II-A. TYPES OF GENERAL PURPOSE COUPLINGS

Section II-

Flexible Couplings

A. TYPES OF GENERAL PURPOSE COUPLINGS

This section will discuss couplings for general purpose applications. These couplings are used on pumps and other equipment that if shut down will not shut down the plant or the process. These will transmit torque from one shaft to another while allowing misalignment and axial motion between the ends of the coupled shafts.

It is conventional to classify these couplings by the mechanisms by which they allow relative motion as discussed in section I-A. That is, sliding or rolling motion, flexing, or combinations of these two basic mechanisms. Further, it has become common to further classify couplings as General Purpose (low speed-generally motor speeds) or Special Purpose (high speed-generally over motor speeds)

The Special Purpose (high speed) types have become the area of greater interest due to their being technically more sophisticated and elaborate in design. General purpose types are generally more standardized and less sophisticated in design, but are used in quantities substantially greater than high performance types.

1. Classifications

It is not feasible to discuss in detail all the various general purpose couplings because of the very large variety of configurations available. Therefore this discussion will consider only the most widely used generic types. These are:

1. Lubricated
    - Gear
    - Grid
2. Non-lubricated
    - Disc
    - Elastomeric

Within these classifications we will describe many design variations including floating shaft arrangements, single and double engagement types, cutout, shear pin, brake, slide, flanged sleeves, continuous sleeves, shifter types, close coupled, spacer types, insulated couplings and etc.

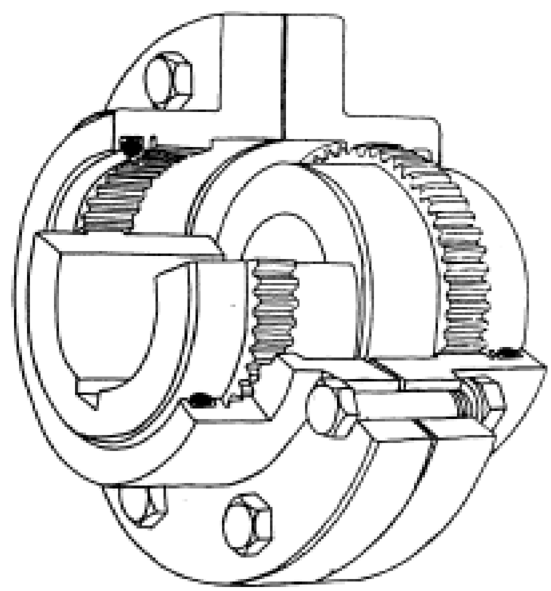
2. Lubricated

a. Gear Coupling

1) Basic Design

(Figure II-A-1). The most common popularly used flexible shaft coupling is the gear coupling. Gear couplings have been manufactured since before World War 1.

Figure II-A-1. Gear Coupling

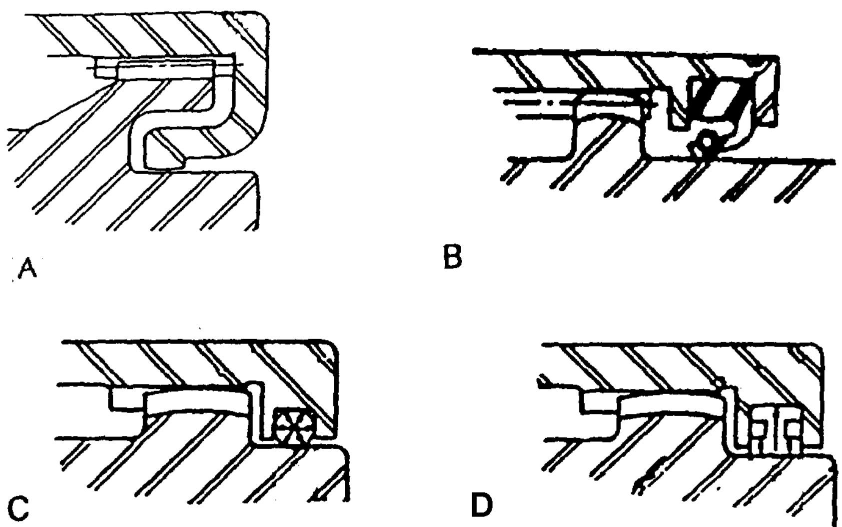


2) Seal Designs

(Figure II-A-2). Lubricated types require seals to retain the lubricant. Various seals have been used, but currently the most common types are:

- Labyrinth seal (Figure II-A-2A)
- High misalignment lip seal (Figure II-A-2B)
- "O" Ring (Figure II-A-2C)
- Molded rubber (Figure II-A-2D)

Figure II-2 Various Gear Coupling Seals



3) Lubrication.

Most gear couplings are lubricated. The required lubrication methods are:

(1) grease lube - most common
(2) continuous oil lube - high speed drives
(3) batch oil lube - usually low speed
(4) non lube - non metallic sleeve teeth (Figure II-A-3)

Figure II-A-3 Nylon Sleeve Gear Coupling

4) Basic Coupling Types.
   Basic design features of gear couplings are:
   (1) double engagement (Figure II-A-4A)
   (2) single engagement (Figure II-A-4B)

