

Robot Production Factory with Robots



In June 2015, we started operating a robot production factory in Suzhou, China. This factory is intended to leverage the power of robotics based on the concept of "Producing robots using robots."

The robots are involved with processes that require high quality and heavy-duty assembly that human beings are not good at, while people are involved with simple work such as preparation and allocation of parts. This realizes high levels of both quality and productivity.

Introduction

With the rapid economic growth in China, serious issues such as labor shortages have been emerging in the manufacturing industry in recent years.

As one issue in the manufacturing industry in China, it is becoming difficult to secure a high-quality workforce. In China, the turnover of workers is high, and workers are not loyal to their companies even after being trained for a long period of time. Therefore, management is always facing the issue of securing high-quality workers.

Controlling labor costs is another serious issue. The manufacturing industry in China has been increasing its production amount based on the advantage of its labor costs. Now, however, the issue is how to improve profits, which have been tight because of increasing labor costs.

1 Background

The most effective means of solving these issues is the introduction of robots. When using robots, product quality can be stabilized without being dependent on the skills or experience of humans, and production is not affected by fluctuations in labor costs.

In order to inform our customers of the advantages of robots, we opened a production factory in Suzhou, China in June 2015, which is based on the concept of "Producing robots using robots." We aimed to give the factory the role of showroom for potential customers considering the introduction of robots by realizing a highly automated cutting-edge factory using robots.

2 Factory concept

In this factory, the processes that used to depend on human workers, from picking of parts to assembly, painting, and inspection were highly automated to simultaneously achieve both high product quality and productivity. In addition, safety, the most important matter when using robots, was ensured. Moreover, the factory was given a showroom structure that could be observed by visitors.

① Stabilization of quality

In this factory, stable product quality with processes that are affected by the skill or experience of workers, such as the insertion of gears into reduction gears, is performed by robots that always operate accurately.

② Enhancement of production efficiency

In this factory, higher productivity than that in the case of full automation is achieved by dividing processes according to what humans and robots are good at. For instance, a formation in which humans insert bolts and robots manage the torque and perform final fastening.

③ Ensuring safety

By adopting Kawasaki's unique safety system, the coexistence of operating robots and workers in one area has been enabled.

④ Showroom structure

Normally, an automated production line has a structure in which products are accessed from both sides of the production line. However, in this factory, a structure that rotates products was introduced and robots are placed only on one side to realize a showroom line that can be easily observed by visitors.

3 Each piece of equipment of the robot production factory

In order to realize ① through ④ described in the previous section, we composed each piece of equipment in the robot production factory by integrating existing technologies and cutting-edge technologies, taking full advantage of being a robot manufacturer.

As illustrated in **Fig. 1**, the robot production factory consists of a sub-assembly cell, a main assembly line, a painting line, a harness assembly line, and an operation inspection line.

(1) Stabilization of product quality

There are three robot models produced in this factory (the CP high-speed palletizing robot, the BA small arc welding robot, and the CX large payload robot; shown in **Fig. 2**) that have been newly developed to accommodate robot assembly and complete painting of robots, and all these models are produced using the same equipment.

In assembly work, the skill or experience of the workers may affect the product quality. However, by having assembly work performed by robots instead of humans, it has become possible to always perform accurate operations and management, and stable product quality has thus been achieved.

