

KAWASAKI HEAVY INDUSTRIES, LTD.

Friction Spot Joining System

Features

- ◆ Friction Spot Joining (FSJ) is an entirely new joining method which is used on lap joints of aluminum, magnesium, and other light metals.
- ◆ The electric power consumption of the FSJ is 1/20 or smaller as compared to Aluminum Resistance Spot Welding (RSW).
- ◆ During the FSJ process the material does not actually melt, the heat deformation is minimal.
- ◆ The system mechanics are very simplistic with no need for auxiliary equipment as required by the RSW. Neither cooling water nor compressed air is required, allowing for broad reductions in both equipment and running cost.
- ◆ The joining tool, used in the FSJ system, is susceptible to little wear and tear, keeping consumable costs low.
- ◆ With no dust or fumes to worry about and no need for a large electrical current, the FSJ process is clean and does not generate any electromagnetic noise.

Basic Concept or Summary

- ◆ There are 2 types of FSJ, i.e. “stationary system” and “robot system”.



[Stationary FSJ system]

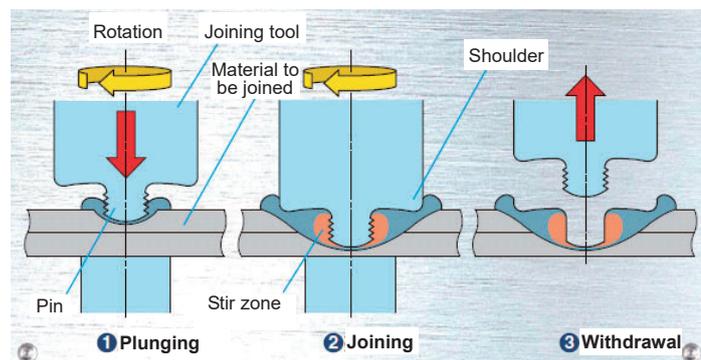
The gun and backing are mounted on a special trestle. The workpiece is secured by jigs. It can also be held by a robot manipulator.



[FSJ Robot system]

The system is composed of a 6-axis articulated robotic arm and an FSJ gun, and is moved to the work to join. The gun is controlled by the robot controller as an external drive.

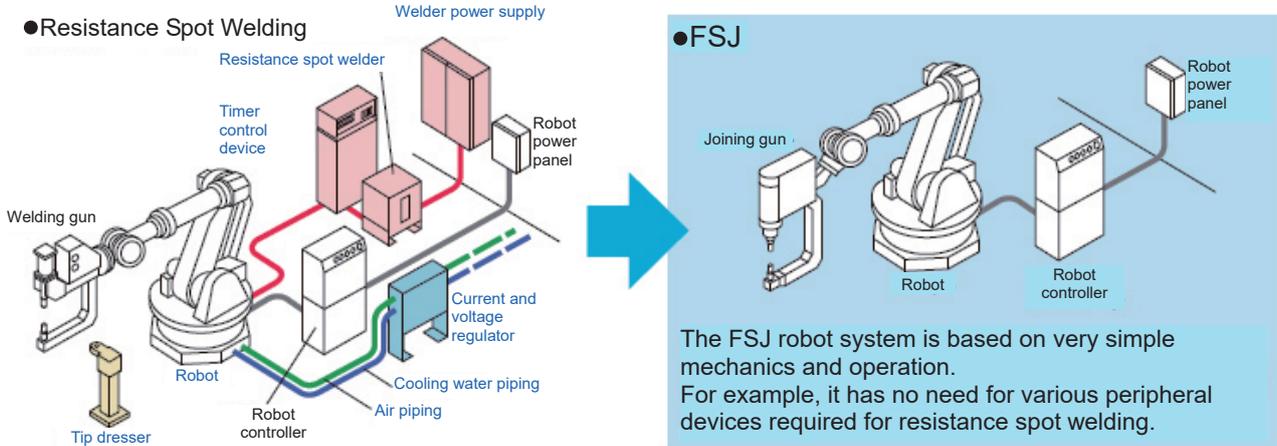
- ◆ The joining process is very simple, carried out in the following three stages:
 - (1) **Plunging:** The joining tool, while rotating, is forced against the workpiece with a specified amount of pressure. This pressure creates frictional heat between the workpiece and the pin on the tip of the tool, softening the metal and allowing the pin to plunge into the workpiece.
 - (2) **Joining:** The pin becomes completely embedded in the workpiece and the press force on the tool is maintained for a given interval even after the shoulder on the outer edge of the tool comes in contact with the workpiece.
 - (3) **Withdrawal:** The tool and the pin are withdrawn after the joining is completed.



Effects or Remarks

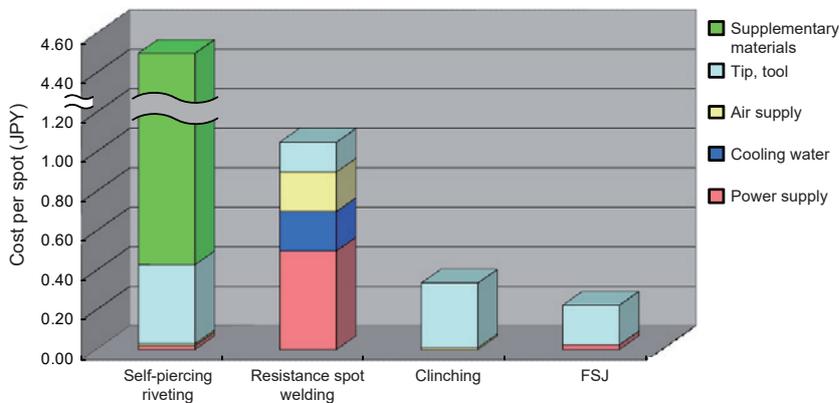
- ◆ The energy consumption can be 1/20 or smaller as compared to RSW, i.e. the energy conservation effect is 95% or more.
- ◆ Besides, the system mechanics are very simplistic with no need for auxiliary equipment or air, allowing for broad reductions in both equipment and running cost. This is a system product truly suited to the energy conservation era.

Example comparison of resistance spot welding and friction spot joining systems structures



- ◆ If compared with other joining systems such as RSW or riveting, it is found that the FSJ is overwhelmingly good at economic efficiency, as shown in the graph below.

Cost comparison (Our estimation)



- ◆ We have a patent for this FSJ technology in Japan, U.S.A. and Europe.
- ◆ The application of this technology is widening recently covering not only the joint of aluminum alloy but also the joint of steel and aluminum alloy.

Installation in Practice or Schedule

Domestic A number of the FSJ systems have been shipped to many customers including automobile manufacturers. However, we are not allowed to disclose the details.

Overseas A number of the FSJ systems have been shipped to many customers including automobile manufacturers. However, we are not allowed to disclose the details.

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