New Standards in Radiation and Friction

Vibration Welding. Significant advancements have been made in friction welding equipment. The development of all-electric vibration welding machines, particularly when used in combination with upstream infrared-preheating, has significantly increased not only energy-efficiency but also greatly enhanced the precision and accuracy of the machine and subsequently, the plastic part being assembled.

Fig. 1. The M-624HRSi all-electric vibration welding unit with infrared preheating (CVT) was presented at K2007
(figures: Branson)

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With the development and production of all-electric vibration welding machines for plastic parts, Branson Ultraschall, Dietzenbach, Germany, a subsidiary of Emerson Technologies GmbH & Co. OHG, is following the trend in plastics machinery manufacturing towards electric drives, and thereby remains the pioneer in vibration welding solutions. The company decided at an early stage to pursue the question of energy efficiency rigorously and invest in the development of sustainable drive concepts for plastic joining technologies. The result of this pursuit is clearly evident in the current product portfolio of electrically driven machines.

Branson has already presented the world's first all-electric vibration welder at K2007, showing the M-624HRSi **(Fig. 1)** and establishing the M6 for medium-sized parts, such as automotive rear lamps, expansion/fluid reservoirs and air intake manifolds with weld surface areas up to 500 cm^2. This all-electric machine has met the increasing market requirements for precision, repeatability, speed and energy efficiency.

The all-electric drive technology of the vibration welding machines proved very efficient, particularly in combination with the upstream infrared preheat process. This approach could soon become the industry standard for plastic joining. Particularly in the automotive industry, where high-mechanical-stress engine compartment parts are common, and in the lighting industry where very strict optical requirements are common. This concept, designated Clean Vibration Technology (CVT), →

Fig. 2. The M-934LSi all-electric vibration welding unit, with a lifting table of 1,750 x 540 mm, is suitable for large parts

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combines conventional vibration welding (friction welding) with energy-efficient plastication of the joint zones by infrared preheating. Add to it the efficiency, dynamic response, and precision of an electric drive, and the result is particle-free vibration weld seams that satisfy high mechanical strength requirements.

In addition, the electrical drive satisfies one of the market's other key requirements of energy-efficiency, while at the same time delivering high-precision welding results . The electric drive is characterized by excellent drive dynamic response combined with maximum lift table speeds that are up to twice as fast as comparable hydraulic drives, while attaining excellent positioning accuracy.

Designed for Large Parts

To further expand this potential and meet market demands for welding precision, cycle-time optimization and energy efficiency, in the standard portfolio for large parts, such as instrument panels, Branson presented the M-934LSi at K 2010, the world's largest all-electric vibration welding machine **(Fig. 2)**. These systems for large-scale parts are equipped with two synchronized axes (lifting and sliding table), that allow freely programmable curve kinematics adapted to the fixture (E-Cam). Particularly for complex parts with undercuts, such as instrument panels, but also where multiple fixtures are used (fixture changing) on one welding machine, this offers huge advantages and the flexibility that is required by the automotive industry nowadays.

The product portfolio of all-electric vibration-welding systems now comprises different units with lift-table dimensions of 1,330 mm × 540 mm and 1,750 × 700 mm, and with weld surface areas up to 750 cm^2. Three different machine types operate with a vibration frequency of 100 Hz and one with 240 Hz.

Fig. 3. With the VC-100 PC control, the lifting table and sliding table movement can be precisely synchronized

All the all-electric vibration welding machines have integrated force control, which is unlike the preset force method typically used by hydraulic systems. In the all-electric machines, a force sensor measures the applied force and transmits the data to the controller. Deviations from the setpoint force are registered and corrected, which ensures excellent reproducibility of force during the weld. Temperature differences caused by shutdowns, such as those occurring with comparable hydraulically driven units, are also eliminated by the force control, which leads to tighter process tolerances.

Furthermore, all electrically driven vibration welding machines from Branson are equipped with the standard IPC control VC-100 PC **(Fig. 3)**, which allows comprehensive parameter selection, giving the operator complete command over the weld process.

