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(54) **FOLDING PLIERS**

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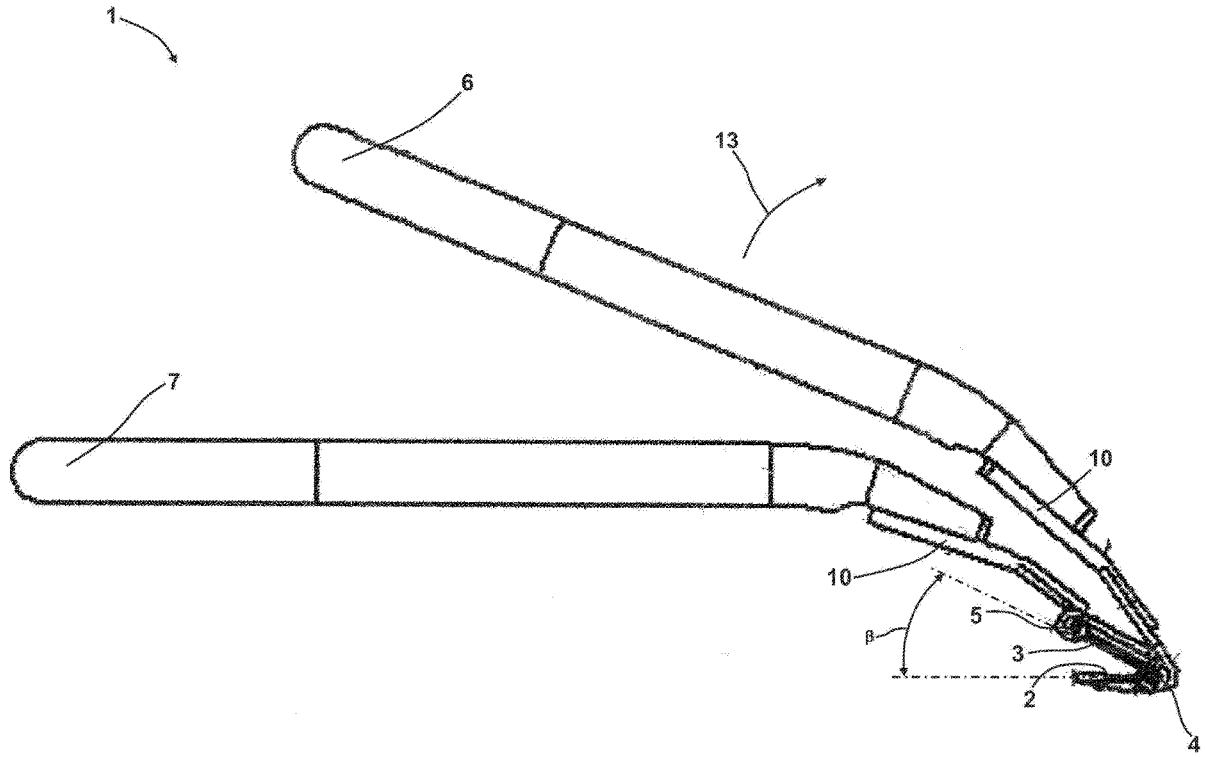
(57) **ABSTRACT**

Folding pliers for bending sheet metal includes a first clamping area and a second clamping area. Clamping areas are connected for rotation about a first axis. A first handle piece, which is connected to the first clamping area, and a second handle piece is pivotably connected to the first handle piece. The second handle piece is connected to the second clamping area and is rotatable about a second rotation axis, so when the first handle piece is pivoted relative to the second handle piece from a transport position, the first clamping area is moved relative to the second clamping area to clamp a piece of sheet metal between the clamping areas. After this, another pivot movement of the first handle piece relative to the second handle piece causes rotational movement of the first clamping area and second clamping area about the second rotation axis to bend the clamped sheet metal.



