Production Technologies for the Small-size AC Servo Motor "SANMOTION R" Series

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1. Introduction

Recent years have seen an overall decrease in the size of general industrial equipment. Market demands have led to motors that are smaller size and lighter weight while providing increased torque, faster rotations, and lower cogging torque.

The increasing market demand for smaller motors with higher functionality has spurred Sanyo Denki to add the "SANMOTION R" Series to our current P Series and Q Series AC servo motors as a strategic product for the next term.

This document introduces the production technology used in the manufacture of the small-size AC servo motor "SANMOTION R" Series (referred to below as the "R Series").

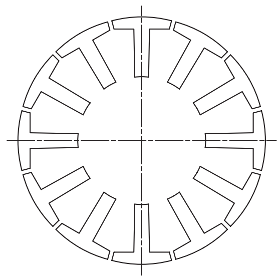
For the development of the R Series, the manufacturing method was also considered as an important topic of discussion along with the small size, high performance specifications desired by customers. All related departments participated in this development at the same time to start production design.

In response to the problems mentioned above, we can now introduce the technologies that we have developed in the following areas.

①Stator division method
②Stator winding and connection method
③Stator mold method
④Motor assembly method
⑤Assembly line systematization

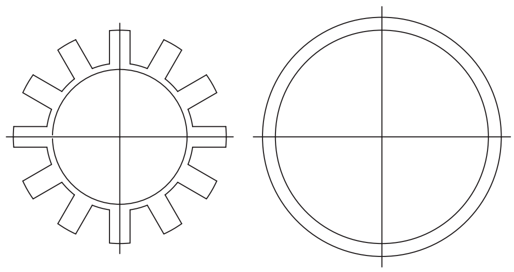
2. Stator division method

The P and Q Series used the 12-division stator construction shown in Fig. 1. Based on the stator shape and initial costs of the required precision molding, these were constructed of two pieces. However, a single stator required six punches to create a planar surface, which greatly increased the press load. The R Series uses the 2-division construction shown in Fig. 2, thus requiring only a single punch to create a planar surface. This improved both the precision of the stator and the productivity of the press, which has become an important issue recently.



Q Series 12 division

Fig. 1　SANMOTION Q stator



R Series 2 division

Fig. 2　SANMOTION R stator

3. Stator winding and connection method

Other important topics are the occupancy ratio of the winding and improvement of the processing of the ends of conductors in stator winding and connection. R Series winding uses a bobbin construction and achieves a high occupancy ratio through perfect layer coil winding. Additionally, the bobbins use square pin construction so that electrical cable terminals all automatically stripped, after which automatic soldering is performed in order to complete a single coil. The connections between coils are made via the circuit board, and the inserted square pins are soldered into the circuit board pattern to complete the circuit. The circuit board then has a power supply connector mounted on it, which results in a significant improvement in the power supply process. These production design have been incorporated into our development of manufacturing equipment and have resulted in a system that is automated from wire winding to processing of the ends of conductors.

4. Stator mold method

The main method of stator construction has employed an exterior aluminum frame to protect the device from the environment. The large number of processes used for aluminum frames has been a topic of discussion. The R Series, as shown in Fig. 3, was able to solve this problem by using a thermosetting resin for the exterior construction. The lack of an aluminum frame improves fabrication while simultaneously enabling the number of parts to be reduced.

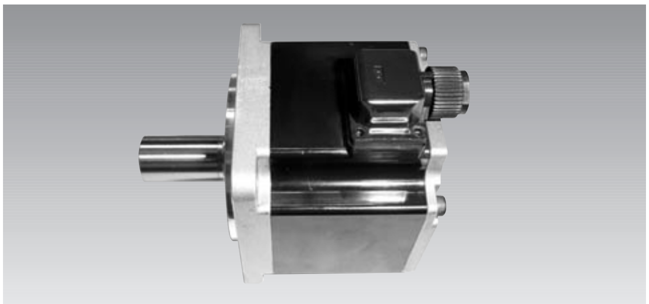


Fig. 3 Thermosetting resin

5. Motor assembly method

We pursued one-way assembly processes for combining the completed components and stators made with the processes outlined above. As shown in Fig. 4, the direction for assembling each component and the direction for tightening the screws is the same, so the device can be fully assembled on the assembler. Fig. 5 shows a photograph of a semi-automatic assembler.