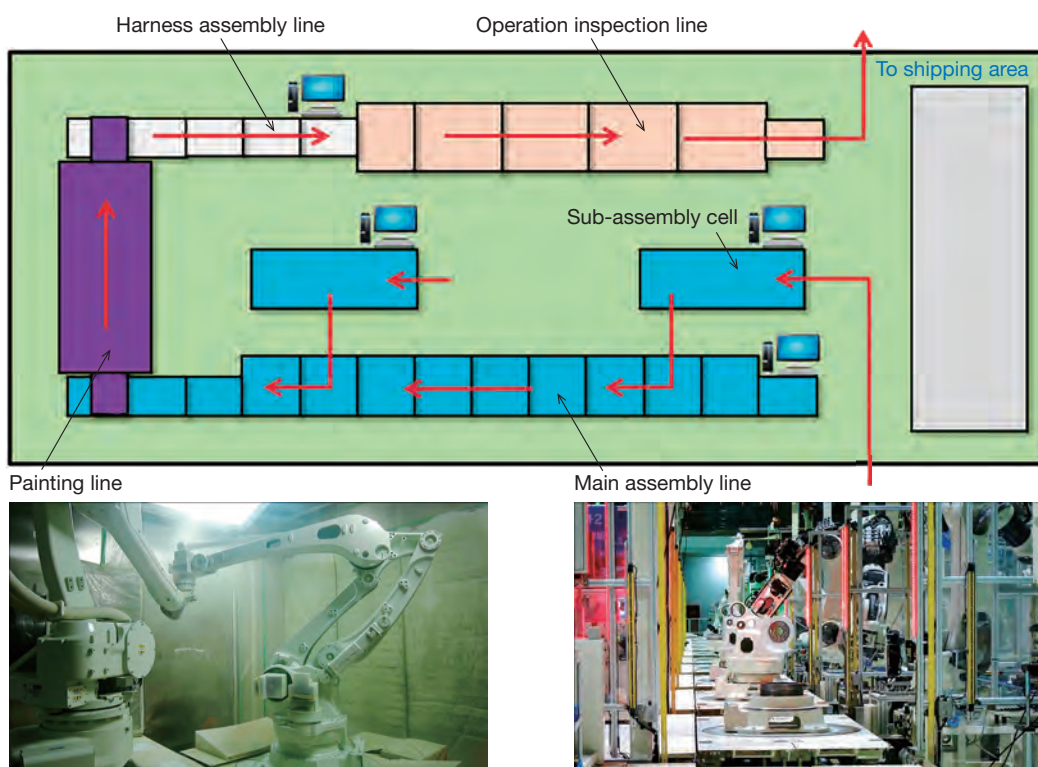


Fig. 1 Robot production factory



Fig. 2 China production model

Technical Description

In this factory, robots perform the bolt fastening work. We have developed and introduced a device in which the robot control axis is incorporated into the main body of the nutrunner, so that management of the fastening torque can also be performed by the robots (**Fig. 3**).

In addition, in order to insert gears into reduction gears without damaging the tooth flanks during the assembly of servomotors or other parts, the gear teeth inside the

reduction gear are measured by a two-dimensional camera (**Fig. 4**). Similarly, the tooth phase of the input gear on the motor side is also measured (**Fig. 5**). By identifying the tooth phases on both sides and compensating for the phase during insertion, it has become possible to reduce mechanical shocks and scratches during assembly.

Moreover, for work performed with robots, each piece of work data including work history, image data during

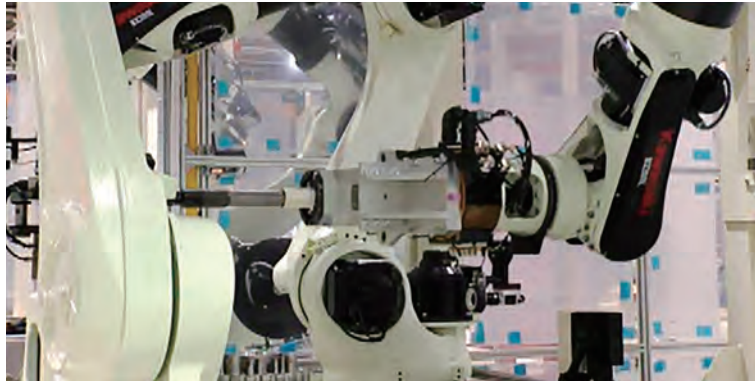


Fig. 3 Nutrunner

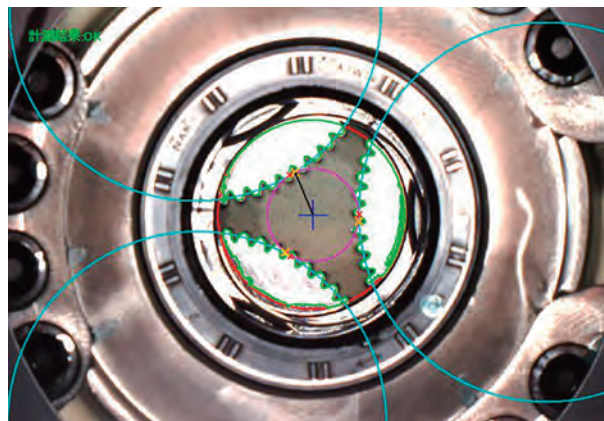


Fig. 4 Reduction gear measurement



Fig. 5 Input gear measurement

sealant coating (Fig. 6), and fastening torque data during bolt fastening, is saved so that past work conditions can be tracked later.

(2) Efficiency enhancement

In this factory, work that can be better performed by humans, such as temporary fastening of bolts, and work that can be better performed by robots, such as accurately transporting parts and assembling them, are divided. In addition, production efficiency is enhanced by making it possible for humans and robots to coexist in the same area, so that robots can prepare for the next task while humans are working.

