United States Patent

Nilsson et al.

[15] **3,698,220**

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[54] **PRESS FOR HOT HYDROSTATIC EXTRUSION**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **72/60**

[51] **Int. Cl.** **B21d 25/06**

[58] **Field of Search** 72/60, 272, 273, 253

[56] **References Cited**

UNITED STATES PATENTS

3,531,965	10/1970	Nilsson	72/60
3,563,075	2/1971	Beresnev et al.	72/60

Primary Examiner—Richard J. Herbst

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[57] **ABSTRACT**

A press for hot hydrostatic extrusion of a billet, has a stand, a pressure chamber axially movable in the stand to engage a die mounted in one end against a die support carried by the stand, a punch slidable in the pressure chamber to raise a pressure medium in the pressure chamber to extrusion pressure, and a billet holder slidable in the chamber for pressing the billet against the die during sliding movement of the pressure chamber to closing position.

In order to prevent contact between the die support and the die until extrusion is about to begin, with consequent cooling of the billet which interferes with the extrusion, an annular canted spring is arranged in a groove in the face of the die support opposite the die so as to prevent contact therebetween during closing movement of the pressure chamber.

3 Claims, 4 Drawing Figures

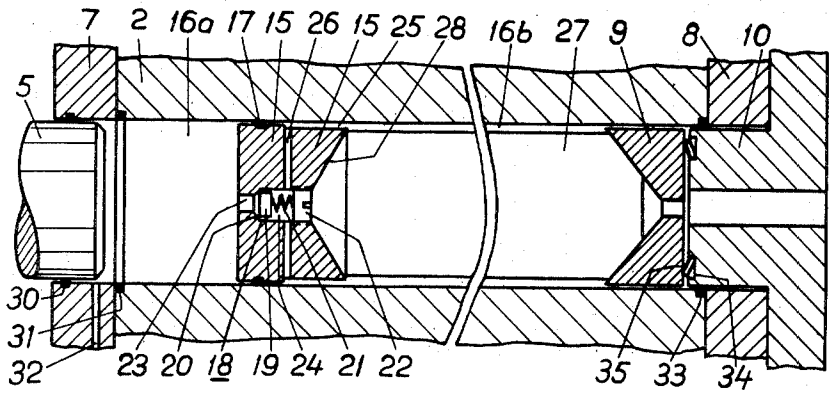


Fig. 1

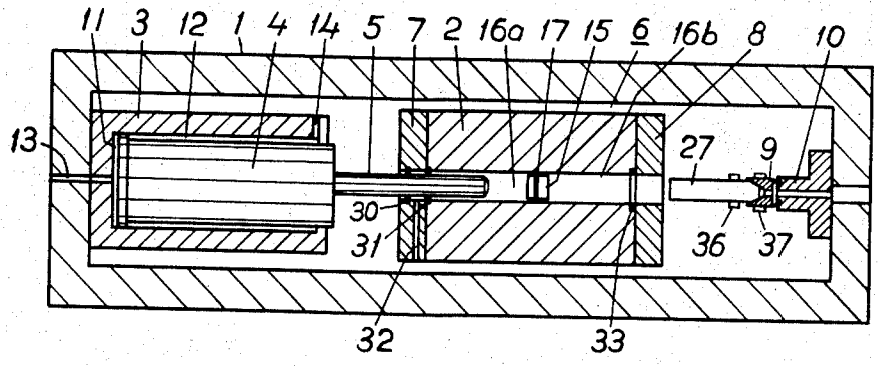


Fig. 2

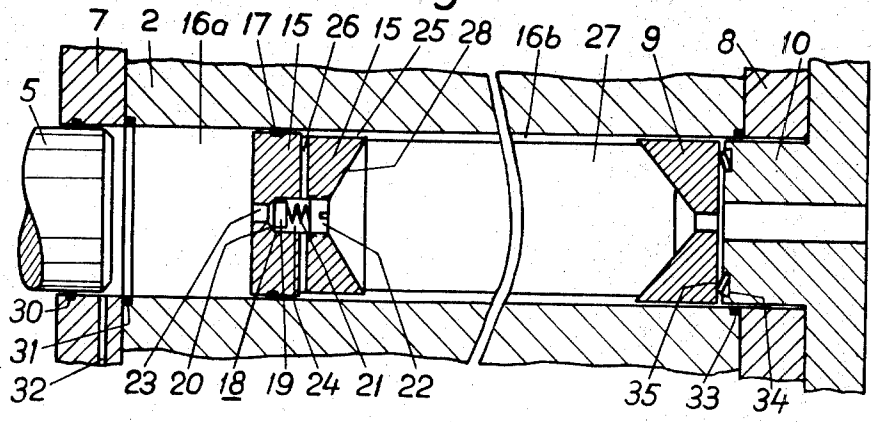


Fig. 3

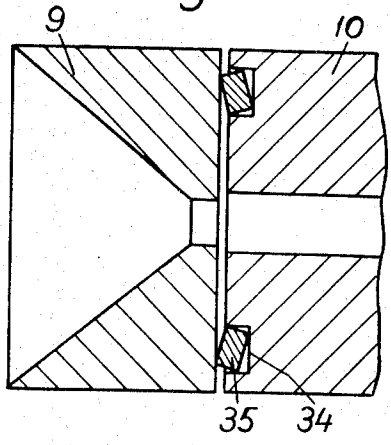
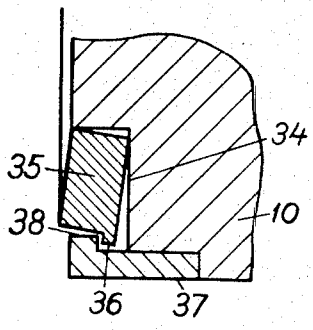


Fig. 4



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PRESS FOR HOT HYDROSTATIC EXTRUSION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a press for hot hydrostatic extrusion, preferably a press in which, during the closing of the pressure chamber, a billet and a die are held in the desired position by a billet holder pressing billet and die against a die support.

2. The Prior Art

For hydrostatic extrusion a billet is inserted in a pressure chamber formed by a cylinder, a die having an opening with the cross-section desired for the product extruded and a pressure generating punch which, when pushed into the cylinder, generates the high pressure required for the extrusion in a pressure medium surrounding the billet and thus exerting pressure on it from all sides. The ratio between the cross-sectional surface of a billet and the cross-sectional surface of a product shaped in the die is called the area reduction ratio in hydrostatic extrusion. Usually a high value is desired for the area reduction ratio. The economy of the method is, namely, to a great extent dependent on the area reduction ratio since this limits the cross-section of the billet and thus the amount produced per working cycle. The magnitude of the area reduction ratio is dependent on the material and the temperature. For copper the area reduction ratio at 15 kb pressure is about 50 at room temperature and about 800 at 300°C.

The reduction ratio increases sharply with increased temperature. Hot extrusion thus offers a way of considerably increasing production and decreasing costs for hydrostatic extrusion in cases where such material, equipment and dimensions for the product are used that the reduction ratio and the operating pressure of the press limit the size of the billet so that the volume of the pressure chamber is poorly exploited.

