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Malegue

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[54] **METHOD AND APPARATUS FOR THE HOT PIERCING OF METAL BILLETS**

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[58] **Field of Search**.....72/253, 254, 256, 264, 265, 72/266, 272, 273; 29/DIG. 17, DIG. 47; 72/343

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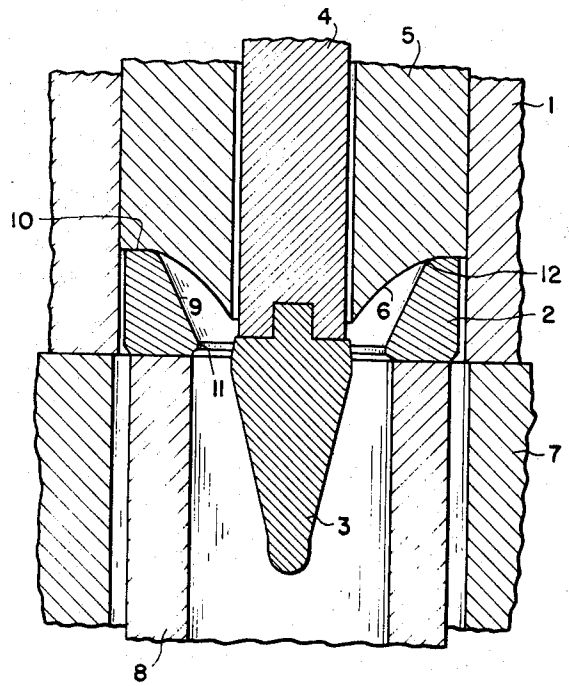
[57] **ABSTRACT**

An improvement in the hot piercing of a previously cold drilled metal billet in which the bottom of the piercing press is equipped with a frustoconically bored ring, the aperture of which noticeably exceeds the cross-section of the desired billet bore or the expanding tool. During extrusion in an extrusion press, the section of the billet coming from the lower part of the piercing press is placed in the extrusion press adjacent to the dummy block.

5 Claims, 1 Drawing Figure



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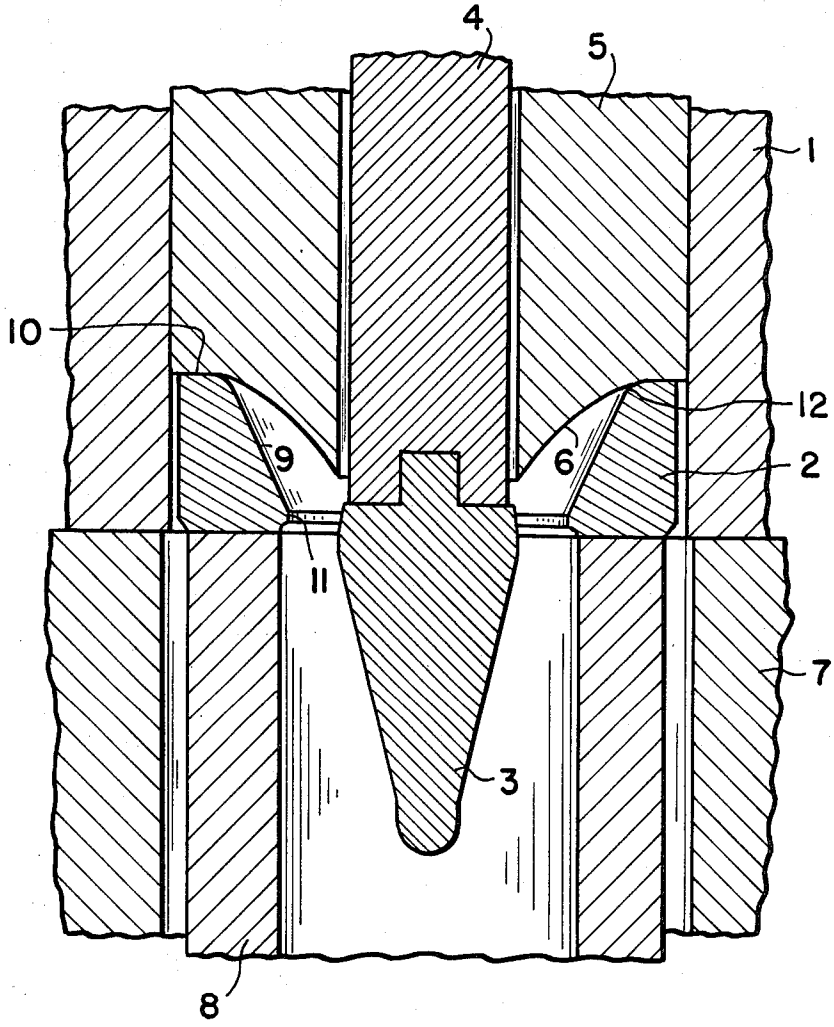

