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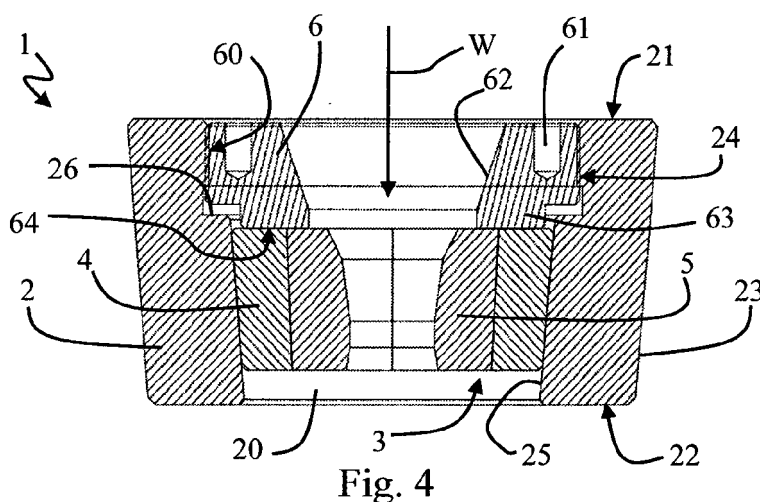
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(54) **Drawing die tool and method of forming such a drawing die tool**

(57) A drawing die tool (1) is provided, which comprises: a wear-resistant forming insert (5) having an outer surface (50) tapering in a working direction (W); a steel sleeve (4) made of hot working steel into which the wear-resistant forming insert (5) is fitted by shrink-fitting, the steel sleeve (4) having an internal surface (41) tapering in the working direction which is adapted for cooperating with the outer surface (50) of the wear-resistant forming

insert (5) and an external surface (40); an outer casing (2) having an internal surface (25) in which the steel sleeve (4) together with the wear-resistant forming insert (5) is mounted with the external surface (40) of the steel sleeve (4) contacting the internal surface (25) of the outer casing (2); and a securing element (6) for securing the steel sleeve (4) and the wear-resistant forming insert (5) in the outer casing (2).



Description

[0001] The present invention relates to a drawing die tool and to a method of forming a drawing die tool.

[0002] Die tools for forming a material in a process in which the material to be formed is moved relative to the die tool are largely employed particularly in the field of metal working. Typically, such die tools are used for drawing or hot extrusion of metals. In such applications, die tools are typically provided with a wear-resistant forming insert as a functional part which is in contact with the material to be formed. In metal forming applications, the wear-resistant forming inserts are typically made from cemented carbide material.

[0003] Although the general setup appears somewhat similar in hot extrusion processes and in drawing processes, there are important differences: In hot extrusion processes of metals, during operation the die tools are subjected to high temperatures due to the required high temperature of the metal to be formed. Thus, one of the most important aspects in die tool design is to provide a die tool capable to withstand the high working temperature occurring during operation.

[0004] In drawing processes, elevated temperatures result from frictional forces acting between the material to be formed and the forming surfaces of the die tool. However, due to the cold working process involved in a drawing process, an even more important aspect in die tool design of a drawing die tool is to keep resulting frictional forces on a level as low as possible.

[0005] GB 2 043 511 A describes an interchangeable die for drawing and drawing-and-shaving comprising an outer casing having a frusto-conical bore which receives a frusto-conical clamping sleeve. The clamping sleeve has a cylindrical bore in which an annular shoulder is provided for locating a cylindrical cemented carbide forming insert in the clamping sleeve. The clamping sleeve has a plurality of axially extending slots. The sleeve, and with it the forming insert, is clamped in position by means of a cylindrical externally screwthreaded thrust ring which is screwed into a cylindrical bore portion of the outer casing.

[0006] It is an object of the present invention to provide an improved drawing die tool which provides improved dimensional accuracy, low resulting frictional forces during operation, small size of the drawing die tool and at the same time high mechanical resistance.

[0007] The object is solved by the drawing die tool according to claim 1. Further developments are specified in the dependent claims.

[0008] The drawing die tool comprises: a wear-resistant forming insert having an outer surface tapering in a working direction; a steel sleeve made of hot working steel into which the wear-resistant forming insert is fitted by shrink-fitting, the steel sleeve having an internal surface tapering in the working direction which is adapted for cooperating with the outer surface of the wear-resistant forming insert and an external surface; an outer cas-

ing having an internal surface in which the steel sleeve together with the wear-resistant forming insert is mounted with the external surface of the steel sleeve contacting the internal surface of the outer casing; and a securing element for securing the steel sleeve and the wear-resistant forming insert in the outer casing.

