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(54) **Apparatus for cambering a tool of a bending apparatus.**

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EP-A- 0 067 766
DE-A- 1 452 677
DE-A- 1 752 346
DE-A- 2 534 664
DE-A- 2 914 744
FR-A- 783 147

(73) Proprietor: **Liet, Cornelis Hendricus**
Denekamperdijk 38
NL-7581 PJ Losser (NL)

(72) Inventor: **Liet, Cornelis Hendricus**
Denekamperdijk 38
NL-7581 PJ Losser (NL)

(74) Representative: **de Vries, Johannes Hendrik Fokke et al**
Octrooibureau Los en Stigter B.V. P.O. Box 20052
NL-1000 HB Amsterdam (NL)

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Description

The invention relates to apparatuses for cambering a tool of a bending apparatus according to the preamble of claim 1 and claim 2.

Such apparatuses serve for adjusting a compensation for the deflection of the upper beam at high loads occurring in a bending apparatus. In a known apparatus usually a high number of adjusting elements along the length of the tool are provided which only provide a local support of the tool (see DE-A-17 52 346). Further for adjusting a desired camber all adjusting elements have to be adjusted accurately. As moreover all adjusting elements have a different shape or design and must be made with a relatively high accuracy, the manufacturing costs of the known apparatus are high.

EP-0 067 766 discloses an apparatus according to the preamble of claim 1 and claim 2. In this knwon apparatus one of the adjusting wedges is moveable in a direction transverse to their longitudinal direction. Thereby, a number of actuating means for moving the movable adjusting wedges are required along the length of this wedge. Further, the joining complementary surfaces of the wedges are shaped in a complicated manner.

The invention aims to provide apparatuses of this type which are simple and can be made at relatively low cost.

To this end the apparatuses according to the invention are characterized by the features of claims 1 and 2 respectively.

In this manner simple made apparatuses are obtained wherein the tool is supported along the whole length by the adjusting wedges and wherein the adjusting wedges can be actuated at their free ends.

According to a simple embodiment one adjusting wedge is mounted stationary and the other adjusting wedge is slidable.

In case of a bending apparatus with great length the trend of the curved surfaces in vertical direction can be rather great, whereby the mounting height of the adjusting wedges becomes a disadvantage. According to the invention this disadvantage can be overcome in that both adjusting wedges each consist of two or more adjusting wedge parts connected to each other, wherein the curved complementary surfaces of the subsequent adjusting wedge parts are staggered in vertical direction.

The mechanical manufacturing of the adjusting wedges becomes simple if the adjusting wedges are made of a relatively soft steel, wherein the movable surfaces of the adjusting wedge(s) are provided with a bronze layer.

Preferably the adjusting wedges are mounted on the lower beam and are received in a recess in the lower side of the tool table.

The invention will be further explained by reference to the drawings in which some embodiments are schematically shown.

Fig. 1 is a perspective view of a bending apparatus comprising an embodiment of the apparatus according to the invention.

Fig. 2 is a partially shown longitudinal section of the lower beam and the tool table of the bending apparatus of fig. 1, wherein an actuating mechanism of one adjusting wedge is shown.

Fig. 3 is a section according to the line III-III of fig. 2.

Fig. 4 schematically shows the adjusting wedges of the apparatus of fig. 2, wherein the adjusting wedges are in a neutral position.

Fig. 5 schematically shows the adjusting wedges of fig. 4, wherein the adjusting wedges are in their maximum camber position.

Fig. 6 is a view corresponding with fig. 4 of an alternative embodiment of the adjusting wedges in the neutral position.

Fig. 7 shows the adjusting wedges of fig. 7 in the maximum camber position.

Fig. 1 shows a bending apparatus 1 comprising a stationary lower beam 2, on which a tool table 3 is mounted. A die 4 is fixed on the tool table 3. The bending apparatus 1 further comprises an upper beam 5 movable up and down and driven by two cylinder piston assemblies 6. For measuring the movement of the upper beam 5, sensors 7 are mounted near the cylinder piston assemblies 6, only one of the sensors being shown in fig. 1. Said sensors 7 are supported by substantially C-shaped supports 8 fully free of the frame of the bending apparatus 1, so that a deformation of the web plates 9 (only one of which is shown in fig. 1) during exertion of high forces does not affect the sensors 7.