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METHOD AND APPARATUS FOR THE HOT PIERCING OF METAL BILLETS

This invention is directed to the hot piercing of metal billets and their extrusion into tubes and hollow sections. More particularly, it is directed to an improved method for carrying out the hot piercing operation also called "expansion" which consists in hot deforming to the desired bore diameter (also called expansion diameter) a billet in which an axial pilot hole has been previously cold drilled.

Presently, this hot piercing is conducted in a vertical piercing press, the container of which is equipped at its lower end with a cylindrically bored ring through which the piercing tool can run with a very slight clearance, see French Pat. No. 1,130,759. In such a process the lower portion of the metal billet is sheared off at the end of the hot piercing operation, thus creating a discard or "residue."

Where the expansion diameter is small, the weight of the residue is small and the presently employed process is generally satisfactory. However, when the expansion diameter is relatively large, the metal loss or residue is substantially more noticeable. Moreover, since the inside diameter of the lower cylindrical ring must be accurately selected, it is necessary to have available as many lower ring sizes as there are expansion diameters.

The present invention avoids these above-identified drawbacks. With my improved process, the whole of the billet is deformed during the expansion operation without any shearing and without producing any discard or residue, although the lower face of the billet is deformed into a bulge during hot piercing, the extent of the bulge increasing as the ratio of expansion diameter to wall thickness increases. The billet is extruded with its bulged face adjacent to the extrusion ram and, therefore, the bulge becomes part of the extrusion discard. The extrudate is perfectly satisfactory as regards both metallurgical structure and geometry. In addition, a single ring can be used for a wide range of expansion diameters.

My invention consists in placing at the lower end of the piercing press container a ring having a frustoconical bore, the smaller base of which is downstream from the larger base. The smaller base has a diameter largely exceeding the working diameter of the expansion tool. The billet previously drilled and heated to deformation temperature is hot expanded and then is inserted into the container of an extrusion press in such a manner that the billet end coming from the lower part of the piercing press container comes into contact with the dummy block of the extrusion press. The extrusion takes place in the known manner.

The preferred embodiment of my invention is shown in the single figure of the accompanying drawing which is an axial section of the lower part of a piercing press equipped with a ring according to the invention and containing a billet just expanded according to may improved method of hot piercing.

The container **1** of the piercing press is equipped at its lower end with an annular ring **2**. The container **1** and the annular ring **2** are supported by base sections **7** and **8** of the piercing press in a known manner. Annular ring **2** has a frustoconically shaped central bore **9**. An expansion tool **3** is secured to a spindle **4** which is acted upon by the press to expand or pierce a billet **5**.

The outside diameter of the annular ring **2** is slightly smaller than the inside diameter of the container. The larger base **10** of the frustoconical bore **9** has a diameter preferably exceeding 70 percent of the container diameter. The smaller base **11** which is downstream of the larger base **10** has a diameter preferably exceeding 50 percent of the container diameter. The inside surface of the ring **2** terminates in a toric surface **12** melting into the larger base **10**. The radius R of the toric surface **12** is at least 3 percent of the container diameter and not smaller than **5** mm (0.200 inch), see the figure. The total height of the ring is advantageously from 70 to 120 mm (2.750 to 4.750 inch).