[0009] In the present context, the term working direction specifies a direction into which a material to be drawn is moved relative to the drawing die tool. In the typical case of a stationary drawing die tool the working direction corresponds to the direction into which the material to be drawn is moved. Since the wear-resistant forming insert has the outer surface which tapers in the working direction and the steel sleeve has the corresponding tapering internal surface, these surfaces cooperate to act against the axial forces arising during the drawing process, i.e. to act against the axial forces applied to the forming insert by the material which is forced through the forming insert. The securing element prevents undesired movement of the exchangeable wear tool formed by the wear-resistant forming insert and the steel sleeve during the drawing process and acts against resulting axial forces directed in the direction opposite to the working direction which occur at the end of a drawing process. Such axial forces at the end of a drawing process are inertia forces resulting from terminating forcing material through the internal forming surface of the wear-resistant forming insert.

[0010] Since the steel sleeve is made of hot working steel, the steel sleeve maintains its mechanical properties even at the high temperatures resulting from the friction between the forming insert and the worked material during the drawing process. Since the forming insert is shrunk into the steel sleeve by shrink fitting, the steel sleeve provides compressive pre-stress to the wear-resistant forming insert increasing the mechanical resistance of the forming insert by acting against the tensile stresses generated in the forming insert by the drawing process. Due to the hot working steel having a high yield strength employed, the steel sleeve provides the required pre-stress with small dimensions in a thickness direction. Thus, the drawing die tool can be realized in a very compact size. Further, this enables shrink-fitting of the forming insert at elevated temperatures, e.g. higher than 500 °C, without deteriorating the mechanical properties of the steel sleeve.

[0011] The combination of the steel sleeve being made of hot working steel and the tapering shapes of the surfaces of the steel sleeve and of the forming insert allows repeatedly shrink-fitting the forming insert into the steel sleeve and removing it therefrom. Thus, the wear-resistant forming insert can e.g. first be fitted into the steel sleeve by the shrink-fitting process which influences the size of the internal forming surface of the forming insert due to caused deformations. In this mounted state, the internal forming surface of the forming insert can reliably be machined to the desired dimensions with low dimensional tolerances, e.g. by grinding or electric discharge machining (EDM). Thereafter, the wear-resistant forming

insert can be removed again from the steel sleeve by application of elevated temperature to the steel sleeve and by pressing the forming insert out in a pressing machine and the forming insert can be subjected to a coating process at high temperatures which would be too high for the material of the steel sleeve. E.g. a typical chemical vapor deposition process (CVD) involving high temperatures above 800 °C can be used for coating at least the internal forming surface of the wear-resistant forming insert. After the coating process, the forming insert can again be shrunk into the same steel sleeve as before such that the internal forming surface assumes exactly the same dimensions to which it was accurately machined before. In this way, a wear-resistant forming insert shrink-fitted into a steel sleeve and comprising a coated internal forming surface can be provided with very high dimensional accuracy. Coating the internal forming surface can effect a considerable reduction of the frictional forces arising during the drawing process such that tougher materials, such as e.g. stainless steel, can be drawn much easier, the drawing speed can be increased, and wear of the wear-resistant forming insert is significantly reduced. All this is achieved without adversely affecting the achievable dimensional tolerances. Further, after the forming insert is deteriorated by wear, it can easily be removed from the steel sleeve and its material can be recovered in a recycling process.

[0012] According to a further development, the external surface of the steel sleeve tapers in the working direction and the internal surface of the outer casing tapers in the working direction. In this case, the steel sleeve together with the forming insert is reliably centered in the outer casing. Further, the tapered shape of these surfaces also acts against the axial forces generated during the drawing process. In combination with the tapering shape of the forming insert's outer surface and of the steel sleeve's internal surface, this results in a very rigid construction of the drawing die tool even at small dimensions and undesired axial movement of the steel sleeve and/or the forming insert during the drawing process is reliably prevented.

[0013] According to a further development, at least an internal forming surface of the wear-resistant forming insert is provided with a wear-resistant coating. In this case, friction between the internal forming surface of the forming insert and the worked material can be reliably reduced such that tougher materials can be drawn much easier, the drawing speed can be increased, and wear of the forming insert is reduced. Preferably, the coating has the properties of a coating applied by chemical vapor deposition (CVD). If the coating is formed by a CVD process, particularly wear-resistant coatings are enabled.