Figure II-A-4A Double Engagement

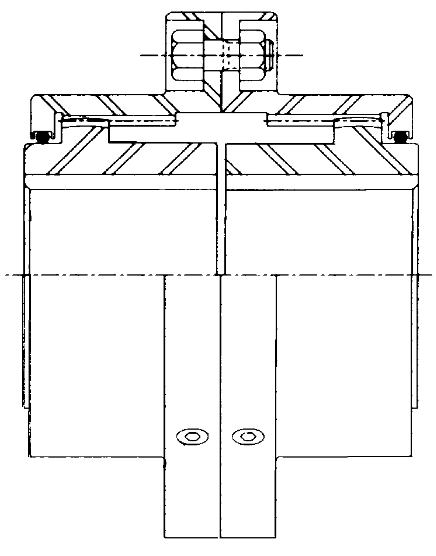
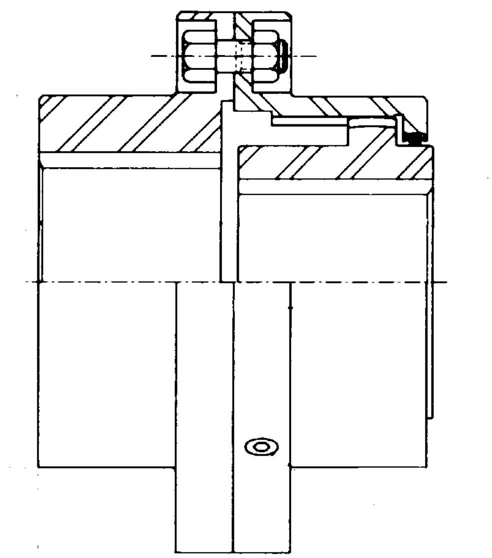
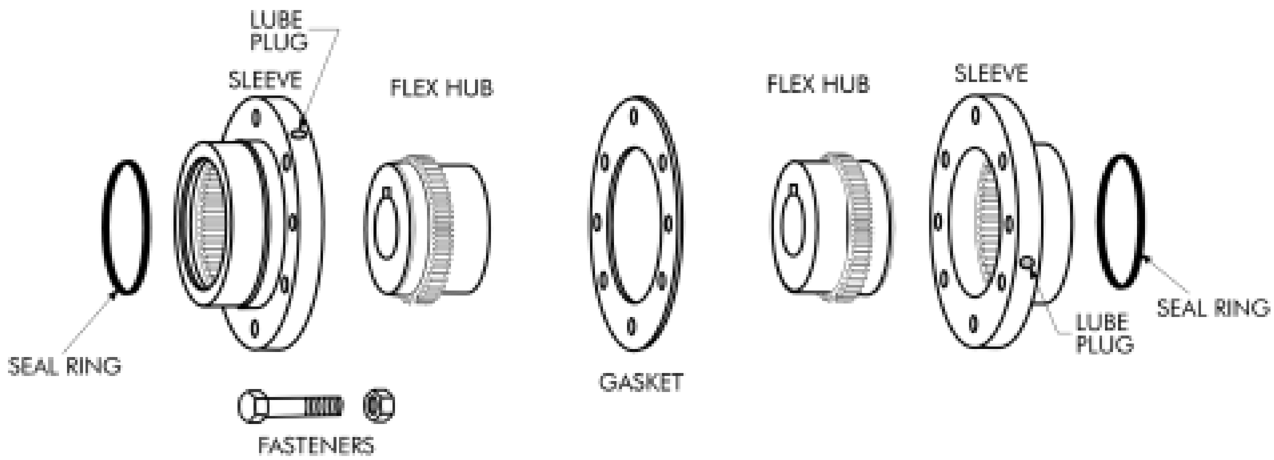


Figure II-A-4B Single Engagement



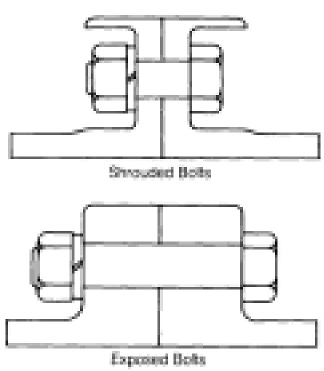
Basically a gear coupling consisting of two contact points is called a double engagement coupling. Alternately, a single engagement coupling has one engagement point and one rigid hub. Components of a standard sleeve coupling (close coupled) consist of tw o sleeves, tw o hubs, seals and hardw are (Figure II-A-5).

Figure II-A-5 Construction of a Typical Gear Coupling



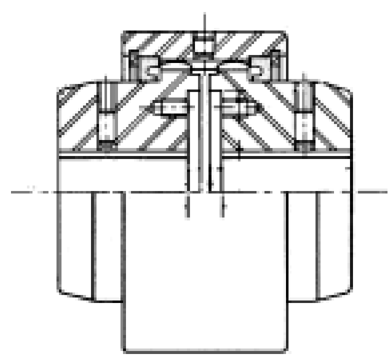
Flanged couplings can be exposed bolt or shrouded bolt types (Figure II-A-6).

Figure II-A-6 Exposed Bolt-Shrouded Bolt Flange Designs



In addition to the conventional flanged sleeve coupling, there is a continuous sleeve design (Figure II-A-7).

Figure II-A-7 Continuous Sleeve Design



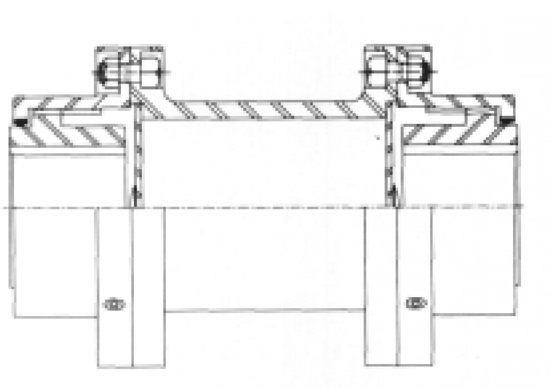
The components of a continuous sleeve coupling are as show n (Figure II-A-8).

