US 20160325338A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2016/0325338 A1**

**Rixen et al.** (43) **Pub. Date: Nov. 10, 2016**

(54) **METHOD FOR CREATING THROUGH-PASSAGES IN A METAL BODY BY MEANS OF HIGH-SPEED IMPACT CUTTING**

(71) Applicants: **Wolfgang Rixen**, Solingen (DE); **Gerrit Pies**, Solingen (DE)

(72) Inventors: **Wolfgang Rixen**, Solingen (DE); **Gerrit Pies**, Solingen (DE)

(21) Appl. No.: **15/111,627**

(22) PCT Filed: **Jan. 13, 2015**

(86) PCT No.: **PCT/EP2015/000038**

§ 371 (c)(1),
(2) Date: **Jul. 14, 2016**

(30) **Foreign Application Priority Data**

Jan. 15, 2014 (DE) ..... 102014 000 299.3

**Publication Classification**

(51) **Int. Cl.**

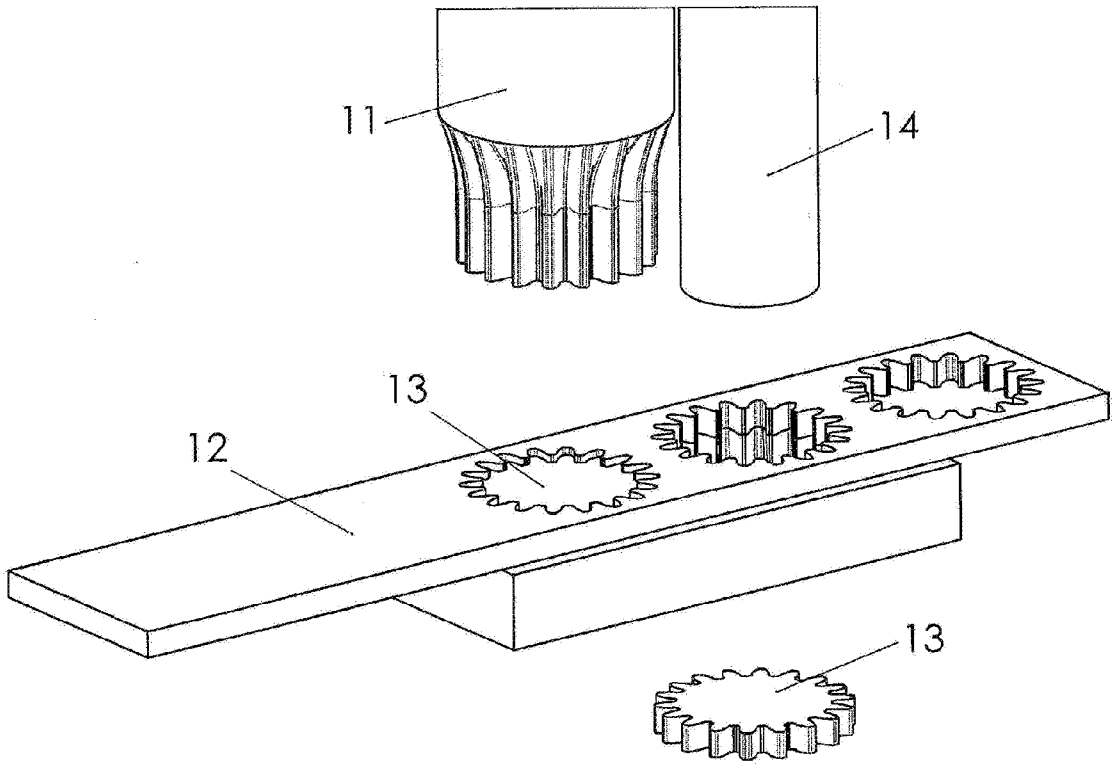
| | |
|---|---|
| ***B21D 45/00*** | (2006.01) |
| ***B21D 45/02*** | (2006.01) |
| ***B21D 53/28*** | (2006.01) |
| ***B21D 28/14*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***B21D 45/003*** (2013.01); ***B21D 28/14*** (2013.01); ***B21D 45/02*** (2013.01); ***B21D 53/28*** (2013.01)