[0014] According to a further development, the securing element has a ring shape and is provided with an external thread. In this case, the securing element can reliably secure the steel sleeve and the forming insert along the entire circumference thereof. Preferably, the outer casing comprises an internal thread cooperating

with the external thread of the securing element for securing the steel sleeve and the forming insert in the outer casing. In this case, the securing forces are reliably provided by cooperation between the steel sleeve and the outer casing which may also be made of steel.

[0015] According to a further development, the securing element comprises a retaining surface abutting against the steel sleeve and against the forming insert. In this case, the securing element reliably secures both the steel sleeve and the forming insert. It should be noted that the retaining surface may e.g. comprise a single surface abutting against both the steel sleeve and the forming insert or e.g. a plurality of part surfaces, e.g. separated by a step or groove. In the latter case, e.g. one or more part surfaces of the retaining surface may abut against the steel sleeve and one or more part surfaces of the retaining surface may abut against the wear-resistant forming insert.

[0016] Preferably, the hot working steel of the steel sleeve is hardened to at least 45 HRC, preferably between 45 and 50 HRC. In this case, the steel sleeve reliably provides high yield strength even at small dimensions.

[0017] Preferably, the wear-resistant forming insert is made from cemented carbide material.

[0018] The object is further solved by a method of forming a drawing die tool according to claim 10. Further developments are specified in the dependent claims.

[0019] The method of forming a drawing die tool comprises the following steps:

- Shrink-fitting a wear-resistant forming insert having an outer surface tapering in a working direction into a steel sleeve made from a hot working steel and having an internal surface tapering in the working direction;
- Machining an internal forming surface of the forming insert to predetermined dimensions;
- Dismounting the wear-resistant forming insert from the steel sleeve;
- Subjecting the wear-resistant forming insert to a coating process;
- Mounting the wear-resistant forming insert back into the steel sleeve by shrink-fitting;
- Placing the steel sleeve with the wear-resistant forming insert in an outer casing having an internal surface such that an external surface of the steel sleeve rests against the internal surface of the outer casing; and
- Securing the steel sleeve and the wear-resistant forming insert in the outer casing by a securing element.

[0020] With this method of forming a drawing die tool, the same advantages can be achieved as have been described before with regard to the drawing die tool. In particular, since the wear-resistant forming insert is fitted into the steel sleeve, then machined, thereafter removed

again and coated before being shrunk into the steel sleeve again, the internal forming surface comprises, on the one hand, high dimensional accuracy and, on the other hand, at the same time provides reduced frictional forces during the drawing process.

[0021] According to a further development, dismantling the wear-resistant forming insert from the steel sleeve comprises heating the steel sleeve. In this case, due to the steel sleeve being made of hot working steel and the forming insert being shrunk into the steel sleeve, the wear-resistant forming insert can easily be removed from the steel sleeve without damaging any of these components. Preferably, dismantling the wear-resistant forming insert from the steel sleeve comprises heating the steel sleeve and pressing the forming insert out, preferably in a pressing machine. Thus, the steel sleeve is reusable and has a long working life.

[0022] If the coating process is a CVD coating process, particularly wear-resistant coatings can conveniently be applied to the internal forming surface of the forming insert. According to one development, the coating process involves temperatures above 800 °C or even above 900 °C.

[0023] According to a further development, machining the internal forming surface of the forming insert comprises at least one of grinding and electrical discharge machining (EDM). In this case, the internal forming surface can be machined to the desired dimensions with particular high accuracy.

[0024] Further developments and advantages will become apparent from the following description of an embodiment with reference to the enclosed drawings.

[0025] In the figures:

- Fig. 1: is a perspective view of a drawing die tool according to an embodiment;
- Fig. 2: is a side view of the drawing die tool of Fig. 1;
- Fig. 3: is a top view of the drawing die tool;
- Fig. 4: is a sectional view of the drawing die tool according to the embodiment;
- Fig. 5: is a sectional view of an exchangeable wear tool formed by a wear-resistant forming insert shrunk into a steel sleeve; and
- Fig. 6a to 6c is a schematic illustration for explaining a method of forming a drawing die tool.

[0026] An embodiment will now be described with reference to the enclosed figures.

[0027] In the embodiment, the drawing die tool 1 is configured as a drawing die tool for forming metal, in particular for drawing stainless steel. In the specific embodiment shown, the drawing die tool 1 is adapted for drawing metal wire.