Figure II-A-8 Continuous Sleeve in Detail

Flexible Couplings

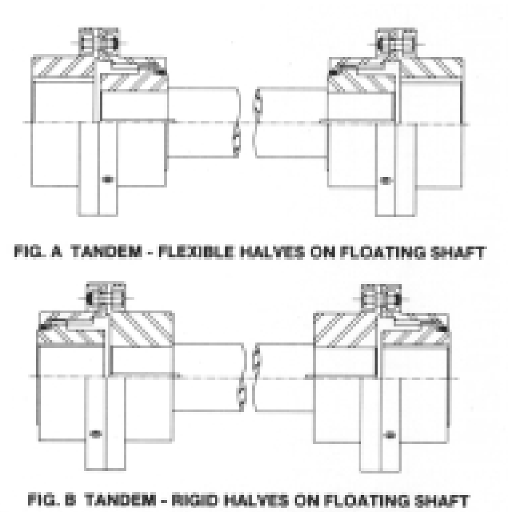
Flanged type gear couplings can be provided with a spacer (Figure II-A-9). This is a configuration commonly used in pump installations to facilitate removal of the pump rotor for maintenance.

Figure II-A-9 Spacer Design



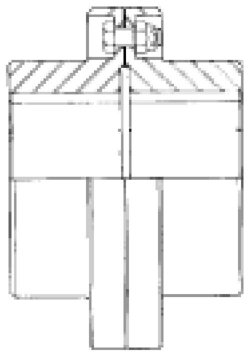
Single engagement styles are normally used in floating shaft assemblies which can be assembled in either rigid flex - flex rigid or flex rigid - rigid flex assemblies (Figure II-A-10).

Figure II-A-10 Floating Shaft Designs



Most gear coupling suppliers have available a rigid hub primarily for use in floating shaft assemblies. Using two rigid hubs bolted together, a rigid/rigid assembly is available (Figure II-A-11). The rigid/rigid assembly does not accommodate misalignment and is not correctly classified as a flexible coupling.

Figure II-A-11 Rigid Coupling Design



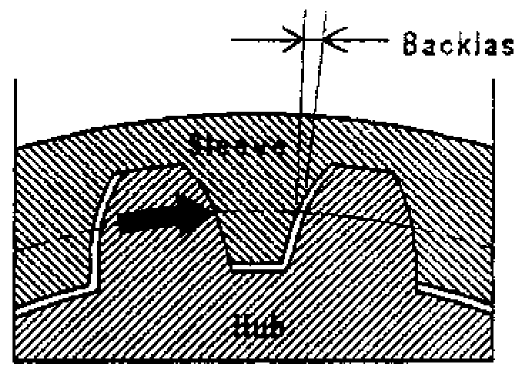
5) Advantages.

The advantages of gear couplings are that the torque capacity for a given diameter is greater than for any other type of coupling. This results in a smaller size coupling therefore saving weight and saving space. Generally gear couplings are all metallic; therefore, can handle more corrosive atmospheres than those couplings using non metallic components. They also can handle higher temperatures than couplings that have non metallic components. They have a high torsional stiffness, handle higher speeds, have good inherent balance and some types are field repairable.

6) Backlash

(Figure II-A-12). In order to obtain the desired flexibility to handle misalignment, the gear mesh is provided with a designed backlash. This backlash is a clearance between the hub teeth and the sleeve teeth. This clearance allows the lubricant, which is an essential part of the coupling, the opportunity to coat the contact surfaces. This lubrication reduces metal to metal contact, thus minimizing wear, noise and lowering the operating temperature.

