# A FABRICATOR VIEWS TITANIUM POWDER METALLURGY

By H. W. DODDS

*Vice President, Engineering Services, The Brush Laboratories Co., Cleveland 8, Ohio*

Several years ago, the Brush Laboratories Company, a division of Clevite Corporation, embarked upon a development program for the fabrication of titanium by powder metallurgy. An evaluation of the advantages and disadvantages, compared with other methods of fabrication, had to be made. Since the start of our program, numerous advances have been made in both the art of powder metallurgy, and the art of arc melting and forging titanium. However, it is our belief that many of the early advantages foreseen for powder metallurgy exist. Powder metallurgy offers a way of making uniform, fine grain structured parts which have the densities and properties of wrought and forged material. This is not only true in the commercially pure titanium, but is proving to be true in the field of the alloys of titanium.

Since titanium is still an expensive metal, the sponge costing $3.95 a pound, utilization of this raw material is a very vital factor in any method of fabrication. Powder metallurgy offers some outstanding advantages in this aspect also. A study has been made by one of the jet aircraft engine companies on a titanium bearing housing. For the simplicity of figures, let us say that this bearing housing weighed one pound. By the arc melting and forging process employed, it was found that it was necessary to have 8-10 pounds of sponge as a starting material to make this one-pound finished machined bearing housing. By the Brush Laboratories' powder metallurgy process, we have been able to produce these bearings using only 1.9 pounds of sponge to make this one pound finished machined bearing housing. By reducing the amount of initial material used, we were able to effect a substantial saving in machining time; we were thus able to realize a 20 to 25 percent saving on the end cost of the product.

The Brush Laboratories have developed two methods for the fabrication of titanium by powder metallurgy. The first method which we developed was for prototype application, wherein the end user may only want a half-dozen shaped pieces, and still does not want to go to the additional expense of tooling of forging dies or to hog it out of a billet. We call this process our hot pressing process. Essentially, a piece of graphite is machined out to the desired contour of the part which the customer wants. This is then filled with a weighed amount of powder, and a graphite plunger is placed above the powder column. This assembly is then installed in the vacuum sintering furnace, as you see in Fig. 1. After the cover is put on the furnace, it is then evacuated to a pressure of about 1 or 2 microns. When this pressure has been reached, the gas-fired normalizer or electric sintering furnace is turned on and the compact heated to a temperature of 850°-900° C. Hydraulic pressure then is applied through a packing gland in the top of the furnace,

*Fig. 1*