[0028] The drawing die tool 1 comprises an outer casing 2 configured such that it can be securely fixed in a drawing machine (not shown). The outer casing 2 has

substantially a hollow cylindrical shape with a symmetry axis Z. A through-hole 20 extends through the outer casing 2 from an inlet side 21 to an outlet side 22. A working direction W along which the material to be formed is moved relative to the drawing die tool 1 during operation extends in parallel to the symmetry axis Z from the inlet side 21 to the outlet side 22 of the outer casing 2. The outer casing 2 has an outer wall 23 extending between the inlet side 21 and the outlet side 22. The outer wall 23 has a substantially frustoconical shape tapering in the working direction W. Adjacent to the inlet side 21, the through-hole 20 is provided with an internal thread 24 the function of which will be described more in detail further below. At the other end of the outer casing 2, adjacent to the outlet side 22 the through-hole 20 comprises an internal surface 25 which tapers in the working direction W. The diameter of the through-hole 20 in the region of the internal surface 25 is smaller than the diameter of the through-bore 20 in the region of the internal thread 24. In the specific embodiment shown, the internal surface 25 tapers conically. Between the region of the internal thread 24 and the region of the tapering internal surface 25, a step 26 is provided in the wall of the through-hole 20.

[0029] An exchangeable wear tool 3 comprising a steel sleeve 4 and a wear-resistant forming insert 5 is arranged in the region of the tapering internal surface 25 in the through-hole 20 of the outer casing 2, as can e.g. be seen in Fig. 4. The exchangeable wear tool 3 is separately shown in Fig. 5.

[0030] The steel sleeve 4 is made of hot working steel hardened to a hardness between 45 and 50 HRC, wherein HRC means the Rockwell hardness which is determined as defined in DIN EN ISO 6508-1. The steel sleeve 4 comprises a ring shape having rotational symmetry about the symmetry axis Z. The steel sleeve 4 comprises an external surface 40 which tapers in the working direction W. The shape of the external surface 40 corresponds to the shape of the tapering internal surface 25 of the outer casing 2. In the specific embodiment, the external surface 40 of the steel sleeve 4 tapers conically with a cone angle corresponding to the cone angle of the internal surface 25. The steel sleeve 4 further comprises an internal surface 41 which also tapers in the working direction W. In the specific embodiment, the internal surface 41 tapers conically. Thus, the steel sleeve comprises a ring shape with a through-hole tapering in the working direction W and with an external surface 40 also tapering in the working direction W.

[0031] The wear-resistant forming insert 5 comprises a ring shape with an outer surface 50 tapering in the working direction W. The shape of the outer surface 50 corresponds to the tapering shape of the internal surface 41 of the steel sleeve 4. In the specific embodiment shown, the outer surface 50 tapers conically with the same cone angle as the cone angle of the internal surface 41 of the steel sleeve 4. As can be seen in Fig. 5, the axial length of the wear-resistant forming insert 5 is substantially identical to the axial length of the steel sleeve

4 such that the wear-resistant forming insert 5 can be entirely placed in the through-hole of the steel sleeve 4. The wear-resistant forming insert 5 has outer dimensions which - at room temperature - are slightly larger than the dimensions of the through-hole in the steel sleeve 4 such that the wear-resistant forming insert 5 can be securely fixed under compressive pre-stress in the through-hole by shrink-fitting. The wear-resistant forming insert 5 is fitted in the through-hole of the steel sleeve by a shrink-fitting process in which the steel sleeve 4 is heated up such that it thermally expands and the wear-resistant forming insert 5 can be pressed into the through-hole of the steel sleeve 4. After placing the wear-resistant forming insert 5 in the through-bore, the steel sleeve 4 is cooled down again such that it shrinks and applies a compressive force upon the wear-resistant forming insert 5. In this shrink-fitted state, the wear-resistant forming insert 5 is held in the steel sleeve 4.

[0032] The wear-resistant forming insert 5 is made from a cemented carbide material comprising hard particles and a binder. For example, the hard particles can comprise tungsten carbide and/or other carbides, carbonitrides and/or oxycarbonitrides of metals of groups IV, V and VI of the periodic table of elements. For example, the binder can comprise a metal, in particular at least one of Co, Fe, and Ni. The wear-resistant forming insert 5 comprises an internal forming surface 51 which is configured to contact the material to be worked during the drawing process and which forms the material to the intended shape. In the embodiment, the internal forming surface 51 is provided with a wear-resistant coating which is applied to forming insert 5 in a CVD (chemical vapour deposition) coating process at temperatures above 800 °C as will be described more detailed below.