In hydrostatic extrusion a liquid pressure medium comes into direct contact with the heated billet to be extruded. This causes many problems, such as boiling in the pressure medium. The boiling problem has been solved when the billet is inserted in the pressure chamber by preventing the pressure medium from coming into contact with the billet before the pressure chamber is closed. A method for hydrostatic extrusion and a press for carrying out the method are described more fully in Swedish applications of Hans Larker and Jan Nilsson, for "Press for Hot Hydrostatic EXtrusion" (KN3572U) and "Method of Hydrostatic EXtrusion" (KN3571U) filed Feb. 25, 1971. When a heated billet and a heated die are inserted, a billet holder is preferably used which is movable in the high pressure cylinder and holds the billet and die in the correct position while the pressure chamber is being closed, by pressing the billet and the die against a die support with a suitable force. A billet holder of this type is described in more detail in U.S. Pat. No. 3,531,965. Upon contact between the hot die and a cold die support, the die is rapidly cooled as is also the point of a billet protruding into the inlet of the die. When the die and point of the billet are cooled, the required pressure rises at the selected area reduction ratio. This may mean that the pressure required to start the extrusion process cannot be achieved and the extrusion cannot therefore be completed.

SUMMARY OF THE INVENTION

By means of the present invention the cooling of the die is considerably reduced during insertion of the billet and die in the pressure chamber of the press by keeping the die and the die support separated from each other. According to the invention, in order to prevent contact between the die support and the die until extrusion is about to begin, with consequent cooling of the billet which interferes with the extrusion, an annular canted spring is arranged in a groove in the face of the die support opposite the die so as to prevent contact therebetween during closing movement of the pressure chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further described with reference to the accompanying drawings.

FIG. 1 shows schematically a press according to the invention,

FIG. 2 shows on a larger scale the actual pressure chamber and certain neighboring parts, and

FIG. 3 shows the die, the support and the element used to separate the die and the support, in more detail.

FIG. 4 shows a method of designing the die support and separating element so that this element remains in the die support.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings, 1 designates a press stand. In this stand a horizontal high pressure cylinder 2 is axially movable. The required operating cylinders are not shown. At one end of the stand is an operating cylinder 3 having an operating piston 4 which is in the form of a differential piston and connected to a pressure generating punch 5 which projects into the high pressure cylinder 2 and generates the pressure required for the extrusion process in the pressure chamber 6. This is formed by the cylinder 2, end members 7 and 8, punch 5, a die 9 projecting into the opposite end of the cylinder, and the die support 10. The pressure generating punch is operated by supplying pressure medium from a pressure medium source, not shown, to one of the spaces 11 or 12 formed between the cylinder 3 and the piston 4. The supply conduits are designated 13 and 14.

