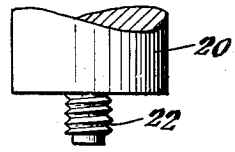
May 14, 1957 C. R. TALMAGE 2,791,804

METHOD AND APPARATUS FOR FORMING POWDER METAL PARTS HAVING UNDERCUTS OR THE LIKE

Filed Jan. 7, 1953

Fig. 1



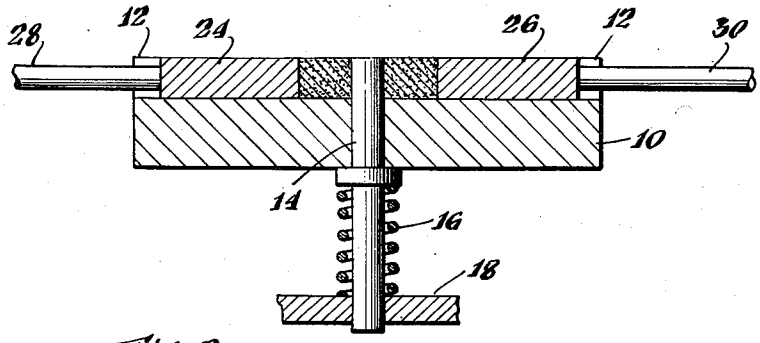


Fig. 2

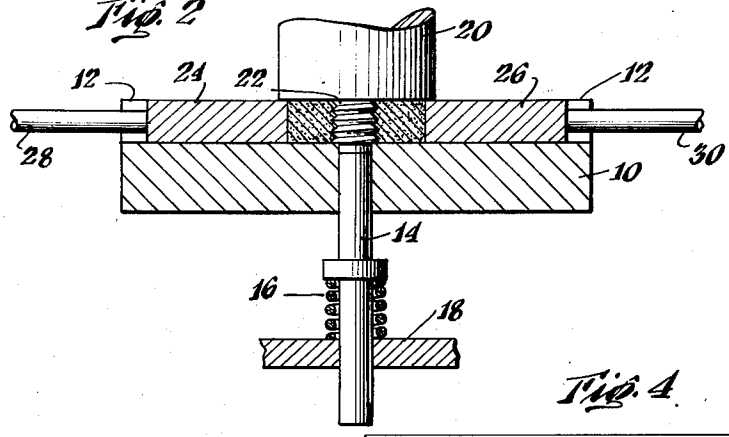


Fig. 4

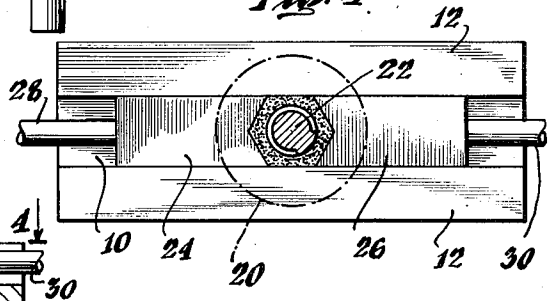
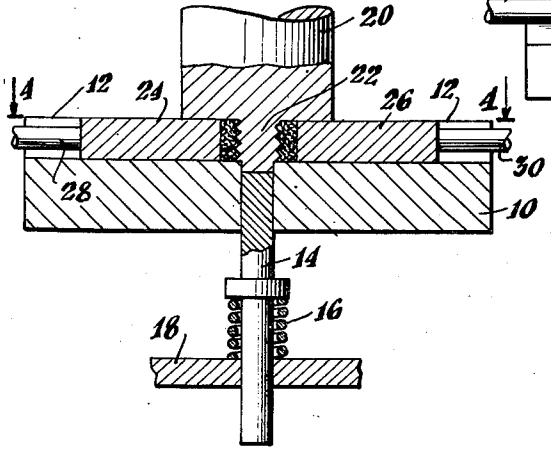


Fig. 3



INVENTOR.
Charles Robert Talmage
BY
Eyre, Mann & Burrus
ATTORNEYS

United States Patent Office 2,791,804
Patented May 14, 1957

2,791,804

METHOD AND APPARATUS FOR FORMING POWDER METAL PARTS HAVING UNDERCUTS OR THE LIKE

Charles Robert Talmage, New Canaan, Conn.