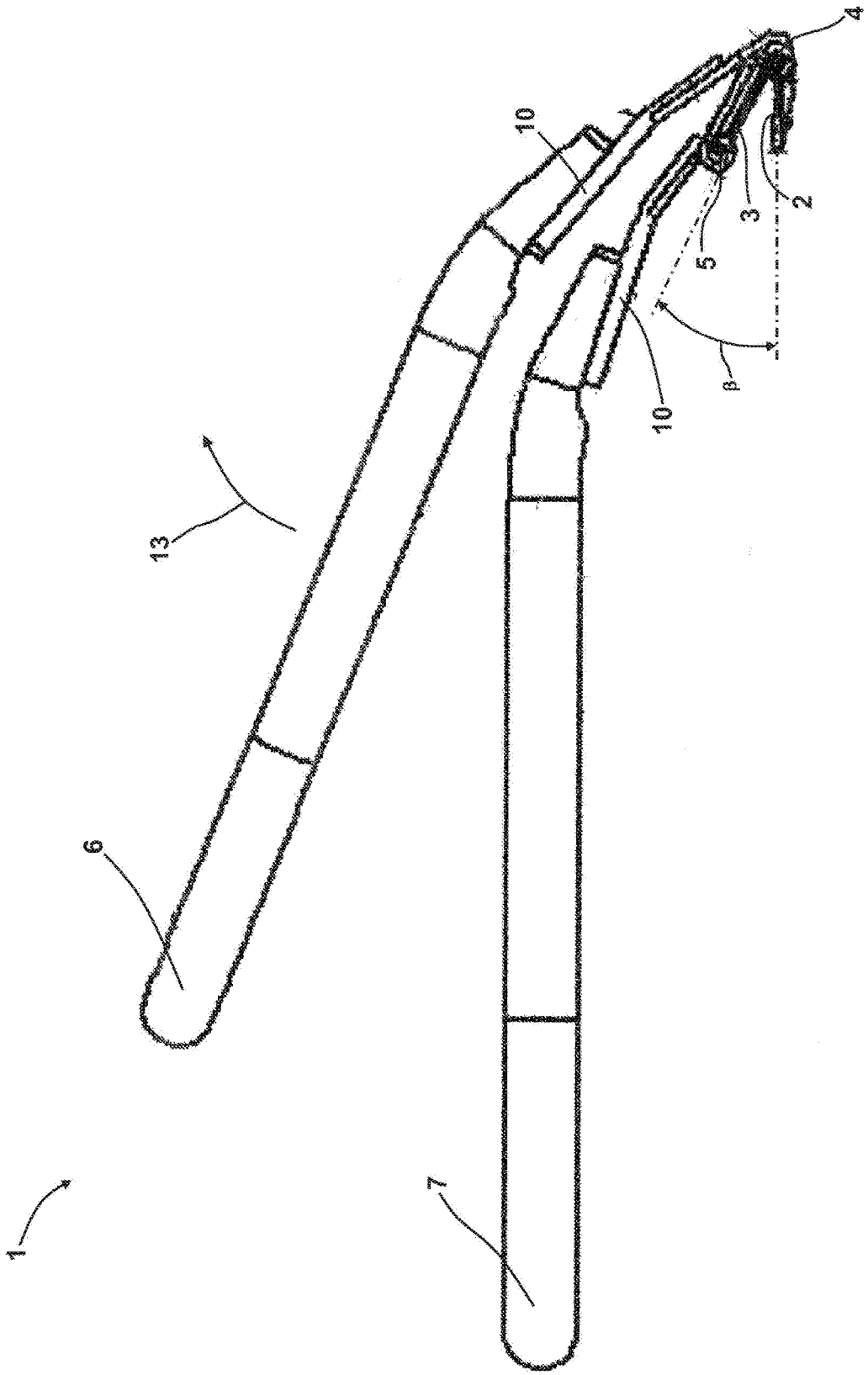


Fig. 1

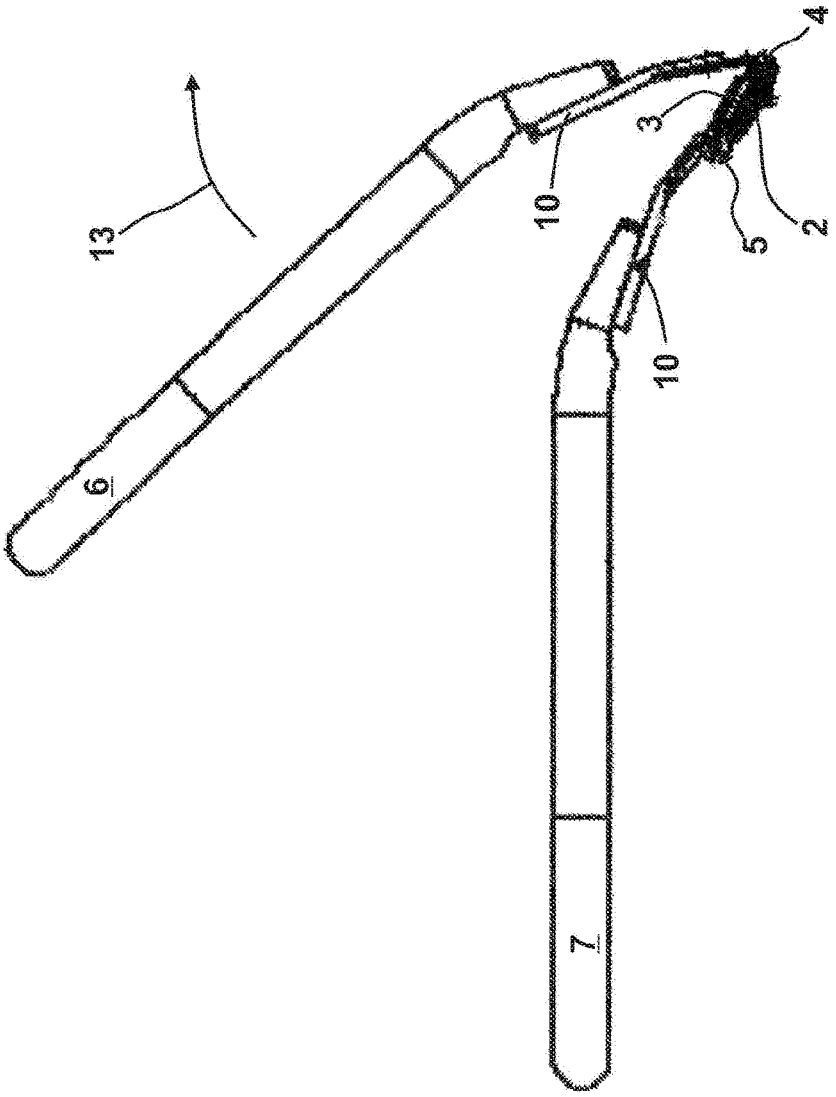


Fig. 2

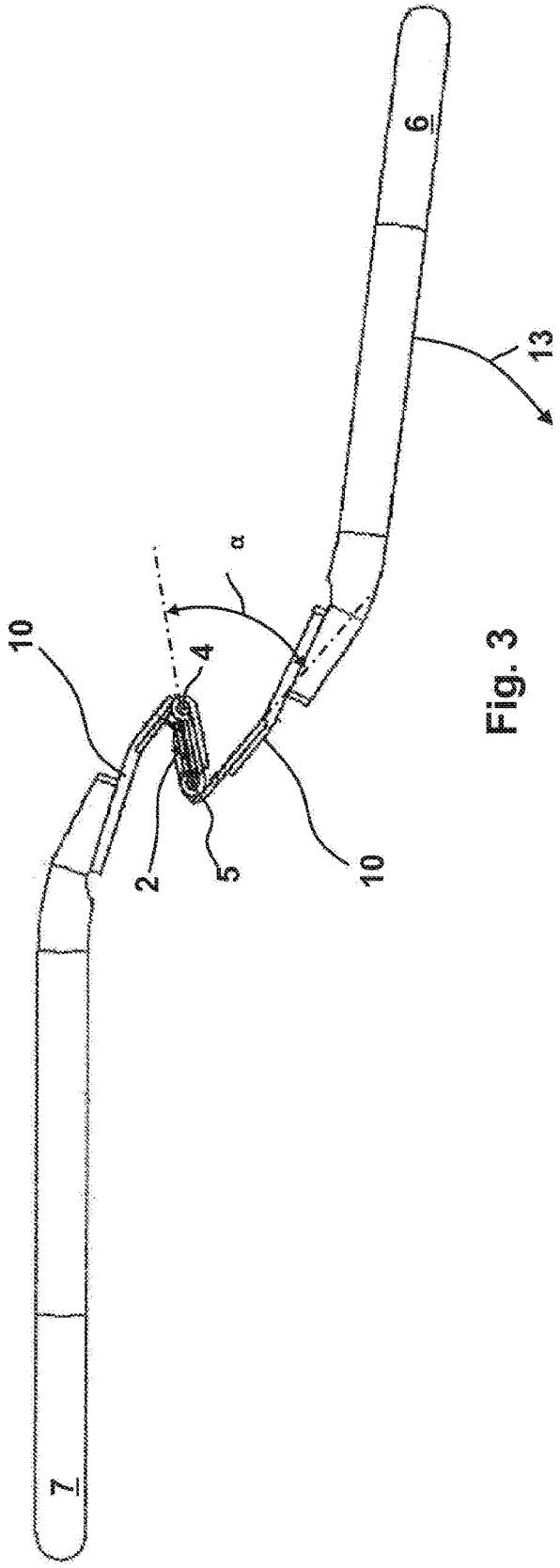


Fig. 3

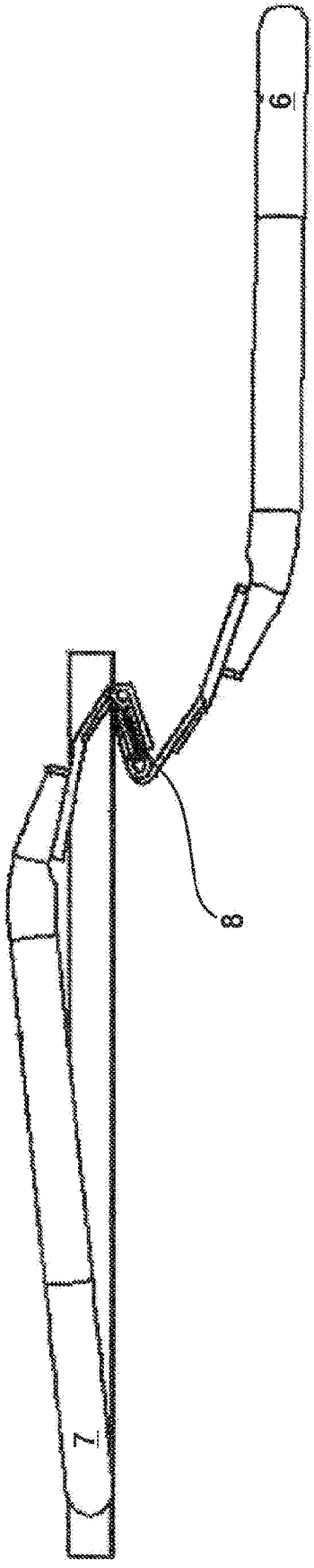


Fig. 4

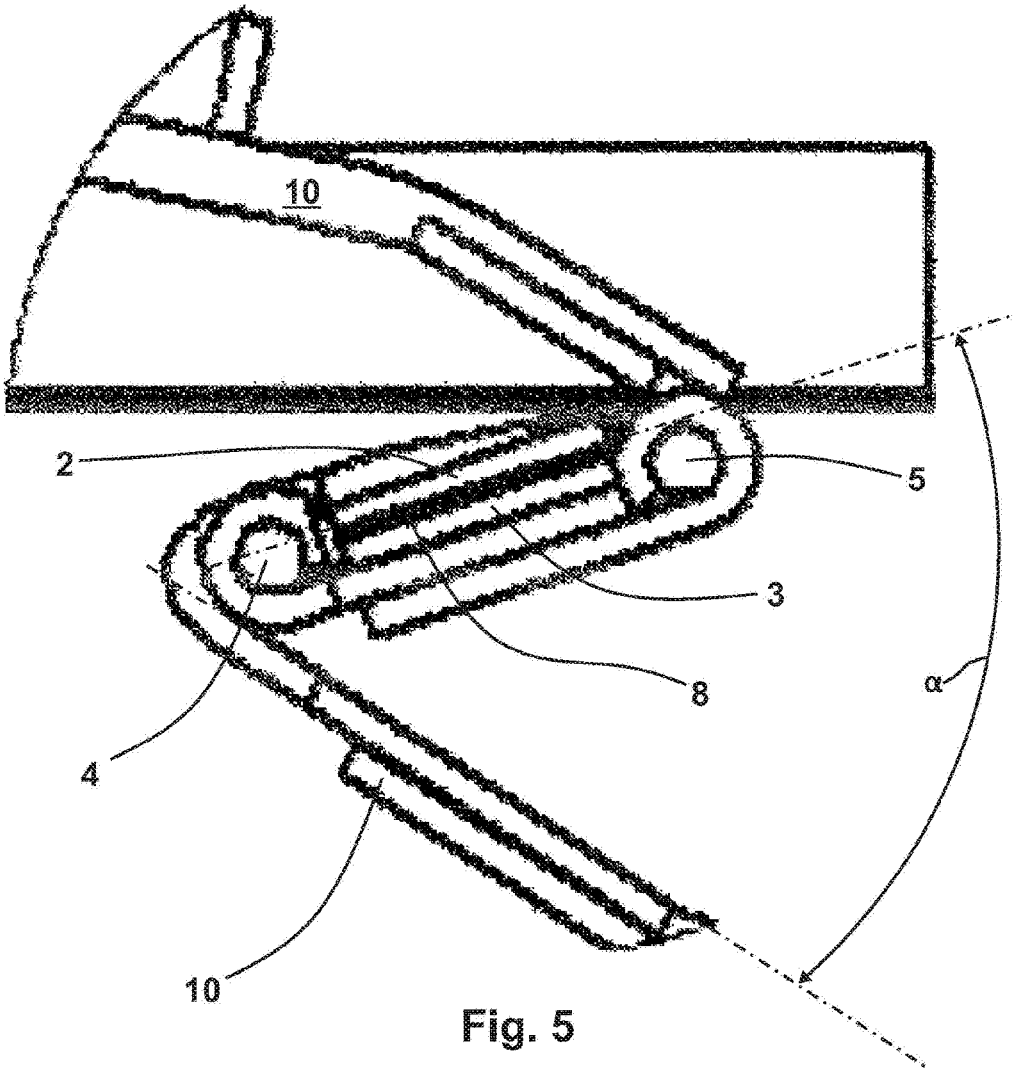


Fig. 5

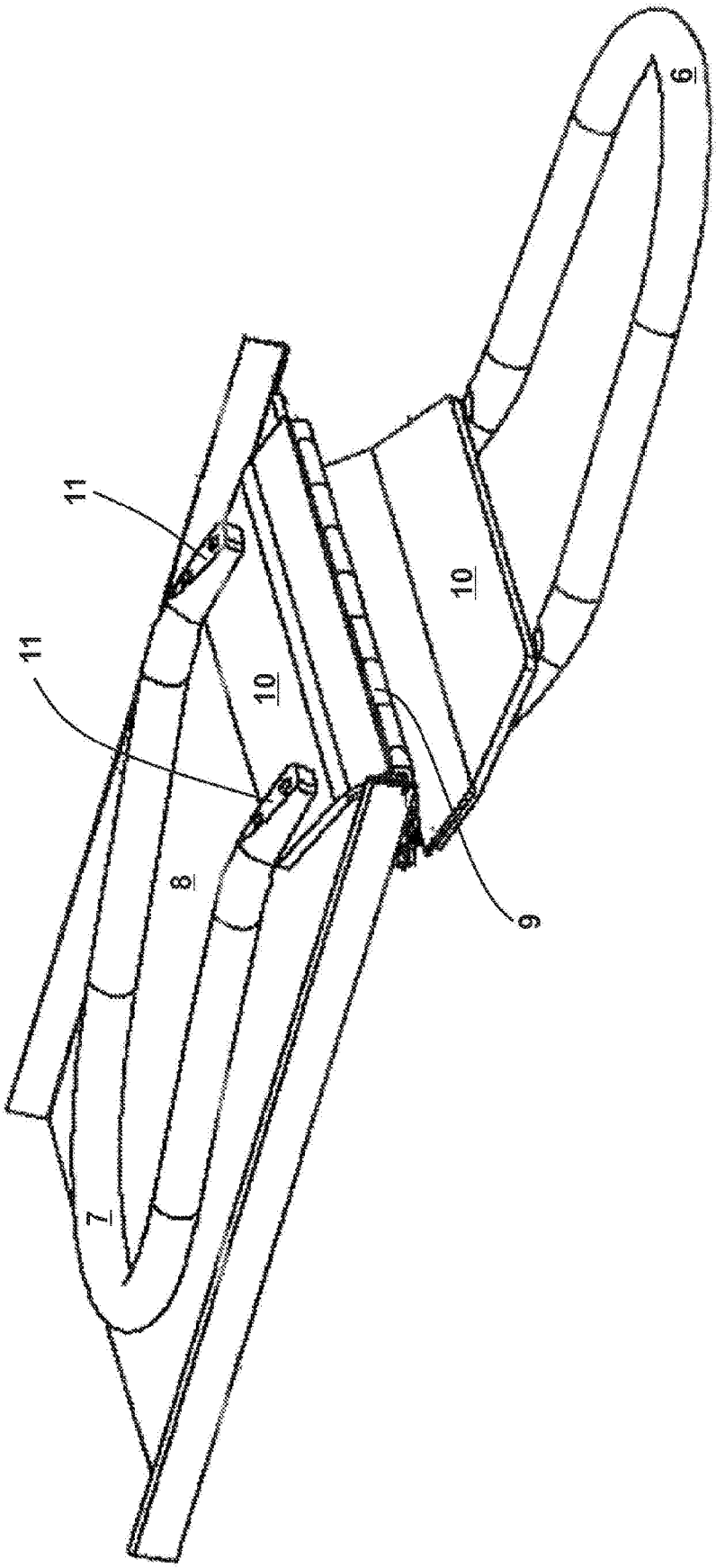


Fig. 6

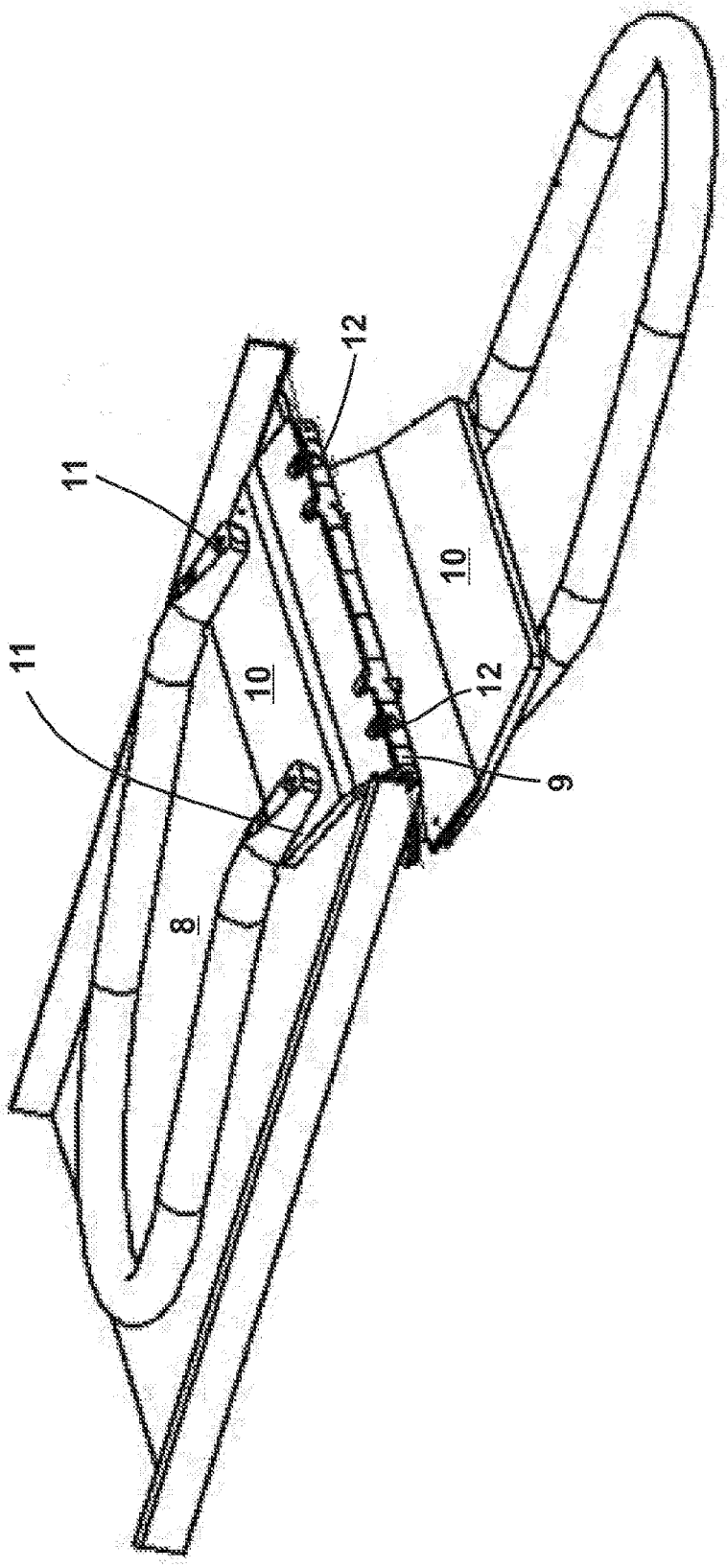


Fig. 7

FOLDING PLIERS

[0001] The invention relates to folding pliers for bending sheet metal, comprising a first clamping area and a second clamping area, wherein the clamping areas are connected such that they can be rotated about a first rotation axis, and also a first handle piece and a second handle piece connected to the first handle piece in a pivotable manner, wherein the first handle piece is connected to the first clamping area.

[0002] From the prior art, various tools for folding sheet metal or bending sheet metal have become known. However, tools from the prior art are unwieldy and heavy, for which reason said tools are, for example, not suitable for folding or bending sheet metal on facades in a simple manner.

[0003] This is addressed by the invention. The object of the invention is to specify a tool of the type named at the outset which is light and easy to handle and can be used portably.

[0004] According to the invention, this object is attained with folding pliers of the type named at the outset in which the second handle piece is connected to the second clamping area such that the second handle piece can be rotated about a second rotation axis, so that when the first handle piece is pivoted relative to the second handle piece from a transport position, the first clamping area is moved relative to the second clamping area such that a piece of sheet metal positioned between the clamping areas can be clamped by the clamping areas, after which a further pivot movement of the first handle piece relative to the second handle piece causes a rotational movement of the first clamping area together with the second clamping area about the second rotation axis relative to the second handle piece, in order to bend the clamped sheet metal.