The upper beam 5 carries a stamp 10 which cooperates with the die 4 for bending a material plate. During bending the upper beam 5 will bend somewhat, which bending-through, in order to obtain an accurate bending of the plate material, must be compensated by providing the stamp 10 or the die 4 with an opposite bending-through. This opposite bending-through is generally indicated as camber. With a correct adjustment of the camber, a straight bending line is obtained during the bending operation.

For adjusting the camber the bending apparatus 1 is provided with a camber apparatus 11 comprising two adjusting wedges 12, 13 disposed upon eachother and further shown in figs. 2-5. The adjusting wedges 12, 13 are mounted on the lower beam 2, wherein a recess 14 is provided in the lower side of the tool table 3, in which recess the adjusting wedges 12, 13 are received.

The tool table 3 is connected to the lower beam 2 under spring pressure, for which purpose in the shown embodiment three lateral rods 15 are mounted near the ends of the tool table 3 and in the centre of

the lower beam 2, respectively, which lateral rods protrude outwardly of the lower beam 2 on both sides. Draw bolts 16 protrude through each lateral rod 15 on both sides of the lower beam 2, by means of which draw bolts 16 the tool table 3 is fixed, wherein Belleville-washers or cupped spring washers 18 are provided between each bolt head 17 and the lateral rods 15.

The adjusting wedges 12, 13 are slidable with respect to eachother in longitudinal direction, in that at the embodiment shown the upper wedge 12 is slidable backward and forward, while the lower adjusting wedge 13 is attached to the lower beam 2. The actuation of the adjusting wedge 12 is provided through a draw/push bolt 19 which is movable backward and forward through a 90° transmission 20 by rotating a shaft 21 of the transmission 20. The shaft 21 can be rotated with a manually operable adjusting wheel or alteratively by means of an electromotor.

In fig. 4 the adjusting wedges 12, 13 are shown in a neutral position, wherein the upper surface 22 of the adjusting wedge 12 extends parallel to the lower surface of the adjusting wedge 13 and therefore no correction of the bending-through of the upper beam or the stamp 10, respectively, takes place. For adjusting a certain correction the upper surface 22 should be provided with a bending-through opposite to the bending-through of the upper beam 5, which opposite bending-through can be indicated as camber curve. In fig. 5 the adjusting wedge has been moved maximum to the left, whereby the upper surface 22 has the maximum opposite bending-through, which is indicated strongly exaggerated in fig. 5 by a dashed line 24 with respect to a straight line 25. Actually the maximum bending-through for a length of the adjusting wedges of 3 m is approximately 1 mm.

The desired bending-through of the upper surface 22 of the adjusting wedge 12 for compensating the bending-through of the upper beam 5 is obtained in that the joining complementary surfaces 26, 27 in the side view of figs. 4 and 5 has a somewhat S-shaped curved trend, wherein the highest point 28 and the lowest point 29 of the curved surfaces 26, 27 in the neutral position of fig. 4 lies substantially at the location of the respective sensors 7. The trend of the curved surfaces 26, 27 substantially corresponds with the integral of the camber curve 24 shown in fig. 5.

If for adjusting the camber only one adjusting wedge is moved as in the embodiment shown, it is to be preferred to design the curved surfaces 26, 27 in the neutral position in such a manner that the highest point 28 and the lowest point 29 are lying outwardly of the sensors 7 at a distance of substantially half of the stroke of the slidable adjusting wedge 12.

When the bending apparatus is designed for bending plate material of great sizes so that the length of the lower beam 2 and the upper beam 5 is for example 6 m, the overall height of the adjusting wedges 12, 13 could be too high for mounting in the recess 14 in the tool table 3. In order to reduce the overall height of the adjusting wedges 12, 13 in case of great length, both adjusting wedges 12, 13 can for example consist of two interconnected adjusting wedge parts 30, 31 and 32, 33, respectively, wherein the curved complementary surfaces 26, 27 of the subsequent adjusting wedge parts 30, 31 and 32, 33, respectively, are staggered in vertical direction as shown in figs. 6, 7.

The described camber apparatus 11 shows the advantage that the adjusting wedges 12, 13 extend along the whole length of the die 4 to be cambered, so that the support of the tool table 3 and thereby of the die 4 is provided along substantially the whole length. The operation of the camber apparatus 11 is very simple. Further the manufacturing of the adjusting wedges 12, 13 is not very complicated so that the manufacturing costs are relatively low.