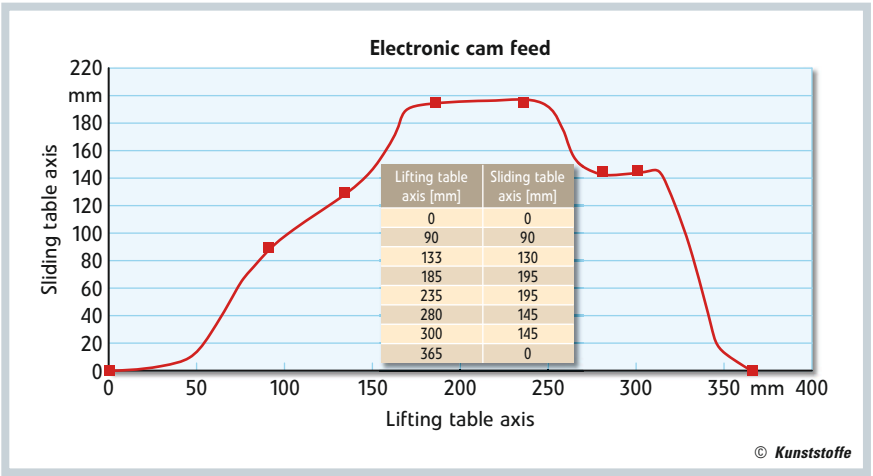

Fig. 4. A lifting table/sliding table control following the master-slave principle permits precise coupling of the movement sequences

The new development of the electronic cam (E-Cam) system must also be mentioned here. Unlike mechanical cams, in which the lift table and the sliding table movement are synchronized by means of mechanical roller guides, the E-cam follows its electronically programmed path of motion. This affords the operator many advantages and more degrees of freedom. With mechanical cam drives, when the operator changes the weld fixture, a new cam plate must be machined and installed in the machine. With the E-Cam, only a new parameter setting is loaded into the VC-100 controller, and the new fixture can be put into operation **(Fig. 4)**.

New Vibration Head Generation

The new I-Class vibration head family, which is based on already patented PMT (programmable motion control) technology, expands the M-Class vibration head family introduced years ago. This new, more powerful vibration-head series offers a compact and scalable platform for small and medium-sized applications up to max. 70 kg fixture weight. In addition, the I-Class weld heads offer increased weld-surface power, and can be flexibly configured. With the I-Class, the patented PMT concept is used throughout all systems, which contributes to a better performance and energy balance and faster amplitude control for vibration welding machines. In developing this new system, compatibility with existing fixtures was a priority, i. e. existing fixtures can be easily adapted to the new generation of vibration heads. The I Class vibration heads are used in the M-5i1H/Hi, M-5i2H/Hi and M-5i3H/Hi vibration welding machines.

Branson gained an important success in its reorientation when it was nominated as a system supplier in the field of vibration welding for the Golf instrument panel by Volkswagen in Wolfsburg, Germany. For the Volkswagen Group, one of the key factors in its choice of partner was the electrical drive technology for vibration welding machines. Welding precision, cycle time optimization and energy efficiency were at the forefront for the customer. The vibration welding process will be used in the instrument panel for the future Golf generation along with ultrasonic and infrared welding.

Plastic welding technology will become significantly more important to manufacturing in the future. Not least because of current trends in the automo-

tive industry, such as new innovative materials, for example fiber reinforced composites for weight reduction, environmentally friendly product design through the reduction of consumables such as adhesives, clips and screws etc. Branson therefore sees huge growth potential in the implementation of its Clean Joining Technologies. This new product classification includes three clean and economically friendly welding technologies which have complementary application profiles :

- Contoured Infrared Technology (CIT),
- Clean Vibration Technology (CVT), and
- Contoured Laser Technology (CLT).

These three processes will meet current market demands for cleanliness, optical appearance, 3-D design and functional integration, as well as the increased use of high-temperature low-viscosity thermoplastics and successfully enable innovative application solutions in different product sectors. ■

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