Figure II-A-12 Backlash

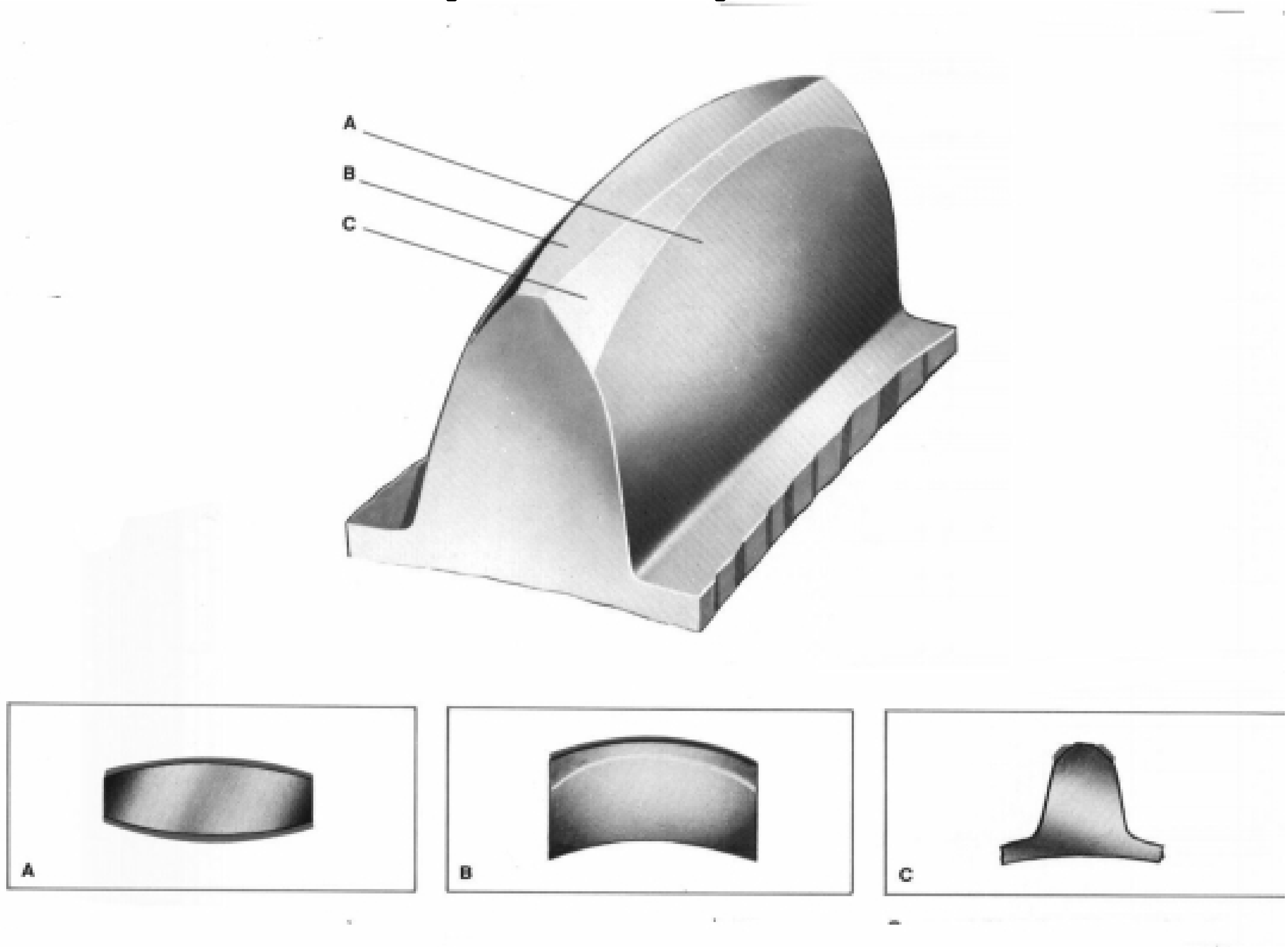


7) Crow ning

(Figure II-A-13). For application w here the operating angle is over ¼^0 crow ning of teeth is advantageous. This prevents tooth end loading an excessive amount of backlash in the hub gear teeth. Crow ning is formed on the hub gear teeth in such a w ay that the surfaces are curved. There are three basic types of crow ning:

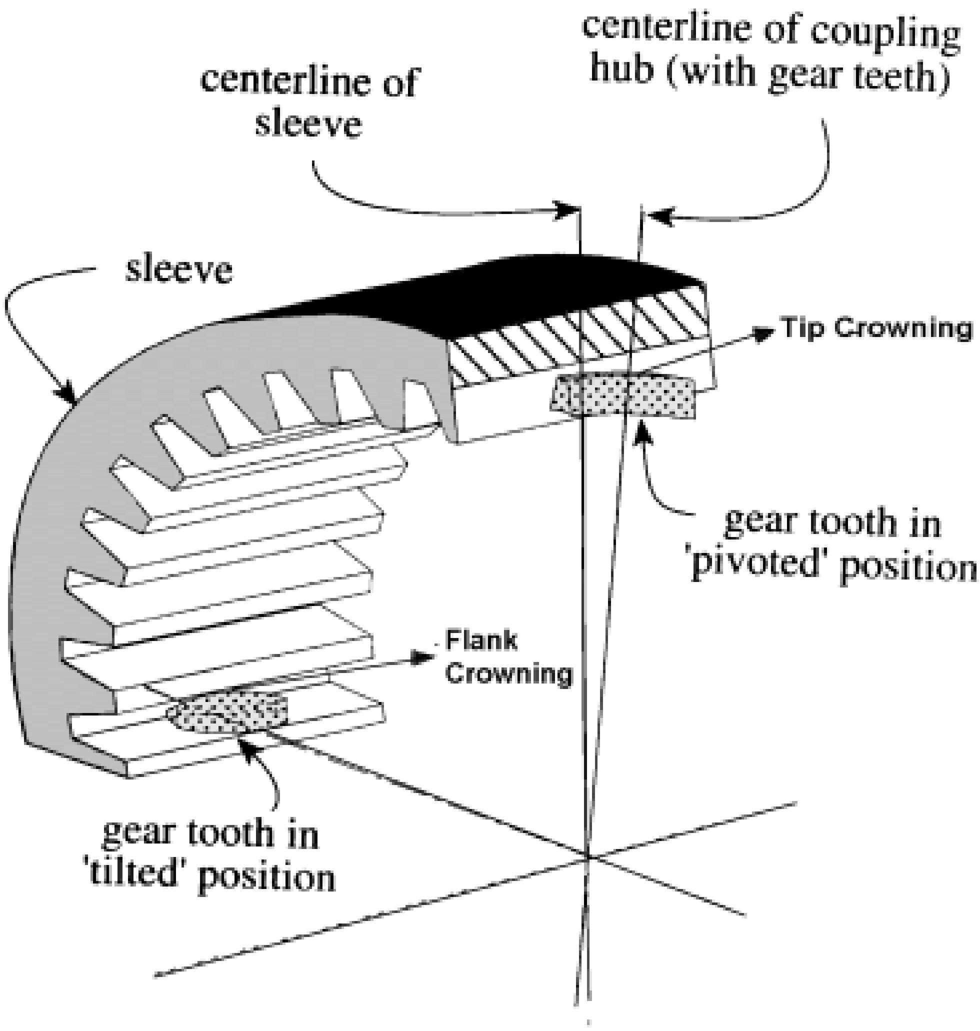
(1) Flank crow ning (Figure II-A-13A)
(2) Tip (and root) crow ning (Figure II-A-13B)
(3) Chamfer crow ning (Figure II-A-13C)

Figure II-A-13 Crow ning of Teeth



The tip and flank crowns are provided to permit misalignment (Figure II-A-14).

