LETTER FROM LONDON

Metalworking goes fluid

Hydrostatic methods look more efficient than present means

British metallurgists are developing new ways of forming metals, ways that appear to promise substantial increases in production efficiency.

The new method—hydrostatic extrusion, forging or pressing—uses high fluid pressure to change the shape of unheated metal.

In some cases the metal is squeezed through a die by the fluid; in others, it is merely contained by the fluid while being manipulated into shape by other means.

At a recent demonstration held at the National Engineering Laboratory in Glasgow, Dr. H. L. D. Pugh showed that fine wire can be hydrostatically extruded at the rate of 11,000 feet per minute from rods of soft metal such as gold, silver and lead. This is more than twice the speed of conventional wire drawing. The extrusion ratio—the reduction in area each time the metal is passed through the die—is about 14,000 to one.

The wire is pushed through the die by fluid pressure rather than being pulled through from the far side as in conventional wire-drawing. Because of this the process is not limited by the tensile strength of the thin wire; in conventional operations the wire tends to break if too great a pull is applied.

Steel wires can be extruded already coated with a layer of lead or zinc to inhibit corrosion; this is done by hydrostatically extruding one rod within another hollow rod. Extremely brittle materials, even marble, may be extruded without cracking by placing a second fluid in the space beyond the die and extruding from a very high fluid pressure to a lower pressure. Billets of complex shape can be extruded, without the need for complicated tooling, since the pressurized fluid wholly surrounds the billet and supports it.

A notable advantage of hydrostatic extrusion over ordinary ram extrusion is that there is no friction between the billet and its container. This means that long billets can be extruded. Wire which is to be extruded to a thinner size can be kept coiled in the high-pressure chamber. It does not buckle on its way to a die because the fluid pressure is equal on all sides.

In pressing automobile bodies, the application of hydrostatic pressure also has advantages; stresses needed to shape the metal can be distributed so that they are compressive rather than tensile. This permits deeper pressings to be made in the sheet. Tubes can likewise be widened while being shortened by the hydrostatic pressure, and flanges of even thickness can be formed on tubes and bars.

Hydrostatic pressure inhibits the formation of microvoids in the deformation zone, says Dr. Pugh, and, because of this, there is less internal damage than with conventional metalworking.

The product, he says, has greater residual ductility—it can undergo more stretching. The fact that it is formed while cold also makes it stronger.

A modification of Dr. Pugh's hydrostatic wire extrusion process has already been proposed by Dr. B. Lengyel of the Imperial College of Science and Technology, London. He points out that the rod of metal that is to be extruded can be allowed to stick out of one end of the high-pressure chamber provided suitable seals can be made to prevent the fluid escaping. If this is done, wire of unlimited length can be semi-continuously extruded because rods can be joined to one another. Dr. Lengyel is at present working on the problem of seals and also on the related problem of designing for large cyclic fatigue stresses which will occur when high-strength materials (such as stainless steels and nickel alloys) are extruded. These materials will require pressure of up to 200 tons per square inch, whereas soft metals need only 80 tons.

Research on the process goes on at an experimental hydrostatic extrusion press operated by Dr. Hans Kronberger, reactor group chief scientist at the United Kingdom Atomic Energy Authority, where soft metals are extruded at high speeds through single or multiple dies. Industry experimenters can hire the press for test runs. Dr. Kronberger says industry is at present more interested in extruding the softer metals where large-cyclic fatigue stresses are not a problem.

In spite of the enthusiasm of industrialists and researchers, it will be some time before hydrostatic metalworking can be fully integrated into the production lines. Expensive wire-drawing machines and other metalworking presses already exist, and they cannot be scrapped overnight. But the technique clearly holds great promise for the future.

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