(57) **ABSTRACT**

The invention relates to a method for creating through-passages in a metal body by means of high-speed impact cutting (HSIC) with a closed cutting line, characterized in that a punch (**11**) having a first dimension (D) corresponding to the through-passages is introduced down to an insertion depth at which the break passes through the entire metal body in the direction of action of the punch (**11**), forming a slug (**13**), and then the stroke movement is stopped and the punch (**11**) is withdrawn again, and in that in a subsequent step the slug (**13**), which is still located in the through-passage, is driven out of the through-passage by means of an ejector, which has a smaller second dimension than the punch (**11**).



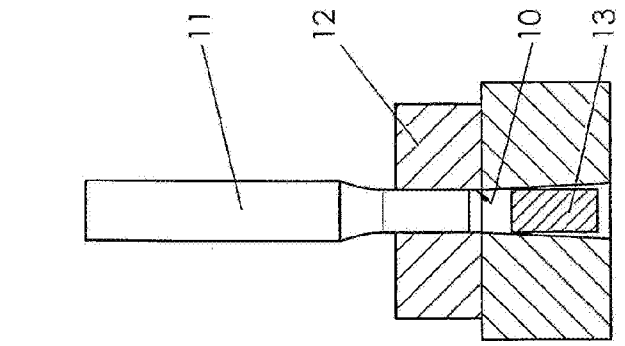



Fig. 4 PRIOR ART

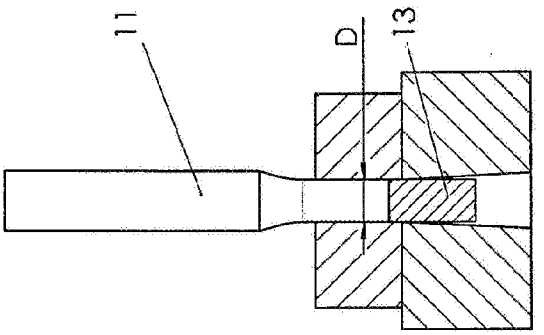



Fig. 3 PRIOR ART

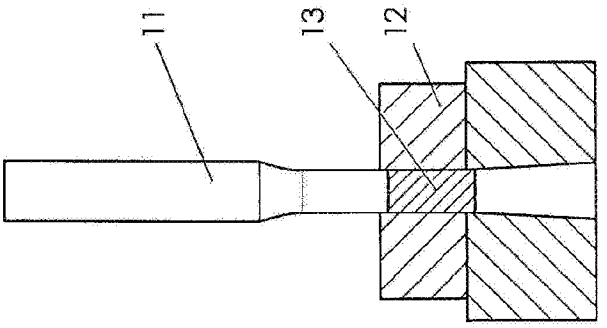



Fig. 2 PRIOR ART

