TECHNICAL NOTES AND RESEARCH BRIEFS

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AWARD-WINNING ACOUSTIC DEVICES

AMONG THE "100 MOST SIGNIFICANT NEW technical products of the year" chosen from entries in 15 product categories in Industrial Research Inc.'s annual competition are three underwater acoustic devices, described in *Oceanology International* for November/December 1967. One of these is an electromechanical system for unscrambling the "Donald Duck" speech of aquanauts working in an oxygen–helium atmosphere. The "Helium-Voice Translator," developed by General Precision's Aerospace Group, Pleasantville, New York, enables "near real-time communication between surface and diver by means of two rotating mutually eccentric disks that face each other. One has a narrow magnetic track and the other has four playing heads. The latter turns at a slower speed than the former with the eccentricity adjusted so that the four playing heads operate one at a time in a continuous sequence."

A second award was made for the "Wire Arc Seismic Section Profiler" (WASSP), submitted by Geotech, Garland, Texas, a device for producing high-level underwater acoustic pulses for seismic ocean bottom profile measurements. The pulses are produced "by means of the vaporization of a wire having the approximate diameter of a human hair. The controlled wire vaporization provides acoustic energy at higher pressures and lower frequencies than had been possible with a spark discharge of equal energy. And because the wire, instead of the water, is vaporized, the system is equally useful in salt and fresh water.

"WASSP uses as many as four high-voltage condensers to produce up to 120 000 joules of energy. When the electrical energy is discharged through the coupling of insulated cable to the electrodes some 4 to 5 meters below the surface, the wire, automatically positioned between the electrodes, immediately is vaporized. This creates a plasma region between the electrodes until the condenser bank is emptied.

"The high temperature of the plasma generates a rapidly expanding steam bubble. Upon cooling, the bubble region collapses—or implodes—with no reverberations. The generation of the bubble and its collapse propagate through the water as pressure pulses, and are the total acoustic source. The system can be programmed to fire every 6 seconds.

"Performance tests have shown higher over-all efficiency: peak pressures are several times greater than for standard SSP electrodes; bubble life is nearly doubled—from 15 to more than 25 milliseconds; and the source has an amplitude spectrum that peaks at 30 to 35 cps instead of 45 to 50 cps, as in the spark technique."

The third award-winning device is an underwater location aid developed by NASA'S Langley Research Center, Hampton, Virginia. It is an active/passive sonar combination. The transmitter, placed at the reference point underwater, emits an omnidirectional signal at 38 kc for a period of up to 50 h. The receiver, which is directional, can be used from a locator craft, or can be transferred to a hand-held unit for use by a diver to home on the transmitter.

A fourth award winner, this one depending upon acoustics in air or gases, was also announced in *Industrial Research* for December 1967. It is a sonic anemometer from Cambridge Systems Incorporated, Newton, Massachusetts, which enables measurement of winds velocity in terms of its orthogonal components. It determines the velocity of a gas or ai rstream by measuring the effect on the propagation of two acoustic pulses traveling in opposite directions over the same path. Time delay to reach dynamic equilibrium would presumably be insignificant, in general. One application is expected to be at missile launch sites, where it is important to be able to predict peak gust loads on vehicles.

10.2, 10.3

ULTRASONIC PLASTICS STAKING AND WELDING

ULTRASONIC STAKING, a recently developed technique for assembling plastics to metal or other nonplastic materials has been announced by Branson Sonic Power, Division of Branson Instruments, Inc., Danbury, Connecticut.

The new assembly method employs an ultrasonic system that converts 60-cycle, 110-V current to 20 000-cycle mechanical vibrations. The mechanical vibratory energy is transmitted into the plastic through a contact device called a "horn" (Fig. 1). The horn is generally a half-wave resonant metal section.

Most staking applications involve the assembly of metal and plastic, with a preformed hole in the metal designed to receive a plastic stud. With the introduction of ultrasonic vibrations from the tip of the horn, sufficient heat is generated to melt and reform the plastic stud into a locking head. The flow of molten plastic and the final configuration of the staked head is determined by the shape of the horn face (see Fig. 2). Ultrasonic exposure time is usually less than 1 sec. Typical applications for ultrasonic staking include automobile instrument clusters and tail light assemblies, components for the appliance industry, including radio and television cabinets and panels, and electronic components.

