

July 7, 1959

J. SEJOURNET ET AL
METHOD OF EXTRUDING METALS

2,893,554

Filed Nov. 7, 1952

2 Sheets-Sheet 1

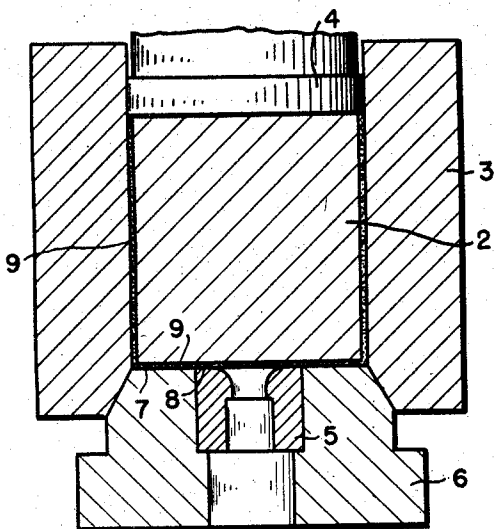


Fig. 1

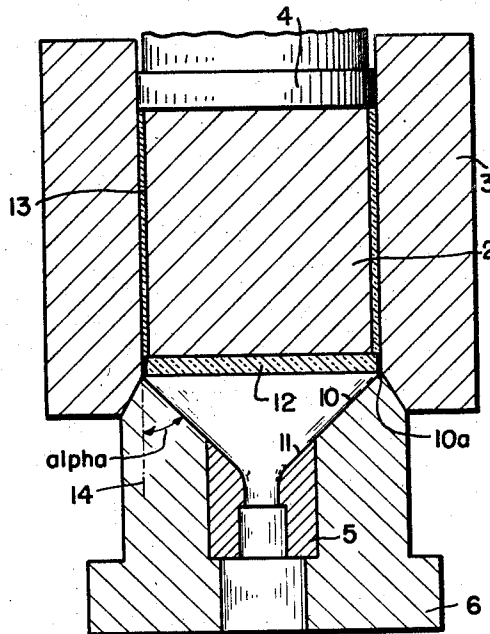


Fig. 2

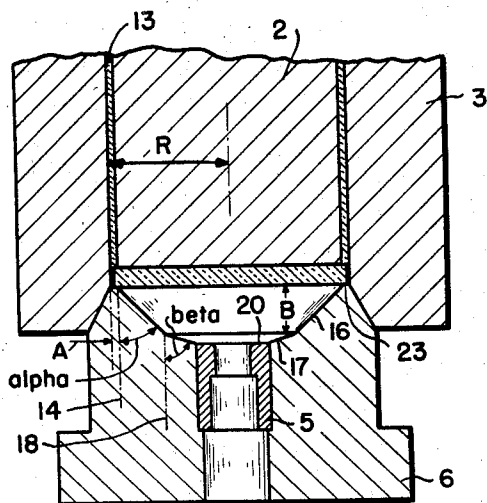


Fig. 3

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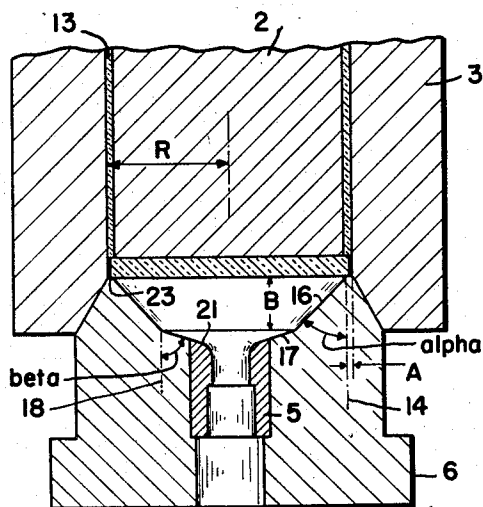


Fig. 4

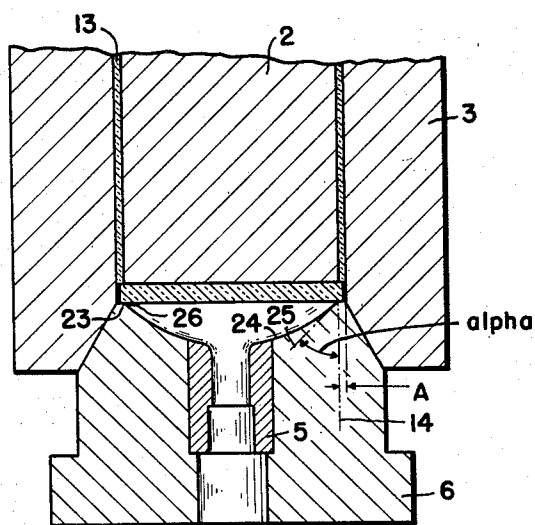


Fig. 5

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METHOD OF EXTRUDING METALS

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Application November 7, 1952, Serial No. 319,348

Claims priority, application France November 10, 1944

2 Claims. (Cl. 207—10)

This invention relates to a method of extruding a heated metal billet from a container through a die located at one end of the container, and constitutes an improvement over the method disclosed in Sejournet et al. Patent 2,538,917, granted January 23, 1951.