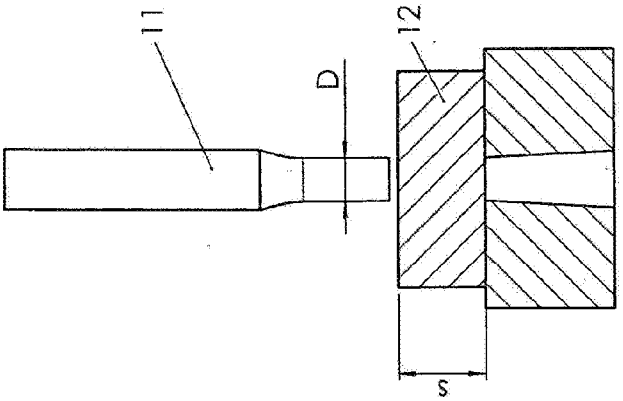



Fig. 1 PRIOR ART

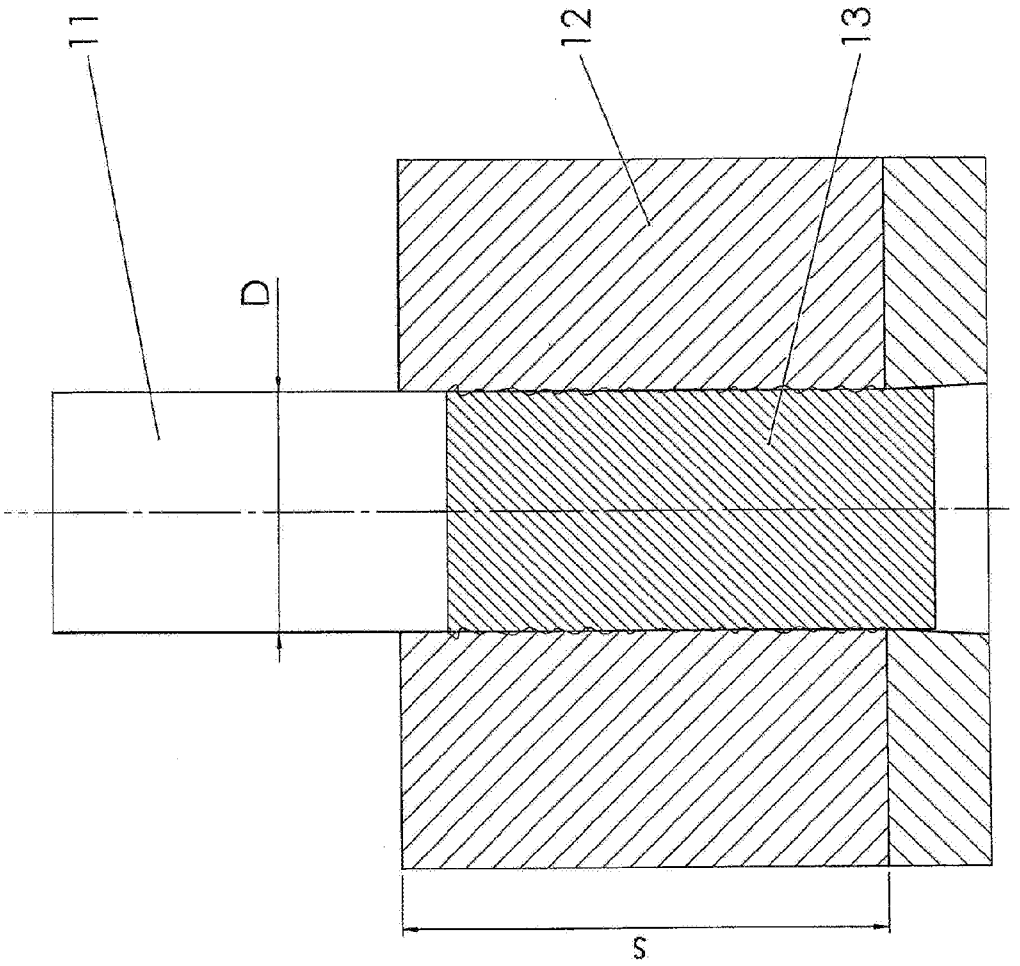



Fig. 5 PRIOR ART

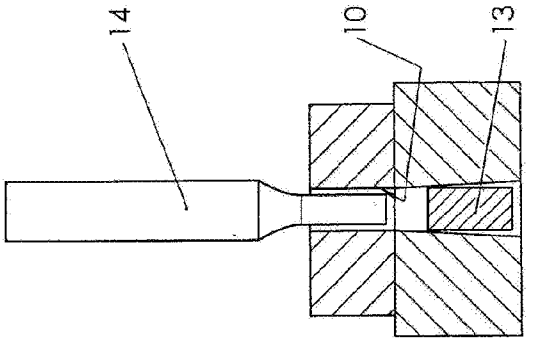



Fig. 9

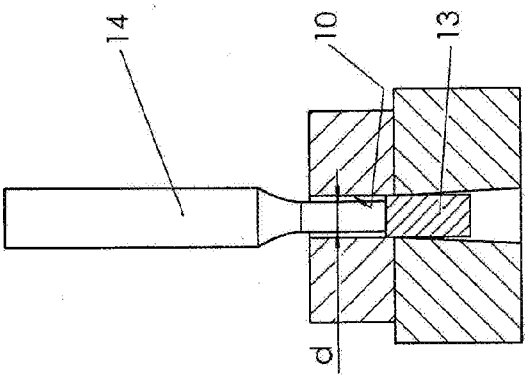



Fig. 8

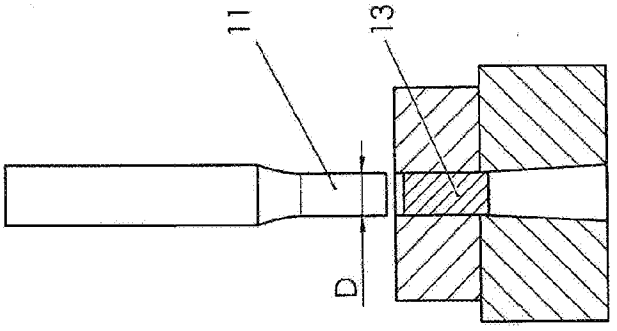



Fig. 7

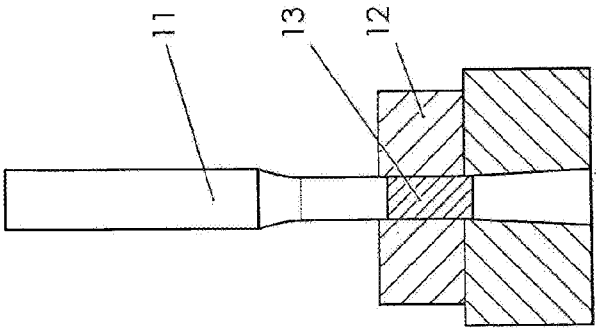



Fig. 6

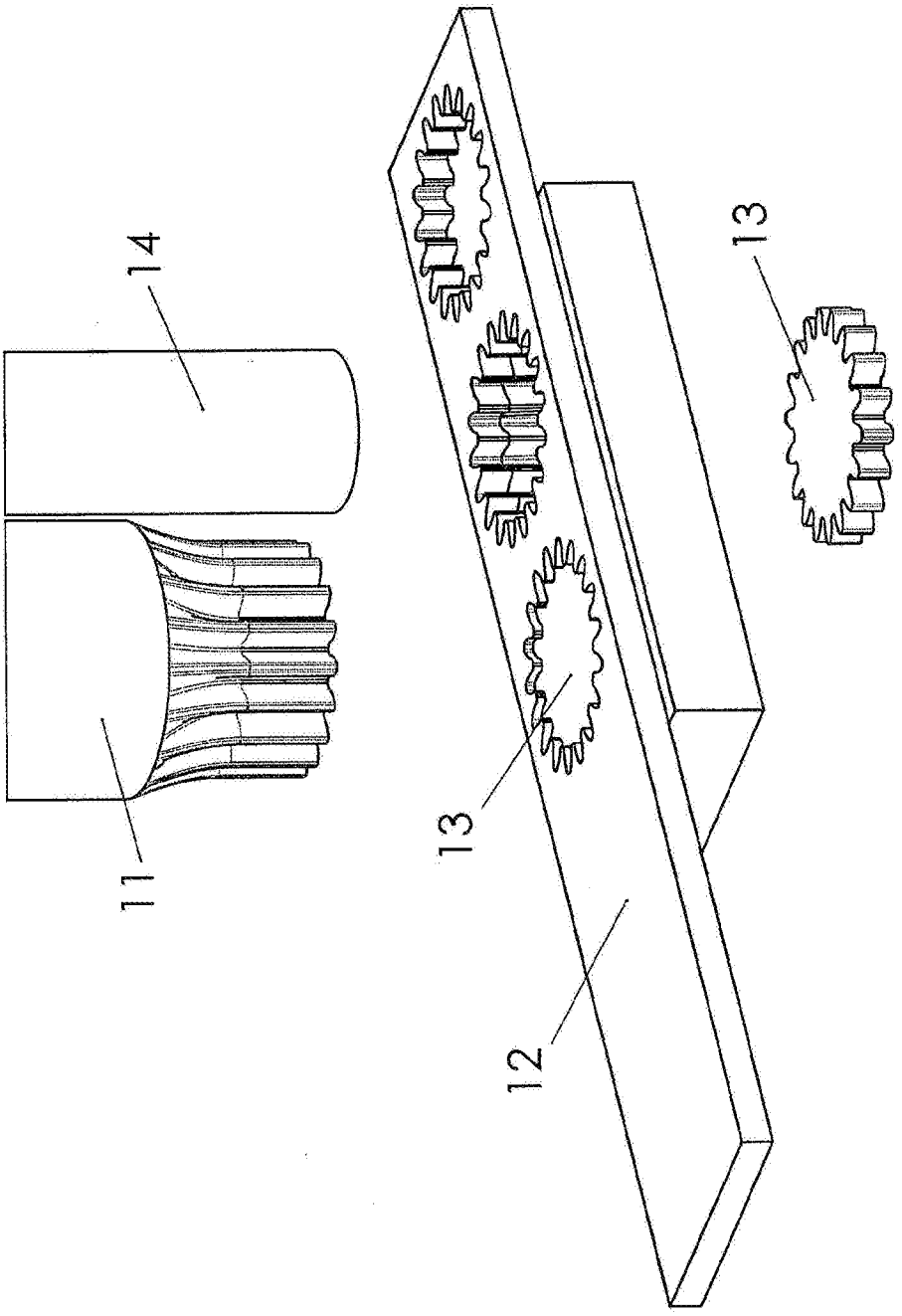



Fig. 10

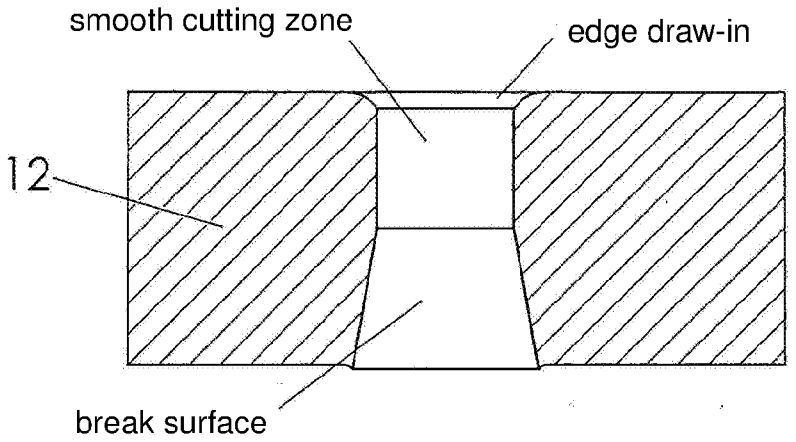



Fig. 11 PRIOR ART

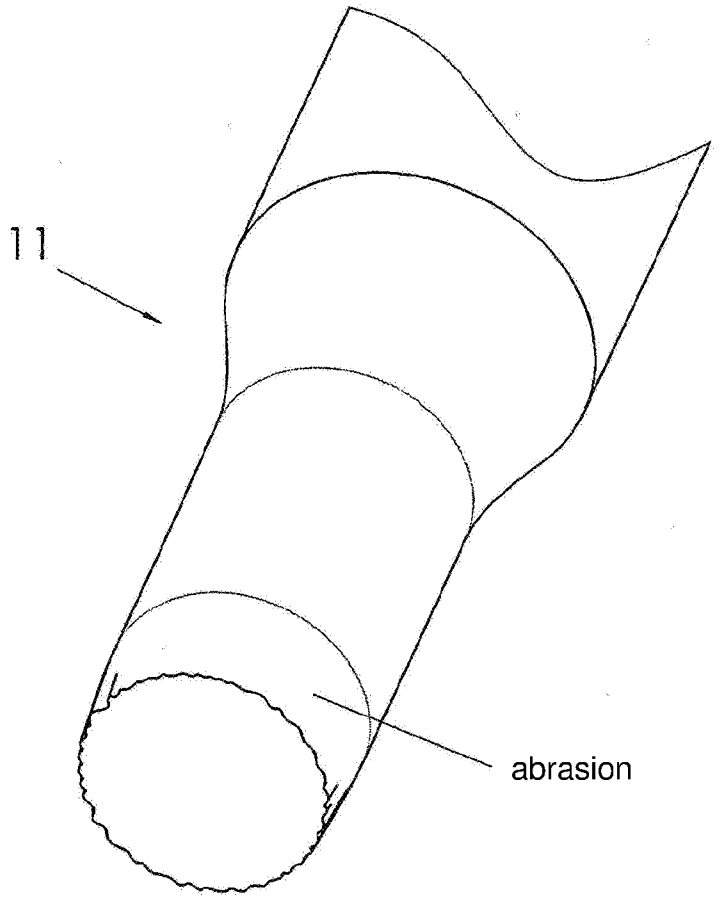



Fig. 12

PRIOR ART

# METHOD FOR CREATING THROUGH-PASSAGES IN A METAL BODY BY MEANS OF HIGH-SPEED IMPACT CUTTING

**[0001]** The invention concerns a method for creating through-passages in a metal body by means of high-speed impact cutting with closed cutting line, referred to in the following as HSIC.

**[0002]** The produced products may be contour bodies that are punched out of the metal body or through-passage shapes. The metal body can be flat or uneven or can have a curved surface.