[0033] As can be seen in Fig. 4, the exchangeable wear tool 3 comprising the steel sleeve 4 and the wear-resistant forming insert 5 is arranged in the tapering region of the through-hole 20 of the outer casing 2 such that the external surface 40 of the steel sleeve 4 contacts the tapering internal surface 25 of the outer casing 2.

[0034] The exchangeable wear tool 3 is secured in the outer casing 2 by a securing element 6. The securing element 6 is adapted for securing the steel sleeve 4 and the wear-resistant forming insert 5 in the outer casing 2. The securing element 6 has substantially a ring shape. The outer surface of the securing element 6 is provided with an external thread 60 adapted for cooperating with the internal thread 24 of the outer casing 2. Thus, the securing element 6 can be screwed into the outer casing 2. On its side facing away from the steel sleeve 4 and the forming insert 5, the securing element 2 is provided with a plurality of engagement portions 61 configured to be engaged by a fastening tool for screwing the securing element 6 in and out. In the embodiment shown, the engagement portions 61 are formed by blind holes into which corresponding pins of a fastening tool can be engaged. However, other realizations of the engagement portions are also possible. The securing element 6 com-

prises a through-hole 62 having a diameter which is larger than the inner diameter of the internal forming surface 51 of the forming insert 5.

[0035] On the side facing the steel sleeve 4 and the wear-resistant forming insert 5, the securing element 6 comprises a protrusion 63 having a reduced outer diameter such that the protrusion 63 can be moved into the tapering internal surface 25 of the outer casing 2 when the securing element 6 is screwed into the outer casing 2. On the side facing the steel sleeve 4 and the forming insert 5, the protrusion 63 comprises a retaining surface 64 configured for abutting against the steel sleeve 4 and the forming insert 5. In the specific embodiment shown, the retaining surface 64 is a ring-shaped flat surface surrounding the through-hole 62. When the securing element 6 is screwed into the outer casing 2, the retaining surface 64 acts against the steel sleeve 4 and the forming insert 5 to secure the exchangeable wear tool 3 in the outer casing 2. As can be seen in Fig. 4, the retaining surface 64 has an inner diameter which is smaller than the outer diameter of the forming insert 5 and an outer diameter which is larger than the inner diameter of the through-hole in the steel sleeve 4 on the side facing the securing element 6. In this way, the securing element 6 secures both the forming insert 5 and the steel sleeve 4 by abutting against their respective surfaces.

[0036] Thus, in the described embodiment the tapering outer surface 50 of the forming insert 5 and the corresponding tapering internal surface 41 of the steel sleeve 4 taper in the working direction W such that their tapered engagement acts against the axial forces arising during a drawing process performed with the drawing die tool 1. Similarly, the tapering external surface 40 of the steel sleeve 4 and the corresponding tapering internal surface 25 of the outer casing 2 taper in the working direction W such that their tapered engagement also acts against the arising axial forces during the drawing process. In consequence, a very rigid construction of the drawing die tool 1 is achieved even if the wall thickness of the steel sleeve 4 is chosen to be relatively small.

[0037] A method of forming the drawing die tool 1 will now briefly be described with reference to Figs. 6 a) to 6 c).

[0038] In a first step, the wear-resistant forming insert 5 is fitted into the steel sleeve 6 by a shrink-fitting process in which the steel sleeve 6 is heated up, the wear-resistant forming insert 5 is inserted into the steel sleeve 6, and the steel-sleeve 6 is cooled down thereafter. Due to the shrink-fitting, the steel sleeve 6 applies compressive forces against the forming insert 5 to stabilize the forming inserts 5 against forces acting during the drawing process. As a result of the shrink-fitting process, the inner dimensions of the internal forming surface 51 of the forming insert 5 change slightly due to the acting forces.

[0039] In a second step, the exchangeable wear tool 3 of Fig. 6a is machined to achieve the desired shape and dimensions of the internal forming surface 51 of the forming insert 5. In the embodiment, the internal forming

surface 51 is machined by grinding and/or EDM. Thus, the shape and dimensions of the internal forming surface 51 can be adjusted with high accuracy. In particular, the shape and dimensions of the internal forming surface 51 are machined taking into account the thickness of a CVD coating which will be applied to the internal forming surface 51 as explained below.

