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INTRODUCTION *to* POWER MOTION PRODUCTS

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The Boston Gear Story

Established in Charlestown, Massachusetts Boston Gear was founded by none other than the man who invented the calculator - George Grant. Grant headed the business from 1877 to 1891, when it was sold to Frank Burgess, a businessman with one overriding goal: to provide accuracy, economy, and despatch, or, in today's marketing vernacular, quality, price, and service - and indeed, those are the hallmarks upon which Boston Gear was built.

Since then, the Boston Gear story has been measured in one milestone after another, including:

- our inaugural product catalog in 1892;
- the first catalog to include complementary parts, such as pulleys, u-joints, sprockets, and shafts was printed in 1899;
- our special "horseless carriage catalog" published in 1900 for that newfangled invention - the car
- the Thanksgiving Eve, 1909, Boston Gear Works fire in Quincy, Massachusetts, in which everything was destroyed;
- the company's reopening just months later in February 1910;
- the early-1960s development of a line of electrical motion control devices, which has since been expanded into a comprehensive selection of AC and DC motor controllers, motors and other accessories;
- the advent of fluid power products, bringing the total number of products available through Boston Gear to over 30,000;
- the 1968 introduction of the modular worm gear speed reducer - a first in the industry, and a product that provides a long life of smooth, efficient, trouble-free performance;
- the establishment of the Louisburg, NC, speed reducer manufacturing facility in the 1970s;
- the 1975 venture into on-line communication with distribution, which resulted in over 14,000 miles of leased telephone lines during the two subsequent years alone;
- the company's move to Quincy, MA, in 1977;
- completion of the state-of-the-art Florence, KY, National Distribution Center in 1980;
- the 1983 introduction of the in-line helical and right angle helical/bevel gear speed reducers;
- the acquisition of Ferguson Gear in 1989, at which time Boston Gear transferred the machinery for the manufacture of open gearing and coupling products to Ferguson's Charlotte, North Carolina, location;
- our 1996 acquisition by the Colfax Corporation;
- and our 2000 merger with Warner Electric

elcome to *Power Transmission 101* (also known as Gearology) – a course designed to teach you everything you need to know about the Boston Gear family of power transmission drives.

Why a comprehensive course about power transmission? For two very good reasons: First, the more you know about power transmission, the more you'll be able to help your customers select the right products for their applications. Second, there's a potential sale to be made every place a shaft turns! And in American industry, that means virtually everywhere – from a giant automobile manufacturing plant in the Midwest to a small mom-and-pop bakery on the Rhode Island shore.

Boston Gear's *Power Transmission 101* course won't make you a mechanical engineer. It will, however, provide you with the basic knowledge and confidence to solve most of your customers' and prospects' power transmission needs – and problems. As a result, you will be "adding value" for your customers and setting the stage to increase your sales. And that's a win-win for everyone.

On that note, let's get familiar with some of the basics of power transmission – keeping in mind that you should have a complete set of Boston Gear catalogs nearby for quick reference.

There are a number of variables to consider when selecting a power transmission drive for a given application. The most important of these variables are:

- Horsepower or torque to be transmitted
- Required speeds (revolutions per minute, rpm)
- Duty cycle

As a first step in the power transmission drive train selection process, you must determine what these variables are by conferring with your customer or prospect.

Boston Gear makes many types of gears for use in open and enclosed gear drives, each of which will be discussed in greater detail in subsequent chapters. To help prepare you for these lessons, it is important that you become familiar with the terminology used in the power transmission industry (and included in the Glossary Sections at the end of certain chapters. Don't be concerned if you don't become instantly fluent in the language of Gearology. By the time you complete *Power Transmission 101*, you'll be speaking like a real "pro."

THE DRIVE SYSTEM

There are many Boston Gear components in a complete power transmission drive, each of which will be discussed in detail later on. With that in mind, let's take a quick look at the components you can "package" for any given drive application.

BEARINGS

A bearing is a mechanical device that supports the moving parts of a machine. Its primary purpose is to reduce friction. Bearings are made to support radial loads, thrust loads, or combined radial-thrust loads. They may be categorized into two general classes, each with two sub-types:

1) **Plain**
   a) **Cylindrical**
   b) **Thrust**
2) **Anti-Friction Bearings**
   a) **Ball bearing**
   b) **Roller bearings**

Fig 1.1
Bear-N-Bronz
Plain Cylindrical Bearings

Fig 1.2
Bost-Bronz Thrust Bearings

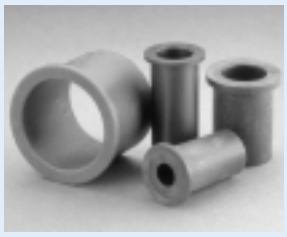

Fig 1.3
Bost-Bronz Flanged Bearings

Boston Gear sells two types of **plain bearings**: *Bear-N-Bronz*, made from a cast, solid bronze material, and *Bost-Bronz*, made from a porous bronze, oil impregnated type of bearing material. Bear-N-Bronz bearings are available as plain bearings, cored bars or solid bars. Bost-Bronz bearings are available as plain bearings (also known as sleeve bearings), flanged bearings, thrust-bearings, cored bars, solid bars and plate stock. *(See Figures 1.1, 1.2, 1.3)*

