

Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a high-precision punch and die apparatus, comprising a stationary frame, a punch adapted for movement relative to said frame, said punch having integral bearing surfaces and at least one cutting edge, a die adjustably mounted to said frame to receive said punch therethrough, said die having at least one cutting edge adapted to coact with said at least one cutting edge on said punch.

Description of the Prior Art

The prior art is replete with disclosures of various apparatus intended to achieve precisely controlled positioning of a moving member. For example, U. S. Patent No. 3,903,993 to Vorrhees et al. discloses a press slide which is reciprocable in a press frame. Hydrostatic bearings guide the slide as it reciprocates, and they resist any lateral deflection thereof due to an unbalanced load. For another example, U. S. Patent No. 4,448,460 to Yamamoto discloses a hydrostatic bearing arrangement intended to achieve greater load bearing capacity and rigidity for a sliding member. Also, U. S. Patent No. 4,606,587 to Thompson discloses a precision air slide that includes a slide ram which is movable, with the aid of air bearings, inside a relatively stationary segmented housing. DD-A-0 135 591 discloses a punch press having a differential piston connected between the punch and the actuator handle.

While such known apparatus may have sufficed for their respective purposes, there has remained a persistent need for an effective and practical way to achieve both high precision and negligible wear in punch and die apparatus.

SUMMARY OF THE INVENTION

Accordingly, a primary object of this invention has been to meet the foregoing need in such apparatus, and to do so in a totally reliable, yet practical and economical, manner. That and other objects have been achieved by the invention herein disclosed and claimed.

This invention finds utility in a high-precision punch and die apparatus comprising a stationary frame; a punch adapted for movement relative to the frame, the punch having integral bearing surfaces and at least one cutting edge; and a die adjustably mounted to the frame to receive the punch therethrough, the die having at least one

cutting edge adapted to coact with the cutting edge(s) on the punch. The invention is characterized by the bearing surfaces being pneumostatic surfaces in a pair of pneumostatic bearings provided to constrain and guide movement of the punch through the die, each bearing being a segmented linear slide bearing that includes a plurality of slide segments formed with a pneumostatic bearing surface, the slide segments being adjustably mounted, relative to the frame, to receive the punch therebetween so that the bearing surface on each slide segment is in closely spaced relation to an opposing one of the bearing surfaces on the punch. Also provided are means for controllably supplying a pressurized gas to the bearing surface on each slide segment, to facilitate constraining and guiding movement of the punch through the die, and means for effecting such movement of the punch through the die so as to move the cutting edge(s) on the punch into coacting relation with the cutting edge(s) on the die.

This invention, and its objects and advantages, will become more apparent in the detailed description of the illustrated embodiments thereof presented hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the embodiments of this invention presented below, reference is made to the accompanying drawings, wherein like reference characters denote like elements, and wherein:

Fig. 1 is a perspective view of a punch as configured in accordance with an embodiment of this invention;

Fig. 2 is a perspective view of the punch shown in Fig. 1 together with a segmented die configured in accordance with an embodiment of this invention;

Fig. 3 is a perspective view of the punch and die shown in Fig. 2 together with a pair of pneumostatic bearings configured in accordance with an embodiment of this invention;

Fig. 4 is a perspective view similar to Fig. 3 but with additional structure for mounting the die and pneumostatic bearings, and with schematic depiction of respective means for pressurizing the bearings and moving the punch therethrough;

Fig. 5 is a perspective view similar to Fig. 4 but showing an exemplary work piece still in place after being notched by the punch and die;

Fig. 6 is a perspective view of a set-up bar useful in correctly sizing and aligning the bearings and die shown in Figs. 3-5; and

Figs. 7-10 are perspective views illustrating alternative embodiments of the present invention.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Because certain parts of punch and die apparatus are well known, the following description is directed in particular to those elements forming, cooperating directly with, or relating to, this invention. Elements not specifically shown or described herein are selectable from those known in the relevant art.

