

PATENT SPECIFICATION

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(54) A METHOD OF PIERCING A METAL BLOCK AND A PRESS FOR CARRYING OUT THE METHOD

(71) We, MANNESMANN AKTIENGESELLSCHAFT, a German Body Corporate of 2 Mannesmannufer, 4 Düsseldorf 1, Federal Republic of Germany, do hereby declare 5 the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The invention relates to a method of piercing a solid cylindrical metal block which is provided with an initial hole in the centre of one end face, the metal block being inserted in the approximately cylindrical bore of a housing and a piercing mandrel being introduced into the block under pressure and with the use of lubricant.

For forming holes in solid blocks, these are either initially drilled and the drilled 20 hole is widened with a conical mandrel, or a truncated piercing mandrel is driven therein. The first-mentioned method requires relatively inconsiderable pressure forces. On the other hand, the drilling required is an 25 additional operation. This method is nowadays used usually for billets of steel or steel alloys.

The second method requires a press and only one working operation for piercing; 30 but the pressure forces which have to be applied are considerably greater than when widening an already drilled hole with a conical mandrel and the concentricity of the hole which is formed relative to the external 35 surface of the block is usually less reliable.

We have sought to improve and facilitate the hot punching of a block and to reduce the danger of forming an eccentric hole due to excessive pressure force applied and consecutive deflection of the piercing mandrel. 40 Thus, it is possible to carry out the piercing on presses which are designed specifically for the purpose or in the case of existing installations without substantial additional 45 apparatus and outlay for widening work.

Accordingly, the present invention provides a method of piercing a solid cylindrical block comprising forming an initial hole in an end face of the block, the hole 50 having a curved bottom merging with a

conical surface, at least partially filling the hole with lubricant, placing the block in a housing and inserting a piercing mandrel into the hole, the mandrel having a configuration of a truncated cone with a planar or slightly convex front end having less curvature than the curved bottom of the hole such that the front end of the mandrel partially but not completely fills the hole upon being inserted into the hole and engages the hole's conical surface, and piercing the block by forcing the mandrel through the block causing the mandrel to move the conical surface of the hole deeper into the block without direct engagement of the bottom of the hole by the front end of the mandrel, so that a portion of the hole is filled with lubricant throughout the piercing operation.

The invention is based on the realisation 70 that a supply of lubricant in the so-called flow-inhibited zone immediately in front of the piercing mandrel and the use of a conical piercing mandrel facilitate the formation of the hole. With a cylindrical piercing 75 mandrel with a concave end face and a supply of lubricant situated in front of the end face, it would not be likely that the piercing mandrel would be reliably lubricated and the pressure force reduced. With 80 a conical piercing mandrel having a slightly convex or planar end face, on the other hand, the lubricant can be observed to flow gradually out of the flow-inhibited space over the generated surface of the cone 85 formed on the piercing mandrel, and there are only slight deviations from the concentricity of the hole which is formed.

One possible cause for the eccentricity of the hole produced during piercing is the necessary clearance between the block and the bore of the housing which clearance is usually eliminated by a special axial upsetting of the block which requires considerable pressure force. Preferably, the block is 90 self-centred in the housing. For this purpose, the block is thickened at one end to such an extent that this region of the block completely fills the bore in the housing. This thickening can be carried out for example 95 100

on an initial piercing press with lateral displacement of the block material. It is more advantageous to provide the block with a concentric initial hole with a machining 5 operation and to produce the thickening with the piercing mandrel itself.

It is also preferable to centre the block at its other end in the housing, a conical narrowing of the bore being provided for 10 this purpose. The thickening of the end of the block and the narrowing of the bore in the housing are preferably of such an extent that the block comes to abut completely against the cutting plate only as a 15 result of light pressure of the piercing mandrel. Thus the block can no longer yield laterally in its entirety especially since the truncated cone-shaped piercing mandrel brings about a more uniform lateral 20 placement of the block material outside the original centring seatings.

The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings.

25 Fig. 1 shows the block provided with an initial hole.

Fig. 2 shows the penetration of the punching mandrel.

30 Fig. 3 shows a central position and Fig. 4 shows the end position of the punching mandrel.

A solid, originally cylindrical metal block 1 shown in Fig. 1 is thickened locally at 3 by forming an initial hole 2 therein without 35 the removal of material, the hole 2 receives a lubricant 4. The initial hole 2 is formed outside housing 5 of the press in order so that the thickening 3 can develop unhindered, and the diameter of the block 1 40 is not smaller at the thickened portion than the internal width of the housing. Thus the thickening 3 provides a first centring surface.