**[0003]** A method for adiabatic separation of workpieces by means of high-speed impact cutting (HSIC) is disclosed in DE 103 17 185 A1.

**[0004]** This publication discloses a method for producing profiled parts by separation from profiled rods. In this context, the profiled rod is clamped in a tool between two active parts wherein the facing contact side of the active parts is designed in the form of dies in which the shape of the profile to be processed is cut out, respectively. Moreover, the sizes of the contact sides have the dimensions of the profiled part to be cut. Finally, the separation is carried out adiabatically at a very high impact speed of the cutting punch wherein the force is transmitted by means of the punch onto one active part.

**[0005]** The method described therein is used for cutting to length a plurality of mentioned profiles (see DE 103 17 185, paragraph 6).

**[0006]** Accordingly, this concerns exclusively the separation of profiled members that are not provided with bores. In particular, there are also no through-passages provided in this context.

**[0007]** As in conventional punching, wear occurs also in HSIC in the area of the tool wall surface due to adhesion and, as a result thereof, due to abrasion, as shown in FIG. **12**. The break line or break surface, which results in HSIC by utilizing the adiabatic material state and is extending underneath the active surface of the tool in the direction of impulse propagation, scatters statistically in the direction of the hole and the surrounding material, as shown in FIG. **5**. Due to this scattering, without the known funnel-shaped breakout, see FIG. **11**, observed in conventional punching, high adhesion forces between punch and through-passage wall result upon penetration of the HSIC punch and accelerate wear caused by abrasion. This may result in a reduced service life, in particular of the punch, in comparison to conventional punching. Penetration of the punch is required in the current prior art.

**[0008]** It is therefore an object of the invention to improve a method of the aforementioned kind in such a way that the service life, in particular of the punch, can be significantly increased with technically simple means.

**[0009]** This is realized in the method of the aforementioned kind in that a punch, having first dimensions corresponding to the through-passages, is introduced to an insertion depth at which the break in the direction of action of the punch extends all the way through the entire metal body with formation of a slug, the stroke movement is then stopped, and the punch is retracted again, and in that, in a subsequent step, the slug which is still located within the through-passage is driven out of the through-passage by means of an ejector that has a smaller second dimension compared to the punch.