Figure II-A-14 Misalignment



In a double engagement coupling, each half coupling provides half of the misalignment. At high angles, flank crowning is an important consideration in the design to eliminate high concentration of load at the ends of the teeth (Figure II-A-15). The contour of the crown is conventionally a segment of an arc which tends to equalize the contact area between the hub teeth and the sleeve teeth.

Figure II-A-15 Flank Crowning Prevents End Loading

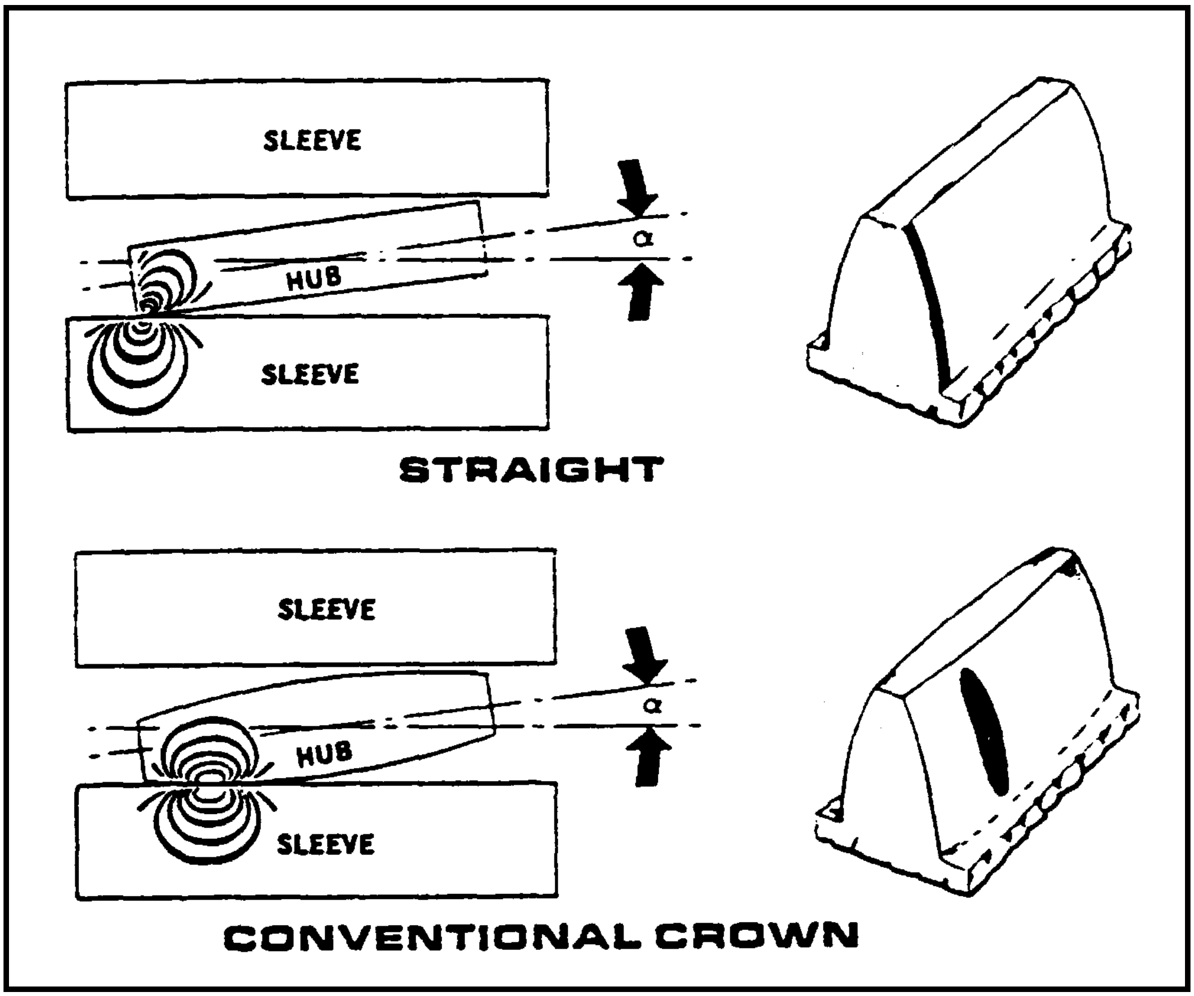
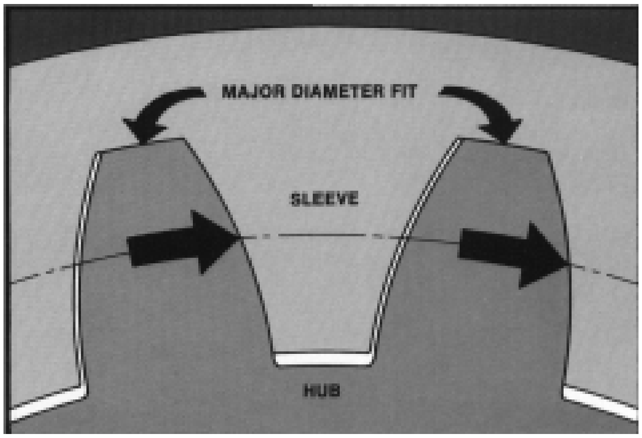


Figure II-A-16 Major Diameter Fit

8) Major Diameter Fit
(Figure II-A-16)