Application January 7, 1953, Serial No. 329,984

5 Claims. (Cl. 18—16.5)

Many types of metal parts are now formed by so-called powder metallurgy. In that art the metal powder is poured into a mold or die and then is subjected to heavy pressure to shape it, after which it is sintered. In some instances it is subsequently subjected to a second pressing or coining operation. One of the limitations to this usual type of process is that the part must be so shaped that it will draw in the direction of the line of filling of the mold, that is, in the direction of the movement of the compression plunger. Also distribution of powder is limited by the fact that the fill is in the direction of pressure.

I have discovered that these difficulties can be overcome if simultaneously with the movement of the plunger which moves in the direction of filling the mold, or subsequent to the time when such plunger has reached its ultimate position, additional plunger movements take place to compress the powdered metal in a direction at an angle to the line of filling. The important requirements of my invention are that a plunger or die member must move substantially in the direction of the line of filling the mold and this plunger must reach its ultimate position relative to the mass prior to the time when the plunger moving at an angle thereto undergoes its final compressive movement. In such case the plunger moving in the direction of filling will in substance serve as a fixed mold wall, and the final compressive force will principally be exerted in a direction at an angle to the movement of such plunger.

This invention can readily be understood from the example illustrated in the accompanying drawing in which:

Fig. 1 is a sectional view showing the position of the die parts just after the powder has been put into the mold.

Fig. 2 is a similar view showing the position of the parts after the plunger which moves in the direction of filling has reached its ultimate position.

Fig. 3 is a similar view showing the position of the parts after the final compression has been accomplished.

Fig. 4 is a sectional view on line 4—4 of Fig. 3.

In these drawings for purposes of illustration I show a die for forming hexagonal nuts which are internally threaded. In this drawing **10** designates the lower die which is stationary. Attached to the die **10** (or integral with it) are die sides **12**. **14** is a core pin, which as shown in Fig. 1, is held up by spring **16** during the time when the mold is being filled with powder. **18** is a core pin retainer.

The upper plunger or punch member which moves in the direction of filling of the die is designated by the numeral **20**. In the example shown this member **20** has a downwardly extending projection **22** which is externally threaded. Two horizontally movable die or plunger members **24** and **26** are adapted to move at substantially right angles to the line of movement of the upper punch member **20**.

As shown in Fig. 1, when the die is to be filled with

powder, the upper punch **20** is raised and horizontally movable plunger members **24** and **26** are moved back a short distance to give a cavity opening of proper size relative to the finished part. The core pin **14** is held up by the spring **16**. Iron powder is then filled into the die at the top, and the upper punch is brought down to the position shown in Fig. 2 where its sides overlie the side members **12**, as shown in dot and dash lines in Fig. 4. The movement of the upper punch **20** pushes down on core pin **14** so that its position in the center of the powder is replaced by the projection **22**.

With the parts held firmly in this position, heavy pressure is exerted on the horizontally movable plunger members **24** and **26** as by the bars **28** and **30** which are activated through any desired mechanical medium. These members **24** and **26** compress the powdered metal around the projection **22** so that the powder will be shaped into the form of a hexagonal nut with internal threads. It is to be noted that the members **24** and **26** do not contact each other but even when they are in their final position, there is a substantial space between them. This is advisable in order that sufficient compression strains be exerted on the central part of the member. At the same time, the fact that these members **24** and **26** approach each other more closely at the sides than at the center is of some assistance (though not always essential), in that an increased pressure is exerted towards the sides of the nut which tends to compress the powder sufficiently into the threads even at a line at right angles to the line of pressure exerted on the members **24** and **26**.

After sufficient pressure has been applied to produce the desired properties in the shaped piece, as is understood by those having knowledge of the art of powder metallurgy, the pressure on the members **24** and **26** is relaxed. The upper punch **20** is then raised carrying with it the compacted nut. When the upper punch is moved up sufficiently so that the compacted nut is free of the side bars **12**, this nut can be screwed off of the projection **22**, as for example by the use of a rubber wheel which is power driven or in any other desired manner. The cycle can then be repeated.