Primary advantages of the ultrasonic technique are high production speed and consistent results. Since frequency, pressure, and time are always the same during each production cycle, energy transferred as heat is consistent, and far faster than heat applied with a hot iron. Average head-forming time is less than 3 sec, with reject rates reduced to virtually zero. Tight assemblies are assured, since there is no recover due to material memory and no degradation of the plastic.

Unlike ultrasonic plastics welding, ultrasonic staking requires the release of vibratory energy only at the surface of the plastic; therefore, the contact area between horn and plastic is kept as small as possible. Light initial contact pressure produces an immediate surface melt, and, as horn pressure is increased, progressive melting of the plastic stud takes place until the desired head shape is achieved.

Parts normally remain relatively cool because heat is generated only at the plastic–horn interface. Head size and number being formed with one operation determine ultrasonic exposure time.

Similar techniques are used for inserting metal parts into plastics. Sound waves at ultrasonic frequencies are transmitted into the plastic part and travel through it until they meet the area where the metal insert and plastic join. At this joint or interface the energy of the ultrasonic vibrations is released as heat. The intensity of the heat

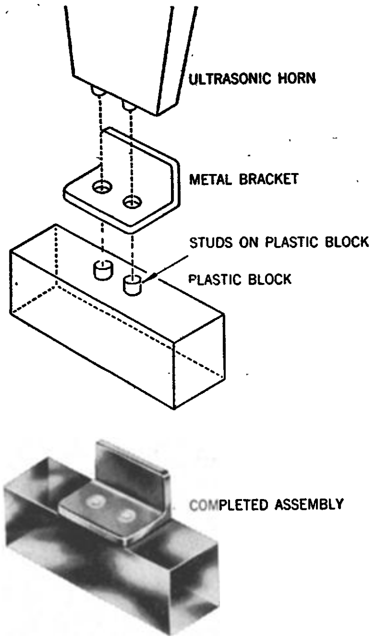

Fig. 1. Ultrasonic staking of metal to plastic.

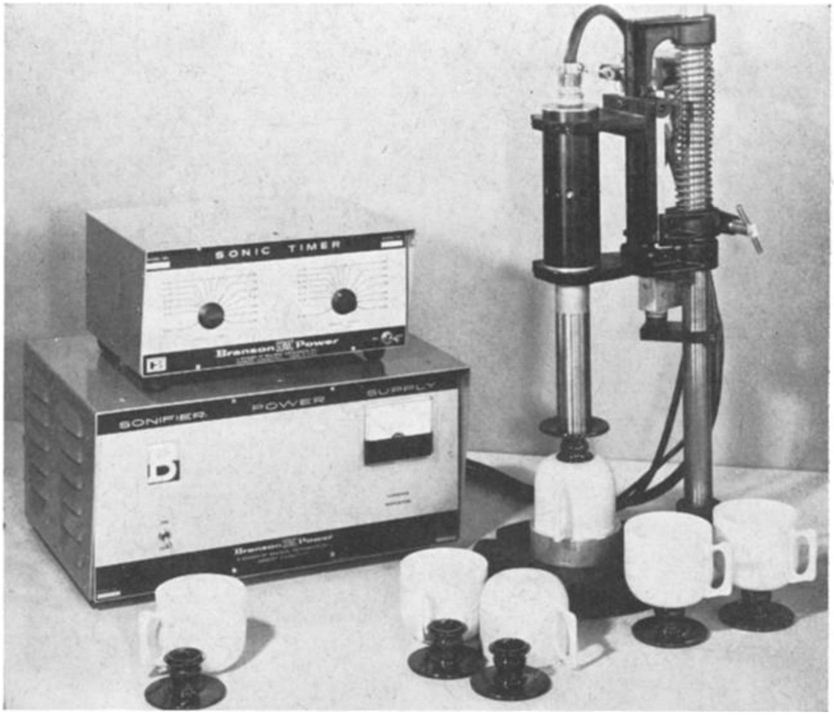

Fig. 3. Branson farfield welding process, Patent No. 3,224,916.