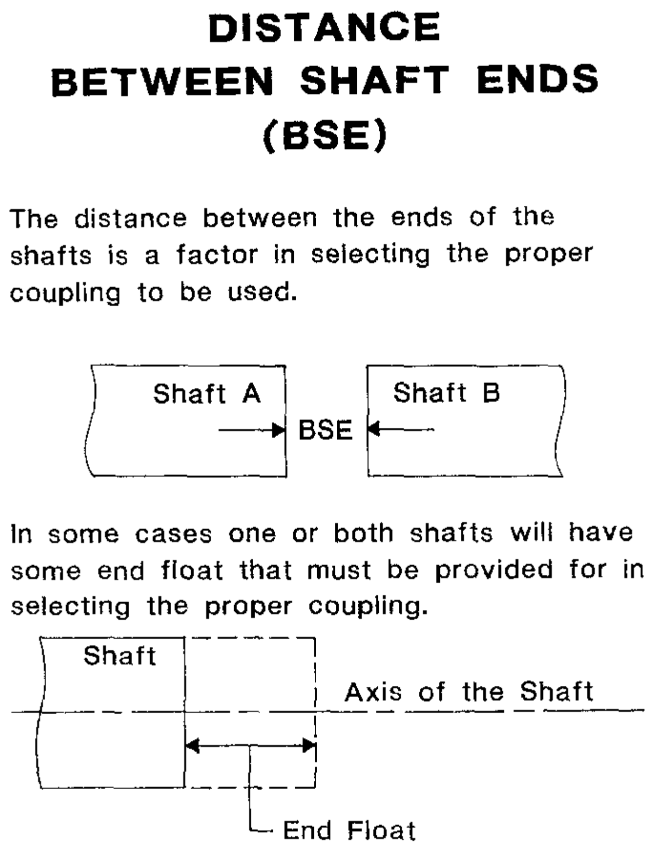


A major diameter fit is used to control clearance betw een the major diameter of the hub and the root of the sleeve tooth. This is necessary to centralize the hub in the sleeve particularly during start up. Gear couplings must have some clearance at the major diameter to permit the hub to slide freely in the axial direction. This is a method to pilot the hub w ith respect to the sleeve teeth until the coupling is loaded in torque. When torque is applied to the hub, the gear teeth w ill operate on the pitch circle (pitch diameter centering). This is the nature of the involute gear tooth system.

9) Distance Betw een Shaft Ends

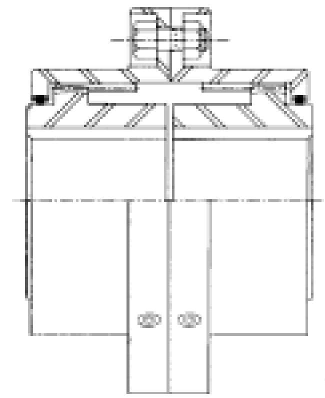
(BE, BSE or DBSE) (Figure II-A-17).

Figure II-A-17 BSE

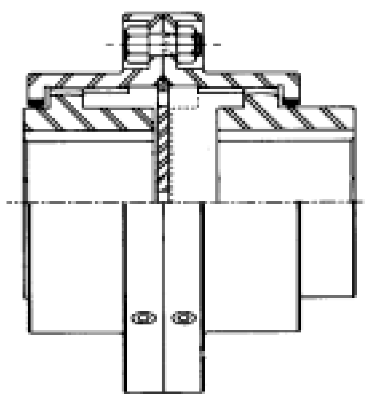


It is important to specify the distance betw een shaft ends in selecting a proper coupling. Often one or both shafts w ill have some end float. This must be provided in the coupling selection. Many standard couplings w ill accept a range of difference betw een the shaft ends. This is obtained by using the normal hub arrangement or a reversed hub arrangement (Figure II-A-18).

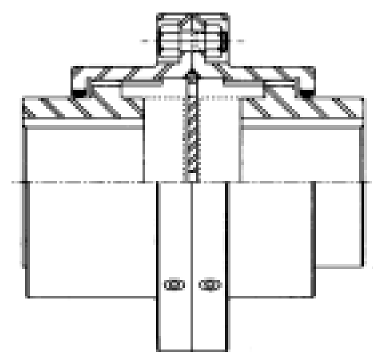
Figure II-A-18 Gap Arrangements



NORMAL HUB ARRANGEMENT



ONE REVERSED HUB

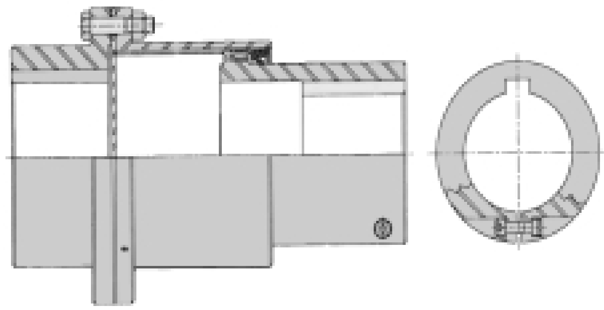


TWO REVERSED HUBS

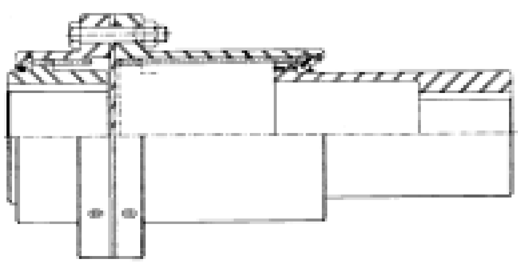
10) Hub Variations

For various applications, it is common to adjust the gear hubs to provide various arrangements such as:

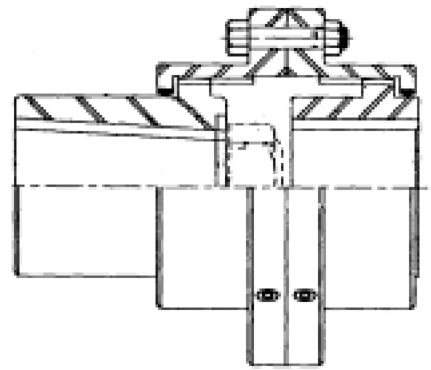
(1) The sliding hub styles (Jordan Coupling), (Figure II-A-19).



