United States Patent [19]

Martinet

[11] **3,782,159**

[45] **Jan. 1, 1974**

[54] ISOSTATIC WORKING PROCESS

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[73] Assignees: **Regie Nationale Des Usines Renault,** Billancourt; **Automobiles Peugot,** Paris, France

[22] Filed: **June 16, 1972**

[21] Appl. No.: **263,612**

[30] **Foreign Application Priority Data**

June 17, 1971 France 7122098

[52] **U.S. Cl.** **72/60,** 72/358, 29/423

[51] **Int. Cl.** **B22d 22/12**

[58] **Field of Search** 29/423, 424, 527.2, 29/527.6; 72/352, 358, 360, 258, 267, 57, 60

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Primary Examiner—Richard J. Herbst
Attorney—Richard K. Stevens et al.

[57] **ABSTRACT**

The invention relates to a process for the working of pieces of metal by high-pressure isostatic die-stamping.

After insertion of the ingot 1 covered with plastic material 2 into the pressure chamber 3 whose walls are constituted by collars 4 and 5 and the floor by the bottom die 6 mounted on the base 7 of the press, the top die 8 is lowered as indicated in FIG. 2, its surface 9 containing the upper shaping impression.

During its re-ascent, the top die 8 takes with it the covering 2 and the article 1, which remains adhering to the top die owing to the fact that its die-stamping seam tightly overlaps the residue of covering material 2 in the clearance 11 between the dies 9 and 6.

7 Claims, 5 Drawing Figures

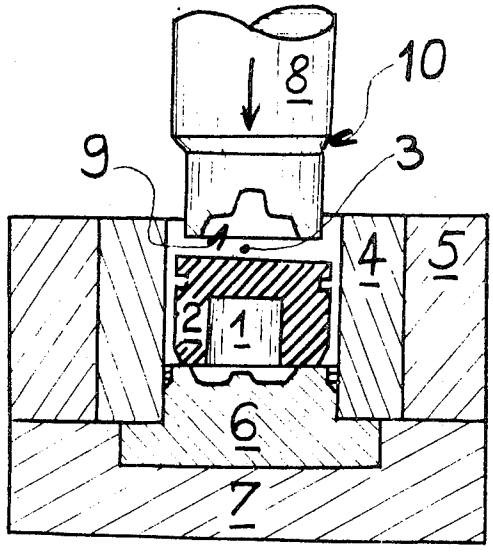


Fig. 1

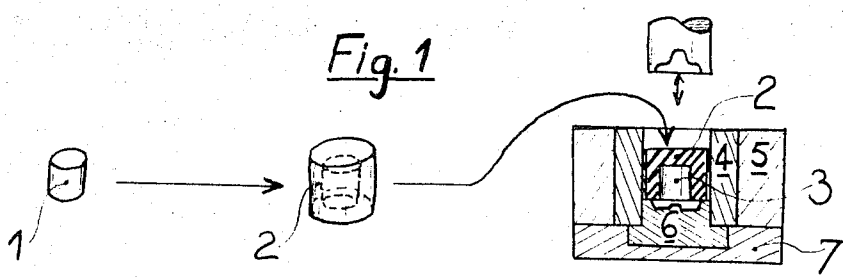


Fig. 2

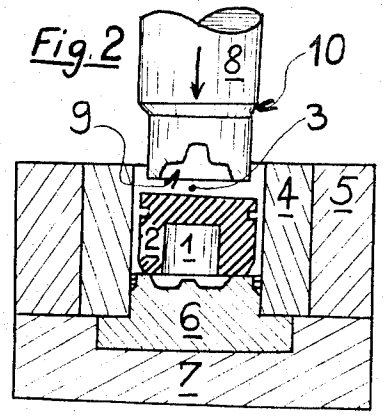
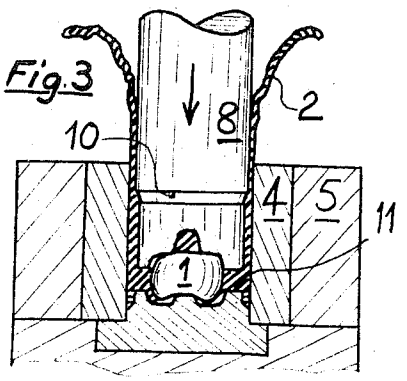


