Proportional Solenoids and Wet ON-OFF Solenoids

1. Design and Features-Proportional Solenoids

The conventional solenoid is a digital device, meaning the plunger is either in the energized or de-energized position. Proportional solenoids, however are an analog device, allowing for incremental positioning. This feature is made possible by a unique design of the magnetic pole configurations and the addition of a return spring supplied in your application. Thus the position of the armature is controlled by varying the input current to the coil. The more current that is applied to the coil, the further the armature moves in its stroke (toward the pole piece). Our proportional solenoids provide stable output force characteristics with low hysteresis and a fast response time for a wide variety of applications, especially for hydraulic applications. (Fig. 1)

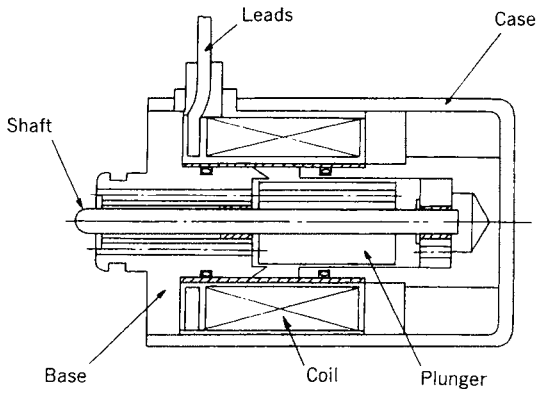

Fig. 1

A) Relationship Between Stroke and Force

A proportional solenoid has two ranges of stroke : the control stroke where the plunger position is dependent on the applied current, and the approach stroke where force is dependent on stroke position. The stroke is specified on each size of the solenoid and most applications use only the control stroke. Fig. 2 shows the characteristics of stroke and force. The spring characteristics is the spring load that has been installed outside the solenoid.

Positions S_1, S_2, and 0 are where the force curves of each current : i_1, i_2, and i_3 intersect the spring characteristics.

At these intersections the forces are balanced (the solenoid's output force is equal to the spring load). This means that with a coil current of i_3, a balancing force by the spring against the plunger is equalized with the resulting position of S_3. When varying the coil current to i_2, the plunger moves to a new "balancing" position S_2. By varying the coil current, the plunger positioning can be controlled and moved "proportionally" to different positions by controlling the coil current. However, in actual applications, consideration has to be given to the influences of load variation, hysteresis and temperature.

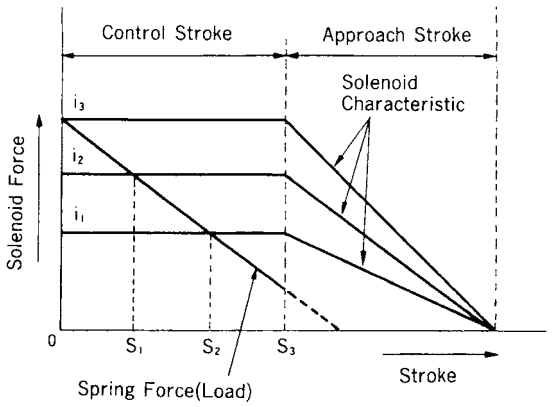

Fig. 2

B) Hysteresis

Hysteresis is represented as a ratio (%) of the rated output force when measured at the same position, as the plunger approaches that position from two directions. In an ideal world, there is no friction, and no residual magnetism, but in the real world these factors do exist and they do affect performance. As such the force when measured at the same position will be different when that position is approached from two directions. This force difference expressed as a percentage is called hysteresis. This can be seen in the following formula :

$$\text{Hysteresis (\%)} = \frac{\Delta X}{X} \times 100$$

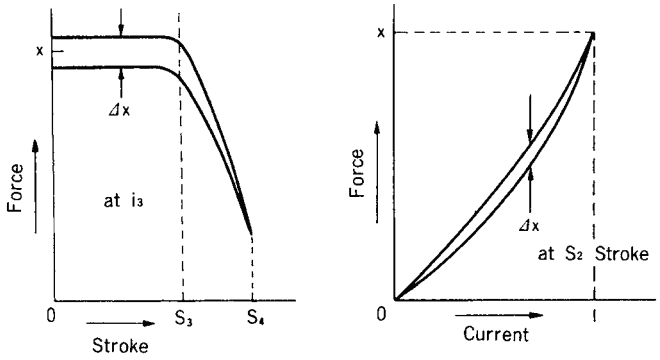

Fig. 3

2. Design and Features-On-Off Solenoids

On-Off solenoids are designed for use in directional control valves that require fast response time, high efficiency, solid mechanical structure and steady force characteristics, all in one package.

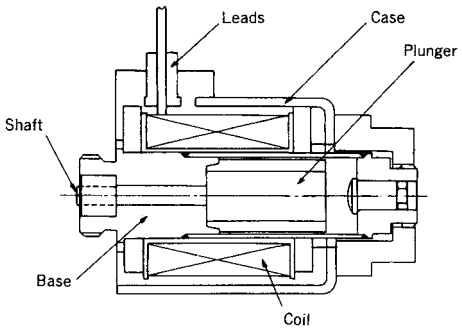

Fig. 4

3. Ordering Information

When placing an order for either proportional solenoids or on-off solenoids, when doing design work, please contact our agents for technical support.

PROPORTIONAL SOLENOID AND WET TYPE (On-Off) SOLENOID

The following are examples of standard solenoids

PS30C

PS36C

PS50C

SW3012C

SW3813C

SW4417C