(2) Special hubs and sleeves (Figure II-A-20).

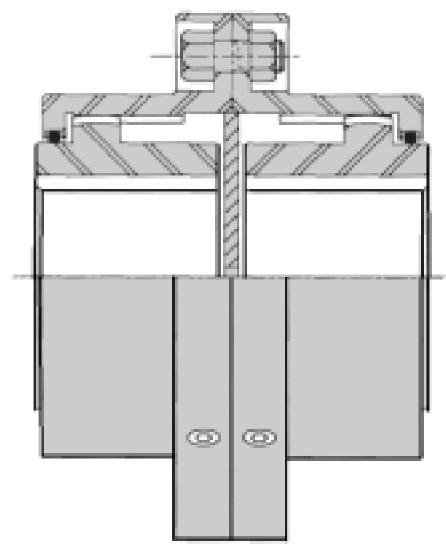


(3) Mill motor/special tapered hubs (Figure II-A-21).



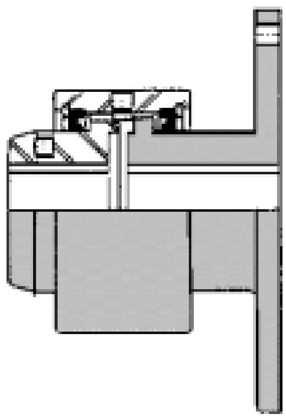
11) Other special gear coupling arrangements

(1) Limited end float (Figure II-A-22)

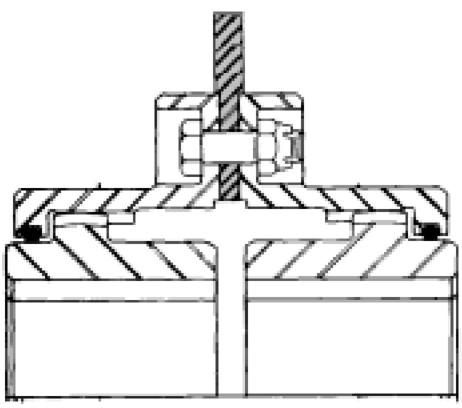


(2) special flanged hubs (Figure II-A-23).

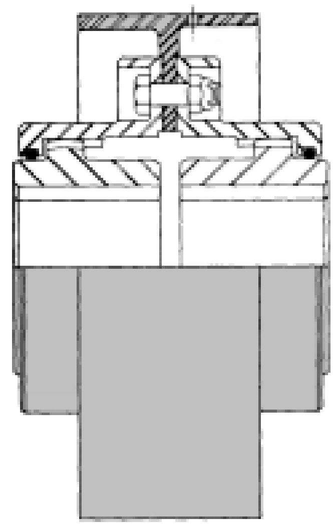
Flexible Couplings



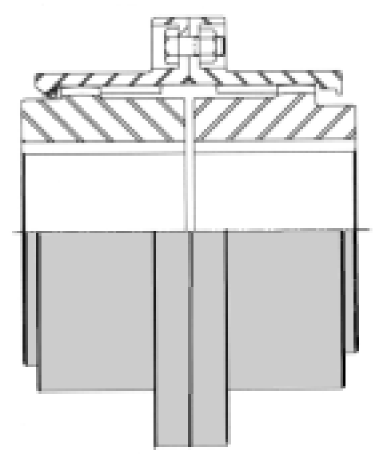
(3) brake disk (Figure II-A-24)



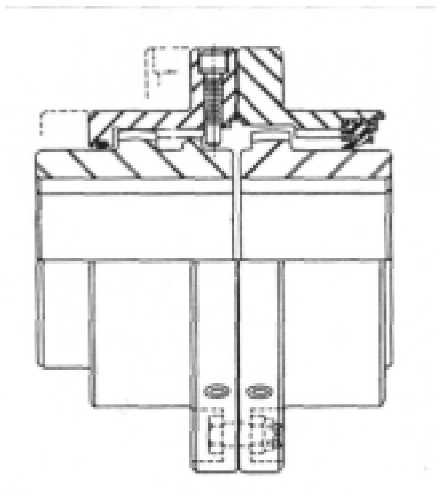
(4) brake wheel (drum) types (Figure II-A-25).



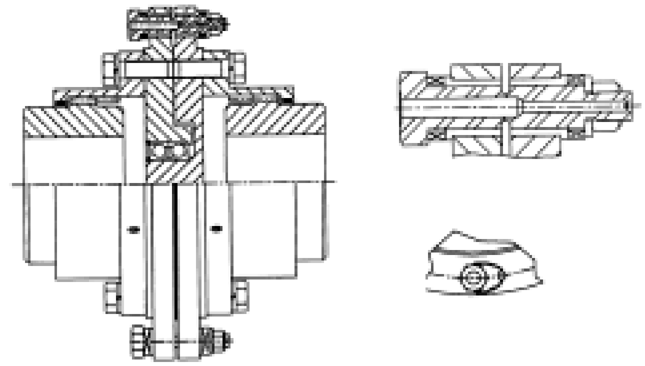
(5) Continuously lubricated (Figure II-A-26)



