Linear Servo Motor "Core Installed Double Side Type"

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1. Introduction

It was originally common that the combination of a rotary actuator and a power motion conversion mechanism such as a ball screw, constituted a linear system in an industrial machine. However, in recent years, applications that need high speed, high acceleration, and high accuracy positioning increasing adopt a linear drive.

In our company, the sale of linear motors began in 1997, and the linear motor has been supplied to many customers.

Our company has carried a lineup of three kinds of linear motor:

① Core installed one side type linear guide system
② Coreless type linear guide system
③ Core installed type cylinder system

However, with the present lineup, a difficult customer demand has been presented. For example:

① Under the influence of magnetic attractive force peculiar to a core installed type linear motor, the large pressure of the core installed type linear motor requires making a mechanism highly stiff, and equipment becomes large.
② Thermal expansion occurs on a mechanism by heat generation of a linear motor own accompanying a high duty drive, and accuracy gets worse.

In order to solve these problems, the core installed double side type linear guide system was newly produced commercially. Its feature is the low magnetic attractive force of a core installed linear motor system. And it carries a cooling mechanism, which reduces the heating value of a motor.

The product system of a linear servo motor is shown in Fig. 1.

In this document, the product outline and the features of this "core installed double side type" linear motor are introduced.

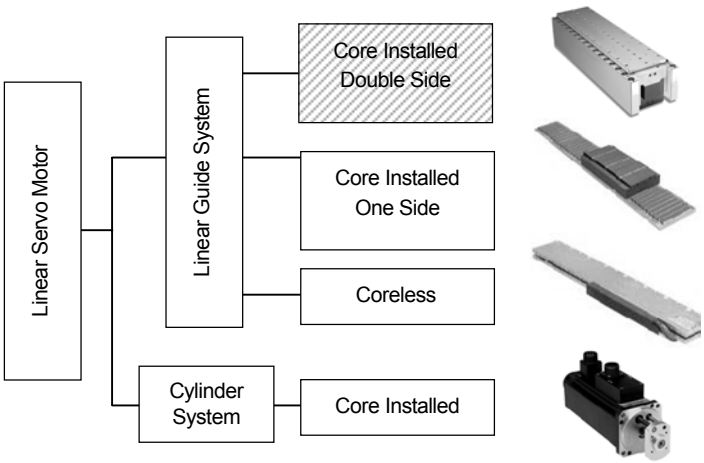


Fig. 1　Product System of the Linear Servo Motor

2. Outline of the Product

2.1 Structure

Fig. 2 shows the "core installed double side type" linear motor. Fig. 3 shows a fixing example. It is taken the structure where this linear motor arranges two plates of the stator (magnet rail) so that a magnet may counter inside, and a mover (coil) drives in between. By its structure, it has the feature, which can sharply reduce magnetic attractive force peculiar to the core installed type linear motor. Moreover, this linear motor carries the cooling mechanism in the inside of the mover (coil), which is a heat source. For this reason, even if it does not install the cooling plate in the exterior of a motor, a mover can be cooled efficient and compactly, and a high output and low heat expansion can be attained.

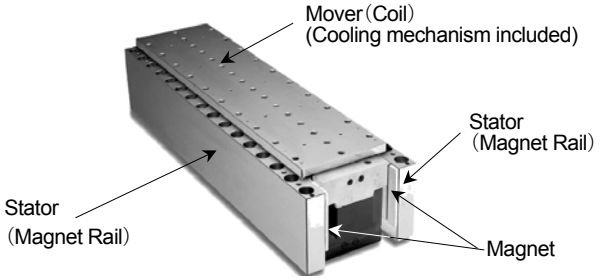


Fig. 2　Linear Motor "Core Installed Double Side Type"

