production of a wide variety of shapes and sizes. Fusible alloy selection, of course, is governed by the temperature needed to cure the plastics.

Dies and Punches

Because bismuth alloys are easy to handle, dimensionally stable and re-usable (some also melt in hot water), they are used in dies for embossing light sheet metal, dies in heavy drop hammers (some weigh 25,000 lb per set), blocks for stretch press forming, and forming blocks for bending extruded shapes, sheet metal and tubing.

In metal forming dies, points of wear are reinforced with machined steel inserts, greatly extending the utility of the inherently soft alloys.

Models and Patterns

Bismuth alloys enable a dentist to reproduce mouth structures accurately. Impressions for orthodontic study are made for the "before, during and after" phases of the work. The chief asset here is durability of the model. Patternmakers use similar techniques to construct accurate metal duplicates of wood patterns for fabricating match plates.

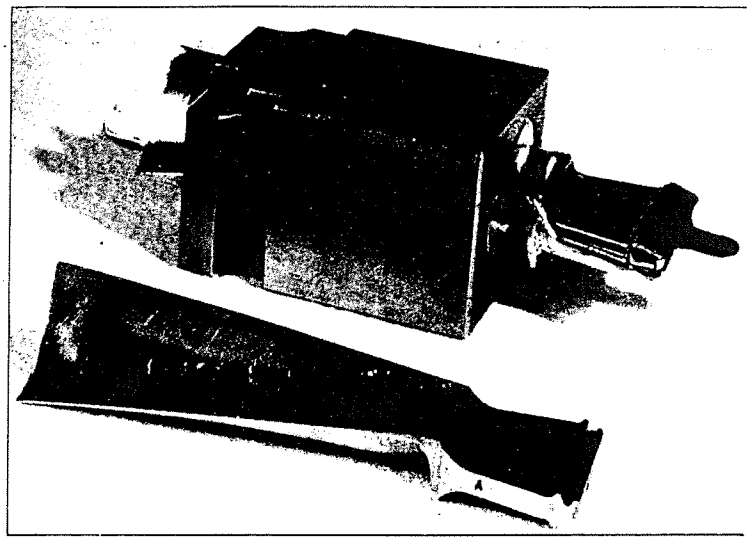
Low melting point alloys provide a rapid, economical means of making molds for various plastics. Examples: acrylic teeth for dentures, blow molds for plastic bottles, vacuum forming molds for sheet plastics, expendable molds for encapsulating electronic components, aesthetic restorations of noses and ears, and molds for fiber glass boats.

Other Uses

Over the years, Alloy 2 has been employed as a filler to support tubing during bending or twisting. When it is poured into a tube and quickly solidified, it acquires great malleability, which permits bending on the smallest radius possible for the material being worked. Hot water melts the metal away so that it can be re-used indefinitely.

In a somewhat related application, Alloy 6 in Table I is employed in forming seamless cross, Y and T-fittings from straight tubes of copper, brass and stainless steel by the Seeber Process. Tubing filled with alloy is placed in a two-piece die which snugly nests the part. Pressure is applied, forcing the tubing to extrude through a port in one half of the die. Because of the filler, tube material flows evenly so that uniform wall thicknesses result.

Certain applications call for only the low melting temperature characteristic of these alloys. While liquid, they can be used to transfer heat or pressure (or both) to quench aluminum castings, vulcanize rubber, and cure plastic coated wire (in continuous runs from the extruder). They are also applied as heat transfer mediums in autoclaves, baths of constant temperature for tempering, and liquid seals for bright annealing and nitriding furnaces.



At Bristol Siddeley Engines Ltd. in England, turbine blades are held in position for machining by a fusible alloy poured in an iron form. Machined blade is at bottom.

Aluminum alloys quench reasonably fast in Bi-Pb eutectic baths. Residual stresses and warpage are reduced, making machining easier and improving corrosion resistance and fatigue life.

In devices such as releasable plugs and links for automatic sprinklers, fire doors, compressed gas tanks and fire alarms, bismuth alloys generally join parts. They are compounded to give way at a predetermined temperature. Other thermal fuses carry electric current. They melt when the safety limit is reached, shutting down the endangered equipment.

A bismuth-tellurium alloy generates electricity by the thermoelectric principle — heating is with gas or a radioactive isotope. Such systems serve remote or inaccessible locations, such as the lighting of buoys and navigation equipment. They eliminate need for batteries and attendant maintenance requirements. In fluorescent lights, thermoelectric materials can boost output as much as 72%, also. As of now, however, material cost limits commercial use. Should thermoelectricity become economically competitive with conventional refrigeration systems, a significant market for bismuth could develop.

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