Although in the described bending apparatus the camber apparatus is mounted on the lower beam, it is of course also possible to incorporate the camber apparatus in the upper beam. Further only the lower adjusting wedge 13 or both adjusting wedges 12, 13 could be movable instead of the upper adjusting wedge 12.

Preferably the adjusting wedges 12, 13 are made of relatively soft steel, whereby the mechanical machining of the curved surfaces 26, 27 is relatively simple. For increasing the durability the surfaces 22 and 26 of the movable adjusting wedge 12 are provided with a layer of bronze.

Although in the described embodiment of the camber apparatus two separate adjusting wedges 12, 13 are used, it is possible according to a favourable alternative embodiment that one of the adjusting wedges 12, 13 is integrated with the tool table 3 or the lower beam 2 of the bending apparatus, respectively. Thereby the manufacturing costs are decreased.

Claims

1. Apparatus for cambering a tool (4 ; 10) of a bending apparatus (1) with a lower beam (2), a tool table (3) mounted on the same and an upper beam (5) movable up and down and coupled near its ends with sensors (7) for measuring the movement of the upper beam, said apparatus comprising two adjusting wedges (12, 13) disposed one upon the other and movable with respect to each other from a neutral position, said adjusting wedges extending along substantially the whole length of the tool between the tool and the corresponding upper or lower beam, characterized in that the adjusting wedges (12, 13) are movable with respect to each other in their longitudinal direction and that the joining complementary surfaces (26, 27) of the adjusting wedges have, in longitudinal section, a curved path in the form of a S-shape lying

on its side and wherein, in the neutral position, the highest and lowest point (28, 29), respectively, of the curved surfaces of the adjusting wedges are located substantially at the location of the respective sensors (7).

2. Apparatus for cambering a tool (4 ; 10) of a bending apparatus (1) with a lower beam (2), a tool table (3) mounted on the same and an upper beam (5) movable up and down and coupled near its ends with sensors (7) for measuring the movement of the upper beam, said apparatus comprising two adjusting wedges (12, 13) disposed one upon the other and movable with respect to each other from a neutral position, said adjusting wedges extending along substantially the whole length of the tool between the tool and the corresponding upper or lower beam, characterized in that both adjusting wedges (12, 13) consist of two or more adjusting wedge parts (30, 31 ; 32, 33) connected to each other, the adjusting wedges (12, 13) being movable with respect to each other in their longitudinal direction, in that the joining complementary surfaces (26, 27) of the adjusting wedges parts each have, in longitudinal section, a curved path in the form of a S-shape lying on its side the curved complementary surfaces of subsequent adjusting wedge parts (30, 31 ; 32, 33) being staggered in vertical direction and wherein, in the neutral position, the highest and lowest point (28, 29), respectively, of the curved surfaces of the adjusting wedges are located substantially at the location of the respective sensors (7).

3. Apparatus according to claim 1 or 2, characterized in that one adjusting wedge (13) is mounted stationary and in that the other adjusting wedge (12) is slidable.

4. Apparatus according to claim 3, characterized in that the highest and the lowest points (28, 29) of the upper surface (27) of the lower adjusting wedge (13) lie at a distance outwardly of the sensors (7) corresponding subtantially to half of the stroke of the slidable adjusting wedge (12).

5. Apparatus according to anyone of the preceding claims, characterized in that the adjusting wedges (12, 13) are made of a relatively soft steel, wherein the movable surfaces of the adjusting wedge(s) are provided with a bronze layer.

6. Apparatus according to anyone of the preceding claims, wherein the tool (4) supported on the tool table (3) is cambered, characterized in that the adjusting wedges (12, 13) are mounted on the lower beam (2) and are received in a recess (14) in the lower side of the tool table.

7. Apparatus according to claim 6, characterized in that the stationnary adjusting wedge (12, 13) is formed by the lower side of the tool table (3) or the upper side of the lower beam (2), respectively.

8. Apparatus according to claim 6 or 7, characterized in that the tool table (3), is connected with the lower beam (2) under spring pressure.

9. Apparatus according to claim 8, characterized in that the tool table (3) is connected to the lower beam (2) at least near the ends and near the centre by draw bolts (16), wherein springs (18) are mounted between the head (17) of each draw bolt (16) and the cooperating stop face (15) of the lower beam.

