Jan. 27, 1959 J. P. LIVINGSTON 2,870,484

SPHERICAL DIE

Filed April 6, 1955

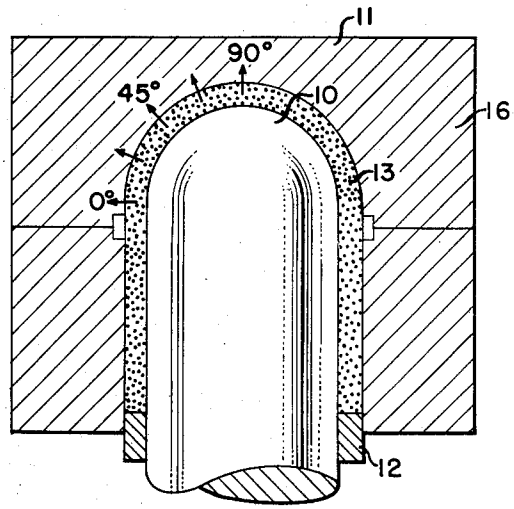


Fig. 1

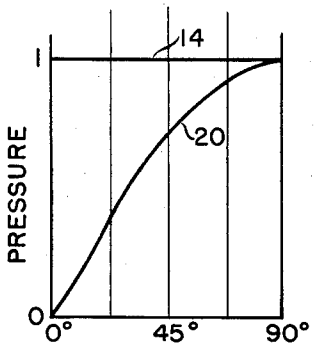


Fig. 2

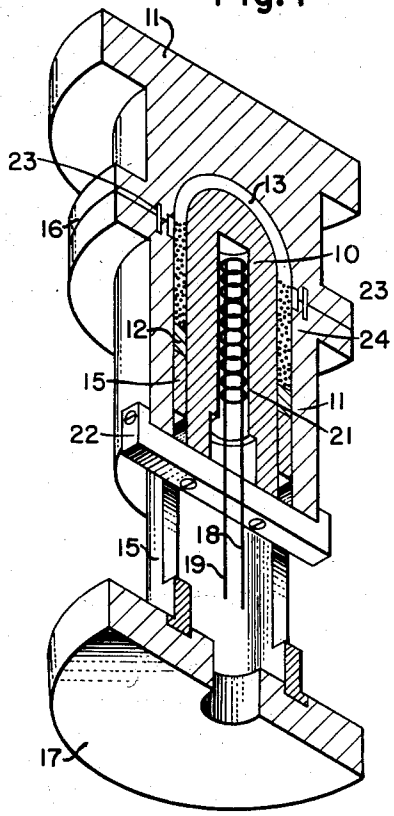


Fig. 3

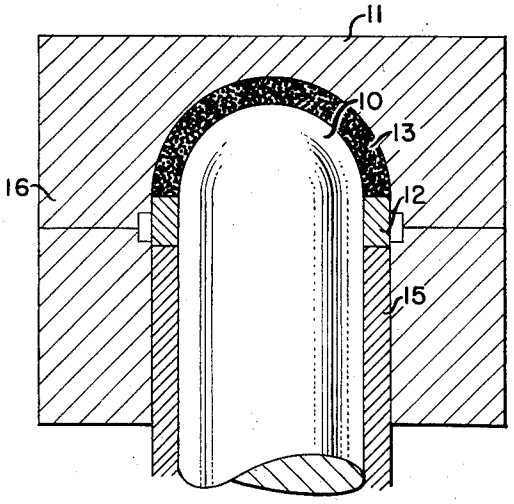


Fig. 4

INVENTOR.
JACK P. LIVINGSTON
BY
Roland A. Anderson

United States Patent Office 2,870,484 Patented Jan. 27, 1959

2,870,484

SPHERICAL DIE

Jack P. Livingston, Los Alamos, N. Mex., assignor to the United States of America as represented by the United States Atomic Energy Commission

Application April 6, 1955, Serial No. 499,771

1 Claim. (Cl. 18—34)

This invention relates to a method and apparatus for pressing powdered materials and is particularly concerned with a method and apparatus for pressing powdered materials into hollow hemispheres.

In the field of experimental nuclear and solid state physics it is often desirable to press certain materials under study into hollow hemispheres or spheres. A very important requirement in this pressed shape or compact is that the wall thickness and density be uniform and precisely known.

Previous methods used to press powdered materials such as uranium hydride into such hollow shapes as hemispherical shells have not achieved uniform density thruout the pressed shape, nor has the density desired been achieved easily and with high accuracy.

The present invention utilizes a new principle to press the powder into the die cavity without the need for relative movement between female and male die elements which leads to the desired uniform density.

An object of this invention is to provide a method and apparatus wherein either thin or thick walled hemispherical shells, hemi-elliptical shells or similar shapes may be pressed easily.