My improved process works as follows. A previously drilled billet **5** which has also been heated to deformation temperature is positioned in container **1** of the piercing press. The expansion tool **3** is forced through the drill bore to form the desired expansion or pierced bore diameter in the known manner. However, the metal flow of the billets create a bulge **6** at the ring end of the container, see the figure. The extent of this bulge varies depending upon the ratio of the expansion diameter and the wall thickness of the hot pierced billet. In other words, the greater the metal flow the greater the bulge. However, there is no discard or residue as in the previously known processes. The hot pierced billet is then positioned in an extrusion press so that the end of the billet containing the bulge is adjacent the standard dummy block. After extrusion in the normal manner, the bulge end of the billet becomes a part of the standard discard.

With only one ring as described above, it is possible to expand billets to bore diameters ranging from 25 percent to 70 percent of the diameter of the smaller base of the ring bore.

The surface condition of the billet bore thus obtained is perfectly sound along the whole useful length of the billet. Slight cracks may be observed only in the bulged lower part of the billet but this is removed with the extrusion discard.

Thus, the process according to the invention, permits the use of the same ring for an important range of expansion diameters. Tooling is thus simplified and the operations are accelerated, since it is possible to change the expansion diameter without changing the ring. On the other hand, any waste of metal is avoided in the hot piercing operation.

EXAMPLE:

In a vertical hydraulic 400 ton piercing press a 226 mm (8.900 inch) container was equipped with a ring according to the invention, the height of which was 90 mm (3.540 inch), the inside bore of which had a larger base 175 mm (6.900 inch) and a smaller base 130 mm (5.120 inch) in diameter, respectively. This press was fed with carbon steel billets previously cold drilled to 20 mm (0.800 inch) and heated to deformation temperature. The billets were expanded (hot pierced) to bore diameters ranging from 50 to 85 mm (2 to 3.350 inch) without any waste of metal. The billets showed bulged lower faces.

These billets were then inserted into a horizontal 3000 ton extrusion press in which the bulged faces were adjacent to the dummy block and extruded into tubes, the various inside diameters of which ranged

from 45 to 80 mm (1.770 to 3.150 inch). The tubes showed a very good concentricity and a perfect metallurgical quality along their whole length.

The metal waste during the successive hot operations was limited to the extrusion discard, i.e., to about 2 percent of the initial metal weight.

I CLAIM:

1. In the process for hot piercing metal billets previously cold drilled and heated to deformation temperature in a piercing press including a piercing press container and an expansion tool and subsequently extruding the hot pierced metal billets in an extrusion press including an extrusion press container and a dummy block, the improvement comprising:

A. equipping the piercing press container at its lower end with an annular ring having a rustoconical bore, the smaller base of the bore being downstream of the larger base and having a diameter substantially larger than the diameter of the expansion tool;

B. hot piercing with an expansion tool the previously cold drilled and heated billet;

C. inserting the hot pierced billet into the extrusion press container so that the end of the billet positioned in the lower end of the piercing press container is adjacent the dummy block; and

D. extruding the hot pierced metal billet.

2. The process of claim 1 wherein the previously cold drilled and heated billet is hot pierced so that its resultant bore diameter is from 25 to 70 percent of the diameter of the smaller base of the frusto-conical bore.

3. The process of claim 1 wherein the diameter of said smaller base is at least 50 percent of the diameter of the container and the diameter of the larger base is at least 70 percent of the container diameter.

4. The process of claim 1 including employing a glass-like lubricant in at least one of the hot piercing step B or the extruding step D.

5. In a piercing press for hot piercing metal billets previously cold drilled and heated to a deformation temperature including a container having an annular ring cooperating with the lower portion thereof and an expansion tool, the improvement com-prising said annular ring having a frustoconical bore, the smaller base of the frustoconical bore being downstream of the larger base and having a diameter substantially larger than the diameter of the expansion tool, the ring having an inside surface terminating at its upstream end in a toric surface melting into said larger base, said toric surface being generated with a radius of at least 3 percent of the diameter of the piercing press container.

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