**[0010]** The gist of the present invention resides in modifying the previously known method for punching by means of HSIC such that the actual generation of the through-passage and the ejection of the slug are carried out separate from each other.

**[0011]** Therefore, a method is proposed in which a particular property of HSIC is utilized. As described above, the break is extending already through the complete workpiece cross-section already at minimal punch insertion depth. Therefore, the actual generation of the hole is already completed to such an extent that the corresponding materials are separated from each other. As soon as this point has been reached, the stroke movement of the punch is stopped, and the punch is retracted. In a subsequent method step, within the same tool, or separate therefrom, the slug that is still located in the through-passage is pushed out by means of an ejector. The latter has in comparison to the actual punch a smaller dimension so that no contact at all exists between its wall surface and the wall of the punched hole or through-passage. Accordingly, the increased wear of the punch by adhesion is avoided.

**[0012]** According to a further embodiment of the invention, it is advantageous that the ejector performs its stroke movement simultaneously with the punch and with the same drive. Accordingly, punch and ejector can operate simultaneously. However, it can also be provided that the at least one ejector carries out its stroke movement independent of the stroke movement of the punch. In this way, it becomes possible to employ remote from the machine a further machine that requires significantly reduced power.

**[0013]** It is particularly advantageous when the slug itself is the product to be produced or the through-passage itself that has been opened by the slug imparts the desired contour to the product to be produced.

**[0014]** Moreover, it can be provided that the HSIC is carried out beginning at a curved surface.

**[0015]** It is also possible that this method is used for producing through-holes in sliding blocks.

**[0016]** Further advantages and features of the invention result from the following description of several embodiments as well as from the drawings to which reference is being had. It is shown in:

**[0017]** FIG. **1** to FIG. **5** the prior art method for generating a through-passage in a metal body by means of high-speed impact cutting HSIC wherein

**[0018]** FIG. **1** shows the situation prior to impact of the punch;

**[0019]** FIG. **2** shows the complete break formation of a slug at a minimal insertion depth;

**[0020]** FIG. **3** shows further pushing out the slug by means of the punch at high circumferential pressure;

**[0021]** FIG. **4** shows retraction of the punch at high friction;

**[0022]** FIG. **5** shows an enlarged detail view according to FIG. **3** with schematic warping between punch and through-hole.

**[0023]** FIGS. **6** through **10** now show the improved method and FIGS. **11** and **12** show the prior art, wherein

**[0024]** FIG. **6** shows a view similar to FIG. **2** with already penetrated punch;

**[0025]** FIG. **7** shows the position of the retracted punch shortly after the state according to FIG. **6**;

**[0026]** FIG. **8** shows an ejector introduced into the through-passage and having a reduced dimension in comparison to the punch;

**[0027]** FIG. **9** the now completed through-passage wherein however the ejector **14** has not yet been retracted;

**[0028]** FIG. **10** a perspective illustration of the method for generating through-passages wherein here, as the workpiece to be produced, the so-called slug is designed as a gear;

**[0029]** FIG. **11** shows a cross-section of a through-hole produced by conventional punching; and

**[0030]** FIG. **12** a perspective illustration of a punch with abrasion.

**[0031]** With the aid of FIGS. **1** to **12**, the known method for producing a through-passage **10** in a metal body **12** by means of HSIC and the method for creating a passage **10** with the aid of an ejector **14** will now be explained in more detail. For both methods the same reference characters are employed, if nothing to the contrary is indicated.

**[0032]** In the known method, a punch **11** is impacting at very high speed on a metal body **12**. This is illustrated in FIG. **1** in such a way that the end face of the punch **11** is shown shortly before penetrating the surface of the workpiece **12**.

**[0033]** According to FIG. **2**, the punch **11** has penetrated slightly into the metal body **12** and has already completely created a so-called slug **13** as a result of HSIC. This slug **13** is already completely separated from the remaining metal body **12**. It is therefore to be noted that already for a minimal insertion depth in the direction of action of the punch **11** the break between the materials is existing all the way through the entire body **12**.

