Fraunhofer Institut Werkstoff- und Strahltechnik

High-power beam deflecting optics for laser beam welding - lasertronic®

Task

Conventional laser processing machines move the processing optics and / or the workpiece. Due to its mass inertia, the mechanical motion system of the laser processing machine limits the accuracy of the processed contour, if the requirement is to process small or heavily curved contours with feed rates of 10 m min^{-1} and higher.

The use of beam deflecting optics for the motion of laser beams on a contour to be processed is an alternative or supplement to conventional laser processing machines with Cartesian or linked axis systems. The handling system will perform the base positioning of a workpiece and processing head and the beam deflecting optics are used instead of conventional focusing optics. The beam deflecting optic with its deflection mirrors realizes the actual work feed of the laser beam on the workpiece.

Solution

The high-power beam deflecting optics developed at the Fraunhofer Institute for Materials and Beam Technology (IWS) are integrated into **lasertronic®**, as these systems combine elements of laser technology, electronics, and information technology.

Fig. 1: High-power beam deflecting optics for CO_2 laser radiation

IWS beam deflecting optics enable a highly dynamic motion of the laser beam on any workpiece contour. Due to the low mass of deflection mirrors moved by means of a galvanometer scanner, this beam motion is possible at very high path speeds (up to 600 m min^{-1}) of the beam spot at extremely high precision (accuracy better than 0.05 mm). The accelerations can be as high as several 100 m s^{-2}. The beam deflecting optics are used with laser powers of **up to 4 kW** for the processing **with CO_2 lasers** (**lasertronic® SAO10.6**) and **up to 3 kW for Nd:YAG lasers** of high beam quality (**lasertronic® SAO1.06**).

High-power beam deflecting optics (Fig. 1) are modularly designed and consist in the simplest case of a beam deflection and beam-focusing unit. The size of the processing field (≥ 50 x 50 mm^2) depends on the used focal length (f ≥ 250 mm).

Fraunhofer Institute for Material and Beam Technology IWS Dresden
(Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Dresden)

Winterbergstr. 28
01277 Dresden, Germany

Contact partner
Dipl.-Ing. Annett Klotzbach
Telefone +49 (0) 351 2583 235
Fax +49 (0) 351 2583 300
E-mail annett.klotzbach@iws.fraunhofer.de
Internet http://www.iws.fhg.de

Task **specific programs** for WinNT® are available **for control** of the galvanometer scanner and the lasers. Their user interface makes it possible to simply program any processing path geometry and path- or time related laser power adjustments for optimized processes. A powerful and modularly expandable PC-board with its own processor enables the calculation and timely synchronized output of the necessary control signals for the galvanometer scanner and the processing laser. The control board as a slave-computer communicates with the CNC of the laser machine through digital interfaces.

A motion synchronized **coupling with a conventional handling system** (gantry, robot) is possible to expand the processing field of the beam deflecting optics. This combination unites the advantage of highly dynamic beam deflection optics with the large working area of a traditional handling system.

Moreover, it is possible to **integrate sensor systems for position detection and process control**.

Results

In recent years the high-power beam deflecting optics (**lasertronic® SAO10.6** and **lasertronic® SAO1.06**) developed at IWS have proven to be successful in several areas of industrial manufacturing. A special area of utilization is the precision welding in spatially limited geometries with high path speeds (Fig. 2 and 3).

Fig. 2a: Exhaust heat exchanger for diesel motors
(Fa. Behr GmbH & Co.)

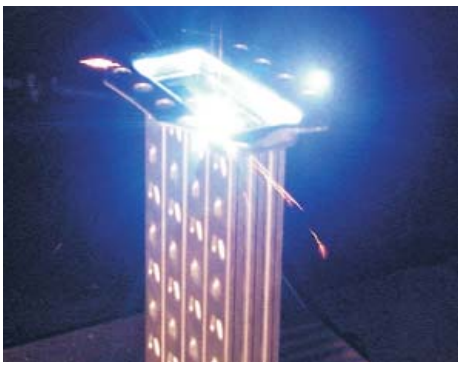

Fig. 2b: Welding of the duct-bottom-joint at the exhaust heat exchanger utilizing CO_2 laser, gantry machine, and beam deflecting optics

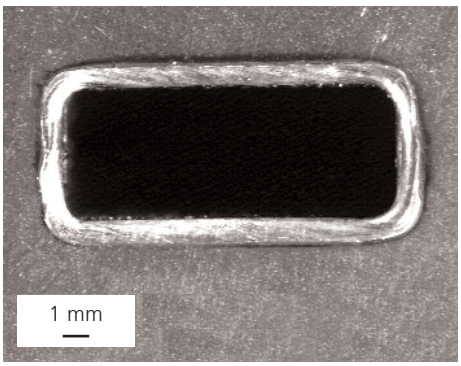

Fig. 2c: Welded duct-bottom-joint on an exhaust heat exchanger

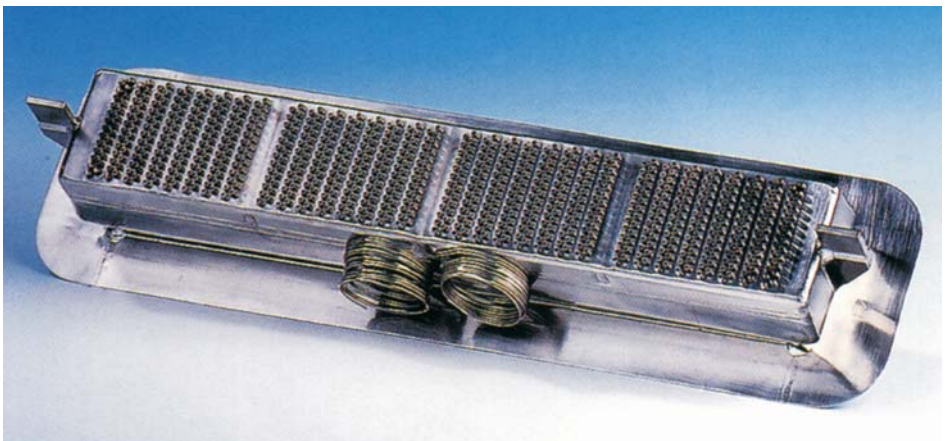

Fig. 3a: Welded nozzles in a glass-drawing pan made of platinum (Saxonia Edelmetalle GmbH); Processing with a CO_2 laser, industrial robot, and a beam deflecting optic with integrated optical measurment sampler for position detection

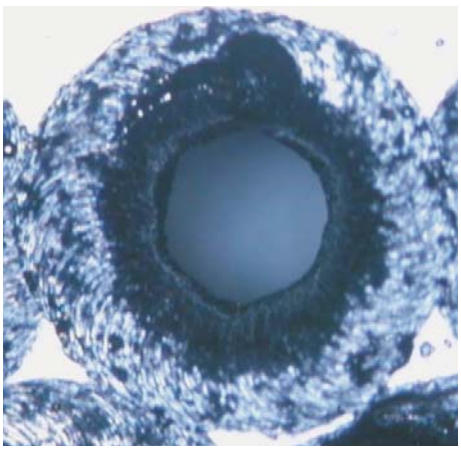

Fig. 3b: Welded nozzle in a glass-drawing pan made of platinum (SEM top view)