[0040] In a following step, the wear-resistant forming insert 5 is again removed from the steel sleeve 4 by heating the steel sleeve 4 and pressing the forming insert 5 out. Due to the hot working steel used for the steel sleeve 4 and due to the specific shape of the steel sleeve 4 and of the forming insert 5, this can be done without damaging the steel sleeve 4 or the forming insert 5. The result of this step is schematically shown in Fig. 6 b). It should be noted that the dimensions of the internal forming surface 51 change during this step in response to unloading the compressive forces.

[0041] Thereafter, the wear-resistant coating insert 5 is subjected to a CVD coating process in a CVD apparatus at high temperatures, in particular e.g. at temperatures above 800 °C or even above 900 °C. During this CVD coating process, a wear-resistant coating is applied at least to the internal forming surface 51 of the wear-resistant forming insert 5. In particular, a thin layer or sequence of layers, e.g. in a range between 4 to 12 µm, of a hard material, such as carbides, nitrides, carbonitrides, or oxycarbonitrides, is applied at least to the internal forming surface 51. Suitable CVD coating processes and CVD coatings are well known in the art of wear part construction and thus will not be explained in detail. For example, a TiN, TiC or TiCN CVD coating can be applied to the internal forming surface 51. However, other CVD coatings are also possible. Using a CVD (chemical vapor deposition) process allows achieving a more wear resistant coating as compared to a PVD (physical vapor deposition) process due to the stronger interaction between the deposited layer and the substrate and due to the higher achievable thickness of the coating. Further, the thickness of the CVD coating can be controlled with high accuracy during the CVD coating process such that the internal forming surface 51 can be machined before the coating process taking into consideration the additional thickness of the coating. Thus, the CVD-coated drawing die tool 1 can be manufactured with high dimensional accuracy.

[0042] Since the forming insert 5 was removed from the steel sleeve 4 before, CVD coating at high temperatures which would damage the steel sleeve 4 is possible.

[0043] In a following step, the CVD-coated wear-resistant forming insert 5 is again mounted into the same steel sleeve 4 as before in a shrink-fitting process as before. During this shrink-fitting process, the internal forming surface 51 of the forming insert 5 assumes substantially the same shape and dimensions as it had as a result of the second step, since the same steel sleeve 4 is used. Thus, the CVD-coated exchangeable wear tool 3 is provided with extremely high dimensional accuracy.

[0044] Thereafter, the exchangeable wear tool 3 comprising the CVD-coated forming insert 5 shrink-fitted in the steel sleeve 4 is mounted in the outer casing 2 and secured therein by screwing-in the securing element 6.

[0045] With the described drawing die tool 1, a large number of advantages is achieved. The exchangeable wear tool 3 can be easily mounted to the outer casing 2 and removed again. Due to the tapering arrangement of the cooperating surfaces in which the respective surfaces taper in the working direction W, the drawing die tool 1 is very resistant against the arising axial forces during a drawing process even at small sizes. High dimensional accuracy of the internal forming surface is achieved and simultaneously CVD coatings requiring high coating temperatures can be applied. After it has worn, the forming insert can be easily separated from the other components and thus the cemented carbide material can conveniently be recycled. Further, the outer casing 2, the securing element 6 and the steel sleeve 4 are re-usable.

Claims

1. Drawing die tool (1) comprising:

a wear-resistant forming insert (5) having an outer surface (50) tapering in a working direction (W),
a steel sleeve (4) made of hot working steel into which the wear-resistant forming insert (5) is fitted by shrink-fitting, the steel sleeve (4) having an internal surface (41) tapering in the working direction which is adapted for cooperating with the outer surface (50) of the wear-resistant forming insert (5) and an external surface (40),
an outer casing (2) having an internal surface (25) in which the steel sleeve (4) together with the wear-resistant forming insert (5) is mounted with the external surface (40) of the steel sleeve (4) contacting the internal surface (25) of the outer casing (2), and
a securing element (6) for securing the steel sleeve (4) and the wear-resistant forming insert (5) in the outer casing (2).

2. Drawing die tool according to claim 1, wherein the external surface (40) of the steel sleeve (4) tapers in the working direction (W) and the internal surface (25) of the outer casing (2) tapers in the working direction (W).

3. Drawing die tool according to any one of the preceding claims, wherein at least an internal forming surface (51) of the wear-resistant forming insert (5) is provided with a wear-resistant coating.

4. Drawing die tool according to claim 3, wherein the coating has the properties of a coating applied by

chemical vapor deposition (CVD).