Fig. 3



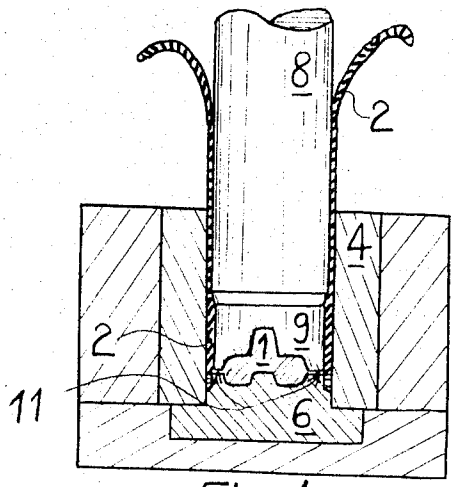


Fig. 4

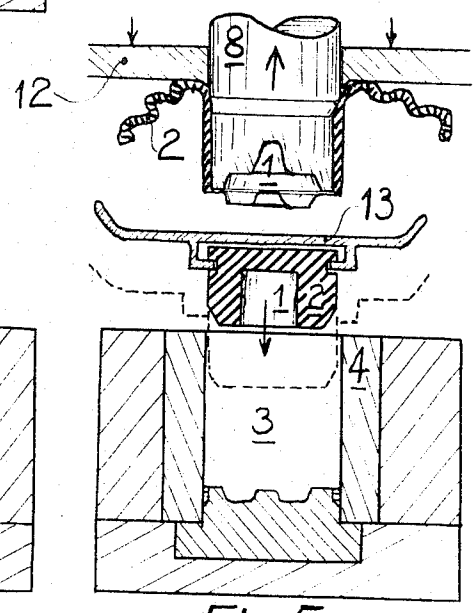


Fig. 5

ISOSTATIC WORKING PROCESS

The present invention relates to a process for the working of pieces of metal by high-pressure isostatic die-stamping.

It is known that if materials are subjected to high isostatic pressure during working, their mechanical properties and in particular their ductility and their plasticity are improved.

This technique has been put into practice in processes such as hydrostatic extrusion and hydrostatic working, in which the workpieces are shaped in an enclosure filled with a non-compressible fluid subjected to high pressure.

In hydrostatic extrusion, the pressure of the fluid itself ensures the advance and ejection of the workpiece through the die.

In hydrostatic working, the compression of the workpiece between its two dies ensures the shaping thereof in the traditional way. The enclosure of high-pressure liquid containing the workpiece and the dies compensates its reduction in volume at the time of closing of the two dies on to the workpiece by ejecting its excess liquid through an escape-channel system provided with a valve ensuring the control of the rate of escape and thus of the resultant hydrostatic pressure.

Two major disadvantages hinder the development of this technique :

The maximum pressure is limited by the strength of the joints of the high-pressure chamber, in particular the joints between the moving die or stamper and the chamber walls. In order to withstand the high pressures, this chamber is generally cylindrical and surrounded by collars. The circular joints are mounted on the top die. Their efficiency is very short-lived, often limited to one operation under the effect of the high pressures involved, as a result of the flow and disintegration of the materials of the joints.

The liquid enclosure method is not well suited to the rapid changes and the cycles of production in industry.

The process which is the subject-matter of the present invention overcomes these two disadvantages at once while offering a simplification of the means for putting it into effect.

