[New Products & New Techniques]

Super Small Canned Motor Pump Model SSPD for Semiconductor Manufacturing

Takayuki KURONUMA*

Abstract

Super small canned motor pumps model SSPD were developed and released in 2013. Lately, their ultra-compactness and low heat capacity have been attracting attention because they are effective for semiconductor manufacturing. Thus, the shipment volume has been increasing. This model also has many other features, such as a flat disc-type permanent magnet motor, special heat-resistant resin as a can material, and a structure with no main shaft, which was realized by integrating the impeller and rotor. This paper introduces the super small canned motor pump model SSPD as a product that combines various technologies of the Ebara Standard Pump Business Division.

Keywords: Low heat capacity, Super small, Semiconductor manufacturing, High efficiency, Energy saving, Permanent magnet motor, High speed, Canned motor, Eddy current

1. Introduction

Ebara developed and released the super small canned motor pump model SSPD in 2013 (**Figure 1**). The product features the ultra-compactness realized by adopting a permanent magnet motor (PM motor hereafter). It also features the capability to reduce heat generation of can material, which has been one of the major causes for temperature rise in canned motors.

Semiconductor demand has been increasing for PCs, smart phones, memories, automatic operation control devices, etc., and is expected to continue increasing for the next several years.

In semiconductor manufacturing, micro wiring technology has been advancing year by year, but still depends on laser multiple exposure for miniaturization since EUV (Extreme Ultraviolet) lithography technology has not yet been established. As the number of exposures increases in the multiple exposure process, the etching process also increases. In addition, NAND flash memories and the like use multilayer structure to increase their memory capacity, requiring a number of etching systems.

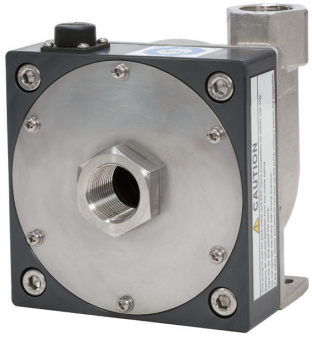


Fig. 1 Canned motor pump model SSPD

Meanwhile, semiconductor factories, requiring large capital investments for clean rooms and auxiliary facilities, cannot be expanded easily. This requires the etching system to be downsized, and the footprint of the chiller unit built into the system is always required to be small. In addition, if wafer temperature can be controlled quickly with high accuracy for each processing step, the processing speed (throughput) can be improved.

Lately, the model SSPD has attracted attention for semiconductor manufacturing because of its ultra-compactness and low heat capacity, and has seen significant growth in shipment volume. This paper

* Fluid Machinery & Systems Company

provides an outline and introduces the features of the canned motor pump model SSPD for semiconductor manufacturing.

2. Features

2.1 Ultra-compactness

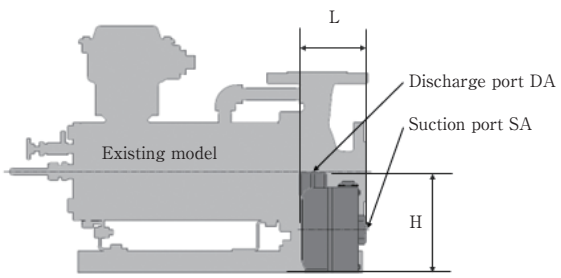
In semiconductor manufacturing, space for equipment installed in clean rooms is limited, always requiring its footprint to be small. This in turn increases demand for downsizing parts to be incorporated into the equipment.

To meet this demand, the pump unit of this product adopts screwed piping, replacing flange piping used in the existing models. It also adopts the end-top type casing. The motor unit uses a PM motor rotating at a high speed, realizing the ultra-compactness of the product. Compared with existing models, it is approximately 1/60 the volume and 1/10 the weight (**Figure 2**). This enables the chiller unit incorporating this product to be built into the etching system.

2.2 Low heat capacity

The etching and other processes in semiconductor manufacturing requires optimal control of wafer temperature to increase the throughput. Circulating the heating medium using a pump is one method, but the heat capacity of the pump itself tends to delay the change of the heating medium temperature.

To prevent this, the product adopts a structure with no main shaft, realized by interposing a pair of bearings between the disc shaped rotor, including a resin molded strong permanent magnet and a disc shaped stator. The heat capacity is reduced to about 1/10 that of existing models.



Model	kW	SA	DA	L	W	H
SSPD	1.1	Rc3/4	Rc3/4	89	120	140

Fig. 2 Comparison between model SSPD and existing model

This enables the heat medium temperature to be changed rapidly in semiconductor manufacturing, improving throughput in the wafer process.