Fig. 1 illustrates a punch 10 configured in accordance with one embodiment of this invention. Punch 10 is an elongate one-piece member made of air-hardened tool steel and having a generally rectangular cross section. Punch 10 has a cut-out section 12 with a cutting edge 14 formed at the upper end thereof. Above and below cut-out section 12, on all four sides of the punch, are integral pneumostatic bearing surfaces, only four of which, 16, 18, 20, and 22, are shown. At the top end of punch 10 are a pair of lugs 24 adapted to be operatively coupled to a suitable motion-imparting means such as a pneumatic cylinder.

Turning now to Fig. 2, punch 10 is shown together with a segmented die 26, which comprises three die segments 26a, 26b, and 26c having cutting edges 28a, 28b, and 28c, respectively. The die segments are clustered about a central portion of cut-out section 12 so as to position their cutting edges for proper coaction with cutting edge 14, to effect thereby a desired cutting action upon downward movement of the punch through the die. The generally U-shaped die 26 is segmented as shown so that each leg of the U individually may be machined to the precision required, sharpened, and adjustably set to achieve a "near zero" clearance with the opposing surface of punch 10. The die segments also are made from air-hardened tool steel.

Fig. 3 shows the punch and die combination of Fig. 2 together with segmented upper and lower pneumostatic linear slide bearings 30 and 34. Upper bearing 30 comprises slide bearing segments 30a, 30b, 30c, and 30d provided with pneumostatic bearing surfaces 32a, 32b, 32c, and 32d respectively. Similarly, lower bearing 34 comprises slide bearing segments 34a, 34b, 34c, and 34d provided with pneumostatic bearing surfaces 36a, 36b, 36c, and 36d respectively. Both bearings 30 and 34 are positioned so that their bearing surfaces lie in close face-to-face relation to respective ones of the bearing surfaces on punch 10. For example, upper bearing surface 32b lies in close facing relation to punch bearing surface 16, while upper bearing surface 32c lies in such relation to punch surface 18. Similarly, lower bearing surfaces 36b and 36c lie in such relation to punch bearing surfaces 20 and 22 respectively.

Fig. 4 illustrates the combination of punch 10 mounted to a stationary rigid mounting frame structure 40. In this figure, the upper and lower bearing segments are shown extended in a retracted manner to provide corresponding integral supports for the die segments. Thus bearing segment 34a as so extended includes a horizontal leg 38a for supporting die segment 26a. Similarly, bearing segment 34b as extended includes a horizontal leg 38b for supporting die segment 26b, and bearing segment 34c as extended includes a horizontal leg 38c for supporting die segment 26c. Each of the die segments 26a, 26b, and 26c is adjustably mounted on its respective supporting leg by mounting screws 26s in oversized mounting screw holes. The mounting frame structure 40 comprises a tubular steel structure of rectangular cross section including four mutually perpendicular walls 40a, 40b, 40c, and 40d. Upper bearing segment 30d and lower bearing segment 34d are rigidly secured to wall 40d. Similarly, upper bearing segment 30c and extended lower bearing segment 34c are rigidly secured to wall 40c. Upper bearing segment 30b also is secured to the adjacent end of upper bearing segment 30d, and lower bearing segment 34b is secured to the adjacent end of lower bearing segment 34d. Upper bearing segment 30a then is adjustably mounted to the adjacent end of upper bearing segment 30b which is adjustably mounted to the adjacent end of upper bearing segment 30c. Similarly, lower bearing segment 34a and supporting leg 38a are adjustably mounted to the adjacent ends of lower bearing segment 34b and supporting leg 38b respectively. Fig. 4 shows the foregoing members so mounted upon structure 40 with punch 10 inserted through the openings thus provided by the air bearings and die.

Also depicted in Fig. 4 are upper bearing gas supply ports 30g and lower bearing gas supply ports 34g. Preferably, for convenience, the gas supplied through those ports to their respective bearing surfaces is air. Ports 30g and 34g are schematically shown connected through suitable control means C30 and C34 to a source G of pressurized air. Also schematically shown in this figure is a pneumatic cylinder P, operatively coupled to lugs 24 at the top end of punch 10, for effecting movement of the punch through the die as required for a desired cutting operation.

Fig. 5 is similar to Fig. 4 in that it shows the principal components of the punch and die apparatus just described, but also shows a rectangular work piece K still in its work position after a notch N has been cut in one edge thereof.