ANTI-FRICTION BEARINGS

Boston Gear's stock line of **anti-friction bearings** is confined to ball bearings for radial loads and thrust loads. The radial line is stocked in precision ground and semi-ground models. The thrust line is stocked in ground steel and stainless steel. *(See Figures 1.5, 1.6)*

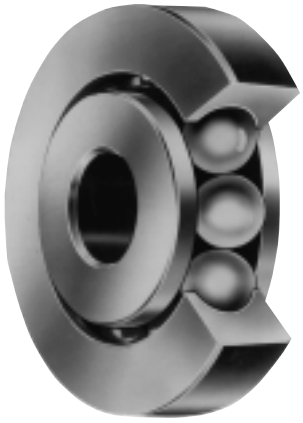

Fig 1.5, Radial Bearing

PILLOW BLOCKS

A pillow block supports a shaft directly on its bore. It has a sleeve or anti-friction bearing mounted on its bore which supports the shaft. The simplest type of pillow block is the *split cast iron or brass model,* which, as shown below, *(See Figure 1.7)* supports a shaft directly in its bore. Another type of Boston Gear pillow block supports the shaft in a *bronze sleeve bearing* that has been assembled in its bore. *(See Figure 1.8)*

PILLOW BLOCKS – ANTI-FRICTION BEARING

An anti-friction bearing pillow block consists of a ball or roller bearing with its spherical outside diameter mounted in a cast iron housing. The spherical shape of the bearing's outside diameter will accommodate some degree of shaft misalignment. For this reason, they are often referred to as "self-aligning". *(See Figure 1.9)*

Fig 1.6, Thrust Bearing

FLANGED CARTRIDGES

A flanged cartridge consists of a ball or roller bearing with spherical outside diameter mounted in a cast iron housing. The spherical shape of the bearing's outside diameter will accommodate some degree of shaft misalignment. They, too, are often referred to as "self-aligning". *(See Figure 1.10)*

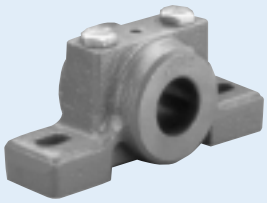

Fig 1.7, Split Cast Iron Pillow Block (no bearing)

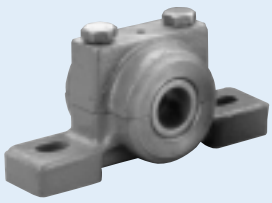

Fig 1.8, Split Cast Iron Pillow Block with Bost-Bronz bearing

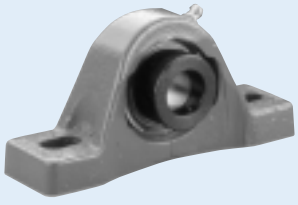

Fig 1.9, Radial Bearing

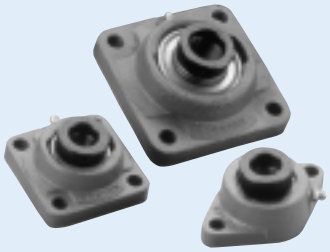

Fig 1.10, Cast Iron Flange Bearings

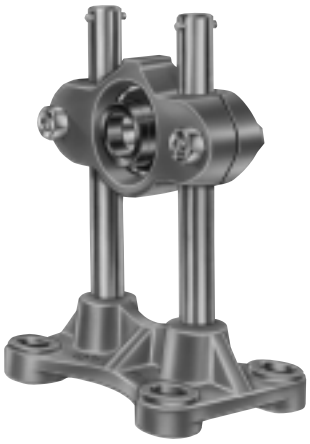

Fig 1.11, Adjustable Shaft Support

SHAFT SUPPORTS

An adjustable shaft support consists of a ball bearing with spherical outside diameter and a cast iron housing or carrier, two support shafts and a base. The spherical shape of the ball bearing's outside diameter will accommodate some degree of shaft misalignment. Thus, like flanged cartridges, they, too, are often referred to as "self-aligning". *(See Figure 1.11)*

COUPLINGS

Couplings are used to connect two pieces of shafting. While there are many types of couplings, Boston Gear carries three basic types that will take care of the great majority of applications:

- **Sleeve couplings** *(See Figure 1.12)*
- **Multi-Jaw couplings (primarily for light duty)** *(See Figure 1.13)*
- **Three Jaw/Insert couplings** *(See Figure 1.14)*

