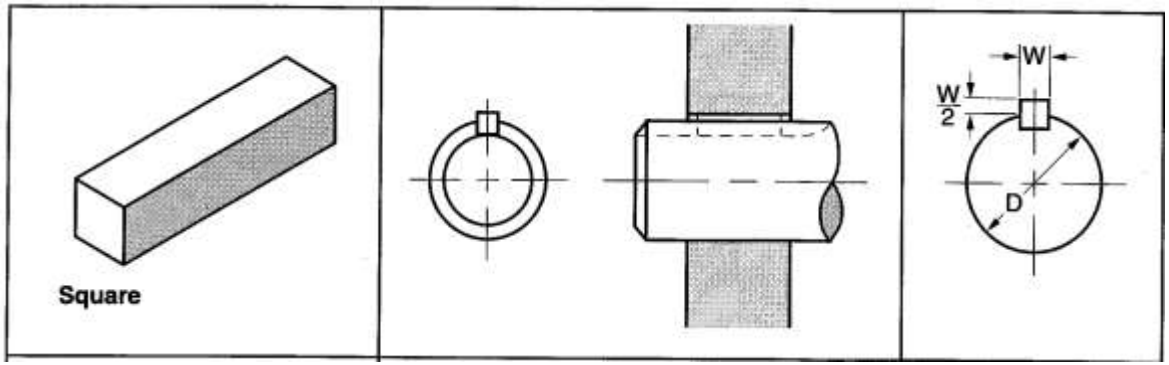
A key is a piece of steel inserted between the shaft and hub or boss of the pulley to connect these together in order to prevent relative motion between them.

It is always inserted parallel to the axis of the shaft. Keys are used as temporary fastenings and are subjected to considerable crushing and shearing stresses.

A keyway is a slot or recess in a shaft and hub of the pulley to accommodate a key.

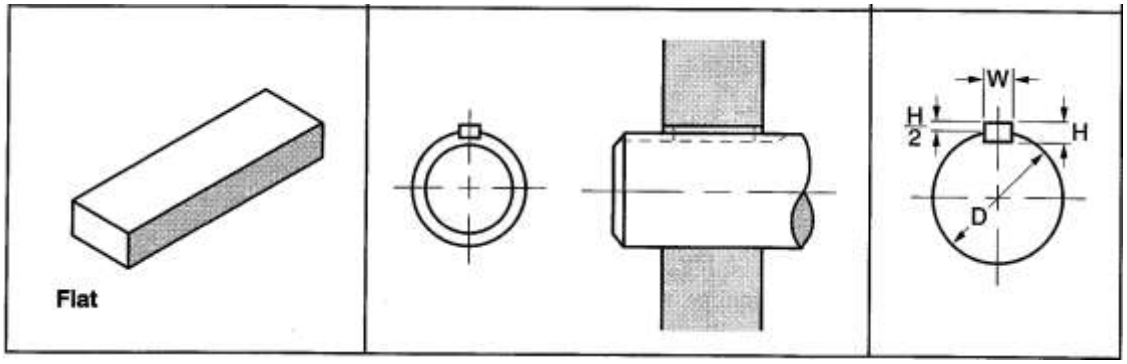
Square Sunk Key

The only difference between a rectangular sunk key and a square sunk key is that its width and thickness are equal.