Fig. 6 illustrates a set-up bar B that is used in setting up the described apparatus to achieve the required sizing and alignment of its pneumostatic

bearings and die. As may be seen from a comparison of Figs. 1 and 6, bar B is similar to punch 10 without cut-out section 12 and lugs 24. Bar B is made slightly wider and thicker than punch 10 in order to achieve the clearances needed between the punch and the bearings and die. In setting up the apparatus, bar B is positioned in the bearing and die openings, and the adjustably mounted bearing and die segments are then set in contact with the opposing surfaces on the bar. The mounting screws for those segments are then tightened, and the bar is removed. In this manner, the bearings and die are precisely aligned with one another, and they are sized to provide the working clearances needed between them and the punch. The punch is then inserted through the bearing and die openings and operatively coupled to the aforementioned pneumatic cylinder P.

Fig. 7 illustrates an alternative embodiment of the present invention. Shown in this figure is a punch 50 which is similar to punch 10 but differs therefrom in that cut-out section 52 of punch 50 is configured to provide a rectangular punch finger 54 having four orthogonal cutting edges 56. Adjustably mounted for alignment with punch finger 54 is a segmented die 58 comprising four die segments 58a, 58b, 58c, and 58d. Those segments have cutting edges 60a, 60b, 60c, and 60d which coact with punch finger cutting edges 56 to cut a rectangular aperture. Punch 50 is provided with pneumostatic bearing surfaces above and below die 58 for cooperation with pneumostatic bearings similar to those described above.

Fig. 8 depicts another embodiment of this invention wherein punch 70 has, within its cut-out section 72, a depending cylindrical punch finger 74 with a circular cutting edge 74e. For convenience, finger 74 may be made removable from the punch. In this embodiment, the cooperating die 76 is a non-segmented, one-piece die provided with a cylindrical die opening 76o having a circular cutting edge 76e that coacts with punch finger cutting edge 74e to cut a circular aperture. Here too, the punch is constrained and guided by pneumostatic bearings disposed above and below the die.

Fig. 9 illustrates still another embodiment, which is similar to that shown in Fig. 3 but differs therefrom in that die 26' in Fig. 9 is disposed below both pneumostatic bearings 30' and 34'. In this embodiment, punch 80 has its cut-out portion 82 and cutting edge 84 located at the bottom end of the punch to cooperate with the die 26' below lower bearing 34'.

Fig. 10 depicts yet another embodiment, which is similar to that shown in Fig. 9 but differs therefrom in that punch 90 in Fig. 10 has, depending from its bottom end, a cylindrical punch finger 92 with a circular cutting edge 92e disposed above a

cooperating one-piece die 76' having a cylindrical die opening 76o' and circular cutting edge 76e'. As in the Fig. 8 embodiment, finger 92 may be removable from punch 90 for convenience in sharpening and replacement.

From the foregoing, it will be seen that this invention is adaptable for use in various ways to meet a variety of needs in punch and die apparatus. Such apparatus as improved by this invention has proven successful in high-volume production applications requiring extremely precise punch constraint and guidance, very little tool wear, and facile set-up and change-over capability.

Claims

1. A high-precision punch and die apparatus comprising

a stationary frame (40);

a punch (10) adapted for movement relative to said frame (40), said punch (10) having integral bearing surfaces (16, 18, 20, 22 et al.) and at least one cutting edge (14);

a die (26) adjustably mounted to said frame (40) to receive said punch (10) therethrough, said die (26) having at least one cutting edge (28a, b, c) adapted to coact with said at least one cutting edge (14) on said punch (10);

characterised by said bearing surfaces (16, 18, 20, 22) on said punch being pneumostatic bearing surfaces;

a pair of pneumostatic bearings (30 and 34) for constraining and guiding movement of said punch (10) through said die (26) each of said bearings (30 and 34) being a segmented linear slide bearing including a plurality of slide segments (30a, b, c, d and 34a, b, c, d) provided with a pneumostatic bearing surface (32a, b, c, d and 36a, b, c, d), said slide segments (30a, b, c, d and 34a, b, c, d) being adjustably mounted, with respect to said frame (40), to receive said punch (10) therebetween so that said bearing surface (32a, b, c, d and 36a, b, c, d) on each of said slide segments (30a, b, c, d and 34a, b, c, d) is in closely spaced relation to an opposing one of said bearing surfaces (16, 18, 20, 22 et al.) on said punch (10);