It consists of :

a. pre-covering the workpiece-blank in a material of appropriate plasticity, forming in the ambient conditions a body whose dimensions are slightly smaller than those of a compression chamber ;

b. introducing the workpiece into said compression chamber, the bottom of which is constituted by the moulding impression of the bottom die, and closing the compression chamber over the workpiece by lowering a stamper or top die into the compression chamber, the surface of said top die forming the moulding impression for the workpiece ;

c. removal, during the descent travel of the top die and the shaping of the workpiece between the two impressions, of the excess covering material by extrusion thereof between the walls of the top die and of the compression chamber, the clearance between top die and chamber and the plasticity of the covering material being such that the extrusion pressure corresponds to the desired isostatic pressure for shaping of the workpiece ;

d. releasing and removing workpiece and covering from the top die and from the removal chamber and inserting a new pre-covered workpiece into the compression chamber.

It can be seen that this process is compatible with the production cycles of traditional die-stamping, the pre-covering of the workpieces and the final separation of the articles obtained and of their residual covering material being carried out in independent operations.

The absence of liquid eliminates the problems of sealing, the sole static joint between the bottom die and the compression chamber not posing problems of retention. There is no longer a joint between top die and compression chamber as in the known devices.

By regulating the clearance of the top die in the pressure chamber and by regulating the plasticity of the covering material, it is possible to control precisely the desired isostatic pressure. This may also be varied in accordance with a given program by varying the cross-section of the top die and thus the extrusion pressure in accordance with the penetration of the top die.

In particular, this possibility enables one to increase the isostatic pressure according to the amount of deformation of the workpiece during working. There are thus reduced the concentrations of pressure on the workpiece and the corresponding zones of cold-working. There likewise result a better control and an economy of power used. The apparatus used remains very simple and reliable.

The removal of the article produced and of its extruded covering is effected by the mere return of the top die, to which the working pressure makes them adhere and from which they are then detached by a retaining comb, the top die continuing its ascent travel. Tapers on the top die and on the walls of the compression chamber may be provided in order to facilitate these successive stripping operations.

An example of the production of an article in accordance with the process of the invention may be found in the description and in the attached drawings, in which :

FIG. 1 illustrates diagrammatically the stages of covering the workpiece and inserting it into the pressure chamber of the press ;

FIG. 2 illustrates the entry of the top die, closing the pressure chamber ;

FIG. 3 illustrates the beginning of deformation of a workpiece and the simultaneous extrusion of the covering material ;

FIG. 4 illustrates the top die at the end of its descent travel, the working of the piece being complete ;

FIG. 5 illustrates the stripping of the covering and of the workpiece by return of the top die through a removal plate, and also the insertion of a new covered workpiece into the pressure chamber, this being brought into position by the removal tray of the previous workpiece.

In FIG. 1 there is illustrated a traditional workpiece 1, which is covered by a plastic material 2 so as to form a generally cylindrical ingot of slightly smaller diameter than the compression chamber 3 which is to accommodate it.

This covering is produced by casting, injection under pressure, compacting, or any other appropriate technique according to the nature of the material chosen, which may be a plastic synthetic resin or a wax, possibly containing an additive permitting regulation of its plasticity, or a low melting-point alloy for example of the group containing tin, lead and bismuth. Among the

latter, the alloy known by the name of gerrobend, which melts at a temperature in the order of 70° C, is particularly suitable.

This low melting temperature simplifies the covering of the workpieces and also the removal and recovery of this covering after the working. Its high cost price is compensated by its total recovery and its recycling by melting and re-use after extrusion.

The covered ingot may have details of shape such as bevels, grooves, etc. . . , intended to facilitate the handling and insertion of the ingots.

After insertion of the ingot **1** covered with plastic material **2**, into the pressure chamber **3** whose walls are constituted by collars **4** and **5** and the floor by the bottom die **6** mounted on the base **7** of the press, the top die **8** is lowered as indicated in FIG. **2**, its surface **9** containing the upper shaping impression.

The top die **8** may contain variations of cross-section **10** which cause corresponding reductions in the cross-section of extruded covering material when they engage in the pressure chamber **3**, and a correlative increase in its pressure. For this purpose there may likewise be provided on the top die grooves of decreasing cross-section and depth, or any other similar shape compatible with the latter requirements of stripping of the extruded product.