2.3 High efficiency

Compared to our existing models, implementation of loss reduction measures in this product realizes improvements in overall pump efficiency and approximately 45 % reduction in power consumption.

The loss reduction measures include reduction in heat loss by a PM motor, reduction in eddy current loss by special heat-resistant resin, and reduction in bearing loss. Use of a hydrodynamic type for the sliding bearings reduces bearing loss by approximately 100 W. This is equivalent to approximately 10 % reduction in power consumption. In addition, since the bearing causes no friction during steady operation of the pump, it can survive longer.

2.4 Certification acquired

Since one of our customer requirements was compliance with overseas standards, we have acquired the following certifications for this product.

-For the US market: NRTL certification (UL 778)

-For European market: CE Mark Attestation (EN 809/EN 12100)

Chemical substance content of the product is managed in accordance with RoHS Directive.

3. Product Outline

3.1 Product Specifications

The specifications of the canned motor pump model SSPD are shown in the **table** below. For the handled fluid, fluorinated inert liquid is specified for semiconductor manufacturing applications. The liquid has excellent electrical insulation and thermal properties and does not dissolve in most solvent at any temperature, high or low. Therefore, it is suitable for cooling electronic equipment.

Since the product is driven by an inverter, its performance is same at 50 Hz and 60 Hz.

3.2 Structure

Figure 3 shows the structure of the product. This product is a PM motor pump of canned structure integrating a PM motor and a pump with no shaft seal such as a mechanical seal. The other features are as

Table Specifications

Model		Model SSPD
Handled liquid		Fluorinated inert liquid − 20 to 90 ℃
Maximum operating pressure		1 MPa
Flow rate range		10 to 60 L/min
Structure	Impeller	Closed
	Casing	End top type
	Bearing	Sliding bearing (inside motor)
Connection		Rc 3/4 Suction × Discharge: Internal thread
Material	Impeller	Special heat-resistant resin
	Casing	SCS14
	Motor frame	Special heat-resistant resin
Motor	Type	Permanent magnet motor
	Phase / Pole	Three-phase / Eight-pole
	Max. rotation speed	6000 min^{-1}
	Output	1.1 kW
Installation location		Indoor, Ambient temperature 0 to 40 ℃
Noise		56 dB (A)
Certification		NRTL, CE, RoHS

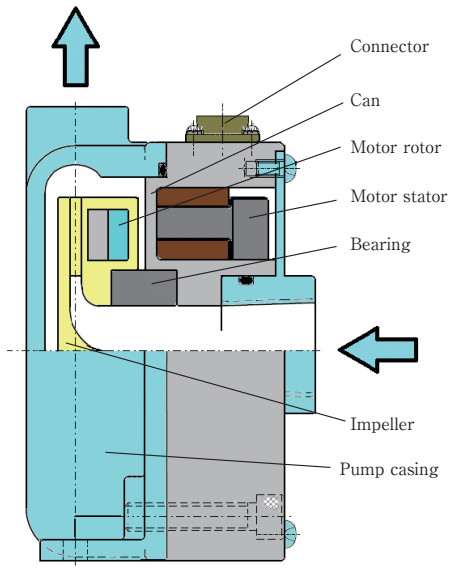


Fig. 3 Structure

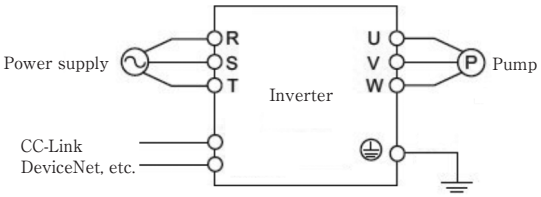


Fig. 4 Inverter wiring diagram

follows.

-A flat disc-type permanent magnet motor
-A special heat-resistant resin for stator can and rotor can material
-Structure with no main shaft realized by integrating the impeller and rotor
-A sliding bearing integrating thrust and radial types
-Leak and dust free structure with no shaft seal using canned motor
-Noise reducing structure with no motor cooling fan

3.3 Inverter and control

The PM motor of this pump is driven and controlled by an inverter. A commercially available product suitable for the PM motor can be used for the inverter. **Figure 4** shows an example of wiring for the inverter of the pump.

While many of our standard pumps have been used as facility equipment, this PM canned motor pump is designed to be suitable for installation in FA equipment including semiconductor manufacturing equipment.

4. Conclusion

The model SSPD introduced in this paper is a product featuring “ultra-compactness” and “low heat capacity” realized by our own technology to meet market demand. This pump has already gained a high reputation in the market, and sees many requirements for expanding the temperature and total head. We intend to continue to expand this product family to meet market demand.

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