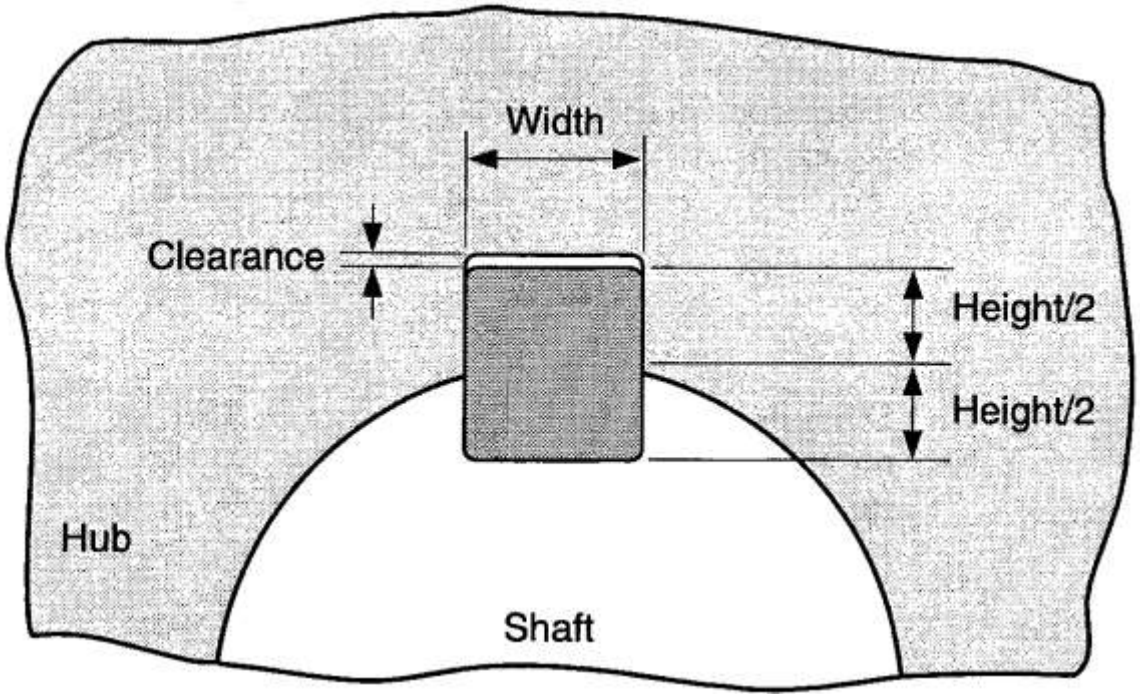


Flat Parallel Sunk Key

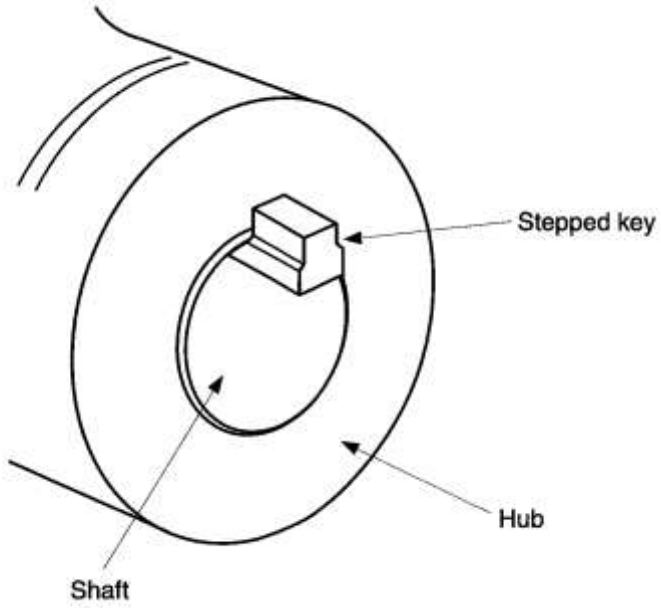
The rectangular has a greater shear section and uniform in width and thickness throughout. They may specified higher torque drives and where the hub wall thickness or section is reduced such as pulley, gears or large diameter shafts.



All square or flat keys need to be a good fit on the keyway sides with a top clearance

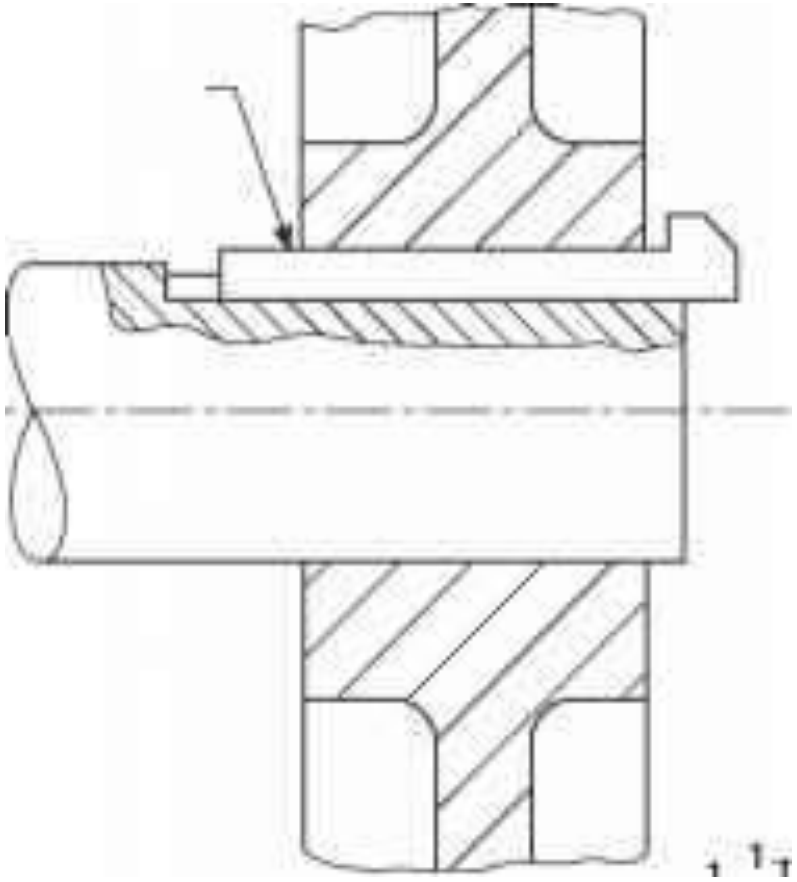


Some times on old or refurbished equipment you may find a stepped. This is to accommodate keyways of different sizes, note the key must be stepped an equal amount on both sides



Gib-head Key

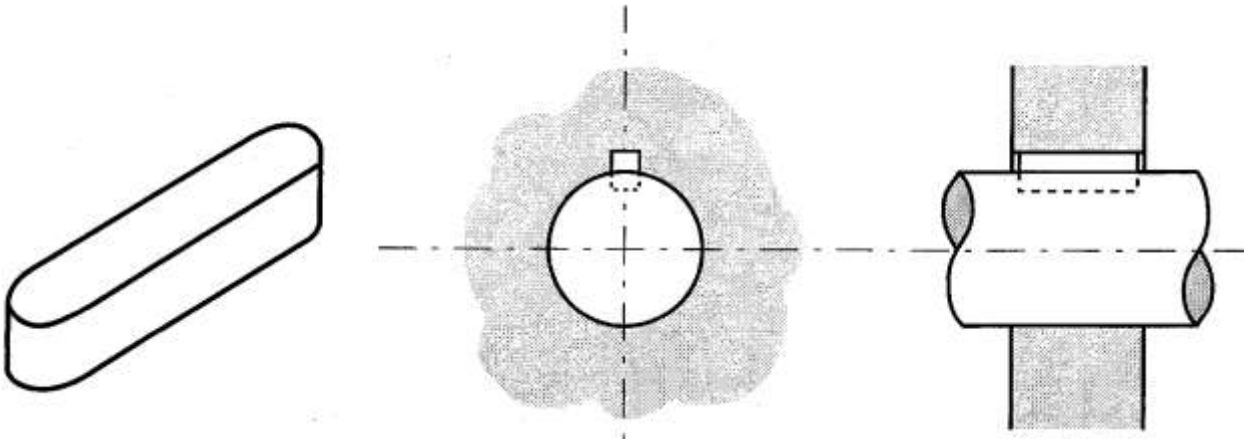
It is a rectangular sunk key with a head at one end known as gib head. It is usually provided to facilitate the removal of key.