means (30g, C30 and 34g, C34) for controllably supplying a pressurized gas (G) to said bearing surface (32a, b, c, d and 36a, b, c, d) on each of said slide segments (30a, b, c, d and 34a, b, c, d) to facilitate said constraining and guiding of said movement of said punch (10) through said die (26); and

means (P) for effecting said movement of said punch (10) through said die (26) so as to move said at least one cutting edge (14) on



bearings and die. As may be seen from a comparison of Figs. 1 and 6, bar B is similar to punch 10 without cut-out section 12 and lugs 24. Bar B is made slightly wider and thicker than punch 10 in order to achieve the clearances needed between the punch and the bearings and die. In setting up the apparatus, bar B is positioned in the bearing and die openings, and the adjustably mounted bearing and die segments are then set in contact with the opposing surfaces on the bar. The mounting screws for those segments are then tightened, and the bar is removed. In this manner, the bearings and die are precisely aligned with one another, and they are sized to provide the working clearances needed between them and the punch. The punch is then inserted through the bearing and die openings and operatively coupled to the aforementioned pneumatic cylinder P.

Fig. 7 illustrates an alternative embodiment of the present invention. Shown in this figure is a punch 50 which is similar to punch 10 but differs therefrom in that cut-out section 52 of punch 50 is configured to provide a rectangular punch finger 54 having four orthogonal cutting edges 56. Adjustably mounted for alignment with punch finger 54 is a segmented die 58 comprising four die segments 58a, 58b, 58c, and 58d. Those segments have cutting edges 60a, 60b, 60c, and 60d which coact with punch finger cutting edges 56 to cut a rectangular aperture. Punch 50 is provided with pneumostatic bearing surfaces above and below die 58 for cooperation with pneumostatic bearings similar to those described above.

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cooperating one-piece die 76' having a cylindrical die opening 76o' and circular cutting edge 76e'. As in the Fig. 8 embodiment, finger 92 may be removable from punch 90 for convenience in sharpening and replacement.

From the foregoing, it will be seen that this invention is adaptable for use in various ways to meet a variety of needs in punch and die apparatus. Such apparatus as improved by this invention has proven successful in high-volume production applications requiring extremely precise punch constraint and guidance, very little tool wear, and facile set-up and change-over capability.

Claims

1. A high-precision punch and die apparatus comprising
 - a stationary frame (40);
 - a punch (10) adapted for movement relative to said frame (40), said punch (10) having integral bearing surfaces (16, 18, 20, 22 et al.) and at least one cutting edge (14);
 - a die (26) adjustably mounted to said frame (40) to receive said punch (10) therethrough, said die (26) having at least one cutting edge (28a, b, c) adapted to coact with said at least one cutting edge (14) on said punch (10);
 - characterised by said bearing surfaces (16, 18, 20, 22) on said punch being pneumostatic bearing surfaces;
 - a pair of pneumostatic bearings (30 and 34) for constraining and guiding movement of said punch (10) through said die (26) each of said bearings (30 and 34) being a segmented linear slide bearing including a plurality of slide segments (30a, b, c, d and 34a, b, c, d) provided with a pneumostatic bearing surface (32a, b, c, d and 36a, b, c, d), said slide segments (30a, b, c, d and 34a, b, c, d) being adjustably mounted, with respect to said frame (40), to receive said punch (10) therebetween so that said bearing surface (32a, b, c, d and 36a, b, c, d) on each of said slide segments (30a, b, c, d and 34a, b, c, d) is in closely spaced relation to an opposing one of said bearing surfaces (16, 18, 20, 22 et al.) on said punch (10);
 - means (30g, C30 and 34g, C34) for controllably supplying a pressurized gas (G) to said bearing surface (32a, b, c, d and 36a, b, c, d) on each of said slide segments (30a, b, c, d and 34a, b, c, d) to facilitate said constraining and guiding of said movement of said punch (10) through said die (26); and
 - means (P) for effecting said movement of said punch (10) through said die (26) so as to move said at least one cutting edge (14) on

