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LOCALIZED DIE FORGING OF ALUMINUM PANELS

Item of Interest

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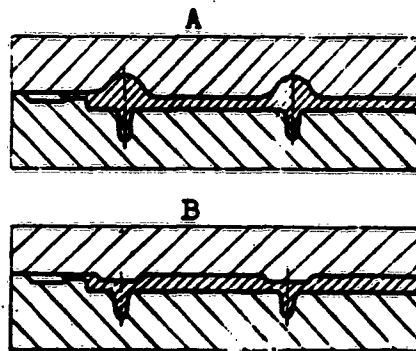
## LOCALIZED DIE FORGING OF ALUMINUM PANELS

**SOURCE:** Yevlanov, N. G., I. M. Rynskiy, and M. Ya. Kuleshov. Manufacturing of panels by a method of localized die forging. *Kuznechno-shtampovochnoye proizvodstvo*, no. 11, 1962, 1-5. (S/182/62/000/011)

A new method -- "localized die forging" -- is suggested for the manufacture of ribbed panels. In localized die forging, the entire panel is forged at one time, but unlike conventional forging, forging pressure is concentrated ("localized") in areas that are more difficult to shape than the rest of the panel. Better conditions are thus created for shaping panel sections with high thin ribs. The new method also differs from sectional die forging, in which a panel is forged in succeeding sections in order to reduce the required press capacity. (See AID Report 62-111.)

Localized forging can be performed in one or two steps, depending on panel size and shape. The same bottom die but differently shaped top dies are used for each step.

Experimental panels (part of an actual panel) with overall dimensions of 440 x 440 mm and ribs 30 mm high and 6 mm thick were forged from B95 [7075] or Al [2017] rolled plate (460 x 460 mm). The dies and blanks were heated together to the forging temperature, which was 430°C for B95 and 450°C for Al alloy. The lubricant used was a mixture of 80% oil and 20% graphite. Seven variants of localized forging were tested, all of them in two steps, with unit pressures of 20, 25, and 30 kg/mm<sup>2</sup> in both steps. Three of the seven -- the second, fifth, and seventh -- were considered optimal.



**Fig. 1.** Second variant  
A - first step; B - second step.

In the second (Fig. 1), the metal is gathered above the ribs in a fullering operation (step 1) and then forced into the rib cavities by a top die with projections directly above the cavities (step 2). The volume of metal gathered above the rib in the fullering operation equals the volume of the rib; the volume of metal forced out by the projection of the top die [volume of the projection] equals one and one-half volumes of the rib with the excess metal flowing into the flash gutter.

In the fifth variant, the first step is performed with a top die of the same shape as that used in the second. The only differences

are that the volume of metal gathered above the rib equals one and one-half volumes of the rib, and the second step is performed with a flat-top die.

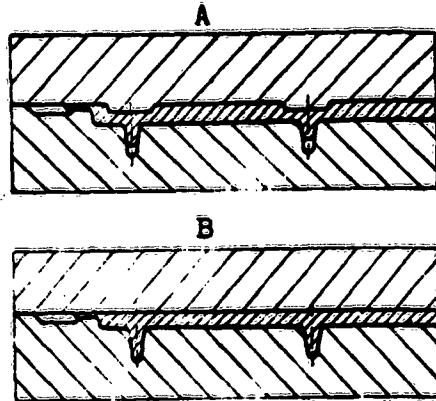


Fig. 2. Seventh variant  
A - first step; B - second step.

the die cavity with an average unit pressure of 25 kg/mm<sup>2</sup>. In conventional forging on the other hand, a unit pressure of 30 kg/mm<sup>2</sup> produces

In the seventh variant (Fig. 2), the volume of metal forced by the projection of the top die into the rib cavity and flash gutter (first step) equals one and one-half that of the rib. Final forging (second step) is performed with a flat-top die.

Fig. 3 illustrates the heights of ribs of Al alloy panels obtained with each variant tested. Column 8 represents conventional die forging using flat-top dies in both steps. As compared to conventional die forging, localized forging of panels increases by 20 to 25% the filling of the rib cavity. As seen from Fig. 3, the second and seventh variants produce panels with ribs 30 mm high and complete filling of the rib cavity with an average unit pressure of 25 kg/mm<sup>2</sup>. In conventional forging, localized forging make it possible to obtain higher ribs in one step than can be obtained in two steps by conventional forging.

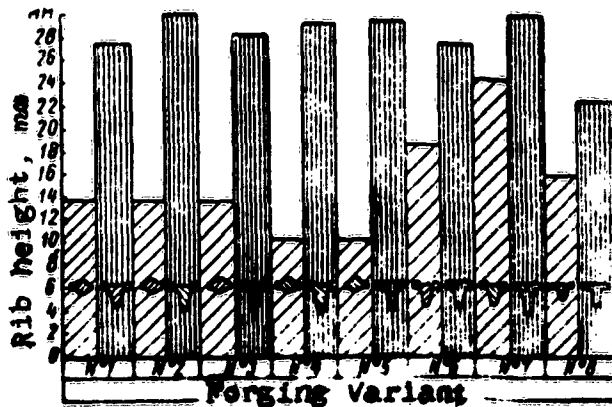


Fig. 3. Rib heights for each variant

Panels forged by the new method had clean surface finish, and their precision met specifications. The deviation in the 180-190-mm pitch between ribs did not exceed  $\pm 0.1$  mm. Fiber flow in all panels well followed their contour, and the mechanical properties along and across fiber flow were higher than those in the specifications. Technical and economic analysis showed that compared to conventional forging deformation force is 25 to 30% lower, filling of the deep cavities is 20

to 25% better, metal utilization is from 17 to 20% higher, and the cost of panels is 20 to 25% lower. This new forging technology is recommended for wide industrial use.

**COMMENT:**

The development of the localized forging method shortly after the development and successful use of sectional die forging is a clear indication that the Soviets have expended considerable effort on the development of production techniques for large integrally stiffened panels (waffle plates) in which machining is minimized and metal utilization maximized and which are applicable for military and civil aircraft manufacture.

Although the experiments discussed dealt with aluminum-alloy panels, it would be very feasible to use each of these methods to produce large integrally stiffened panels from materials other than aluminum. The methods can also be used for other parts besides panels, such as frames, pylons, and structural members that would otherwise require a large number of heavy presses.

The Soviet objective here seems to be either to expand capabilities of existing heavy presses for forging large parts in sizes and shapes beyond their normal capability or on the contrary to eliminate the need of heavy presses for many types of large parts and to release the existing presses for urgent needs of missile and space vehicle construction, where heavy presses are indispensable.