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AN IMPROVED SOCKING TECHNIQUE FOR MASTER SLAVES

Berkeley, California

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A light weight, highly flexible manipulator socking that can be easily fabricated has been developed by the Health Chemistry Department of Lawrence Radiation Laboratory.

A complete socking assembly for a pair of standard Model 8 master-slave manipulators is shown in Fig. 1, mounted on a hot-cell box designed for totally enclosed operation behind a shielding wall.

The assembly can be considered in three sections:

- 1. The upper inverted cone section with its suspension system, which provides for X and Y motion of the slaves.
- 2. The bellows section, which provides for Z motion as well as wrist movement and rotation.
- 3. The mitten, which encloses the tong-activating fingers.

The upper section is constructed of 0.020-in. polyvinyl chloride sheeting, fabricated and welded by standard techniques.

The bellows section is unusual and its fabrication is a follows.

The bellows is formed out of two flat sheets of vinyl (0.020 and 0.040 in.), which are welded together, rolled into a cylinder, and welded with a single seam the length of the cylinder. A V slot is cut into the end of the 0.020-in. section and the edges welded together to produce the desired taper of the lower section to which the mitten will be joined. See Fig. 2, part 1. The upper part of bellows is made of 0.040-in. sheeting to provide support for the lower section and to prevent the folds of the upper section from being pulled out by the suspended weight of the lower section.

The tube is formed into bellows by a pleating technique in which the folds are formed in a simple mold and set with heat.

The mold consists of a series of flat disks with triangular holes, stamped out of 22-gauge aluminum. Since the length of the bellows section is a function of the number of plates used, and the diameter of a function of the size of the

triangular cutout, the dimensions can be altered as desired and tapered sections formed.

The disks are strung on two rods, as shown in Fig. 2.2, and spaced 3/4 in. apart. The molds are placed on the rods with the base of the triangle on top on alternate molds and on the bottom for the others, so that the apex of the triangle alternates from top to bottom on consecutive disks.

The welded vinyl tube is then pulled through the triangular apertures so that a small excess protrudes from the first and last section (Fig. 2.3). Plugs are put into these end sections and the inside of the tube is inflated with air to about a pound pressure to remove wrinkles. The spacing of the disks is then checked and adjusted so that the bulges of the inflated vinyl tube between the disks are relatively even (Fig. 2.4).

The pressure hose is then disconnected, but air is allowed to escape only slowly through a bleedout, so that pressure is maintained while the entire mold is pushed together on the rods, tightly folding the vinyl bulges between the aluminum disks (Fig. 2.5). The collapsed assembly of vinyl tube and mold is tightly clamped (Fig. 2.6) and baked at 120°C for 20 minutes.

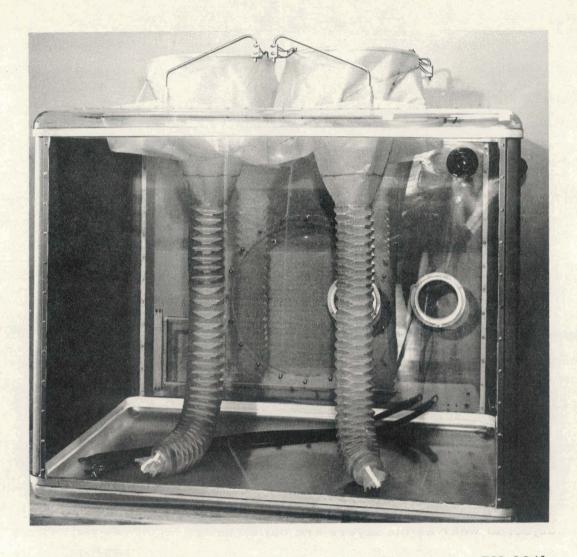
After cooling, the assembly is unclamped and the vinyl section removed from the mold disks. It is now ready to be welded into the upper section of the booting.

The mitten for the tongs is formed by a combination dipping and brushing method using a vinyl plastisol. A thin-shell porcelain mold is used for forming, and the desired thickness of material is built up in a series of dips. Critical areas are brushed to control thickness and the material is jelled between coats by baking for 3 minutes at 185°C. Fiberglass reinforcement are inserted in areas subject to wear as the layers are built up, and become an integral part of the material. When the desired thickness is obtained, the jelled material on its porcelain mold is cured for 18 minutes at 185°C.

The mold is quickly cooled and the vinyl mitten peeled off like a glove. It can then be welded to the bellows sections, with the vinyl plastisol used to form the bond. A special heating ring bakes the joint area to effect a cure at 185°C for 18 minutes.

This type of socking has performed well and has been used in a number of boxes over the past year at Berkeley in a great variety of operations that range from high-level chemistry separations to the machining and welding of irradiated slugs.

Irradiation tests have indicated that the component material of the socking will not suffer radiation damage below 10⁷ r.



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Fig. 1. Hot cell box and socking assembly.

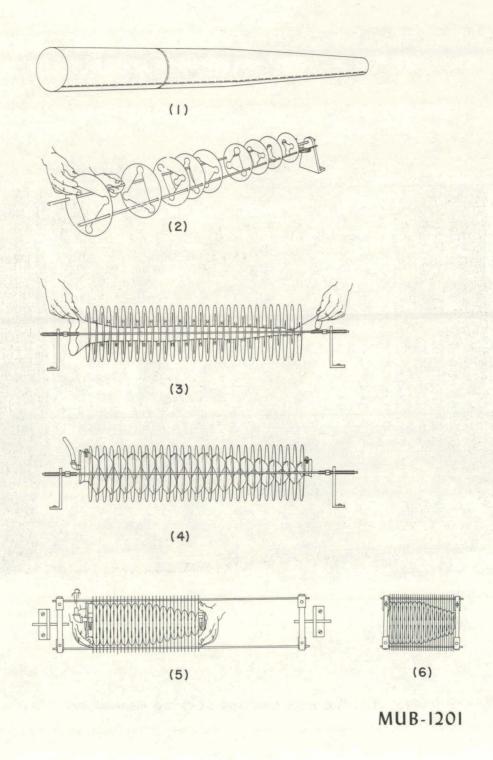


Fig. 2. Forming of the bellows section.

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