[0005] Within the scope of the invention, it was found that a compact and lightweight device for bending sheet metal in a simple manner can be obtained if folding pliers are embodied accordingly and, in a movement of the handle pieces relative to one another, a piece of sheet metal is first clamped between the clamping areas and, in a further movement of the handle pieces relative to one another, the sheet metal is subsequently bent about the second rotation axis due to a movement of the clamping areas together with the sheet metal relative to the second handle piece. Folding pliers of this type can be embodied to be lightweight and compact so that they can also be used portably for facade work, for example. Normally, the sheet metal is clamped as result of a movement of the clamping areas relative to one another about the first rotation axis and the sheet metal bent as a result of a movement of the clamping areas together with the clamped section of the sheet metal about the second rotation axis with a continuous motion of the handle pieces, in order to ensure convenient ease-of-operation.

[0006] To release the finished folded piece of sheet metal from the folding pliers again, the first handle piece is simply moved in the opposite direction of the movement for the clamping and folding of the sheet metal, so that folded sheet metal can be released from the folding pliers.

[0007] It has proven beneficial that the first rotation axis and the second rotation axis are approximately parallel. A distance between the rotation axes is typically less than 20 cm, in particular less than 10 cm, and corresponds to a length of the desired fold or a length of the section of sheet metal to be bent. The clamping areas typically extend from the first rotation axis to the second rotation axis so that a piece of sheet metal is fully clampable preferably in a region between the first rotation axis and the second rotation axis, in order to evenly load the sheet metal and thus obtain a clean edge.

[0008] It is beneficial if the sheet metal can essentially be clamped by the clamping areas over the entire area between the first rotation axis and the second rotation axis. Thus, a clamping is continuously possible in a region between the rotation axes. As a result, a clean bending of the clamped sheet metal, or the sheet metal fixed in place between the clamping areas by a force-fit, is achieved with smooth bent edges.

[0009] A constructionally simple, and at the same time robust, design is achieved if a rotatable connection between the clamping areas and/or between the second clamping area and the second handle piece is formed by a hinge, in particular a piano hinge. A uniform force transmission over a length of the fold is thus also ensured.

[0010] It has proven effective that the first handle piece is connected to the first clamping area via a plate-shaped intermediate element, wherein the first handle piece is preferably connected to the plate-shaped intermediate element via at least two connection positions which are arranged in particular at an end. This ensures a uniform application of force over a length of the fold, so that a particularly smooth and high-quality bent edge can be obtained.

[0011] Analogously, it has proven advantageous if the second handle piece is connected to the second clamping area via a plate-shaped intermediate element, wherein the second handle piece is preferably connected to the plate-shaped intermediate element via at least two connection positions which are arranged in particular at an end.

[0012] To enable a particularly compact transport, it is advantageous if the first clamping area is connected to the first handle piece in a rigid manner, preferably at an angle of less than 100°, in particular less than 50°, preferably 15° to 35°. The handle pieces can then be arranged such that they bear against one another in a transport position, from which transport position a clamping of a piece of sheet metal and a folding are directly possible. Typically, the first clamping area and the first handle piece are connected in the region of the first rotation axis.

[0013] It is beneficial if the first clamping area is connected to the first handle piece in a rigid manner, wherein in a transport position, in which the handle pieces bear against one another, the clamping areas are arranged at an opening angle of 10° to 90°, in particular 15° to 35°, preferably approximately 20°, to one another and are open in order to accommodate a piece of sheet metal. On the one hand, a space-saving transport is thus possible. On the other hand, the folding pliers can then be used for the folding or of sheet metal directly from the transport position.

[0014] To ensure that a rotation about the second rotation axis does not occur until the first clamping area is connected to the second clamping area in a form-fit, possibly via a piece of sheet metal clamped between the clamping areas, it is preferably provided that, in the transport position, a torque that is necessary to move the second handle piece about the second rotation axis relative to the second clamping area is greater than a torque that is necessary to move the first handle piece about the first rotation axis relative to the second clamping area, so that a movement of the first handle piece out of the transport position first initiates a movement of the first handle piece relative to the second clamping area. Constructionally, this can be implemented in the most vary-

ing ways, in particular through joints that move with differing degrees of ease, which joints form the rotation axes.

[0015] A robust design of rotation axes which move with differing degrees of ease can easily be achieved if at least one spring is provided on a joint that forms the second rotation axis, in particular on a piano hinge forming the second rotation axis, with which spring a friction force acting between parts of the joint that can be moved relative to one another can be applied to the joint, in order to define a torque necessary for initiating a movement of the joint, wherein a spring force can be adjusted in particular by a set screw. For example, spring-loaded pressure pieces acting on parts of the second rotation axis that are moved relative to one another can be provided so that a movement of the hinge or a movement of the second clamping area about the second rotation axis relative to the second handle piece is only possible when overcoming a frictional torque produced by the spring or a friction force acting on the parts of the second rotation axis that can be moved relative to one another. Of course, it is also possible that more than one spring is provided, in order to apply a uniform friction force over a length of the hinge. The spring thus acts, for example, directly on a first part of the joint forming the second rotation axis, which first part can be moved relative to a second part of said joint, and presses the first part against the second part with the spring force, so that in order to move the first part relative to the second part it is necessary to overcome a friction force that is defined by the spring force and a friction coefficient.