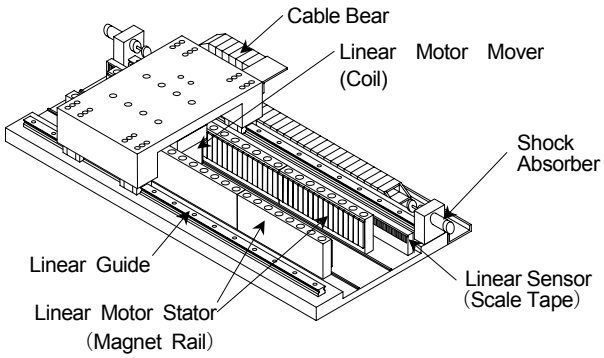


Fig. 3　Fixing Example of the Linear Motor "Core Installed Double Side Type"

2.2 Model Structure

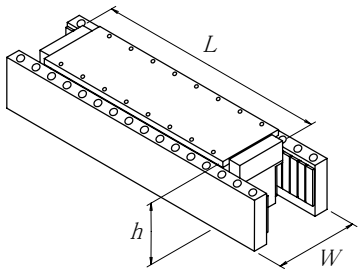
Table 1 shows a list of the "core installed double side Type" linear motor series. This series consists of 5 models of peak force: 1,600-8,000[N], and the model composition covers the large thrust domain of magnetic attractive forces that may become a problem. Please refer to the product catalog of our company [1] for specifications, such as the outside size of a motor.

Table 1 List of the Linear Motor

"Core Installed Type Double Side Style" Series

Coil Model	Peak Force F_p [N]	Continuous Force F_c [N]	Length L [mm]	Width W [mm]	Height h [mm]
DD075C1Y2D	1,600	1,050[(a)]	237	150	127
DD075C2Y2D	3,200	2,100[(a)]	413	150	127
DD075C3Y2D	4,800	3,100[(a)]	589	150	127
DD075C4Y2D	6,400	4,150[(a)]	765	150	127
DD075C5Y2D	8,000	5,200[(a)]	941	150	127

Note (a) For Water Cooling Type



3. Feature

3.1 Reduction of the magnet induction force

Fig. 4 shows a configuration diagram of the core installed type linear motor. And the Fig. 5 shows the magnetic attractive force vs. the gap difference of the core installed double side type linear motor (coil model: D075C4Y2C) Fig. 6 shows the comparison of the magnetic attractive force of the 'one side type' linear motor and the double side type' linear motor. For the 'double side type' linear motor (coil model: DD075C4Y2D, peak force: 6,400 [N]), even if the gap difference ($\delta_1 - \delta_2$) of the mover and stator is 0.4 [mm] the magnetic attractive force is approximately 3,000 [N], which is about a half of the peak force. As opposed to this, the magnetic attractive force of the 'one side type' linear motor (coil model: AIC44-150, peak force: 6,000 [N]), which has almost the same level of force, is about 30,000 [N]. If comparing the magnetic attractive forces of linear motors of the same force, the magnetic attractive force of a 'double side type' linear motor is about 1/10 of the 'one side type' linear motor. Therefore, it turns out that the load, which the 'double side type' linear motor applies to the support mechanism of linear guide, becomes very small when compared with the 'one side type' linear motor.

