Types of Springs & Applications

A spring is a device that stores energy. Th basic ways to store energy with a spring are through compression, extension (tension) as well as torsion.

Type 1: FLAT SPRINGS

1, Flat Springs were originally developed from flat rectangular pieces of spring steel.

2, Their shapes may be different but they are usually found as a single flat spring.

3, example of a flat spring: The contact breaker points spring in an aircraft magneto is an example of a flat spring.

4, flat springs are used in Battery Connections

Type 2: Leaf Springs

Leaf Springs: are formed by layers of flat springs.

Very early aircraft used leaf spring in their landing gear.

however today, leaf spring are most common on automobiles and trains.

Type 3: Spiral springs

Spiral springs: are formed by spirally winding a flat spring or a wire.

This type of spring is sometimes known as a motor spring or a power spring.

Spiral springs are found in analog instruments and are the springs used to power a wind-up clock or watch.

Type 4: helical wound spring

helical wound spring is the most common type of springs.

These springs can be used for compression or tension loads.

They come is a very wide variety of sizes and materials and are used in many applications.

Helical springs used for tension are the same as those used for compression.

The difference is that the tension spring typically has a hook or a loop on each end so that it can be attached and pulled

Reciprocating engine valve springs are an example of helical compression springs.

When they are used in pairs, the compression springs, situated one inside of the other, are wound in opposite directions.

Type 5: Helical torsion springs

are similarly wound as helical tension and compression springs.

They have specially shaped ends that engage a mechanism so that the spring can absorb a torque force when applied.

Type 6: Belleville washers or disc springs

They can be used individually or stacked for more deflection.

The Belleville spring is typically centered axially by a shaft and can be produced to have non-linear load absorbing characteristics.

Type 7: rotary spring or torsion bar spring

rotary spring is a spring that absorbs torsion and angular deflection.

the simplest rotary spring is the torsion bar. Torsion bar springs are basically strait bars of metal with each end fashioned to engage a mechanism so that a torsion load is transmitted to the bar.

Torsion bars are stiff when compared to other springs.

They have many applications the most common of which is in automobile suspension.

Spring Materials

Springs are made from a wide variety of materials. Most are:

1. Hard drawn spring wire (carbon steel stock) is an inexpensive spring wire used in applications with low stress and not where fatigue loading is exerted

2, Oil tempered spring wire has a higher fatigue life and sometimes is used for valve springs

3, Music wire is a high quality, carbon steel stock suitable for small helical springs used in applications involving high fatigue stresses

4, Chrome vanadium steel wire is suitable for high temperature and high stress conditions his type is used to make valve springs for reciprocating engines

5, Chrome silicon steel wire is also used for valve springs but has a higher fatigue life

6, Stainless steel spring wire has excellent corrosion resistant characteristics and low creep at high temperatures

7, Hot wound is a process used in manufacturing the spring by heating the steel, winding, and tempering to the required properties. The main difference between hot wound springs and other types of springs is that the material (usually steel or high carbon steel) is heated prior to the spring being made.

8, the steels used to make flat cold rolls vary in composition, depending on their location. It is usually a carbon-manganese alloy and may be forged from oil-tempered steel (thin sections, clock-type springs) or annealed steel which is subsequently heat-treated.

9, Nonferrous metals are also used to construct springs.

10, Copper based a l loys are used where elect r ica l conductivity is required with an added benefit of being corrosion resistant

11, Nickel alloys are used where the ability to work at elevated temperatures is desired.

Some of the alloys are:

Spring brass - which is comparatively inexpensive, has good electrical conductivity, but is unsuitable for high-stress applications

Nickel silver (also called German Silver) - has better characteristics than brass. It is made from diff rent percentages of copper, zinc and nickel.

Phosphor bronze - has a minimum percentage of 90% copper content. It has excellent electrical conductivity and is suitable for applications of higher stress levels than those of brass.