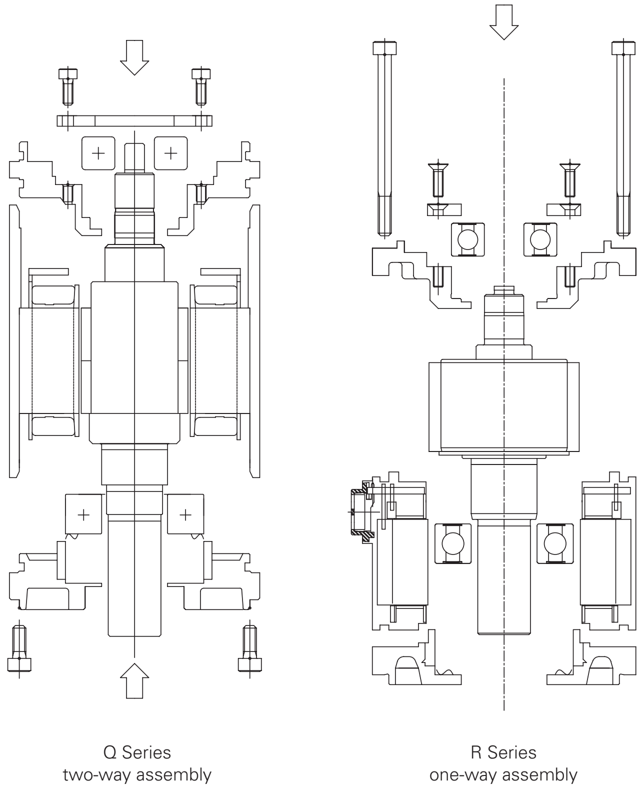


Fig. 4 Comparison of assembly directions

6. Assembly line systematization

We introduced the automatic and semi-automatic devices shown in Fig. 6 into the processes for motor construction and inspection. These devices include our knowledge of production guidance and automated inspection systems. We were able to incorporate this knowledge into the manufacturing line in order to achieve a self-completion process structure and space-saving design. In addition to the picking system shown in Fig. 7, we simultaneously introduced a management system that operates all the way through product warehousing.

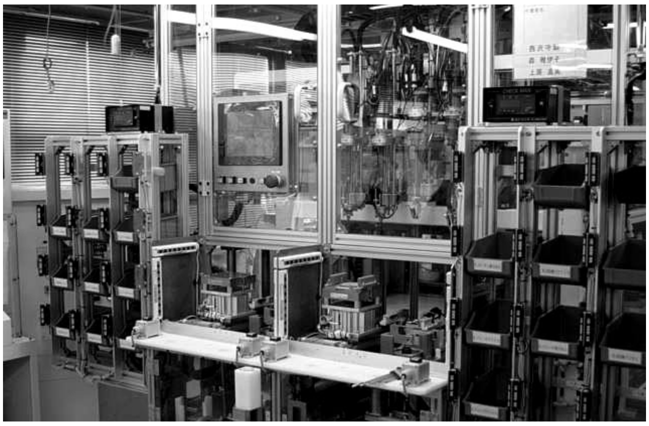


Fig. 5 Semi-automatic assembler

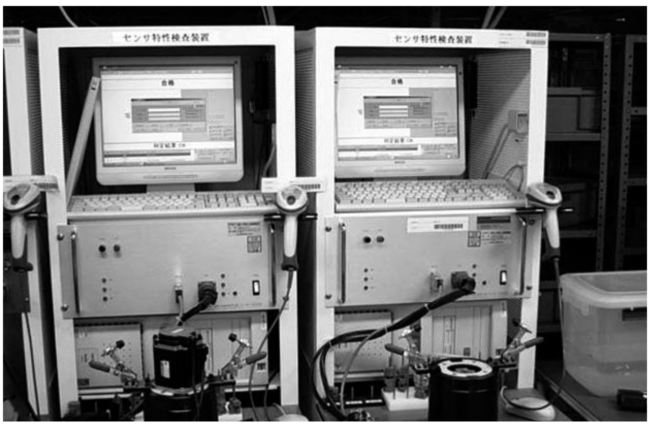


Fig. 6 Inspection device

Fig. 7 Picking system

7. Conclusion

This concludes our introduction to production technologies for the small-size AC servo motor “SANMOTION R” Series. Cooperation from the related departments enabled implementation of concurrent engineering, reduced our part counts, and created a motor suitable for automatic assembly. Additionally, assembly lines are benefiting from our production guidance systems. All processes and inspections have been automated and product quality has been stabilized from the start of mass production. Production management systems have undergone an overall improvement in performance. The impact of this work will be continue to be felt well into the next generation of development.

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