- said punch (10) into coacting relation with said at least one cutting edge (28a, b, c) on said die (26).
2. A punch and die apparatus as claimed in Claim 1 wherein said stationary frame (40) comprises a single tubular metal structure. 5
 3. A punch and die apparatus as claimed in Claim 1 wherein said at least one cutting edge (14) on said punch (10) corresponds in number to said at least one cutting edge (28a, b, c) on said die (26). 10
 4. A punch and die apparatus as claimed in Claim 1 wherein said die (26) is a segmented die including a plurality of die segments (26a, b, c) adjustably mounted, with respect to said frame (40), to receive said punch (10) therebetween; and wherein said at least one cutting edge (28a, b, c) on said die (26) includes a cutting edge on each of said die segments (26a, b, c). 15
 5. A punch and die apparatus as claimed in Claim 4 wherein said punch (10) comprises an elongate member of rectangular cross section; wherein said segmented die (26) is U-shaped; and wherein said plurality of die segments (26a, b, c) comprises three such segments. 20
 6. A punch and die apparatus as claimed in Claim 4 wherein said punch (10) comprises an elongate member of rectangular cross section; wherein each of said segmented linear slide bearings (30 and 34) is rectangular; and wherein said plurality of segments (30a, b, c, d and 34a, b, c, d) of each linear slide bearing comprises four such segments. 25
 7. A punch and die apparatus as claimed in Claim 5 wherein said die (26) is disposed between said bearings (30 and 34). 30
 8. A punch and die apparatus as claimed in Claim 6 wherein said die (26) is disposed between said bearings (30 and 34). 35
 9. A punch and die apparatus as claimed in Claim 1 wherein said bearings (30' and 34') are both disposed at one side of said die (26'). 40
 10. A punch and die apparatus as claimed in Claim 1 wherein said bearings (30 and 34) are respectively disposed at opposite sides of said die (26). 45
 11. A punch and die apparatus as claimed in Claim 1 wherein said bearings (30 and 34) and said die (26) are vertically aligned in superposed relation, with one (30) of said bearings (30 and 34) above and the other (34) below said die (26). 50
 12. A punch and die apparatus as claimed in Claim 1 wherein said gas (G) is air, said pneumostatic bearings (30 and 34) are air bearings, and said pneumostatic bearing surface(s) (32a, b, c, d and 36a, b, c, d) are air bearing surfaces. 55
 13. A punch and die apparatus as claimed in Claim 1 wherein said movement effecting means (P) includes a pneumatic cylinder operatively coupled to said punch (10).

Patentansprüche

1. Präzisions-Stempel- und Matrizenvorrichtung mit
einem ortsfesten Gestell (40),
einem relativ zu dem Gestell (40) bewegbaren Stempel (10) mit integrierten Lagerflächen (16, 18, 20, 22 etc) und mindestens einer Schneidekante (14) und
einer einstellbar an dem Gestell (40) gelagerten Matrice (26), durch die der Stempel (10) hindurchbewegbar ist und die mindestens eine mit einer Schneidekante (14) des Stempels (10) zusammenwirkende Schneidekante (28a, b, c) aufweist,
dadurch gekennzeichnet, daß
die auf dem Stempel vorgesehenen Lagerflächen (16, 18, 20, 22) pneumostatische Lagerflächen sind,
zwei pneumostatische Lagerelemente (30 und 34) vorgesehen sind, die die Bewegung des Stempels (10) durch die Matrice (26) begrenzen und führen und die jeweils aus einem aus mehreren Teilen zusammengesetzten linearen Gleitlager bestehen, das eine Vielzahl von Gleitsegmenten (30a, b, c, d und 34a, b, c, d) aufweist, die jeweils mit einer pneumostatischen Lagerfläche (32a, b, c, d und 36a, b, c, d) versehen sind, und daß die Gleitsegmente (30a, b, c, d und 34a, b, c, d) gegenüber dem Gestell (40) einstellbar gelagert sind, um den Stempel (10) zwischen sich so aufzunehmen, daß die Lagerfläche (32a, b, c, d und 36a, b, c, d) auf jedem der Gleitsegmente (30a, b, c, d und 34a, b, c, d) in geringem Abstand von einer ihr gegenüberliegenden Lagerfläche (16, 18, 20, 22 etc) des Stempels (10) angeordnet ist,
Mittel (30g, C30 und 34g, C34) vorgesehen