Boxed (blind) Keys

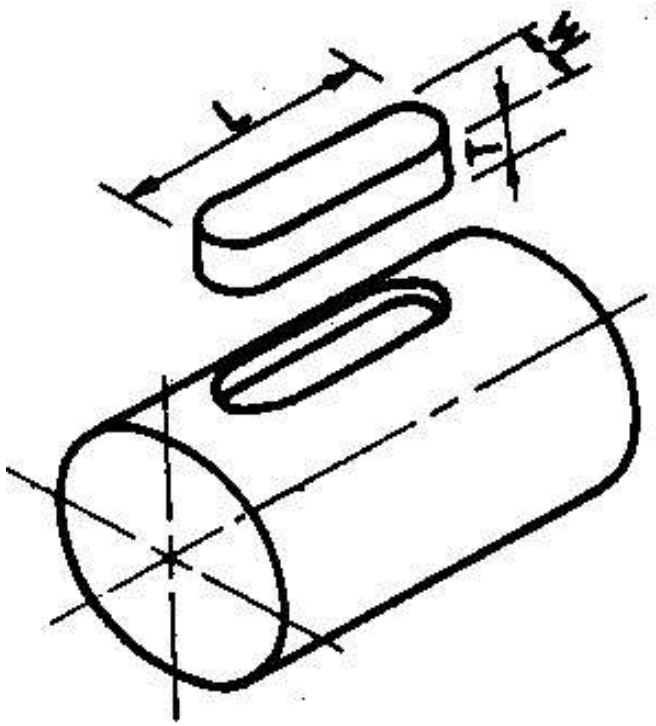
A boxed key can be square or rectangular with rounded ends that fit into a closed end keyway in the shaft. They are mainly used for applications where mating machine components have restrict access at both ends, these keys are normally set deep into the shaft.

Boxed (blind) Keys



Boxed (blind) Keys

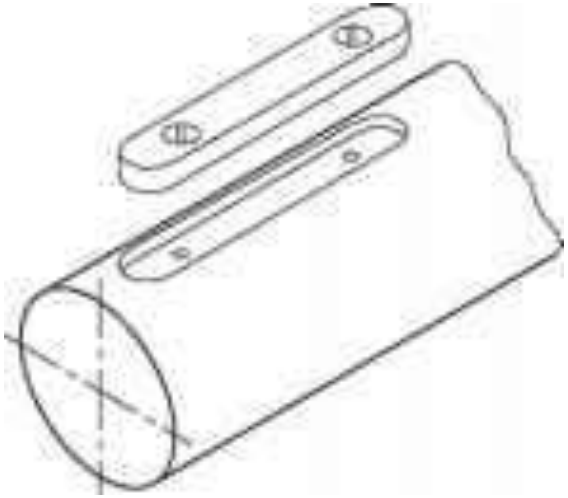
It is uniform in width and thickness throughout. They are very often drilled and tapped in the centre to help with the removal of the key from the keyway.



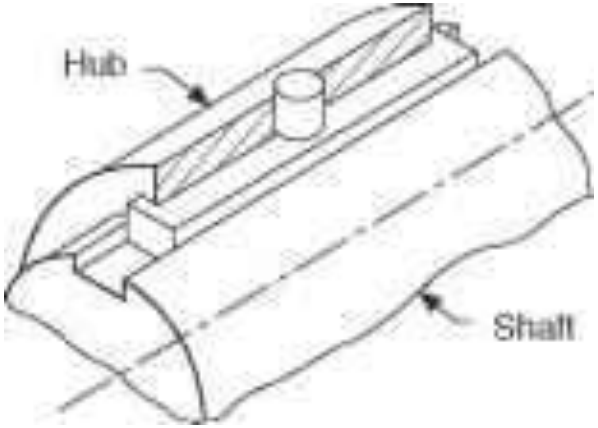
Feather keys

It is a key attached to one member of a pair and permitting relative motion axial movement thus it is particular kind of parallel key which permits axial moment . A feather key is secured either to the shaft or to the hub, the key being a sliding fit in the keyway of the moving piece.

Feather key



Peg feather key

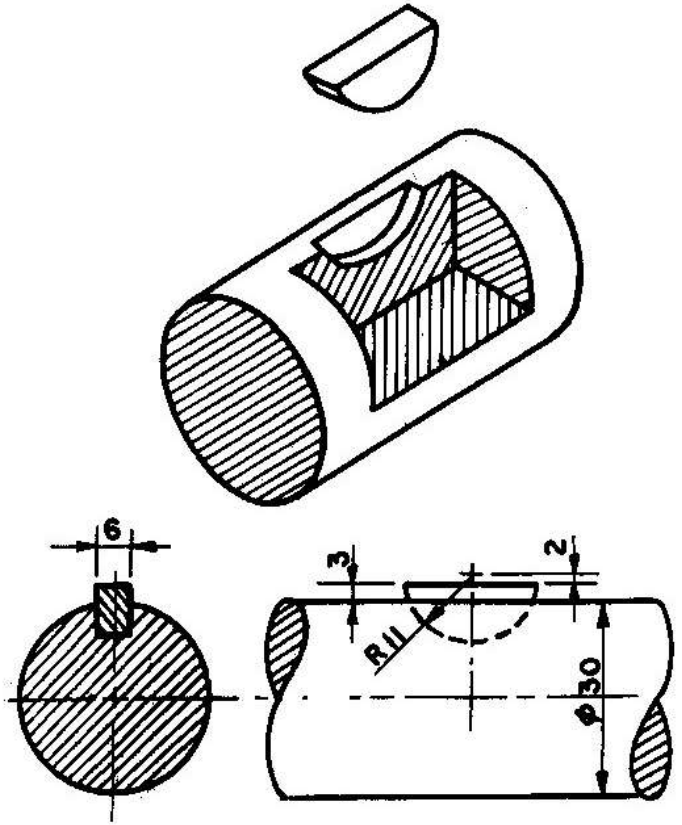


A key attached to one member of a pair and which permits relative axial movement of the other is known as feather key.

It is a special key of parallel type which transmits a turning moment and also permits axial movement. It is fastened either to the shaft or hub, the key being a sliding fit in the key way of the moving piece.

Woodruff keys

It is an adjustable sunk key. It is in the form of a semi-circular disc of uniform thickness.