The present application is a continuation-in-part of our copending application Serial No. 598,516, filed June 9, 1945; now abandoned.

In the accompanying drawings which illustrate several embodiments of our invention, as well as a known method of extrusion—

Figure 1 is a longitudinal section through a container of a press and through the die and die carrier forming the bottom part of the container and showing the billet in the container before extrusion. Figure 1 illustrates a known method; and

Figures 2–5 are similar views, illustrating embodiments of the present invention, parts being broken away.

Referring more particularly to the accompanying drawings, there is shown in Figure 1 a known method of extruding a heated metal billet from a container through a die. A billet 2, such for example as a steel billet, is heated and placed in a container 3 and forced by a plunger 4 through a die 5 supported in a die carrier 6. The surface 7 of the die carrier and the surface 8 of the die are flat. In carrying out this method, it has been customary to lubricate the die and die carrier and container with a lubricant such as grease or a mixture of grease and graphite or grease and soapstone as indicated by reference numeral 9. The results obtained by following this procedure have not been satisfactory, particularly where the metal to be extruded is steel, or other metal or alloy having a high melting point. These difficulties are overcome according to the present invention.

We provide the container with a concave bottom formed of a die carrier having a downwardly sloping surface and a die located at the lowest part of the concave bottom. We place a layer of glass-like lubricating material on the concave bottom of the container prior to extrusion. The billet is then heated to extrusion temperature in a bath of molten salt capable of sticking to the billet, after which the billet is removed from the salt bath and placed in the container, and then is extruded through the die.

Referring to Figure 2 which illustrates one embodiment of our invention, the die carrier 6 has a single flat downwardly sloping surface 10, and the die has a flat downwardly sloping surface 11. A layer 12 of glass-like lubricating material is placed between the end of the billet and the concave bottom of the container prior to extrusion. By "glass-like lubricating material" as used in the description and claims, we mean a material which is incombustible but is fusible at the extrusion temperature and which has a wide melting range as contrasted with a true melting point. Suitable glass-like lubricating materials are glass, slags, and a limited number of salts having wide melting ranges. Glass may be employed in the form of plates of ordinary window glass or in the form of glass wool or cellular glass. Suitable types of

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glass-like lubricating material are described more fully in the Sejournet et al. patent above mentioned.

Before extrusion, the billet 2 is heated to extrusion temperature in a molten salt bath which may be a single salt or a mixture of salts capable of acting as a lubricant between the billet and the container. Barium chloride or a mixture of barium chloride and sodium chloride, for instance a mixture of 90% barium chloride and 10% sodium chloride, are suitable. In the various figures, the layer of salt which adheres to the billet 2 when the latter is removed from the salt bath is indicated by the reference numeral 13.

The downwardly sloping surface 10 of the die carrier 6 should make an angle alpha with the line 14 which extends parallel to the axis of the container which is between 30 and 60°.

Referring to Figure 3, the downwardly sloping surface of the die carrier 6 is made up of two flat portions, the portion 16 lying adjacent to the container 3, and the portion 17 lying adjacent to the die 5. The angle alpha between the portion 16 and the line 14 is between 30 and 60°, and the angle beta between the portion 17 and the vertical line 18 is greater than 60°. The die 5 has a flat top surface 20. The vertical height B between the top and bottom of the portion 16 should be between 1/4 and 1/2 of the radius R of the container 3. Preferably, the height B should be approximately 1/5 of R.

The embodiment shown in Figure 4 is substantially the same as that shown in Figure 3, except that the die 5 has a sloping flat surface 21 instead of the horizontal flat surface 20 shown in Figure 3.

In Figure 2, the sloping surface 10 of the die carrier extends to a point 10a substantially in line with the wall of the container 3, whereas in Figures 3 and 4, the surfaces 16 terminate at a point spaced slightly from the wall of the container to form a shoulder 23 having a width A. This shoulder may be flat or rounded. If a shoulder is used, its width should not be greater than 5 mm.

In Figure 5, the die carrier 6 has a curved surface 24 instead of a flat surface or surfaces. In the case of a curved surface, the angle alpha is the angle between the vertical line 14 and a line 25 drawn tangent to the curve 24 at its point of origin 26. The angle alpha, as in the case of the other embodiments, should be between 30 and 60°.