The block 1 is then introduced into the 45 housing 5 (Fig. 2). The lubricant 4 is introduced into the initial hole 2 in the block 1 only when the block 1 is in the housing 5. The housing 5 has an almost cylindrical bore. The deviation in the portion which is designated as cylindrical amounts to about 50 1%, for better ejecting. However, in region 6 a conical narrowing of the internal clear width of the housing 5 is provided over a length of from half to twice the mandrel diameter. The narrowing is so considerable 55 that the block 1 comes to abut on the narrowed portion, so that a second centring surface 6 is obtained. The housing 5 abuts against a cutting plate 7 in the press frame.

A piercing mandrel 8 is situated on a 60 mandrel rod 9 which is supported on a cross-head (not shown) in a press frame.

Fig. 2 shows the application of the piercing mandrel 8. The block 1 is pressed as far as the cutting plate 7 but is not forced. The 65 otherwise usual forcing of the block 1 with

an annular punch with great compression force is dispensed with in this case. The piercing mandrel 8 has a frustoconical shape and is similar to widening mandrels. However, the smaller base surface of the truncated portion of the mandrel is planar or slightly convex, as illustrated. Since the initial hole 2 is deeper and more acute-angled than the mandrel 8, a supply of lubricant 4 is present in the hole. The block 75 material tends to displace the supply of lubricant but is prevented because of the high pressure per unit of surface area on the frustoconical region of the piercing mandrel. Therefore, a residue of lubricant is still 80 present after the piercing has been completed as Fig. 4 shows.

Because of the widening effect of the frustoconical shape of the piercing mandrel 8 the block 1 also comes to abut gradually 85 in uniform fashion on the internal wall of the housing 5 without the block 1 becoming displaced at the centring surfaces 3 and 6.

At the end of the piercing as shown in Fig. 4 a plug 10 and the piercing mandrel 8 are pushed out through the cutting plate 7. The mandrel rod 9 with the mandrel 8 is drawn back and the block 1 is ejected from the direction of the cutting plate 7, and is usually passed on for further 95 processing.

WHAT WE CLAIM IS:—

1. A method of piercing a solid cylindrical block comprising forming an initial hole in an end face of the block, the hole 100 having a curved bottom merging with a conical surface, at least partially filling the hole with lubricant, placing the block in a housing and inserting a piercing mandrel into the hole, the mandrel having a configuration of a truncated cone with a planar or slightly convex front end having less curvature than the curved bottom of the hole such that the front end of the mandrel partially but not completely fills the hole 110 upon being inserted into the hole and engages the hole's conical surface, and piercing the block by forcing the mandrel through the block causing the mandrel to move the conical surface of the hole deeper into the 115 block without direct engagement of the bottom of the hole by the front end of the mandrel, so that a portion of the hole is filled with lubricant throughout the piercing operation.

2. A method as claimed in Claim 1 in which an increase in diameter is brought about at the end of the block which faces towards the punching mandrel.

3. A method as claimed in Claim 2 125 wherein the increase in diameter is brought about by forming a hole without removal of material, with unhindered lateral displacement of the block material.

4. A method as claimed in Claim 2 130

wherein the increase in diameter is produced by the mandrel itself in a block provided with an initial hole produced by machining with removal of material.

5 5. A method as claimed in Claim 3 or 4 wherein the external diameter of the block in the hot state is smaller than but in the region of the initial hole equal to or larger than the internal clear width of the housing.

10 6. A method as claimed in any preceding claim, wherein the block is received in a housing having a substantially cylindrical bore, and at the end remote from the piercing mandrel abutting against a cutting plate, 15 the bore being progressively reduced at the end initially remote from the mandrel over a length of from half to twice the mandrel diameter.

7. A method as claimed in Claim 6, wherein the reduction of the bore amounts 20 to up to twice the diameter difference between the unpierced block and the cylindrical bore of the housing.

8. A method of piercing a solid cylindrical metal block substantially as herein 25 described with reference to the accompanying drawing.

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COMPLETE SPECIFICATION

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*This drawing is a reproduction of
the Original on a reduced scale*