Woodruff Key

The woodruff key is an easily adjustable key. It is a piece from a cylindrical disc having segmental cross-section.

A woodruff key is capable of tilting in a recess milled out in the shaft by a cutter having the same curvature as the disc from which the key is made.

This key is largely used in machine tool and automobile construction. The main advantages of a woodruff key is:

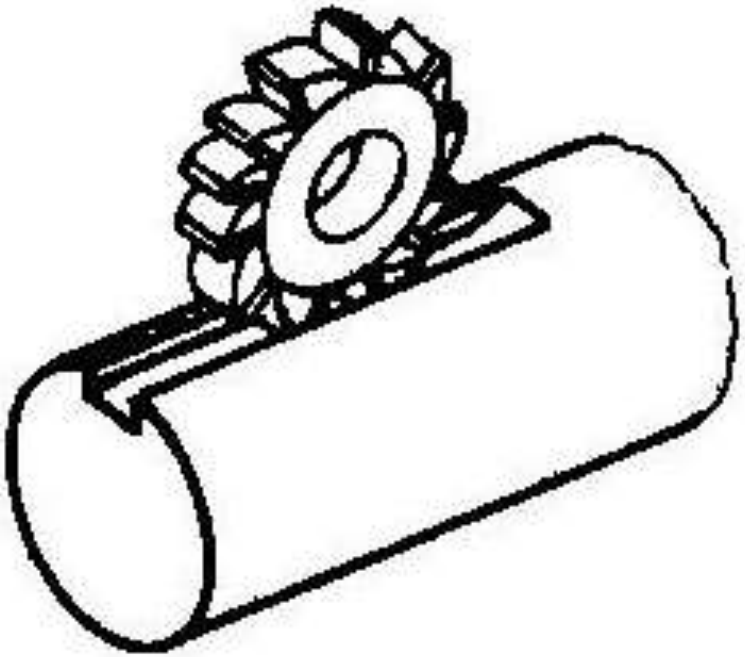
Woodruff Key Advantages are

(a) It accommodates itself to any taper in the hub or boss of the mating piece.
(b) It is useful on tapering shaft ends. Its extra depth in the shaft prevents any tendency to turn over in its keyway.

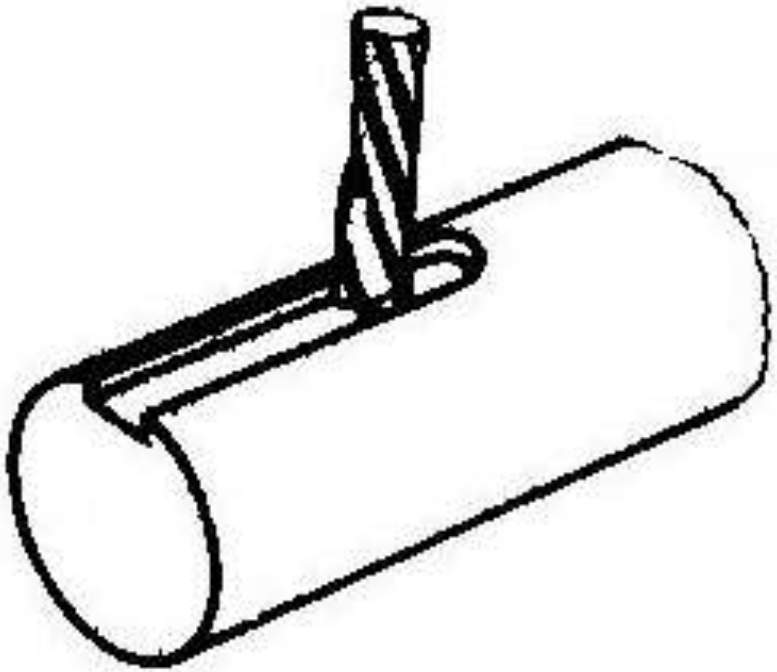
The disadvantages are :

(a) The depth of the keyway weakens the shaft.
(b) It can not be used as a feather.