Upon examination, it will be found that the nut thus formed will be compacted to a sufficiently high degree of uniformity so that when finally sintered, a piece of good strength will be obtained.

While ordinarily it will be desirable to bring the punch member **20** into its predetermined position resting on the side members **12** before plunger members **24** and **26** start their inward movement, such timing is not absolutely necessary and the side members **24** and **26** may start to move in while punch member **20** is still moving. However, punch member **20** should reach its predetermined final position before the final compressive movement of the plungers **24** and **26** is completed.

While the specific means for moving the various parts have not been illustrated in the drawing, various mechanical methods of operating such devices are so well known that such illustration is unnecessary.

It is understood that the example given is intended only to be an illustrative example of the machinery and process forming the basis of my invention, for it is obvious that my invention may be used for making parts of many different shapes and forms such as parts having various types of cores and undercuts and parts of twisted shape.

What I claim is:

1. In a die for forming a threaded nut from metal powder, the combination of fixed members forming a portion of the die whose cavity is formed by bottom and side walls presenting continuous powder retaining surfaces terminating in an open top, a punch carrying an externally threaded projection adapted to be raised to

permit the filling of the die through the open top and then to be moved down to a predetermined position to establish a dimension of the part in the direction of filling, means whereby such punch can be moved into position without substantially compacting the powder and laterally movable die members adapted to move after the punch has reached such predetermined position to compress the powder in a direction transverse the line of movement of said punch whereby the part is given its desired shape by such transverse pressure.

2. In a die for forming a threaded nut from metal powder, the combination of a die cavity having bottom and side wall members presenting continuous powder retaining surfaces which terminate in an open top through which the die cavity is filled, an externally threaded core movable into and out of the die cavity along an axis substantially parallel to the side wall surfaces, means movable in the direction of filling to close said top while the powder remains substantially uncompacted within the cavity and to provide a surface against which the top of the compacted part will be formed, and laterally movable die members adapted to move substantially after closure of the top to compress the powder in a direction transverse to the line of movement of said punch so that the nut is given its desired shape by such transverse pressure.

3. The method of forming a powder metal part in the form of an internally threaded nut which comprises putting metal powder in a die cavity having bottom and side wall members presenting continuous powder retaining surfaces which terminate in an open top; moving into the mass of powder, substantially in the line of filling but without substantially compressing such powder, a die member adapted to close said top to form one face of the nut and carrying an externally threaded projection which is the positive of the hole to be formed in the nut, and with such die member in place to define the thickness of the nut and with the threaded projection within the die cavity, compressing the powder in a direction transverse the line of filling whereby the powder is compacted around said threaded projection to give it the desired shape.

4. In a die for forming a threaded nut from metal powder, the combination of a die cavity having bottom and side wall members presenting continuous powder retaining surfaces which terminate in an open top through which the die cavity is filled, means movable in the direction of filling to close said top, an externally threaded core movable into and out of the die cavity through the top thereof along an axis in the direction of filling, a core extending into said cavity through the bottom thereof and in substantial alignment with said threaded core and adapted to have movement out of the die cavity upon entry of the threaded core therein, said bottom core and threaded core having substantially the same volumetric displacement when within the cavity whereby the threaded core replaces the space occupied by the bottom core during movement of the latter out of the die cavity thereby allowing powder metal within the die cavity to be substantially uncompressed during movement of the threaded core into the die cavity, and means for laterally compressing the powder material around the threaded core to form the nut.

5. The combination set forth in claim 4 further characterized in that the threaded core engages the end of the bottom core to push the latter out of the die cavity during entry of the undercut core therein.

References Cited in the file of this patent

UNITED STATES PATENTS

400,415	Summers et al.	Mar. 26, 1889
760,446	Graham	May 24, 1904
1,386,003	Kempton	Aug. 2, 1921
1,396,779	Post et al.	Nov. 15, 1921
2,152,738	Jeffry	Apr. 4, 1938
2,326,381	Milligan et al.	Aug. 10, 1943
2,350,971	Pecker et al.	June 6, 1944
2,449,407	Mulholland	Sept. 14, 1948
2,499,530	Scott	Mar. 7, 1950