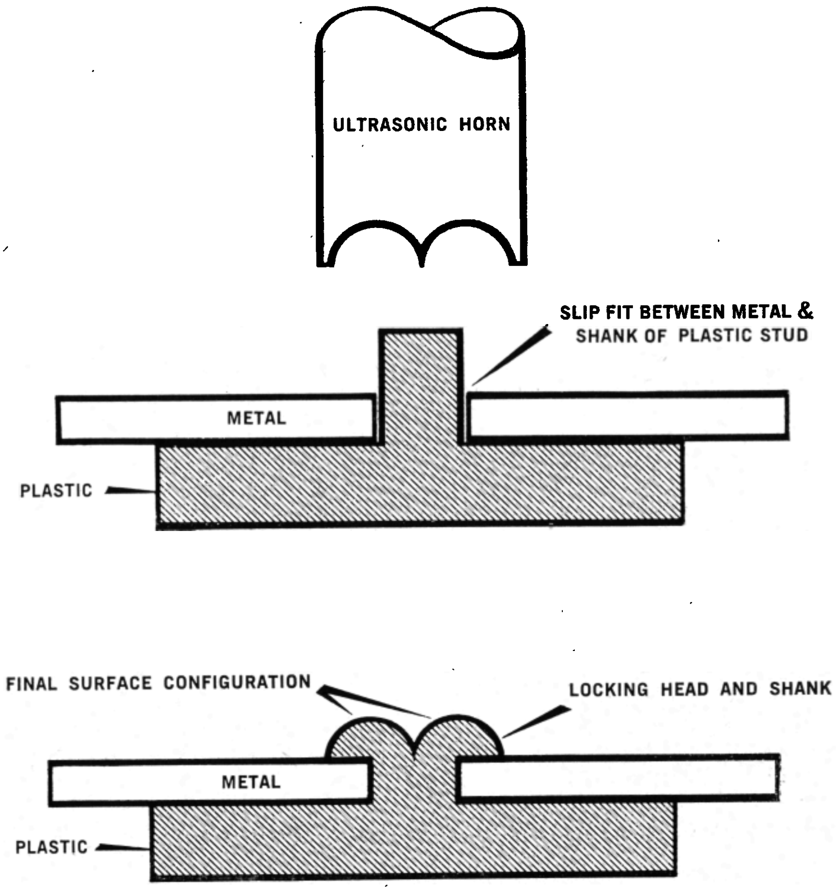

Fig. 2. Ultrasonic plastics staking.

created by the plastic vibrating against the metal is sufficient to melt the plastic momentarily[1] permitting the inserts to be driven into place.

Ultrasonic exposure time is usually less than 1 sec, but during this brief contact the plastic reforms itself around knurls, flutes, undercuts, or threads, to encapsulate the inserts. The ultrasonic exposure time required is determined by the size of metal components and number being inserted at any one time. Many small inserts require an ultrasonic exposure time of as little as 0.1 sec.

Typical parts that can be inserted by the process include bushings, hubs, ferrules, terminals, feed-through fittings, pivots, retainers, fasteners, hinge plates, vent plates, handles, locating pins, binding posts, and decorative attachments. As in the staking operation, the horn must be contoured and dimensioned to suit the particular parts being joined.

Both the staking and inserting processes are related to the ultrasonic welding of thermoplastic parts. In welding, the two parts are rigidly joined by heat developed by friction at the contiguous surfaces of the parts when ultrasonic waves are passed through them.[1,2,3] The frequencies used are typically around 20 kHz. Figure 3 presents an illustrative example of parts that can be welded and the equipment used.~

[1] S. E. Jacke, "Sonic Energy Joins Rigid Plastics," The Iron Age, **195**, 143–145 (1965).
[2] R. B. Bicknall, "Ultrasonics, a New Technique for Welding Thermoplastics," Plastics 65–67 (1965).
[3] "Welding Rigid Thermoplastics—Why Use Ultrasonics?" Ultrasonics **5**, 13–18 (1967).