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NASA TECH BRIEF

Improved Retort for Cleaning Metal Powders with Hydrogen

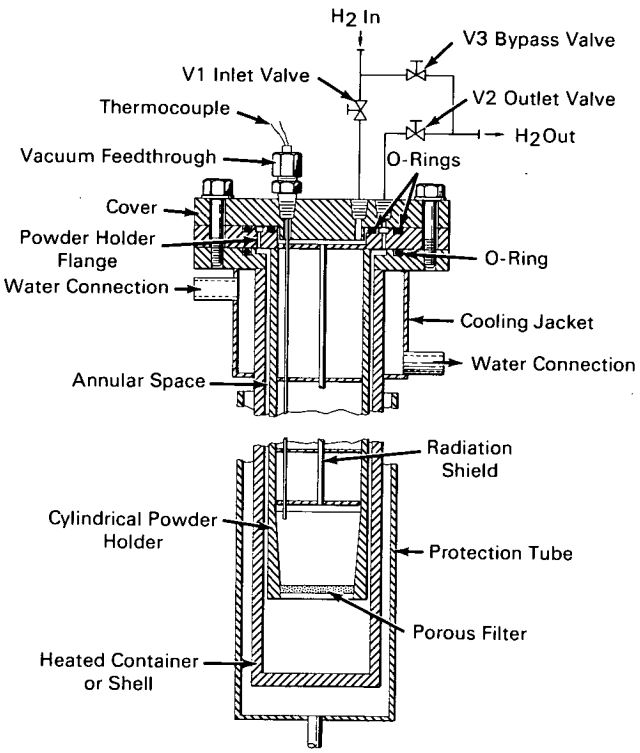

Fig. 1. Retort Assembly

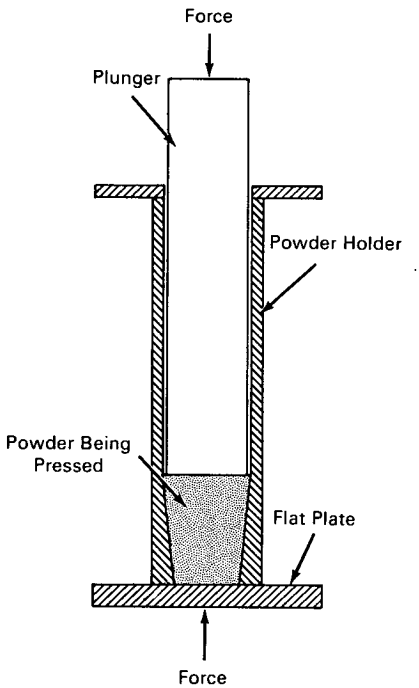

Fig. 2. Pressing Powders in Powder Holder

The problem:

Cleaning of metal powders in a heated retort with a flowing stream of hydrogen occurs by reduction of undesirable impurities such as oxides, halides, carbides, etc. In conventional hydrogen cleaning retorts temperature distribution in the heated zone is often nonuniform. Channeling of the hydrogen through the powder bed commonly results in uneven cleaning of the powder. Cleaning may be inefficient in some types of retorts since it depends on diffusion of reactant and product gases through the powder bed.

The solution:

An improved cleaning retort produces uniform temperature distribution in the heated zone and minimizes hydrogen channeling through the powder bed. Metal powders consistently have low levels of impurities after being cleaned in this retort.

How it's done:

Figure 1 shows the improved retort which consists of a heated container or shell housing a cylindrical powder holder, a radiation shield, and an optional porous filter. Other parts of the apparatus include a

(continued overleaf)

thermocouple, a vacuum feedthrough threaded into the cover and through holes in the radiation shield, three valves, three "O" rings, and a cooling jacket with water connections. Not part of the retort proper is the relatively inexpensive protection tube which is used during high temperature runs to pipe argon or other inert gas around the relatively expensive shell to protect it from oxidation.

During operation, hydrogen enters the retort through the inlet valve, flows down around and through openings in the radiation shields, through the powder bed on top of the porous filter, through the filter, up the annular space between the shell and powder holder, through holes in the powder holder flange, and exits through the outlet valve. The hot gas exhausting through the annular space preheats the incoming gas flowing down the powder holder through the radiation shield and gives a long hot zone with very uniform temperature.

Figure 2 depicts an alternate method of cleaning powders. After removal of the metal filter shown in figure 1, cold pressing of the powder occurs in the tapered section of the powder holder. A plunger applies pressure through the top of the powder holder. The tapered design of the holder and the pressure differential across the bed from top to bottom prevents channeling between the powder holder and powder bed.

Notes:

1. This improved cleaning retort can be used for reducing impurities in nonmetallic as well as metallic powders. It has also been used for reducing chromic chloride and chromous iodide to chromium metal powder and for sintering in a reducing atmosphere. It could also be used for cleaning powders in reducing atmospheres other than hydrogen (such as carbon monoxide or mixtures of methane and hydrogen); and for nitridation of powders.
2. The following documentation may be obtained from:

   The Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference: NASA TND-4912 (N69-10827), Feasibility of Producing Dispersion Strengthened Chromium by Ball-Milling in Hydrogen Halides

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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