Keyways milled

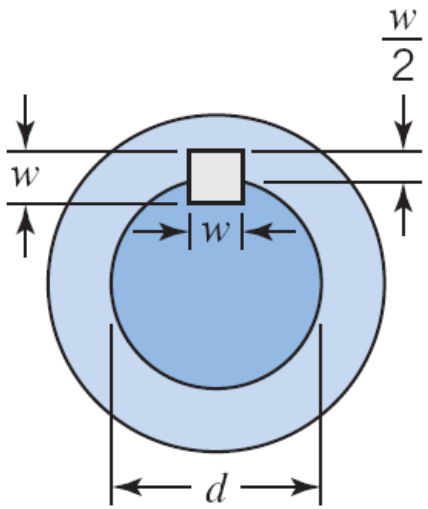


horizontally



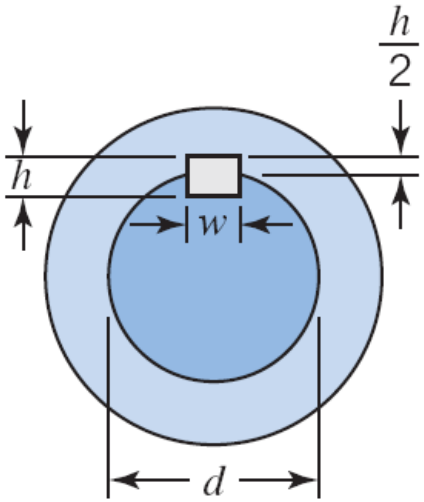
vertically

Common Types of Drive Systems



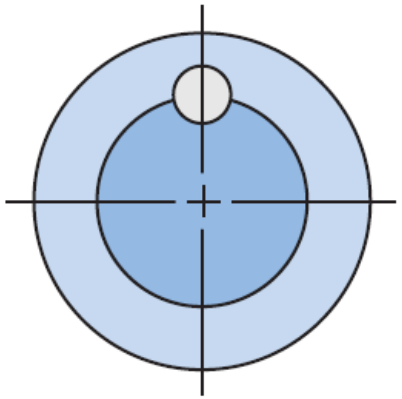
$w \approx d/4$

(a) Square key



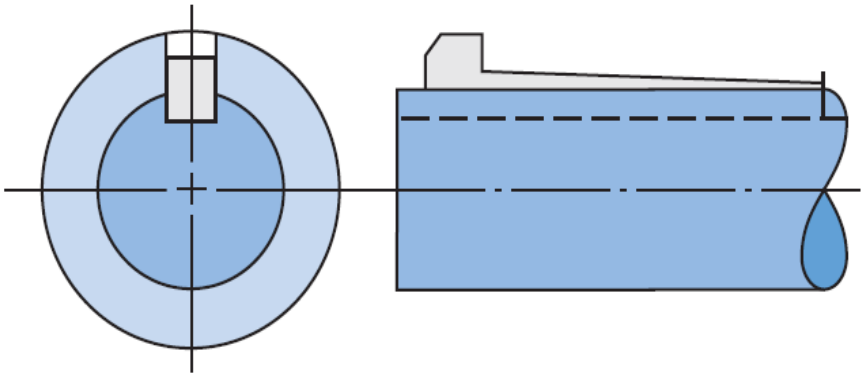
$w \approx d/4; \quad h \approx 3w/4$

(b) Flat key



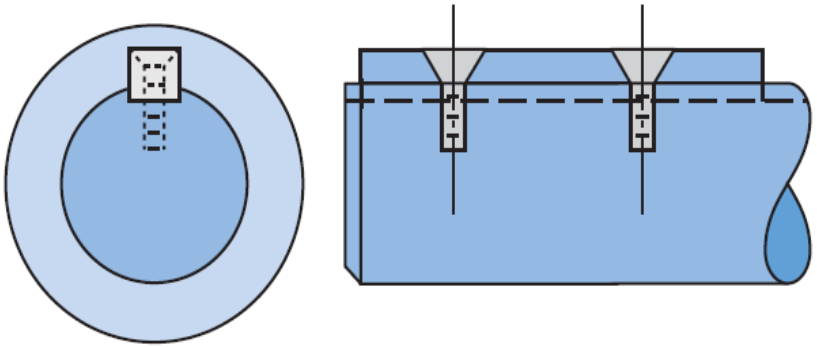
Key usually has drive fit; is often tapered

(c) Round key



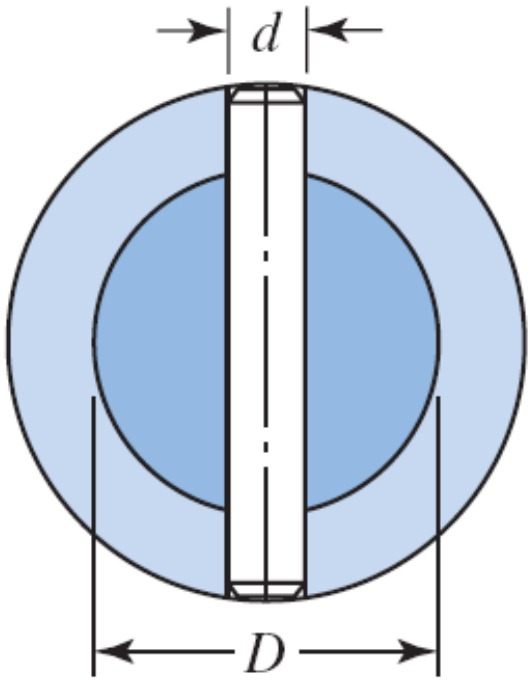
Usually tapered, giving tight fit when driven into place; gib head facilitates removal

(f) Gib-head key

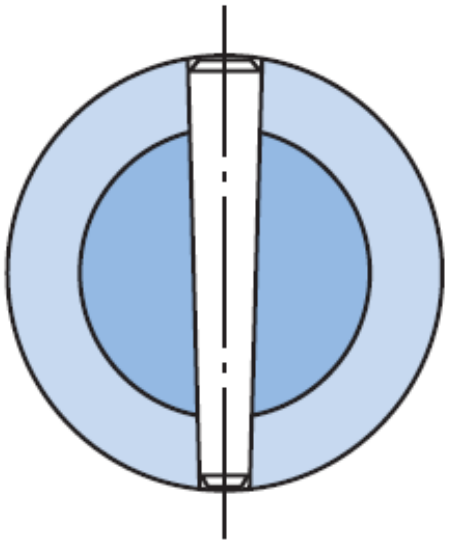


Key is screwed to shaft; hub is free to slide axially – easier sliding is obtained with two keys spaced 180° apart