[0016] Additional features, advantages and effects of the invention follow from the exemplary embodiment illustrated below. The drawings which are thereby referenced show the following:

[0017] FIGS. **1** through **3** Folding pliers according to the invention in different operating states;

[0018] FIG. **4** Folding pliers according to the invention together with a piece of sheet metal;

[0019] FIG. **5** A detailed view of folding pliers according to the invention from FIG. **4**;

[0020] FIG. **6** Folding pliers according to the invention together with a piece of sheet metal;

[0021] FIG. **7** A further set of folding pliers according to the invention together with a piece of sheet metal.

[0022] FIGS. **1** through **3** show folding pliers **1** according to the invention in different operating states. As can be seen, the folding pliers **1** comprise a first handle piece **6** and a second handle piece **7**, wherein the first handle piece **6** is connected to a first clamping area **2** in a rigid manner. The first handle piece **6** and the first clamping area **2** are, as is illustrated, connected to a second clamping area **3** such that they can be rotated about a first rotation axis **4**, so that a section of a piece of sheet metal **8** or the like can be clamped between the clamping areas **2**, **3**.

[0023] The second clamping area **3** is rotatably connected to a second handle piece **7** via a second rotation axis **5** that is parallel to the first rotation axis **4**, so that a piece of sheet metal **8** clamped between the clamping areas **2**, **3** can be bent or folded as the result of a rotational movement of the clamping areas **2**, **3**, which are connected via the clamped piece of sheet metal, about the second rotation axis **5**.

[0024] Both the movement of the first clamping area **2** about the first rotation axis **4** relative to the second clamping area **3** and also the bending movement of the two clamping areas **2**, **3** about the second rotation axis **5** can be initiated by a movement of the first handle piece **6** relative to the second handle piece **7**, so that a clamping and bending of sheet metal **8** can take place with a continuous motion of the first handle piece **6** relative to the second handle piece **7**.

[0025] In FIG. **1**, the folding pliers **1** are illustrated in a transport position in which the folding pliers **1** have a minimal space requirement and the handle pieces **6**, **7** essentially bear against one another. A clamping and folding of a piece of sheet metal **8** is directly possible from this transport position. To do so, a piece of sheet metal **8** that is to be folded is positioned between the clamping areas **2**, **3** of the folding pliers **1**, which areas are opened at an opening angle β of approximately 10° to 35° in this transport position.

[0026] To clamp a piece of sheet metal **8** positioned between the clamping areas **2**, **3**, or to fix said sheet metal **8** in place between the clamping areas **2**, **3** in a force-fit, a first handle piece **6** of the folding pliers **1** is moved relative to a second handle piece **7** of the folding pliers **1** clockwise from the position illustrated in FIG. **1** in a direction of movement **13**. Since the first clamping area **2** is connected to the first handle piece **6** in a rigid manner, a rotational movement of the first handle piece **6** also causes a rotational movement of the first clamping area **2** relative to the second clamping area **3**, whereby a piece of sheet metal **8** positioned between the clamping areas **2**, **3** is clamped by the clamping areas **2**, **3** when the first handle piece **6** is moved clockwise relative to the second handle piece **7**. A position of this type, in which the clamping areas **2**, **3** are closed, that is, in which an opening angle β between the clamping areas **2**, **3** is 0°, is illustrated in FIG. **2**.

[0027] From the position illustrated in FIG. **2**, in a further movement of the first handle piece **6** relative to the second handle piece **7** in the direction of movement **13**, no further movement of the first handle piece **6** about the first rotation axis **4** relative to the second clamping area **3** is henceforth possible, especially since the clamping areas **2**, **3** are already closed. A further movement of the first handle piece **6** relative to the second handle piece **7** clockwise in the direction of movement **13** from the clamping position illustrated in FIG. **2** therefore causes a rotational movement of the clamping areas **2**, **3**, together with the sheet metal **8**, and of the first handle piece **6** clockwise about the second rotation axis **5**. In this movement, the piece of sheet metal **8** clamped between the clamping areas **2**, **3** is bent. A bending position in which the clamping areas **2**, **3** are closed, and are accordingly pivoted relative to the second handle piece **7** is illustrated in FIG. **3**. Here, it can also be seen that the first clamping area **2** is connected to an intermediate element **10** at an angle α of approximately 50°, via which intermediate element **10** the first clamping area **2** is connected to the first handle piece **6** in a rigid manner.

[0028] To release the finished folded or bent piece of sheet metal **8** from the folding pliers **1**, the first handle piece **6** is simply moved in the opposite direction of the direction of movement **13** for the clamping and bending, that is, counterclockwise in this case, so that the clamping areas **2**, **3** are opened and the sheet metal **8** is released.

[0029] FIGS. **4** through **6** show folding pliers **1** according to the invention in an operating position as illustrated in FIG. **3**, but together with a piece of sheet metal **8** clamped between the clamping areas **2**, **3**. As can be seen, the sheet

metal **8** is bent in the region of the second rotation axis **5**. This has occurred as a result of the movement sequence described above.

[0030] As illustrated, the handle pieces **6**, **7** are connected to the clamping areas **2**, **3** via plate-shaped intermediate elements **10**, wherein the handle pieces **6**, **7** are arranged in end regions of the plate-shaped intermediate elements **10**, or are connected to the handle pieces **6**, **7** at connection positions **11** arranged at an end, in order to ensure a uniform force transmission and application to the sheet metal **8**.