A few additional notes about Boston Gear couplings:

- Three-Jaw Insert couplings are used to provide quieter running and to minimize vibration.
- Bost-Flex, light duty couplings have spider-ring design with a special elastomer insert. *(See Figure 1.15)*

Boston Gear FC Series couplings are available with three types of inserts for specific conditions: *(See Figure 1.16)*

- Oil Impregnated Bost-Bronz Insert
- Oil Resistant Synthetic Rubber Insert
- Polyurethane Insert

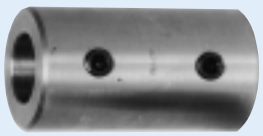

Fig 1.12, Sleeve Type (straight-through) Coupling

Fig 1.13, Multi-Jaw (light-duty) Coupling

Fig 1.14, FC Series Three-Jaw Insert-Type Couplings

Fig 1.15, Bost-Flex Series

Fig 1.16

Oil Impregnated Bost-Bronze Insert	Oil Resistant Synthetic Rubber Insert	Polyurethane Insert
		
Recommended for high torque loads, particularly at slower speeds.	**Recommended where quietness is desired.**	**Recommended where moderate to heavy shock loads are encountered.**

A SPUR GEAR is cylindrical in shape, with teeth on the outer circumference that are straight and parallel to the axis (hole). There are a number of variations of the basic spur gear, including pinion wire, stem pinions, rack and internal gears. *(See Figure 1.17)*

Fig 1.17, Spur Gear Set

PINION WIRE is a long wire or rod that has been drawn through a die so that gear teeth are cut into its surface. It can be made into small gears with different face widths, hubs, and bores. Pinion wire is stocked in 4 ft. lengths. *(See Figure 1.18)*

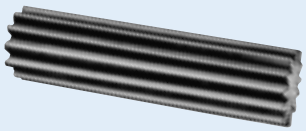

Fig 1.18, Pinion Wire

STEM PINIONS are bore-less spur gears with small numbers of teeth cut on the end of a ground piece of shaft. They are especially suited as pinions when large reductions are desired. *(See Figure 1.19)*

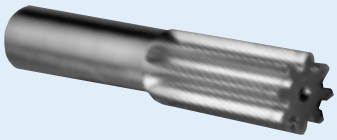

Fig 1.19, Stem Pinion

RACK are yet another type of spur gear. Unlike the basic spur gear, racks have their teeth cut into the surface of a straight bar instead of on the surface of a cylindrical blank. Rack is sold in two, four and six foot lengths, depending on pitch, which you will learn about starting in chapter 2. *(See Figure 1.20)*

Fig 1.20, Rack

INTERNAL GEARS have their teeth cut parallel to their shafts like spur gears, but they are cut on the inside of the gear blank. *(See Figure 1.21)*