Conventionally, there was an issue in which the maximum part weight that could be transported by a robot

was determined by the payload of the robot to be used and that robots with large payloads were large. In order to solve this issue, it has been made possible for robots to transport parts that are heavier than their payloads by incorporating a robot control shaft into the crane driving part and supporting the transported weight with the crane.

In addition to incorporating a robot control shaft into the crane driving part, accurate transportation has been enabled by having the crane operate in collaboration with the robot arm. This system was introduced into processes that require accurate transportation of heavy objects, such as the assembly of reduction gears. The method through which transportation of heavy objects is performed is shown in Fig. 7.

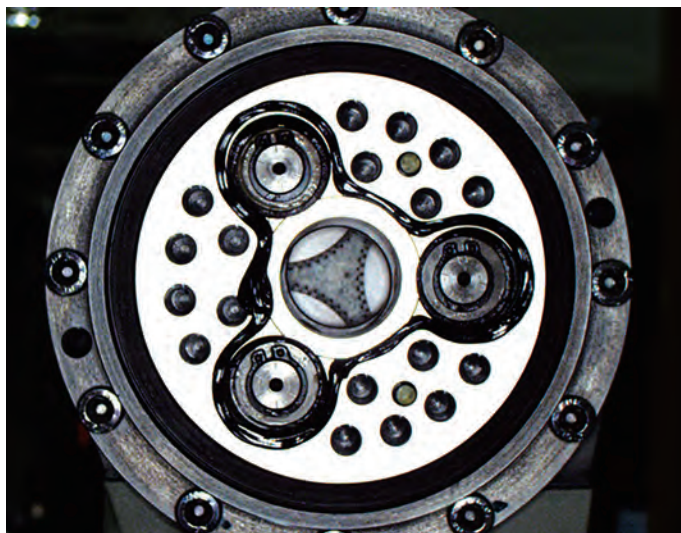


Fig. 6 Reduction gear sealant coating

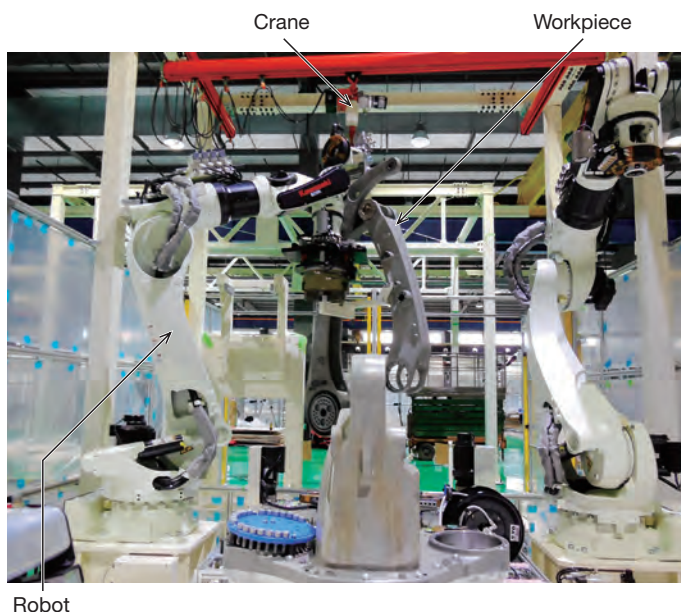


Fig. 7 Transport of heavy works

(3) Ensuring safety

The safety of workers must be guaranteed in order to make it possible for humans and robots to coexist in the same area so that robots can prepare for the next task while humans work. Therefore, in this factory, the safety of workers is ensured by making the robot control circuit a redundant dual channel safety circuit and performing space monitoring, as well as using area sensors in place of conventional safety fences.

(4) Showroom structure

In order for visitors to this factory to observe robot assembly work using robots, transparent panels and area sensors are used to lighten the atmosphere so that the facilities can be easily observed. The views from visitors of the sub-assembly cell and main assembly line are shown in **Fig. 8** and **Fig. 9**.



Fig. 8 Sub-assembly Cell



Fig. 9 Main assembly line

Conclusion

To respond to the growing need for robots in China, we have launched a robot factory in Suzhou, China, with the aim of establishing the Kawasaki brand. In addition, we have also succeeded in making this factory a showroom for the production of robots using robots by introducing many of our robots into the factory and realizing a high degree of automation.

This factory, which serves as a showroom for introducing application examples of robots, has received visitors almost every day since it went into operation, and it has earned a good reputation.

We aim to expand our business in China by utilizing our know-how of robot automation technology acquired through production in China.



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