sind, die der Lagerfläche (32a, b, c, d und 36a, b, c, d) jedes Gleitsegments (30a, b, c, d und 34a, b, c, d) in dosierter Menge ein unter Druck stehendes Gas (G) zuführen, um das Begrenzen und Führen des Stempels (10) bei seiner Bewegung durch die Matrize (26) zu erleichtern, und

eine Einrichtung (P) den Stempel (10) derart durch die Matrize (26) bewegt, daß mindestens eine Schneidekante (14) des Stempels (10) mit der mindestens einen Schneidekante (28a, b, c) der Matrize (26) zusammenwirkt.

2. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das ortsfeste Gestell (40) aus einem einzigen rohrförmigen Metallteil besteht.

3. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß mindestens eine Schneidekante (14) des Stempels (10) zahlenmäßig der mindestens einen Schneidekante (28a, b, c) Matrize (26) entspricht.

4. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Matrize (26) aus mehreren Teilen zusammengesetzt ist und eine Vielzahl von Matrizensegmenten (26a, b, c) aufweist, die gegenüber dem Gestell (40) einstellbar gelagert sind und den Stempel (10) zwischen sich aufnehmen, und daß die mindestens eine Schneidekante (28a, b, c) der Matrize (26) eine Schneidekante auf jedem der Matrizensegmente (26a, b, c) umfaßt.

5. Stempel- und Matrizenvorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß der Stempel (10) aus einem langgestreckten Element mit rechteckigem Querschnitt besteht, daß die aus mehreren Teilen zusammengesetzte Matrize (26) U-förmig ausgebildet ist und daß die Vielzahl von Matrizensegmenten (26a, b, c) drei solcher Segmente umfaßt.

6. Stempel- und Matrizenvorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß der Stempel (10) aus einem langgestrecktem Element mit rechteckigem Querschnitt besteht, daß jedes der aus Segmenten bestehenden linearen Gleitlager (30 und 34) rechteckig ist und daß die Vielzahl der Gleitsegmente (30a, b, c, d und 34a, b, c, d) eines jeden linearen Gleitlagers vier solcher Segmente umfaßt.

7. Stempel- und Matrizenvorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die

Matrize (26) zwischen den Lagerelementen (30 und 34) angeordnet ist.

8. Stempel- und Matrizenvorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die Matrize (26) zwischen den Lagerelementen (30 und 34) angeordnet ist.

9. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Lagerelemente (30' und 34') beide auf einer Seite der Matrize (26') angeordnet sind.

10. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Lagerelemente (30 und 34) auf gegenüberliegenden Seiten der Matrize (26) angeordnet sind.

11. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Lagerelemente (30 und 34) und die Matrize (26) senkrecht übereinanderliegend ausgerichtet sind, wobei eines (30) der Lagerelemente (30 und 34) über und das andere (34) unter der Matrize (26) liegt.

12. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Gas (G) aus Luft besteht, die pneumostatischen Lager (30 und 34) Luftlager und die pneumostatischen Lagerfläche(n) (32a, b, c, d und 36a, b, c, d) Luftlagerflächen sind.

13. Stempel- und Matrizenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Bewegungseinrichtung (P) einen pneumatischen Zylinder umfaßt, der mit dem Stempel (10) in Wirkverbindung steht.

Revendications

1. Dispositif à poinçon et matrice de haute précision, comprenant un châssis fixe (40), un poinçon (10) agencé de façon à pouvoir se déplacer vis-à-vis du châssis (40), ce poinçon (10) comportant des surfaces de portée (16, 18, 20, 22 et autres) venues de matière et au moins une arête de coupe (14), et une matrice (26) montée d'une manière réglable sur le châssis (40) de façon à recevoir le poinçon (10) de manière qu'il la traverse, cette matrice (26) comportant au moins une arête de coupe (28a, b, c) agencée de façon à coopérer avec ladite arête de coupe (14) située sur le poinçon (10), caractérisé en ce que les surfaces de portée (16, 18, 20, 22) situées sur le poinçon sont des surfaces de portée pneumostatiques, deux pa-