**[0034]** Upon further insertion or penetration of the punch **11**, the slug **13** is removed from the body **12**. As can be seen in FIGS. **3** to **5**, wherein FIG. **5** shows a detail view of FIG. **3**, HSIC causes also wear by adhesion, and as a result thereof by abrasion, in the area of the tool wall surface, see in particular FIG. **5**. The somewhat corrugated lines between the punch **11** and the body **12** are meant to schematically indicate the break line which is occurring in HSIC by utilizing the adiabatic material state, wherein the break line extends under the active surface of the tool or the punch **11** in the impulse propagation direction and scatters, considered statistically, in the direction of the through-hole **10** and of the surrounding material of the body **12**.

**[0035]** Due to this scattering, without the funnel-shaped breakout according to FIG. **11** known in conventional punching, high adhesion forces between the punch **11** and the wall of the through-passage **10** result upon penetration of the punch **11** and accelerate wear due to abrasion, as shown in FIG. **12**.

**[0036]** In the now improved method of the aforementioned method for punching by means of HSIC, the actual generation of the through-passage **10** and the ejection of the slug **13** are separated from each other. This is apparent from

**[0037]** FIGS. **6** and **7** that illustrate generation of the slug **13** and retraction of the punch **11**. In this context, it should be noted that a first dimension D at the punch **11** corresponds very precisely to the inner width or diameter of the passage **10**.

**[0038]** In FIG. **8**, it can be seen that an ejector **14** with a second reduced dimension d has pushed the slug **13**, generated already upon short insertion of the punch **11**, all the way through the passage **10** and thus has ejected it.

**[0039]** FIG. **9** shows the end position with removed slug **13** and completely produced passage **10**.

**[0040]** FIG. **10** shows in an exemplary fashion the generation of the passage **10** according to the invention (FIG. **4**). Here, the slug in the form of a gear **13** produced by means of HSIC is utilized. The punches with closed cutting line can be formed in a shape so that, instead of the slug **13**, the metal body **12** that has surrounded it before forms the workpiece.

**[0041]** By means of the method according to the invention, it is now possible to provide in a much shorter time a metal workpiece with a through-passage and to increase the service life of the tool.

LIST OF REFERENCE CHARACTERS

**[0042]** **10** through-passage
**[0043]** **11** punch
**[0044]** **12** metal body
**[0045]** **13** slug, gear
**[0046]** **14** ejector
**[0047]** D first dimension
**[0048]** d second dimension

What is claimed is:

**1-6**. (canceled)

**7**. A method for creating through-passages in a metal body by high-speed impact cutting (HSIC) with a closed cutting line, the method comprising:

introducing a punch, comprising a first dimension that corresponds to a dimension of a through-passage to be produced, with a stroke movement to an insertion depth into a metal body, wherein at the insertion depth a break in a direction of action of the punch exists through the entire metal body and a slug is formed in a through-passage;

stopping the stroke movement of the punch;

retracting the punch;

driving the slug out of the through-passage with an ejector, wherein the ejector comprises a second dimension that is smaller compared to the first dimension of the punch.

**8**. The method according to claim **7**, wherein the ejector performs a stroke movement simultaneously with the punch.

**9**. The method according to claim **8**, comprising driving the ejector and the punch with the same drive.

**10**. The method according to claim **7**, wherein the ejector performs a stroke movement independent of the stroke movement of the punch.

**11**. The method according to claim **10**, comprising driving the punch with a first drive and driving the ejector with a second drive.

**12**. The method according to claim **7**, wherein the slug is a product to be produced.

**13**. The method according to claim **12**, wherein the slug is a gear.

**14**. The method according to claim **7**, wherein the through-passage that is produced by removing the slug from the metal body imparts a desired contour to a product to be produced.

**15**. The method according to claim **7**, wherein the metal body has a curved surface and the punch is introduced via the curved surface.

**16**. The method according to claim **7**, wherein the through-passage is a through-hole of a sliding block.

* * * * *