Another object of this invention is to provide a method and apparatus wherein either thin or thick walled hemispherical shells, hemi-elliptical shells or similar shapes may be pressed easily into compacts with uniform wall density.

Another object of this invention is to provide a method and apparatus wherein either thin or thick walled hemispherical shells, hemi-elliptical shells or similar shapes may be pressed easily and with predetermined wall density.

Further objects and advantages of the present invention will be apparent from the following specifications and claim which include a preferred embodiment of the present invention, and from the drawings, hereby made a part of the specification, wherein:

Figure 1 is a schematic view showing the pressing elements in the initial position.

Figure 2 is a graph comparing the final pressures in the pressed powder from prior art techniques and from the teachings of the present invention.

Figure 3 is a sectioned perspective showing some of the internal elements of the invention.

Figure 4 shows the powder in the final pressed position.

The present invention relates to dies used for hot or cold pressing of powdered metals or other powdered materials. It is particularly concerned with pressing powdered materials into hemispherical shells, hemi-ellipsoidal shells, or similar shapes.

Referring to Figure 1 of the drawing, a male forming element **10** is in a fixed position relative to a female forming element **11**, and a ring **12** is freely slidable along male forming element **10**. If the cavity **13** is partially filled with a powder, it can be seen that when the ring **12** is

forced up, the hollow spherical portion of the cavity will be filled with compacted powder, and except for small frictional losses, the pressure thruout the powder will be constant.

In the graph of Figure 2, line **14** represents the uniform pressure curve for various points in the powder as indicated in Figure 1. This curve is at a constant level or value for all points in the powder because the pressure is uniform. If the pressing were attempted by simply moving the forming element **10** upward and keeping the ring **12** stationary, the pressure curve would be as line **20**, falling off sinusoidally to zero pressure at 0°. Thus, it can be seen that the pressing apparatus of this invention leads to a uniform and accurately known density whereas other systems do not. In addition, it can be seen by reference to Figure 1 that the required density can be achieved by simply stopping the movement of the ring **12** at the proper time. Regardless of the position of the ring **12** when stopped, the wall of the pressed shape will be of proper thickness due to the unique design of the invention. The proper time to stop the ring is when a predetermined pressure has been reached. Naturally, the same result can be achieved by carefully measuring the amount of powder placed in cavity **13** and subsequently stopping the ring at a predetermined position, in which case every piece formed will be identical in physical size and density.

The preferred embodiment of this invention is shown as Figure 3. The die is supported on a base **17**. Attached to base **17** is a vertical sleeve **15** having two diametrically opposite slots in which yoke **22** is freely slidable. Yoke **22** serves to fasten female die element **11** to male die element **10** in fixed relative position and spaced a uniform distance from each other to form cavity **13**. Ring **12** is freely slidable in the cylindrical portion of cavity **13** and can be moved upward by a corresponding movement of sleeve **15**. Within male die element **10** is a heating coil **21** connected to electrical power by means of leads **18** and **19**. The female die section is separable at joint **16** to facilitate introduction of the pressing material and removal of the pressed piece. Locating pins **23** aid in reassembling the female die elements to exactly the same relative position. A metal ring **24** prevents material from being pressed into joint **16**.

In operation, female die member **11** is separated at joint **16**, and a suitable amount of powder is placed in cavity **13** above ring **12**. The die element **11** is reassembled and heated by heating element **21** if a material is being pressed that forms better at an elevated temperature. Pressure is applied to the top of element **11** and the subsequent downward movement of **11** forces sleeve **15** and ring **12** to move upward in cavity **13**, forcing the powder into the shaped region of cavity **13**. After suitable pressure has been applied, the female die element **11** is separated at **16** and the pressed shell is removed.

The section view Figure 4 shows the powder pressed to its final shape.

It is understood that the invention as described is the preferred embodiment and that certain variations will not alter the operation or results. For example, as previously indicated, the cavity and subsequent shaped piece does not have to be the shape of a hollow hemisphere but may be a hollow hemi-ellipsoid or otherwise. The material does not have to be introduced as a powder, but may be pellets or a ring shaped to fit the cavity above the ring pusher. Furthermore, instead of heating the die elements, it is understood that they could be cooled by suitable means if desirable for the pressing operation. The female die element **11** could have a

compression spring between it and base 17 so that the element 11 would always be in a raised position except when under pressure. Other appropriate changes are also understood.

What is claimed is:

A die for pressing powdered materials into a hemispherical shape of uniform density and wall thickness comprising in combination a female die element, a male die element and a pressing ring, said female die element and said male die element held in stationary spaced relation, said space defined by said male and female elements being equivalent to said wall thickness and defining said hemispherical shape, said pressing ring linearly movable along said male die element, means for filling said space with said powdered materials, means for moving said pressing ring along said male die element whereby said powdered material is pressed into said hemispherical shape, and means for heating said male element whereby said powdered materials may be heated while simultaneously being pressed.

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