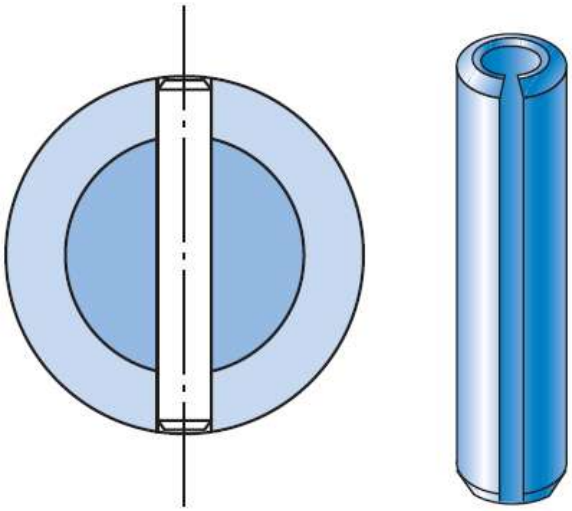
(g) Feather key



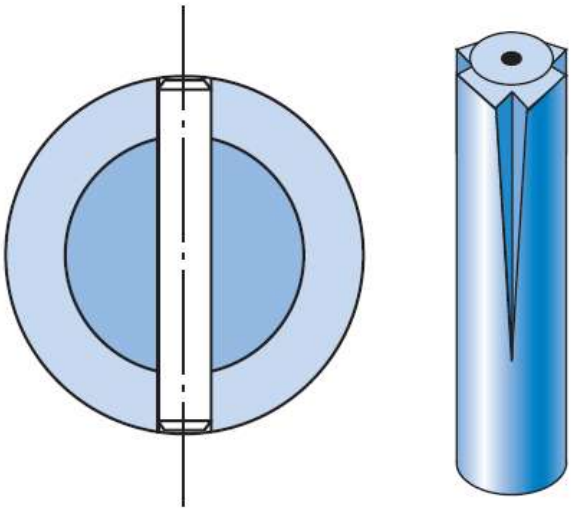
(*a*) Straight round pin



(*b*) Tapered round pin



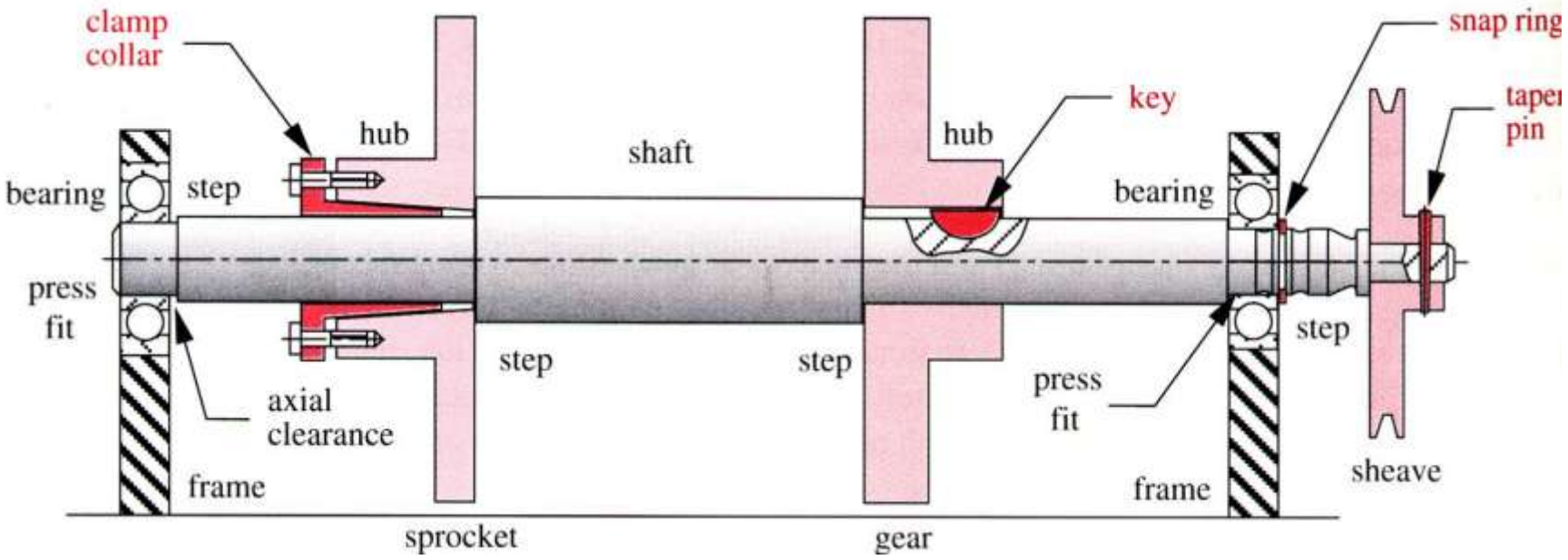
(*c*) Split tubular spring pin



Grooves are produced by rolling, and provide spring action to retain pin

(*d*) Grooved pin

Various Methods of Attaching Components to a Shaft



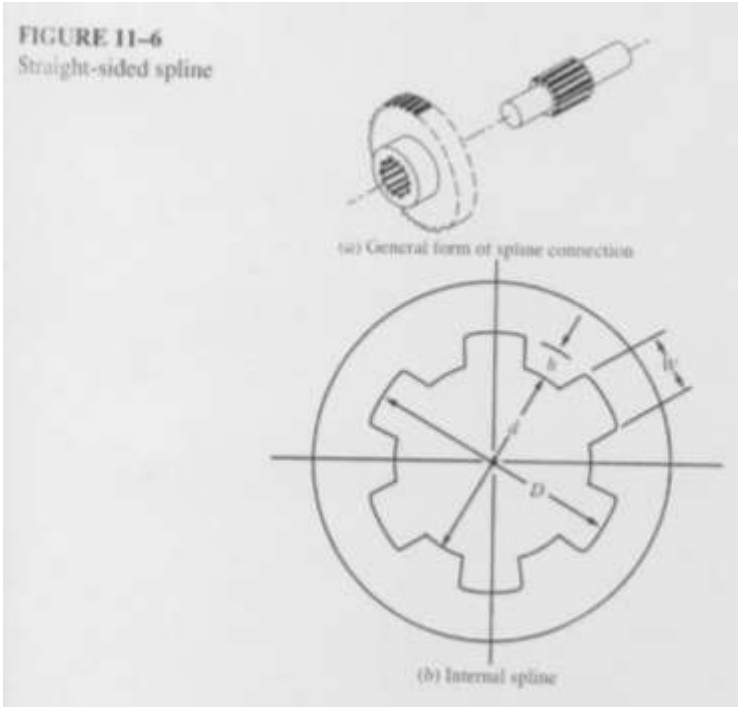
Spline shaft and hub

- A spline shaft is used when the hub is required to slide along the shaft. These shafts are used mostly for sliding gear application as in automotive gear box and propeller shaft of aircraft.
- A spline shaft in which are cut equiangular longitudinal groove, the metal between these groove forming splines or feathers of uniform depth.