FIG. **3** shows the workpiece **1** at the commencement of its deformation, while the covering material **2** emerges by extrusion between the top die **8** and the collar **4**, through the clearance **11** provided for this purpose.

In order to ensure satisfactory guidance of the top die in the collar **4**, local interruptions of this clearance may be provided in the form of longitudinal corrugations on the top die. The reliefs thus formed favour not only the adherence of the covering material to the surface of the top die during the ascent thereof but also the subsequent removal of the extruded covering material from the surface of said top die, the centring ribs thus forming zones of cutting into longitudinal strips of the extruded material. This removal is likewise made easier by the increases in cross-section **10** of the top die **8**, which act in a similar fashion to the clearing curve of the shavings-chipper of a cutting tool in order to separate the strips extruded from the top die during the progression of the penetration thereof.

In FIG. **4** the top die **8** has reached the end of its travel and the deformation of the workpiece **1** is complete. The greater part of the covering material has been extruded or else occupies the clearances **11** provided between the top die **8** and the collar **4**.

The top die **8** now commences its ascent travel, taking with it the covering **2** and the workpiece **1** which remains adhering to the top die, owing to the fact that its die-stamping seam tightly overlaps the remainder of the covering material **2** in the clearance **11** between the dies **9** and **6**.

It is of course possible, without going beyond the scope of the invention, to carry out separately the withdrawal of the top die and the subsequent ejection of the workpiece and covering by means of ejectors. These technical choices depend on the equipment available and the articles to be produced.

FIG. **5** shows the top die **8** continuing its movement of withdrawal past a separation plate **12** forming a retention comb for the extruded covering material **2**, until it is separated from the end of the top die **8**, taking with it the workpiece **1** on to a removal tray **13** which has been positioned below the top die **8** at the time of the withdrawal thereof. This tray **13** may hold in its lower part the next covered ingot **1, 2**, which has been brought into the insertion position over the collar **4**. A lowering of the tray **13** engages the ingot into the compression chamber **3**. Removal of the tray **13** with the previous workpiece then releases the covered ingot, which drops to the bottom of the pressure chamber **3**. The working cycle described above may then recommence.

I claim:

1. A process for isostatic pressure molding of deformable materials in a compression chamber having first and second relatively movable stamping dies, comprising the steps of: covering a workpiece-blank with a plastic material to form an

ingot having dimensions which are smaller than the corresponding dimensions of said compression chamber, said plastic covering material being selected to have a plasticity which, in combination with the clearance between said first die and said chamber, produces an extrusion pressure corresponding to the desired isostatic pressure for shaping said workpiece-blank;

introducing said ingot into said chamber and covering said chamber to sandwich said ingot between said first and second stamping dies in said chamber;

driving one of said dies toward the other die to exert pressure on said ingot to remove said plastic covering material from said workpiece-blank and to deform said workpiece-blank;

extruding said plastic covering material outwardly of said chamber between the walls of said first die and said compression chamber; and

removing the stamped workpiece and extruded covering material from said chamber.

2. A process as claimed in claim **1**, in which the extrusion cross-section between said first die and said compression chamber is varied in order to vary correlatively the isostatic pressure in the compression chamber.

3. A process as claimed in claim **1**, in which the first die is provided with variations of cross-section, decreasing towards its end.

4. A process as claimed in claim **1**, in which the first die is provided with longitudinal ribs ensuring its centering without play in the compression chamber.

5. A process as claimed in claim **1**, in which the stamped workpiece and the extruded covering material remain adhering to the first die during the withdrawal thereof.

6. A process as claimed in claim **5**, in which a removal plate ensures the separation from the first die of the extruded covering material and of the stamped workpiece, said material and said workpiece being collected by said removal tray.

7. A process as claimed in claim **6**, in which said removal tray ensures simultaneously the delivery of the next pre-covered workpiece and its insertion into the compression chamber.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,782,159 Dated January 1, 1974

Inventor(s) Charles MARTINET

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, the correct name of the second assignee is:

-- AUTOMOBILES PEUGEOT --

Signed and sealed this 3rd day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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