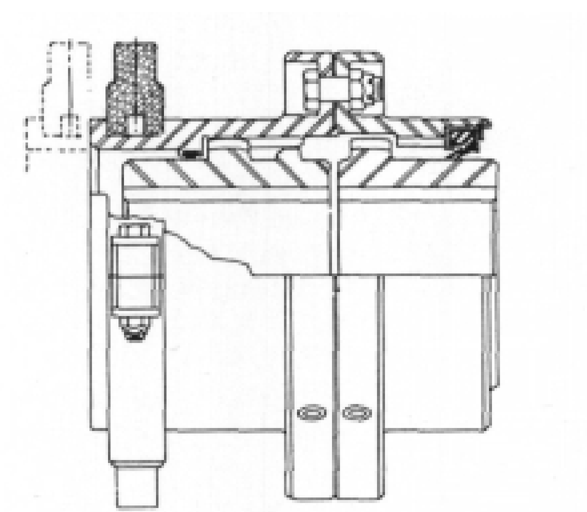
(6) cut out pin type(Figure II-A-27)

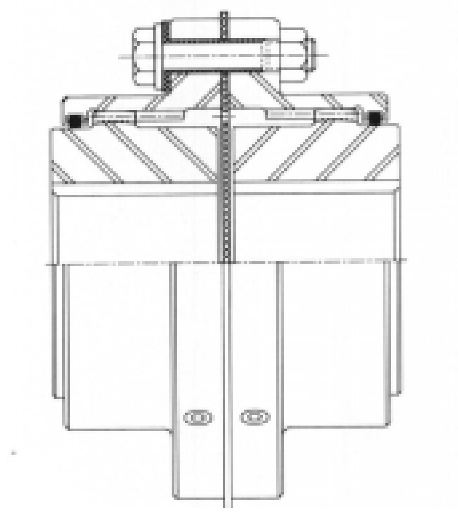


(7) cutout shifter type(Figure II-A-28)



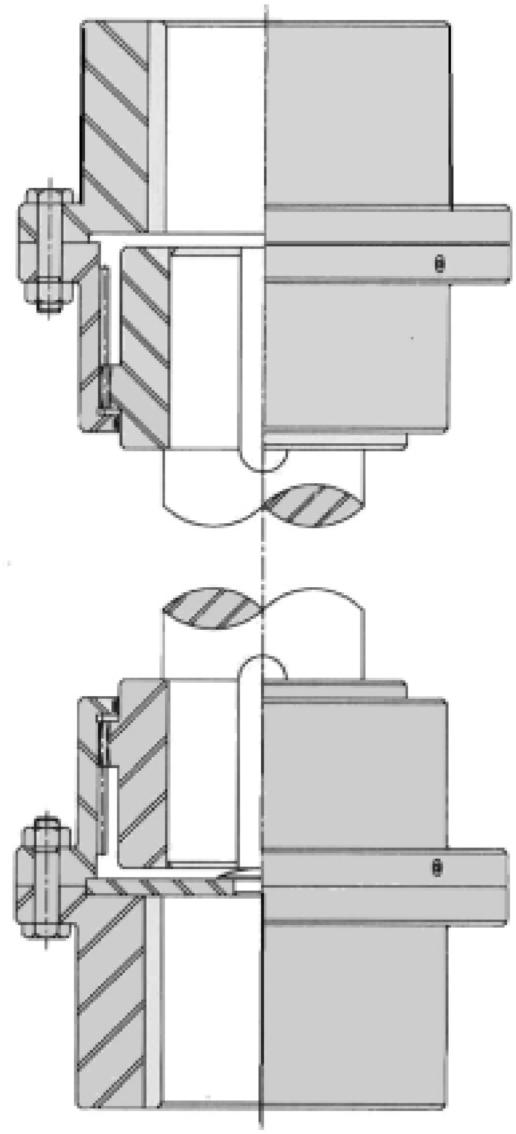
(9) insulated couplings(Figure II-A-30),





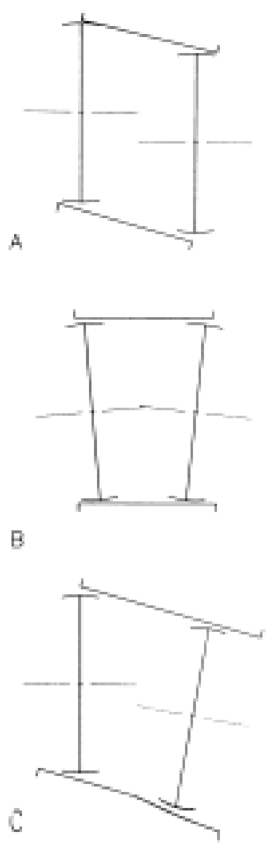
(8) Shear pin coupling(Figure II-A-29)

Figure II-A-31Vertical Gear Coupling



(10) Misalignment.

Misalignment is always a major consideration in the design, rating and application of gear couplings. The various forms of misalignment are as shown in (Figure II-A-32).



12)High Speed Coupling.

High speed couplings are made for applications with higher rotational speeds. They require close tolerances and are usually dynamically balanced. The major components are matched marked and the couplings may be serially numbered with weight balanced hardware. This application usually require special purpose couplings see section IV-A

13) Piloting.

Pilots, rabbets and occasionally pilot rings are used in the aligning of coupling components during installation. Most gear couplings are mounted with an interference fit to the shaft. Interference fitting is desirable in a gear coupling to maintain the centrality of the bore with the pitch diameter of the gear teeth. Occasionally, a clearance fit to the shaft is required by a customer to facilitate assembly. Clearance fits can result in eccentricity of the hub to the shaft or a rocking of the hub on the shaft from the moments and forces resulting from a misaligned coupling. Eccentricity is undesirable in the gear coupling because it causes the gearing to operate off the center of rotation which causes unbalance.