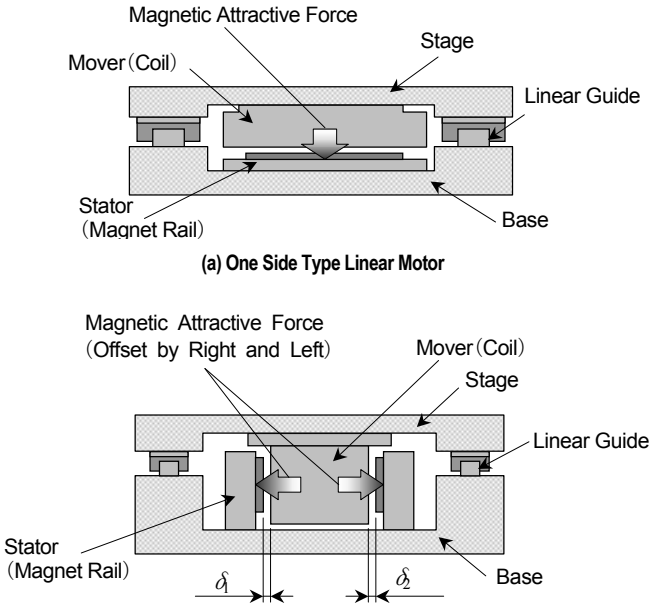


Fig. 4 Configuration Diagram of the Core Installed Linear Motor

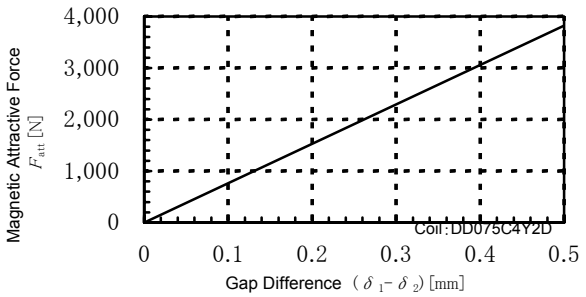


Fig. 5 Magnetic Attractive Force vs. Gap Difference of the Core Installed Double Side Type Linear Motor

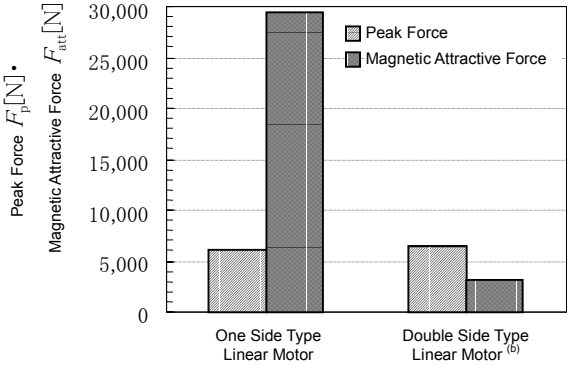


Fig. 6 Comparison of Magnetic Attractive Force of One Side Type Linear Motor and Double Side Type Linear Motor

Note (b) For Gap Difference 0.4[mm]

3.2 Cooling Characteristics

Fig. 7 shows the comparison of temperature rise for self-cooling type and water-cooling type of the core installed double side type linear motor. With the same effective current, the temperature rise of the water-cooling type linear motor is about 1/3 that of the self-cooling type. Considering the temperature of the mover transfers heat to the mechanism, and that heat expansion occurs, when water-cooling type linear motor is used, a mechanism's heat expansion can be reduced by a one third, when compared with a case where self-cooling specification is used.

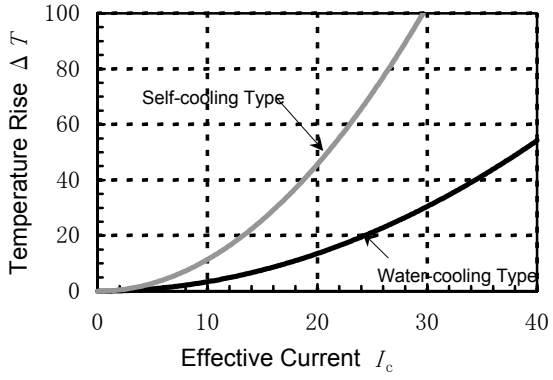


Fig. 7 Comparison of Temperature Rise for Self Cooling and Water Cooling of the Core Installed Double Side Type

4. Conclusion

This paper described the product outline and the features of the "core installed double side type" linear motor. The main features of this linear motor are as follows.

① The core installed double side type linear motor was produced commercially. There are 5 models in this series of peak force: 1,600-8,000 [N].

② The magnetic attractive force of the core installed double side type linear motor is about 1/10 as compared with the core installed one side type linear motor of the same force. Thereby, a mechanism can realize large simplification.

③ The cooling system was built in the inside of mover (coil), which is a heat source in the core installed double side type linear motor. By using this cooling system, the temperature rise of mover can be reduced to one third.

It is thought that the core installed double side type linear motor can greatly contribute to a high speed and acceleration of equipment, high accuracy, and high duty drive.

Moreover, by the appearance of the core installed double side type linear motor, it is thought that the linear motor series is expanded further, and a linear motor meeting broad customer needs can be supplied.

Reference

(1) Sanyodenki Product Catalogue:「SANMOTION LINEAR SERVO SYSTEMS」(2003-04)

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