5. Drawing die tool according to any one of the preceding claims, wherein the securing element (6) has a ring shape and is provided with an external thread (60). 5
6. Drawing die tool according to claim 5, wherein the outer casing (2) comprises an internal thread (24) cooperating with the external thread (60) of the securing element (6) for securing the steel sleeve (4) and the forming insert (5) in the outer casing (2). 10
7. Drawing die tool according to any one of the preceding claims, wherein the securing element (6) comprises a retaining surface (64) abutting against the steel sleeve (4) and against the forming insert (5). 15
8. Drawing die tool according to any one of the preceding claims, wherein the hot working steel is hardened to at least 45 HRC, preferably between 45 and 50 HRC. 20
9. Drawing die tool according to any one of the preceding claims, wherein the wear-resistant forming insert (5) is made from cemented carbide material. 25
10. Method of forming a drawing die tool (1), the method comprising the steps: 30
 - shrink-fitting a wear-resistant forming insert (5) having an outer surface (50) tapering in a working direction (W) into a steel sleeve (4) made from a hot working steel and having an internal surface (41) tapering in the working direction (W), 35
 - machining an internal forming surface (51) of the forming insert (5) to predetermined dimensions, 40
 - dismounting the wear-resistant forming insert (5) from the steel sleeve (4), 45
 - subjecting the wear-resistant forming insert (5) to a coating process, 50
 - mounting the wear-resistant forming insert (5) back into the steel sleeve (4) by shrink-fitting, 55
 - placing the steel sleeve (4) with the wear-resistant forming insert (5) in an outer casing (2) having an internal surface (25) such that an external surface (40) of the steel sleeve (4) rests against the internal surface (25) of the outer casing (2), and
 - securing the steel sleeve (4) and the wear-resistant forming insert (5) in the outer casing (2) by a securing element (6).
11. Method of forming a drawing die tool (1) according to claim 10, wherein dismounting the wear-resistant forming insert (5) from the steel sleeve (4) comprises

heating the steel sleeve (4).

12. Method of forming a drawing die tool (1) according to any one of claims 10 or 11, wherein the coating process is a CVD coating process.
13. Method of forming a drawing die tool (1) according to any one of claims 10 to 12, wherein the coating process involves temperatures above 800 °C.
14. Method of forming a drawing die tool according to any one of claims 10 to 13, wherein machining the internal forming surface (51) of the forming insert (5) comprises at least one of grinding and electrical discharge machining (EDM).