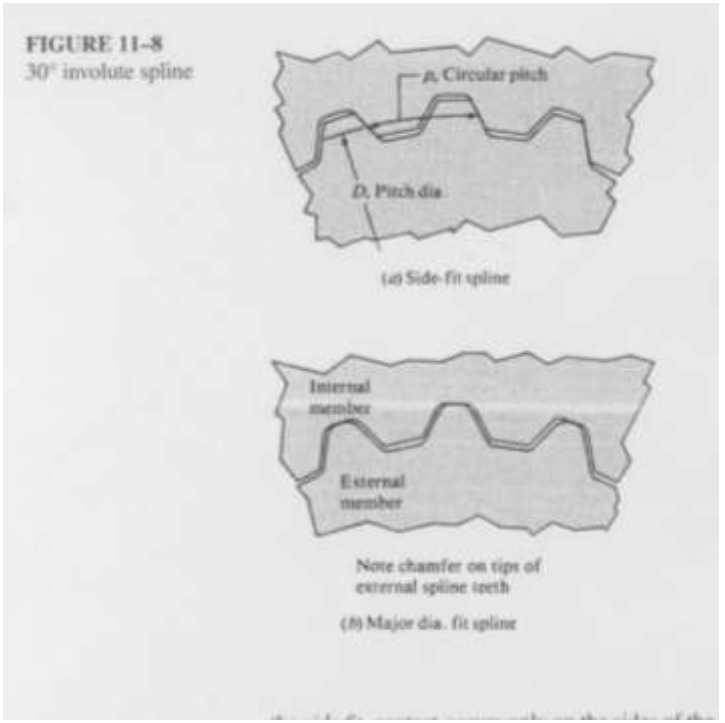
  –By this means the power transmitted is equally divided amongst the number of keys giving great strength and security against total failure than by using a single key.

Two types of splines:

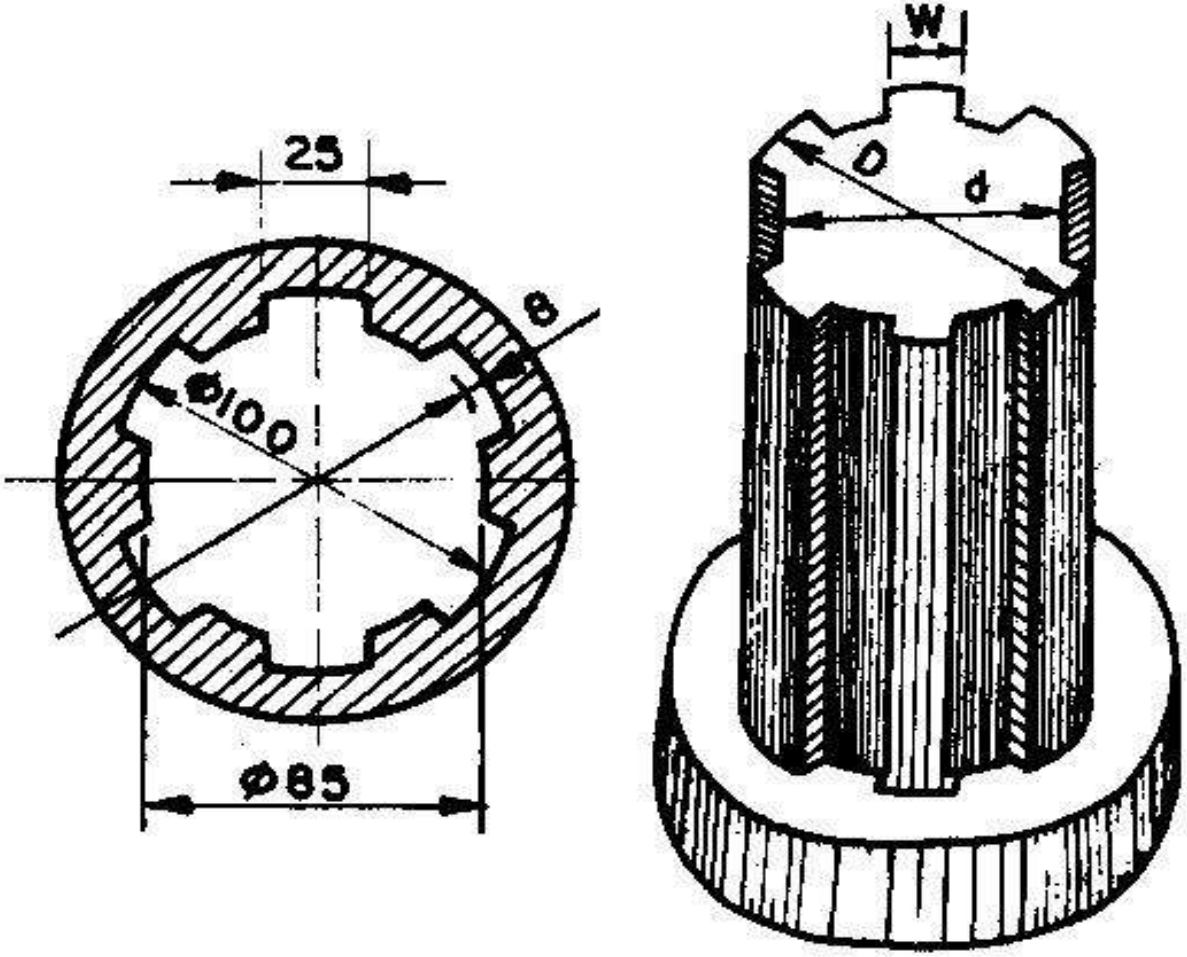
Straight Sided



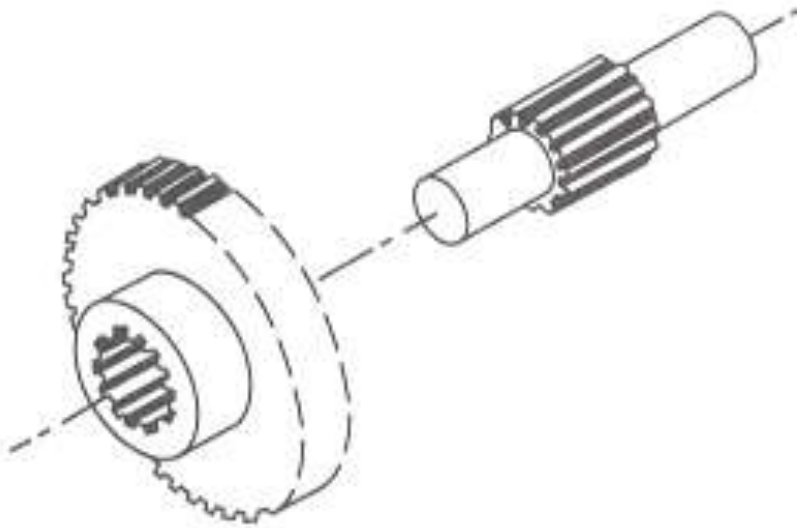
Involute

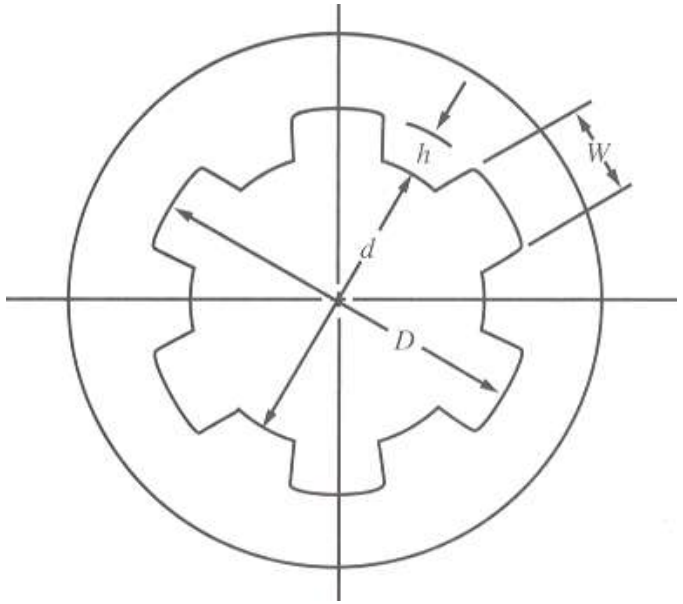


Spline shaft



Splines





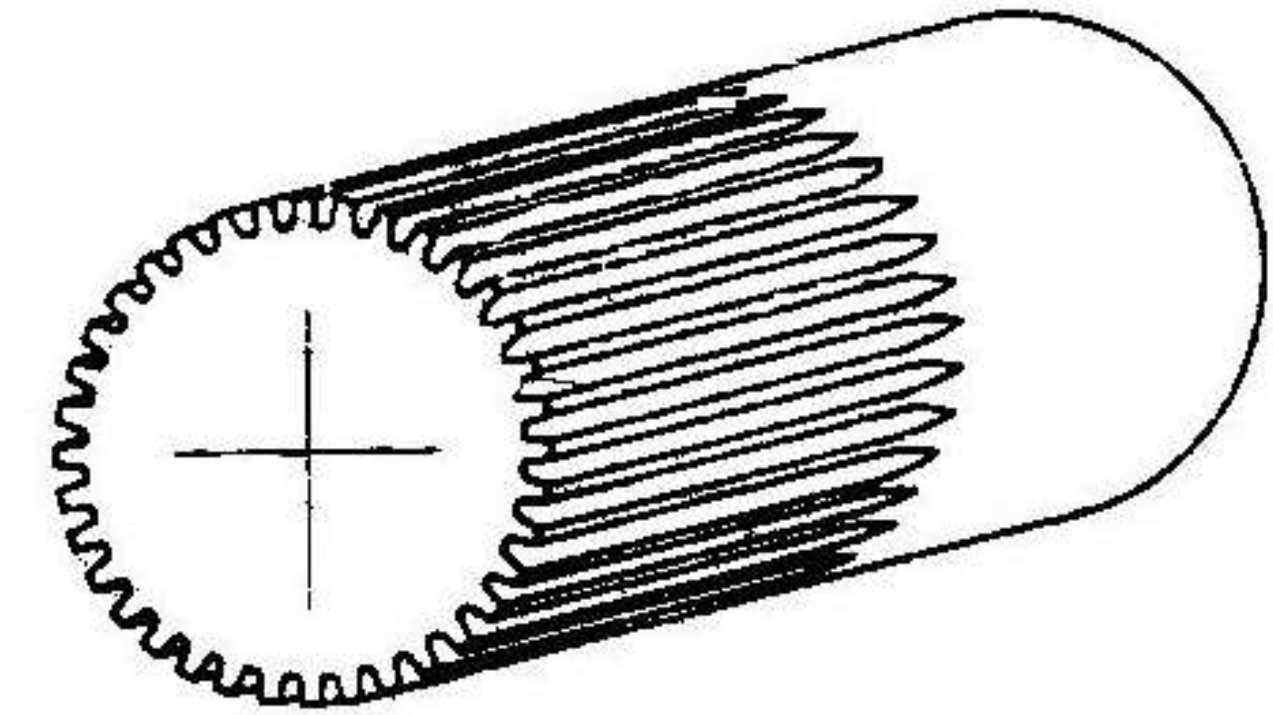
"Axial keys" machined into a shaft

Transmit torque from shaft to another machine element

Serrated shafts

A spine shaft suffer from the disadvantage of reduced strength .this disadvantage is eliminated by use of a serrated shaft which gives maximum strength for a given weight of material. in a serrated shaft , a number of corresponding grooves are cut In the shaft and mating piece, the two being tightly pressed, one over the other the bottom of the serrations and the crests of the teeth are flat. These are used throughout industry but were developed for aircraft manufacturing:

Serrated shaft



Splines

Advantages:

•Can carry higher torque for given diameter (vs keys) or

•Lower stress on attachment (gear)

•Better fit, less vibration (spline integral to shaft so no vibrating key)

•May allow axial motion while reacting torque

Disadvantage:

•Cost

•Impractical to use as fuse

Spline Types

- Straight
  - SAE
  - 4, 6, 10 or 16 splines
- Involute
  - Pressure angles of 30, 37.5, or 45 deg.
  - Tend to center shafts for better concentricity

The End

Any Questions