In the pressure chamber is a billet holder 15 which is shaped as a piston freely movable in the cylinder run. The billet holder is of the type described in the previously mentioned U.S. Pat. No. 3,531,965. The billet holder 15 divides the space 16 in the pressure chamber 6 into two separate spaces 16*a* and 16*b*. The billet holder 15 is provided with a sealing ring 17 which seals against the hollow in the cylinder 2 and with an overflow valve 18 having a valve body 19 which seals against a valve seat 20 and is pressed against this seat by a spring 21, the tension of which can be adjusted with the help of an adjustment screw 22. Between the space 16*a* and the valve 18 is a channel 23. Between the space 24 on the outlet side of the valve and slits 25 at the periphery of the billet holder are channels 26 so that pressure medium can pass to the space 16*b*. The side of the billet holder facing the billet 27 is shaped as a cone 28 so that the billet is centered.

The end members 7 and 8 connected to the ends of the cylinder 2 by means of bolts or draw rods. At one end of the pressure chamber there are two seals spaced slightly from each other. The seals 30 and 31 seal between the pressure generating punch 5 and the end piece 7 and between the punch and the cylinder 2, respectively. The seal 31 is a high pressure seal. In the end member 7 is a channel 32 which opens out between the seals 30 and 31. BY means of a conduit and valve, not shown, the channel 32 can be placed in communication with one or more sources of pressure medium. A seal 33 seals between the die support 10 and the cylinder 2. In the die support 10 is an annular groove 34 and in this groove is an annular spring 35 of the cup spring or annular canted type. The material of this spring is of the same thickness or slightly less than the depth of the groove 34. The spring will thus be completely pressed down into the groove when the die 9 is subjected to a considerable axial load and the die will rest against the inner surface of the die support. The spring ring 35 must be held in some way in the groove 34 in the die support. The outer side of the groove, for example, may be formed by a ring 37 with L cross-section. One leg of the L is directed radially inwards so that between the projecting part 38 formed by the leg and the bottom of the groove 34 an annular groove is formed. The ring 35 is shaped with an annular projection 36 which fits into said groove. The part 38 prevents the ring 35 from falling out of the die support 10.

A heated billet which is to be pressed, and a die, are inserted between the end member 8 of the high pressure chamber 6 and the die support 10 by a manipulator. Only the gripping means 36 and 37 of the manipulator are shown. The chamber 6 is displaced to the right until the end surface of the pressure generating punch 5 is between the seals 30 and 31 in the end member 7. The space 16*a* is now supplied with pressure medium from a source of pressure medium, not shown, the pressure of which is not less than the opening pressure of the valve 18. The billet holder 15 will be displaced to the right under the influence of the pressure medium in the space 16*a* and presses the billet 27 and die 9 towards the die support 10 with a pressure depending on the pressure difference between the spaces 16*a* and 16*b*. The billet is fixed by the pressure so that the manipulator can be removed and the pressure chamber completely closed by the simultaneous displacement of the pressure chamber and the pressure generating punch axially to the right in the position with regard to each other which is shown in FIG. 2. The strength of the ring spring 35 is chosen so that at the holding pressure a gap is formed between the die 9 and the die support 10. An insulating layer of air will then exist between the heated die and the cold die support while the pressure chamber is being closed, thus preventing rapid cooling of the die. When the pressure chamber has been completely closed, as shown in FIG. 2, the pressure of the pressure medium in the space 16*a* is increased considerably above the opening pressure of the valve 18 so that pressure medium flows into the space 16*b* and compresses any air in this space to such a small volume that this air only negligibly affects the movement of the pressure generating punch upon the subsequent increase in pressure in the pressure chamber to the extrusion pressure by the insertion of the pressure generating punch 5 into the space 16*a*. At the increased pressure the force operating on the die 9 will press down the spring element 35 completely into the ring-shaped groove 34. The die will thus rest directly against the die support. A complete operating cycle for a press for hot extrusion, in which the spring element can be used is further described in the application for "-Method of Hydrostatic Extrusion" referred to above.

The invention is of course not limited to the embodiments shown. Many variations are feasible within the scope of the following claims.

We claim:

1. Press for hydrostatic extrusion comprising a press stand, having a die support carried thereby, a high pressure cylinder displaceable axially in the press stand constituting a pressure chamber, a die slidable in between the cylinder and the die support, a pressure-generating punch slidable in the cylinder to generate a pressure necessary for extrusion in a pressure medium enclosed in the pressure chamber and surrounding a billet to be extruded, and a billet holder axially displaceable in the cylinder to retain the billet and the die during a part of the closing movement of the pressure chamber by pressing the billet and the die towards the die support, spring means operatively engaged with the die and the die support to keep the die and die support separated from each other when the die and the billet are held during the closing movement of the pressure chamber until the pressure on the billet exceeds a predetermined amount.

2. Press according to claim 1, in which the spring means comprises an annular spring of the canted type.

3. Press according to claim 2, in which one of the die supports has an annular groove therein facing the die, said die having a depth which is at least equal to the thickness of the spring material, the annular spring being positioned in said groove.

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