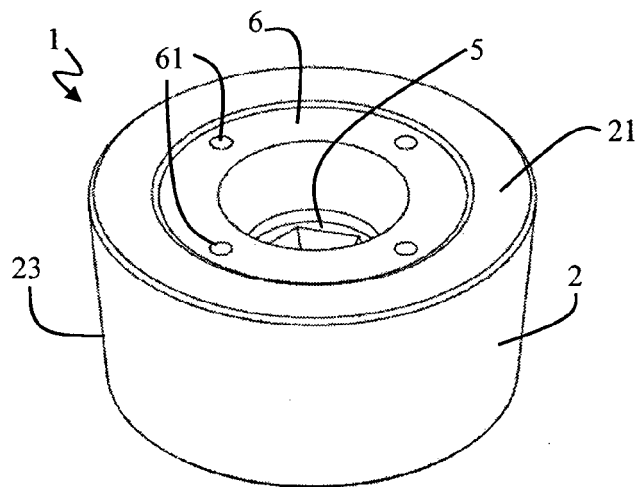


Fig. 1

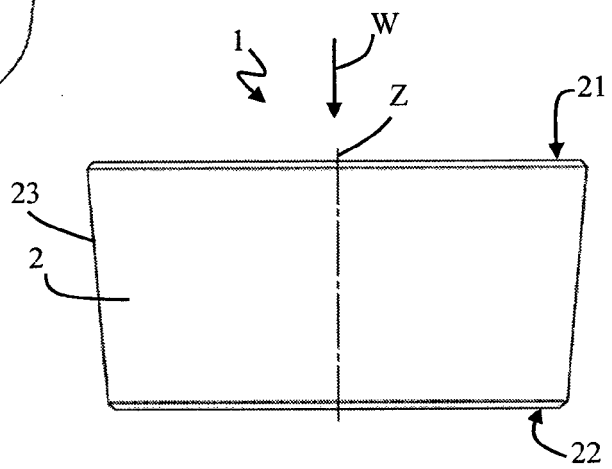


Fig. 2

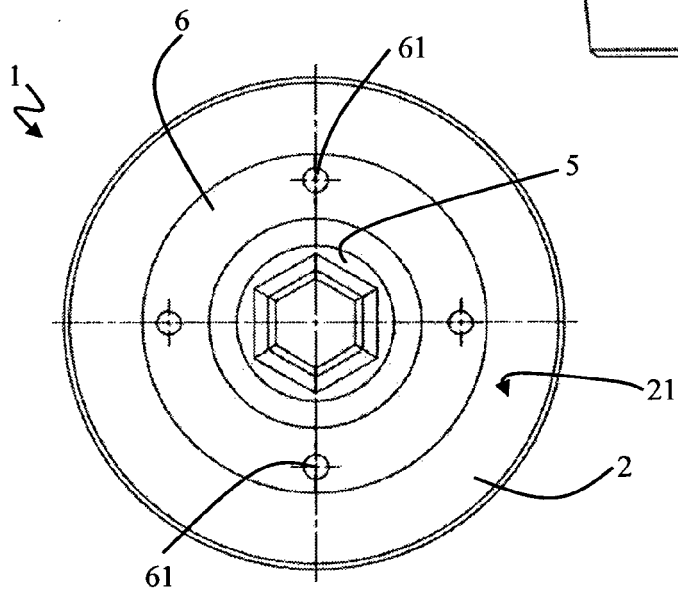


Fig. 3

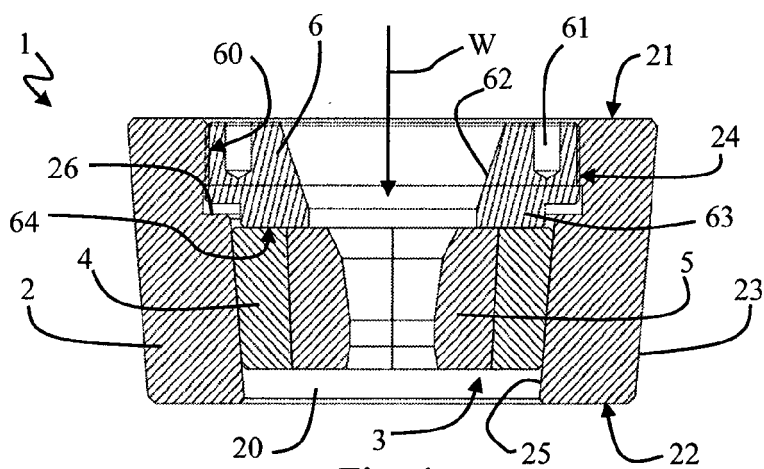


Fig. 4

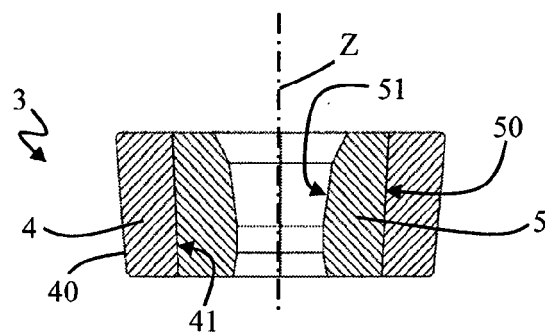


Fig. 5

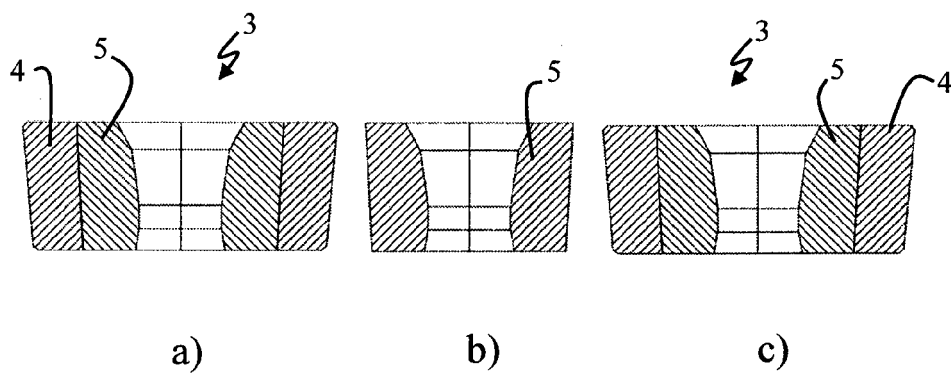


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 13 00 2160

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	GB 2 043 511 A (EDELSTAHLWERKE 8 MAI 1945 FREI) 8 October 1980 (1980-10-08) * the whole document *	1-14	INV. B21C3/04 B21C3/12
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