Ansprüche

1. Vorrichtung zum Wölben eines Werkzeuges (4 ; 10) einer Biegemaschine (1) mit einem unteren Balken (2), einem auf diesem montierten Werkzeugtisch (3) und einem oberen Balken (5), der auf- und abbewegbar und in der Nähe seiner Enden mit Fühlern (7) zur Messung der Bewegung des oberen Balkens gekuppelt ist, welche Vorrichtung zwei Einstellkeile (12, 13) aufweist, die aufeinander angeordnet und gegeneinander aus einer Neutralstellung heraus verstellbar sind, welche Einstellkeile im wesentlichen über die gesamte Länge des Werkzeuges zwischen dem Werkzeug und dem entsprechenden oberen oder unteren Balken verlaufen, dadurch gekennzeichnet, daß die Einstellkeile (12, 13) gegeneinander in ihrer Längsrichtung bewegbar sind und daß die stoßenden Komplementärflächen (26, 27) der Einstellkeile im Längsschnitt einen gekrümmten Verlauf in Form eines auf der Seite liegenden S aufweisen, wobei in der Neutralstellung der höchste bzw. niedrigste Punkt (28, 29) der gekrümmten Oberflächen der Einstellkeile sich im wesentlichen im Bereich der entsprechenden Fühler (7) befindet.

2. Vorrichtung zum Wölben eines Werkzeuges (4 ; 10) einer Biegemaschine (1) mit einem unteren Balken (2), einem auf diesem montierten Werkzeugtisch (3) und einem oberen Balken (5), der auf- und abbewegbar und in der Nähe seiner Enden mit Fühlern (7) zur Messung der Bewegung des oberen Balkens gekuppelt ist, welche Vorrichtung zwei Einstellkeile (12, 13) aufweist, die aufeinander angeordnet und gegeneinander aus einer Neutralstellung heraus verstellbar sind, welche Einstellkeile im wesentlichen über die gesamte Länge des Werkzeuges zwischen dem Werkzeug und dem entsprechenden oberen oder unteren Balken verlaufen, dadurch gekennzeichnet, daß beide Einstellkeile (12, 13) aus zwei oder mehreren Einstellkeilteilen (30, 31 ; 32, 33) bestehen, die miteinander verbunden sind, wobei die Einstellkeile (12, 13) gegeneinander in ihrer Längsrichtung bewegbar sind, daß die stoßenden Komplementärflächen (26, 27) der Einstellkeilteile im Längsschnitt je einen gekrümmten Verlauf in Form eines Abschnittes eines auf der Seite liegenden S aufweisen, wobei die gekrümmten Komplementärflächen aufeinanderfolgender Einstellkeilteile (30, 31 ; 32, 33) in Vertikalrichtung versetzt sind und wobei in der Neutralstellung der höchste bzw. niedrigste Punkt

(28, 29) der gekrümmten Oberflächen der Einstellkeile sich im wesentlichen im Bereich der entsprechenden Fühler (7) befindet.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß ein Einstellkeil (13) feststehend montiert und der andere Einstellkeil (12) gleitverstellbar ist.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß der höchste und niedrigste Punkt (28, 29) der Oberseite (27) des unteren Einstellkeiles (13) sich in einem Abstand außerhalb der Fühler (7) befindet, der etwa dem halben Hub des gleitverstellbaren Einstellkeiles (12) entspricht.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Einstellkeile (12, 13) aus einem verhältnismäßig weichen Stahl hergestellt sind, wobei die bewegbaren Oberflächen des bzw. der Einstellkeile mit einer Bronzeauflage versehen sind.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, bei der das am Werkzeugtisch (3) abgestützte Werkzeug (4) ausgewölbt wird, dadurch gekennzeichnet, daß die Einstellkeile (12, 13) am unteren Balken (2) montiert und in einer Vertiefung (14) in der Unterseite des Werkzeugtisches aufgenommen sind.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß der feststehende Einstellkeil (12, 13) von der Unterseite des Werkzeugtisches bzw. der Oberseite des unteren Balkens (2) gebildet ist.

8. Vorrichtung nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß der Werkzeugtisch (3) mit dem unteren Balken (2) unter Federvorspannung verbunden ist.

9. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß der Werkzeugtisch mit dem unteren Balken (2) wenigstens in der Nähe der Enden und in der Nähe der Mitte durch Zugbolzen (18) verbunden ist, bei denen Federn (18) zwischen dem Kopf (17) jedes Zugbolzens (16) und der mit ihm zusammenwirkenden Anschlagfläche (15) des unteren Balkens montiert sind.

Revendications

1. Appareil pour cambrer un outil (4 ; 10) d'une machine de pliage (1) comportant une poutre inférieure (2), une table (3) d'outil montée sur cette poutre et une poutre supérieure (5) pouvant monter et descendre et reliée, à proximité de ses extrémités, à des capteurs (7) destinés à mesurer le mouvement de la poutre supérieure, ledit appareil comportant deux coins de réglage (12, 13) disposés l'un sur l'autre et mobiles l'un par rapport à l'autre à partir d'une position neutre, lesdits coins de réglage s'étendant sensiblement sur toute la longueur de l'outil entre celui-ci et la poutre supérieure ou inférieure correspondante, caractérisé en ce que les coins de réglage (12, 13) sont mobiles l'un par rapport à l'autre dans leur direction longitudinale, et en ce que les surfaces complémentaires jointives (26, 27) des coins de réglage ont, en coupe longitudinale, un profil incurvé sous la forme d'un S s'étendant sur son côté, et dans lequel, dans la position neutre, les points le plus haut et le plus bas (28, 29), respectivement, des surfaces incurvées des coins de réglage sont situés sensiblement à l'emplacement des capteurs respectifs (7).

2. Appareil pour cambrer un outil (4 ; 10) d'une machine de pliage (1) comportant une poutre inférieure (2), une table (3) d'outil montée sur celle-ci et une poutre supérieure (5) pouvant monter et descendre et reliée, à proximité de ses extrémités, à des capteurs (7) destinés à mesurer le mouvement de la poutre supérieure, ledit appareil comportant deux coins de réglage (12, 13) disposés l'un sur l'autre et mobiles l'un par rapport à l'autre à partir d'une position neutre, lesdits coins de réglage s'étendant sensiblement sur toute la longueur de l'outil entre celui-ci et la poutre supérieure ou inférieure correspondante, caractérisé en ce que les deux coins de réglage (12, 13) sont constitués de deux ou plus de deux parties de coins de réglage (30, 31 ; 32, 33) reliées entre elles, les coins de réglage (12, 13) étant mobiles l'un par rapport à l'autre dans leur direction longitudinale, en ce que les surfaces complémentaires jointives (26, 27) des parties des coins de réglage ont chacune, en coupe longitudinale, un profil incurvé sous la forme d'une section d'un S s'étendant sur son côté, les surfaces complémentaires incurvées de parties des coins de réglage successives (30, 31 ; 32, 33) étant décalées dans la direction verticale, et dans lequel, dans la position neutre, les points le plus haut et le plus bas (28, 29), respectivement, des surfaces incurvées des coins de réglage sont situés sensiblement à l'emplacement des capteurs respectifs (7).

3. Appareil selon la revendication 1 ou 2, caractérisé en ce qu'un coin (13) de réglage est monté de façon fixe et en ce que l'autre coin (12) de réglage est coulissant.

4. Appareil selon la revendication 3, caractérisé en ce que les points le plus haut et le plus bas (28, 29) de la surface supérieure (27) du coin de réglage inférieur (13) s'étendent à une distance, vers l'extérieur des capteurs (7), correspondant sensiblement à la moitié de la course du coin coulissant (12) de réglage.

5. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que les coins (12, 13) de réglage sont réalisés en acier relativement doux, les surfaces mobiles du coin ou des coins de réglage étant pourvues d'une couche de bronze.

6. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'outil (4) supporté par la table (3) d'outil est cambré, caractérisé en ce que les coins (12, 13) de réglage sont montés sur la

poutre inférieure (2) et sont reçus dans un évidement (14) situé dans le côté inférieur de la table d'outil.

7. Appareil selon la revendication 6, caractérisé en ce que le coin fixe (12, 13) de réglage est formé par le côté inférieur de la table (3) d'outil ou le côté supérieur de la poutre inférieure (2), respectivement.

