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

(71) We, MANNESMANN AKTIENGES-
 ELLSCHAFT, 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 par-
 ticularly 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 cylin-
 15 drical 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 now-
 days 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 con-
 40 sequent deflection of the piercing mandrel.
 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 pro-
 vides a method of piercing a solid cylin-
 drical 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 con-
 55 figuration 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 en- 60
 gages the hole's conical surface, and pierc-
 ing 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 65
 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 lubri-
 cated 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 concen-
 tricity of the hole which is formed.

One possible cause for the eccentricity of
 the hole produced during piercing is the 90
 necessary clearance between the block and
 the bore of the housing which clearance is
 usually eliminated by a special axial up-
 setting of the block which requires consider-
 able pressure force. Preferably, the block is 95
 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 com-
 pletely fills the bore in the housing. This
 thickening can be carried out for example 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 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 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 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 displacement 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.

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

Fig. 2 shows the penetration of the punching mandrel.

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 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 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 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 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 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 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 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 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 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 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 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 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.

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 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

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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