- liers pneumostatiques (30, 34) étant prévus pour contenir et guider le déplacement du poinçon (10) à travers la matrice (26), chacun des paliers (30, 34) étant constitué d'un palier lisse rectiligne segmenté comportant plusieurs segments de glissement (30a, b, c, d et 34a, b, c, d) pourvus d'une surface de portée pneumostatique (32a, b, c, d et 36a, b, c, d), ces segments de glissement (30a, b, c, d et 34a, b, c, d) étant montés d'une manière réglable vis-à-vis du châssis (40) de façon à recevoir le poinçon (10) entre eux, de manière telle que ladite surface de portée (32a, b, c, d et 36a, b, c, d) située sur chacun des segments de glissement (30a, b, c, d et 34a, b, c, d) soit disposée d'une manière étroitement espacée vis-à-vis de l'une des surfaces de portée (16, 18, 20, 22 et autres) du poinçon (10) qui lui fait face, et en ce qu'il comprend en outre des moyens (30g, C30 et 34g, C34) servant à fournir un gaz sous pression (G) d'une manière réglable à ladite surface de portée (32a, b, c, d et 36a, b, c, d) située sur chacun des segments de glissement (30a, b, c, d et 34a, b, c, d), de façon à faciliter la retenue et le guidage du déplacement du poinçon (10) à travers la matrice (26), et des moyens (P) servant à réaliser ledit déplacement du poinçon (10) à travers la matrice (26) de manière à déplacer la ou les arêtes de coupe (14) situées sur le poinçon (10) suivant une disposition relative la ou les faisant coopérer avec la ou les arêtes de coupe (28a, b, c) situées sur la matrice (26).
2. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel le châssis fixe (40) comprend une structure métallique tubulaire unique.
 3. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel la ou les arêtes de coupe (14) situées sur le poinçon (10) sont en nombre correspondant à la ou les arêtes de coupe (28a, b, c) situées sur la matrice (26).
 4. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel la matrice (26) est une matrice segmentée comprenant plusieurs segments de matrice (26a, b, c) qui sont montés d'une manière réglable vis-à-vis du châssis (40), de façon à recevoir le poinçon (10) entre eux, et dans lequel les arêtes de coupe (28a, b, c) situées sur la matrice (26) comprennent une arête de coupe sur chacun des segments de matrice (26a, b, c).
 5. Dispositif à poinçon et matrice suivant la revendication 4, dans lequel le poinçon (10) comprend une pièce allongée à section transversale rectangulaire, la matrice segmentée (26) a une forme en U et les segments de matrice (26a, b, c) sont au nombre de trois segments.
 6. Dispositif à poinçon et matrice suivant la revendication 4, dans lequel le poinçon (10) comprend une pièce allongée à section transversale rectangulaire, chacun des paliers lisses rectilignes segmentés (30 et 34) est rectangulaire et les segments (30a, b, c, d et 34a, b, c, d) de chaque palier lisse rectiligne sont au nombre de quatre segments.
 7. Dispositif à poinçon et matrice suivant la revendication 5, dans lequel la matrice (26) est disposée entre les paliers (30 et 34).
 8. Dispositif à poinçon et matrice suivant la revendication 6, dans lequel la matrice (26) est disposée entre les paliers (30 et 34).
 9. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel les paliers (30' et 34') sont tous deux disposés d'un même côté de la matrice (26').
 10. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel les paliers (30 et 34) sont disposés respectivement de part et d'autre de la matrice (26).
 11. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel les paliers (30 et 34) et la matrice (26) sont disposés suivant le même alignement vertical et d'une manière superposée, l'un (30) des paliers (30 et 34) étant situé au-dessus de la matrice (26) et l'autre (34) au-dessous de cette dernière.
 12. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel le gaz (G) est de l'air, les paliers pneumostatiques (30 et 34) sont des paliers à air et la ou les surfaces de portée pneumostatiques (32a, b, c, d et 36a, b, c, d) sont des surfaces de portée à air.
 13. Dispositif à poinçon et matrice suivant la revendication 1, dans lequel les moyens de réalisation de déplacement (P) comprennent un vérin pneumatique accouplé fonctionnellement au poinçon (10).