From what has been said above, it is evident that the present method includes the three features:

(1) The container 3 has a concave bottom formed by the die holder and die;

(2) A layer 12 of glass-like lubricating material is interposed between the billet and the die prior to extrusion; and

(3) The billet is heated in a molten salt bath to provide the layer 13 between the billet and the container prior to the extrusion operation.

The advantage of employing all of these features in combination is shown by the following tests. The equipment used for the tests had the following characteristics.

Horizontal extrusion press:

Strength of press	1,500 metric tons.
Diameter of container	190 mm.
Diameter of billets	180 mm.
Length of billets	400 mm.
Nature of steel	Open-hearth (C=0.08).
Preheating temperature of container	220° C.
Temperature of billet	1190° C.
Diameter of extruded bar	23 mm.
Speed of extrusion plunger	120 mm./sec.

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First test.—In this test, a flat die-carrier was used. A plate of standard window glass 3.5 mm. thick and 186 mm. diameter was placed upon the die. The billet was heated for 95 minutes in a gas atmosphere furnace at 870° C. It was then carried to and immersed in an electrically heated salt bath of pure barium chloride, this bath being at a temperature of 1210° C. The billet was withdrawn from the molten salt bath and placed in the container of the press and a bar was extruded. In carrying the billet from the molten salt bath to the container of the press, the billet cooled about 20°.

The extruded bars thus obtained showed great surface defects called "double skin;" these defects appearing within about 5 meters of the part of the bar which was first extruded.

Second test.—In this test, a concave die-carrier was used. A glass plate of the same dimensions and composition as was used in the first test was placed upon the die. The billet was heated in a reducing atmosphere furnace to a temperature of about 1230° C. It was carried from the furnace and placed in the container of the extrusion press, and a bar was extruded. In carrying out this test, the heating of the billet was obtained entirely by heating in the furnace, the billet not being immersed in a molten salt bath. Although precautions were taken, the billet showed some superficial layers of scale when it was introduced into the extrusion press. Due to the absence of any salt coating on the billet, the extruding operation required a pressure approximately 20% greater than that which was required in the first test. The die was scratched while the first meter of the bar was passing through it, and this caused deep scratches in the extruded bar, making it practically unserviceable. The extruded bar showed hollow longitudinal scratches about 0.5 mm. deep, and ridges which at certain points were 3 mm. high. The die could not be used a second time.

Third test.—In this test, a concave die-carrier was used, but no glass plate or other equivalent material was placed on the die. The billet was heated under the identical conditions as used in the first test and included preheating in a gas atmosphere furnace at 870° C., and a final heating in the salt bath at a temperature of 1210° C. Due to the absence of glass plate between the die and the billet, the extrusion pressure required was about 20% greater than that which was required in the first test.

The extruded bar showed hollow scratches and raised ridges, the scratches being about 0.5 mm. deep and the ridges about 1.5 mm. high. The extruded bar was not satisfactory and the die could not be used in a further operation.

Fourth test.—This test is in accordance with applicants' invention. In carrying out this test, a concave die-carrier was used. A glass plate of standard window glass of the same composition and dimensions as was used in the first test was placed upon the die. The billet was then heated in a manner identical to that used in the first test, employing a gas atmosphere furnace and a molten salt bath of pure barium chloride, and after heating the billet, it was carried to and placed in the container of the extrusion press.

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The extruded bar had a perfectly regular section and did not show any superficial defects. The die was covered with a thin glass layer which was easily removed with emery cloth, and after this operation, the die did not show any wear.

It was possible to carry out the operation 20 times before the die showed any appreciable wear. In fact, the die was used 53 times before it was necessary to discard it or regrind it.

Although we have described the extrusion press as being a vertical press in which the container has a concave bottom formed by the die carrier and die, it is evident that a horizontal press may be employed, in which case, the bottom of the container is to be considered as the end opposite the plunger which forces the billet through the die.

The invention is not limited to the preferred embodiment, but may be otherwise embodied or practiced within the scope of the following claims.

We claim:

1. In a method wherein a heated metal billet is extruded from a container having a concave bottom and a die located at the lowest part of the concave bottom, the improvement which comprises placing on said concave bottom prior to extrusion, a layer of glass-like lubricating material, heating the billet to extrusion temperature in a bath of molten salt capable of sticking to the billet, removing the billet from the salt bath, placing the heated salt-coated billet in the container with the layer of glass-like lubricating material interposed between the billet and die, forcing the billet through the die while melting at least partially the glass-like lubricating material, and guiding the billet in at least its substantially initial movement from the container toward the die so that its surface moves at an angle of 30–60° with the longitudinal axis of the billet.

2. A method according to claim 1, wherein, during that portion of the movement of the billet from the container toward the die which is adjacent to the die, the billet is guided so that its surface moves at an angle of greater than 60° with the longitudinal axis of the billet.

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