[0031] Particularly in FIG. **6**, it can be seen that the first rotation axis **4** and the second rotation axis **5** are in this case constructionally formed by piano hinges **9**, in order to transmit forces in a particularly uniform manner.

[0032] Of course, a length of the plate-like intermediate elements **10** and of the rotation axes **4**, **5** is selected in accordance with a piece of sheet metal **8** that is to be folded or bent, and is individually adaptable if necessary. Analogously, a length of the handle pieces **6**, **7** and a distance of the same from the rotation axes **4**, **5** can be adapted to a specific application case, so that a simple actuation of the folding pliers **1** and a simple folding of sheet metal **8** are respectively possible through corresponding lever lengths.

[0033] FIG. **7** shows a further exemplary embodiment of folding pliers **1** according to the invention together with a piece of sheet metal **8**, wherein the folding pliers **1** are embodied essentially analogously to the folding pliers **1** illustrated in FIG. **6**, but additionally comprise springs in the region of the second rotation axis **5**, which springs are attached by set screws **12**. A friction force acting between parts of the piano hinge **9** forming the second rotation axis **5**, which parts can be moved relative to one another, is thereby produced via the springs, so that a frictional torque produced by these springs must be overcome before the second clamping area **3** can be moved relative to the second handle piece **7** about the second rotation axis **5**. No such springs are provided at the first rotation axis **4**, for which reason a torque for rotating the second clamping area **3** relative to the second handle piece **7** about the second rotation axis **5** is greater than a torque for rotating the first handle piece **6** about the first rotation axis **4** relative to the second clamping area **3**. It is thus ensured that, in a pivot movement of the first handle piece **6** in the direction of movement **13** from the transport position illustrated in FIG. **1**, a rotational movement of the first handle piece **6** together with the first clamping area **2** about the first rotation axis **4** relative to the second clamping area **3** initially occurs, and a rotational movement of the first clamping area **2** together with the second clamping area **3** about the second rotation axis **5** does not occur until the first clamping area **2** is connected to the second clamping area **3** in a form-fit, or bears thereagainst, possibly via a piece of sheet metal **8** or the like clamped between the clamping areas **2**, **3**. A sequence of the movements during the opening of the folding pliers **1** is thereby analogously defined. This ensures a simple handling of the tool. An amount of the frictional torque that is to be overcome can thereby be adjusted via the set screws **12**, via which a pretension of the springs can be set.

[0034] Folding pliers **1** according to the invention are space-saving, lightweight and easy to handle, for which reason they can also easily be used in a portable manner, for example, to bend pieces of sheet metal **8** on facades and the like. In addition, the folding pliers **1** according to the invention are embodied to be robust, so that they are also suitable for rough use conditions, in particular at construction sites.

1. Portably usable folding pliers for bending sheet metal, comprising a first clamping area and a second clamping area, wherein the clamping areas are connected such that they can be rotated about a first rotation axis, and also a first handle piece and a second handle piece connected to the first handle piece in a pivotable manner, wherein the first handle piece is connected to the first clamping area, wherein the second handle piece is connected to the second clamping area such that the second handle piece can be rotated about a second rotation axis, so that when the first handle piece is pivoted relative to the second handle piece in a direction of movement **13** from a transport position, the first clamping area is moved relative to the second clamping area such that a piece of sheet metal positioned between the clamping areas can be clamped by the clamping areas, after which a further pivot movement of the first handle piece relative to the second handle piece in the direction of movement **13** causes a rotational movement of the first clamping area together with the second clamping area about the second rotation axis relative to the second handle piece, in order to bend the clamped sheet metal.

2. The folding pliers according to claim **1**, wherein the first rotation axis and the second rotation axis are approximately parallel.

3. The folding pliers according to claim **1**, wherein the sheet metal can essentially be clamped by the clamping areas over the entire area between the first rotation axis and the second rotation axis.

4. The folding pliers according to claim **1**, wherein a rotatable connection between the clamping areas and/or between the second clamping area and the second handle piece is formed by a hinge, in particular a piano hinge.

5. The folding pliers according to claim **1**, wherein the first handle piece is connected to the first clamping area via a plate-shaped intermediate element, wherein the first handle piece is preferably connected to the plate-shaped intermediate element via at least two connection positions which are arranged in particular at an end.

6. The folding pliers according to claim **1**, wherein the second handle piece is connected to the second clamping area via a plate-shaped intermediate element, wherein the second handle piece is preferably connected to the plate-shaped intermediate element via at least two connection positions which are arranged in particular at an end.

7. The folding pliers according to claim **1**, wherein the first clamping area is connected to the first handle piece in a rigid manner, wherein in a transport position, in which the handle pieces bear against one another, the clamping areas are arranged at an opening angle of 10° to 90°, in particular 15° to 35°, preferably approximately 20°, to one another and are open in order to accommodate a piece of sheet metal.

8. The folding pliers according to claim **1**, wherein, in the transport position, a torque that is necessary to move the second handle piece about the second rotation axis relative to the second clamping area is greater than a torque that is necessary to move the first handle piece about the first rotation axis relative to the second clamping area, so that a movement of the first handle piece out of the transport position first initiates a movement of the first handle piece relative to the second clamping area.

9. The folding pliers according to claim **8**, wherein at least one spring is provided on a joint which forms the second rotation axis, in particular on a piano hinge forming the second rotation axis, with which spring a friction force acting between parts of the joint that can be moved relative to one another can be applied to the joint, in order to define a torque necessary for initiating a movement of the joint, wherein a spring force can be adjusted in particular by a set screw.

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