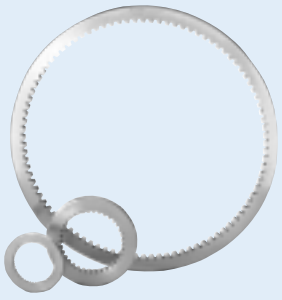

Fig 1.21, Internal Gear

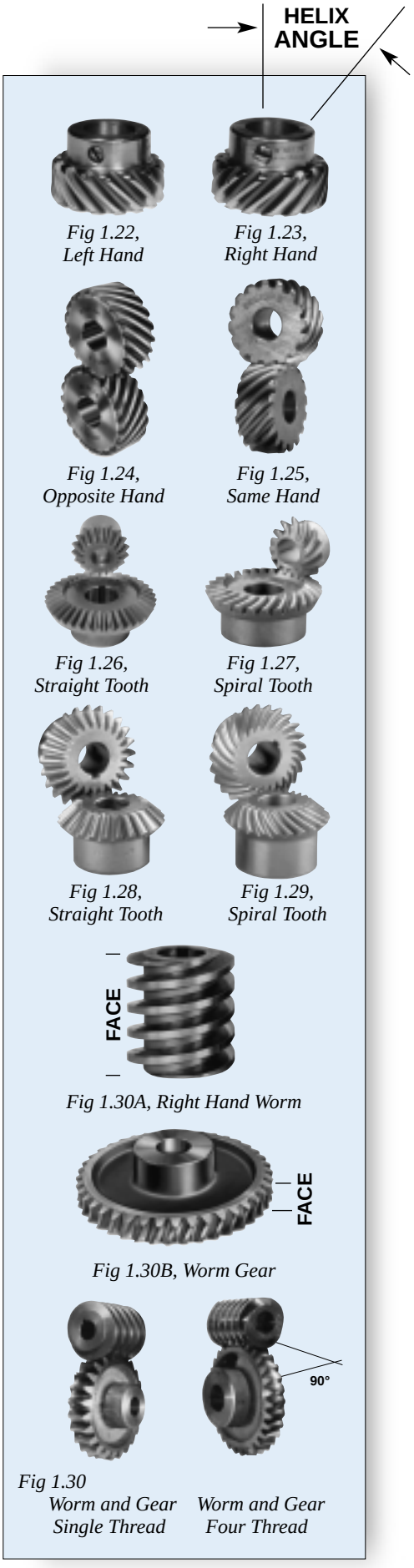

Fig 1.22, Left Hand

Fig 1.23, Right Hand

Fig 1.24, Opposite Hand

Fig 1.25, Same Hand

Fig 1.26, Straight Tooth

Fig 1.27, Spiral Tooth

Fig 1.28, Straight Tooth

Fig 1.29, Spiral Tooth

Fig 1.30A, Right Hand Worm

Fig 1.30B, Worm Gear

Fig 1.30 Worm and Gear Single Thread

Worm and Gear Four Thread

HELICAL GEARS

A helical gear is similar to a spur gear except that the teeth of a helical gear are cut at an angle (known as the helix angle) to the axis (or hole). Helical gears are made in both right and left hand configurations. Opposite hand helical gears run on parallel shafts. Gears of the same hand operate with shafts at 90-degrees. *(See Figure 1.22, 1.23, 1.24, 1.25)*

BEVEL GEARS

A bevel gear is shaped like a section of a cone and usually operates on shafts at 90-degrees. The teeth of a bevel gear may be straight or spiral. If they are spiral, the pinion and gear must be of opposite hand in order for them to run together. Bevel gears, in contrast to miter gears (see below), provide a ratio (reduce speed) so the pinion always has fewer teeth. *(See Figure 1.26, 1.27)*

MITER GEARS

Miter gears are identical to bevel gears except that in a miter gear set, both gears always have the same number of teeth. Their ratio, therefore, is always 1 to 1. As a result, miter gears are not used when an application calls for a change of speed. *(See Figure 1.28, 1.29)*

WORMS & WORM GEARS

WORM Worms are a type of gear with one or more cylindrical threads or "starts" (that resemble screw threads) and a face that is usually wider than its diameter. A worm gear has a center hole (bore) for mounting the worm on a shaft. *(See Figure 1.30A)*

WORM GEARS – like worms – also are usually cylindrical and have a center hole for mounting on a shaft. The diameter of a worm gear, however, is usually much greater than the width of its face. Worm gears differ from spur gears in that their teeth are somewhat different in shape, and they are always formed on an angle to the axis to enable them to mate with worms. *(See Figure 1.30B)*

Worms and worm gears work in sets, rotating on shafts at right angles to each other, in order to transmit motion and power at various speeds and speed ratios. In worm and worm gear sets, both the worm and worm gear are of the same hand. (Because right- hand gearing is considered standard, right-hand sets will always be furnished unless otherwise specified.) *(See Figure 1.30)*

UNIVERSAL JOINTS

Universal joints are used to connect shafts with angular misalignment. Boston Gear sells two basic types of universal joints for a wide variety of applications:

- Center block and pin type *(See Figure 1.31)*
  - "J" Series – medium carbon alloy steel
  - "JS" Series – stainless steel
  - All stocked with solid or bored hubs
- BOS-trong *(See Figure 1.32)*
  - Uses needle bearings for heavier duty applications
  - Made in two basic sizes with a variety of hub diameters and shapes
  - Have keyway and set screw

Fig 1.31,
"J"and "JS" Series Machine-Finished Universal Joints

Fig 1.32,
BOS- trong Heavy-Duty Universal Joint

It's almost time to begin Power Transmission 101...

Now that we have learned about some of the stock components – gears, bearings, pillow blocks, couplings, and universal joints – that make up a Boston Gear power transmission drive or system, it is time to move on to a more detailed look at these and many more system components.

While the information might seem difficult at first, your understanding of the material will be greatly enhanced if you actively refer to your *Glossary of Terms* – and your Boston Gear catalogs – along the way.

One of the most helpful sections in the catalogs is the *Index to Catalog Numbers*, found at the back of the Bearings and Gears catalogs. Here you will find an identification number for every product in the catalogs – listed in both numerical and alphabetical order – along with the page number where the product appears in the catalog. When anyone gives you a catalog number, or when your need to know the specifications of a gear, just check the number stamped on the gear (or its nameplate) and then check out the index for the corresponding catalog page number. It's that easy.

In checking the catalogs, you will also note that there are many other components (such as enclosed gear drives and a complete line of variable speed control systems) that you can sell as part of a complete Boston Gear power transmission "package." All of these components will be covered in detail later in our Gearology course.

So let's get started, beginning with the most basic of gears: the spur gear.

Quiz

CLICK HERE or visit http://www.bostongear.com/quiz to take the quiz