Silicon bronze - has similar characteristics to those of phosphor bronze but is less expensive to produce

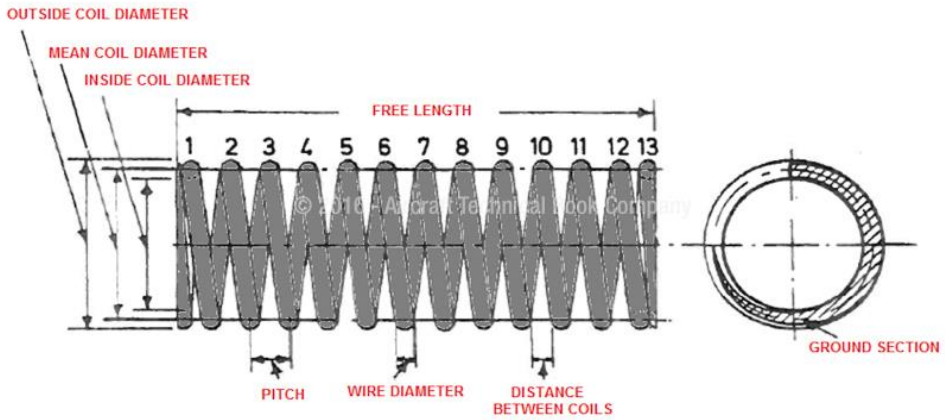
Beryllium copper - has similar conductivity and corrosion resistance qualities to those of copper with the addition 2 to 2.5% beryllium. This increases hardness and fortifies other mechanical properties

High nickel alloys - are commonly found in aero-engine applications. Monel, 'K' Monel (3% aluminum), Permanickel, Inconel and Inconel X (2.5% titanium) are all used to make springs with high temperature and high corrosion resistant characteristics

Composite materials are also used to make components with spring characteristics. Some composite springs involve the joining of certain metals with elastomers to form the antivibration mountings such as those found in aero-engine and auxiliary power units (APUs)

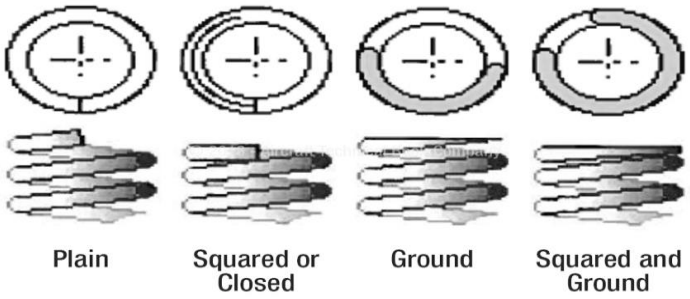
the bungee cord is also a device that acts like a spring. It is a combination of rubber strands encased within a sheath of braided material. These shock cords are used on some older light aircraft landing gear

SPRING DIMENSIONS



spring includes a number of coil turns but does not include any end treatment such as an eye or hook used as an attach point.

Typical coiled springs are finished on each end in a few basic ways:



Spring Characteristics

the myriad of characteristics that are considered when selecting a spring for a given application.

Working Envelope

- Material
- Buckling
- Elastic Modulus
- Magnetic Characteristics
- Wire Hardness
- Heat Treatment
- Coiling Direction
- Stress
- Cycles
- Initial Tension

Solid Height

- Hysteresis

FORCES EXERTED ON, AND APPLIED BY SPRINGS

the three basic forces, which may be exerted on, and applied by springs are:

- **Compression**
- **Tension**
- **Torsion**

LAW OBEYED BY SPRINGS

Springs are fundamental mechanical components which form the basis of many mechanical systems

A spring can be defined as an elastic member, which exerts a resisting force when its shape is changed

Most springs are assumed linear and obey Hooke's Law: $F = -\Delta k$

F = is the resisting force

Δ = is the displacement

k = is the spring constant which is dependent of material properties of the spring