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Sealing of Ferromagnetic Material by Laser Welding†

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The inert-gas arc welding, such as TIG and MIG, is one of the important methods for welding of various metal and alloy, but it is very difficult to apply these welding methods in order to seal ferromagnetic material in a can, for example, because the arc generated between the tungsten or metal electrode and the workpiece is affected extremely by the strong magnetic field produced by the contents. In this study, the laser welding was applied instead of TIG or MIG for sealing of ferromagnetic material, because a laser beam is never affected by the magnetic field.

The laser welding was carried out using a continuous wave CO₂ laser developed by Spectra-Physics Co. The maximum power capacity was 5kW. The laser irradiating condition is shown in Table 1. The shape of the workpieces used for preliminary experiments is shown in Fig. 1. The positions to be welded are shown by a symbol ○ in the figure, and some permanent magnets can be sealed

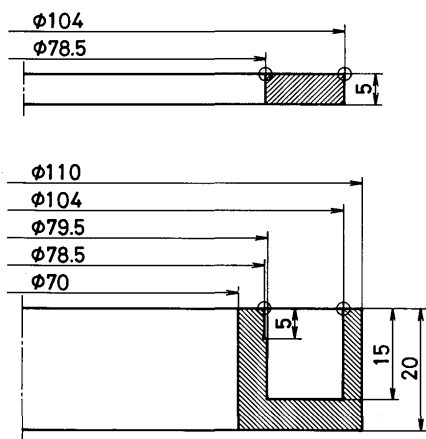


Fig. 1 Shape of the workpieces used for preliminary experiments. A symbol ○ shows the positions to be welded.

in it. The work material used is SUS304 stainless steel, which is equivalent to AISI304.

The external appearances of the weld part are shown in

Table 1 Laser irradiating conditions.

	Power	Focal length of lens	Beam diameter	Traveling velocity
1	1.5kW	254mm	0.1mm	13.2mm/s
2	1.5kW	254mm	0.1mm	17.8mm/s

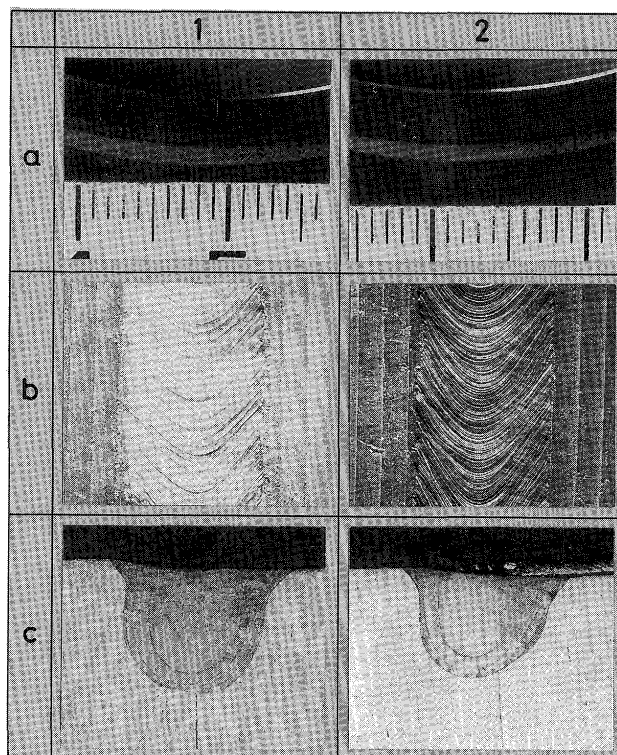


Fig. 2 External appearances (a), their magnifications (b) and transverse cross sections (c) of the weld part.

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Fig. 2(a), and the magnifications of these weld parts obtained by a scanning electron microscope are shown in Fig. 2(b). The transverse cross sections of the weld part are shown in Fig. 2(c). The penetration depth is about 0.6 ~ 0.7mm, which is fully acceptable. Any defects in the bead were not found in the liquid penetrant test and X-ray radiographic inspection, and it was concluded that the laser welding is very effective for sealing of ferromagnetic material.

The laser welding was actually adopted to a coupling half of a magnet drive centrifugal pump as shown in Fig. 3, and good results were obtained in the practical use.

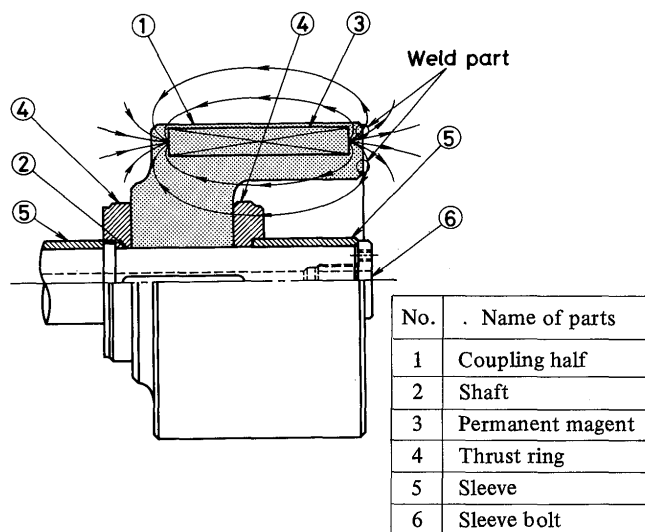


Fig. 3 Coupling half of a magnet drive centrifugal pump and the weld parts, which are shown by a symbol ○.