8. Appareil selon la revendication 6 ou 7, caractérisé en ce que la table (3) d'outil est reliée a la poutre inférieure (2) sous la pression de ressorts.

9. Appareil selon la revendication 8, caractérisé en ce que la table (3) d'outil est reliée à la poutre inférieure (2) au moins à proximité des extrémités et à proximité du centre par des tirants (16), des ressorts (18) étant montés entre la tête (17) de chaque tirant (16) et la face d'arrêt coopérante (15) de la poutre inférieure.

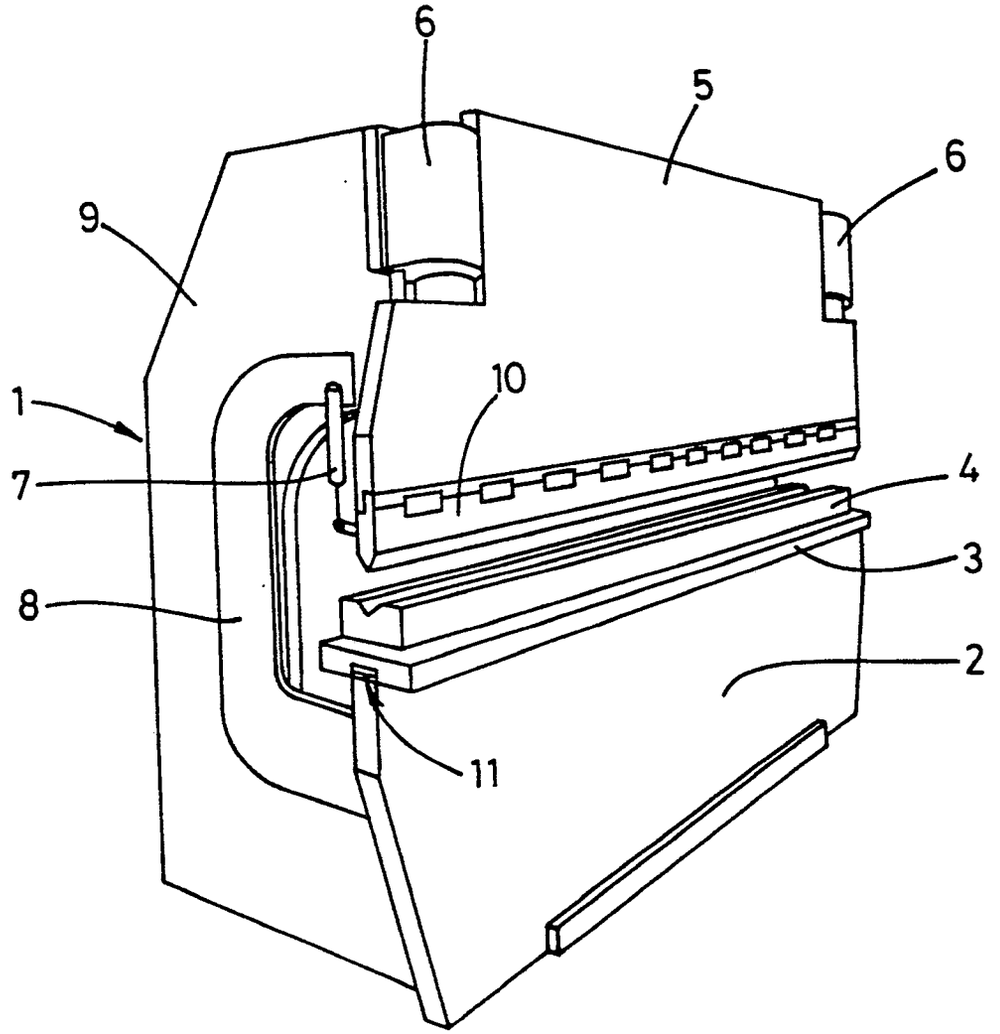

fig.1

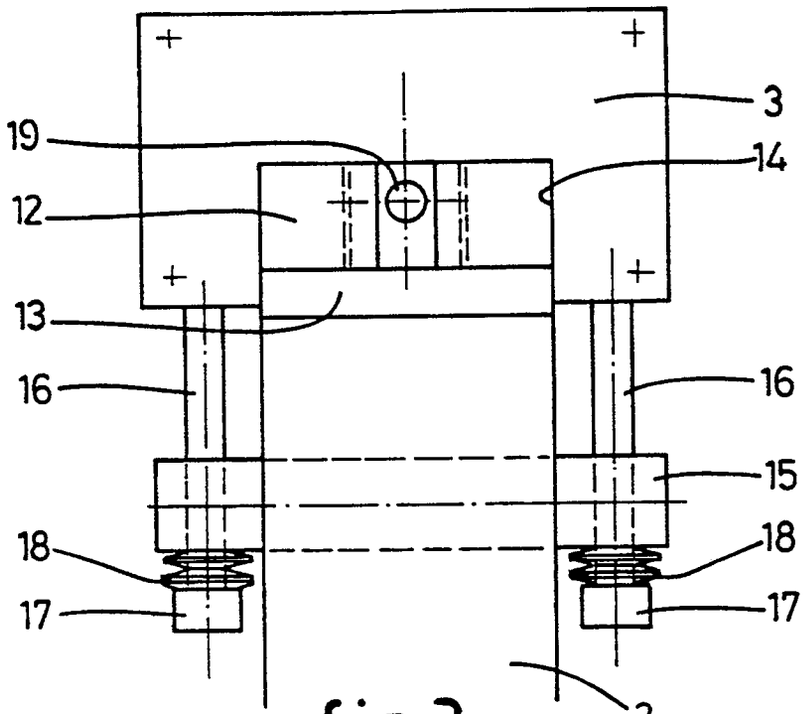

fig.3

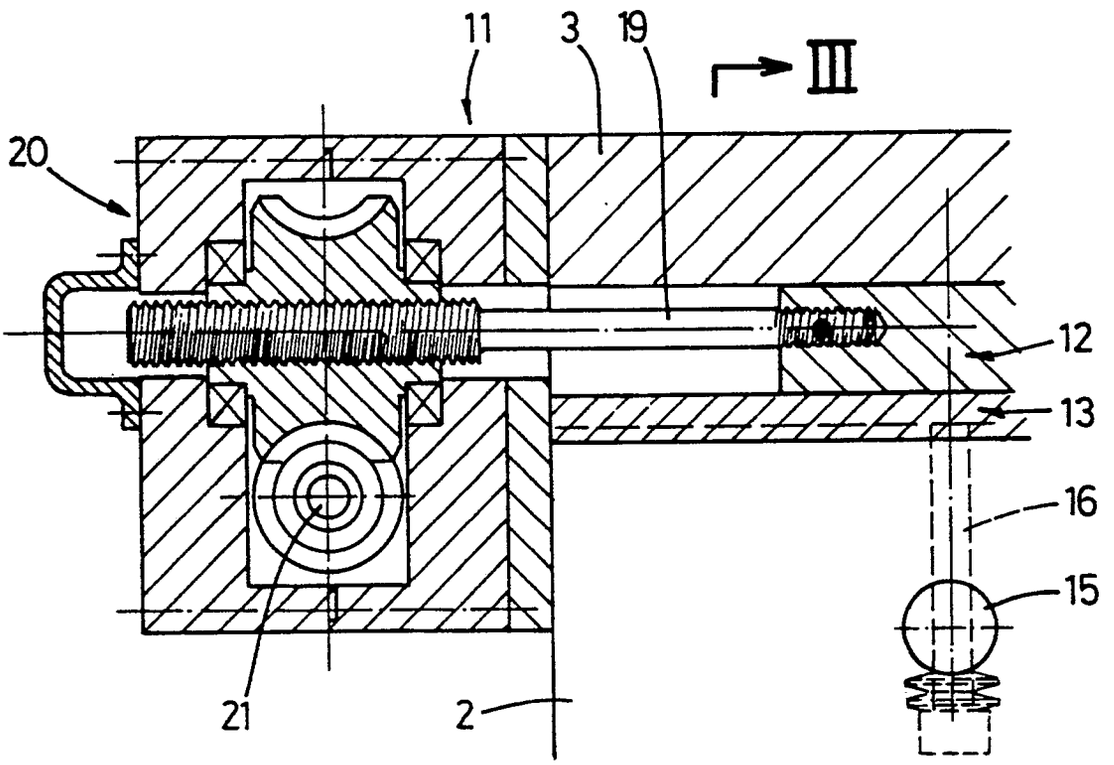

fig.2

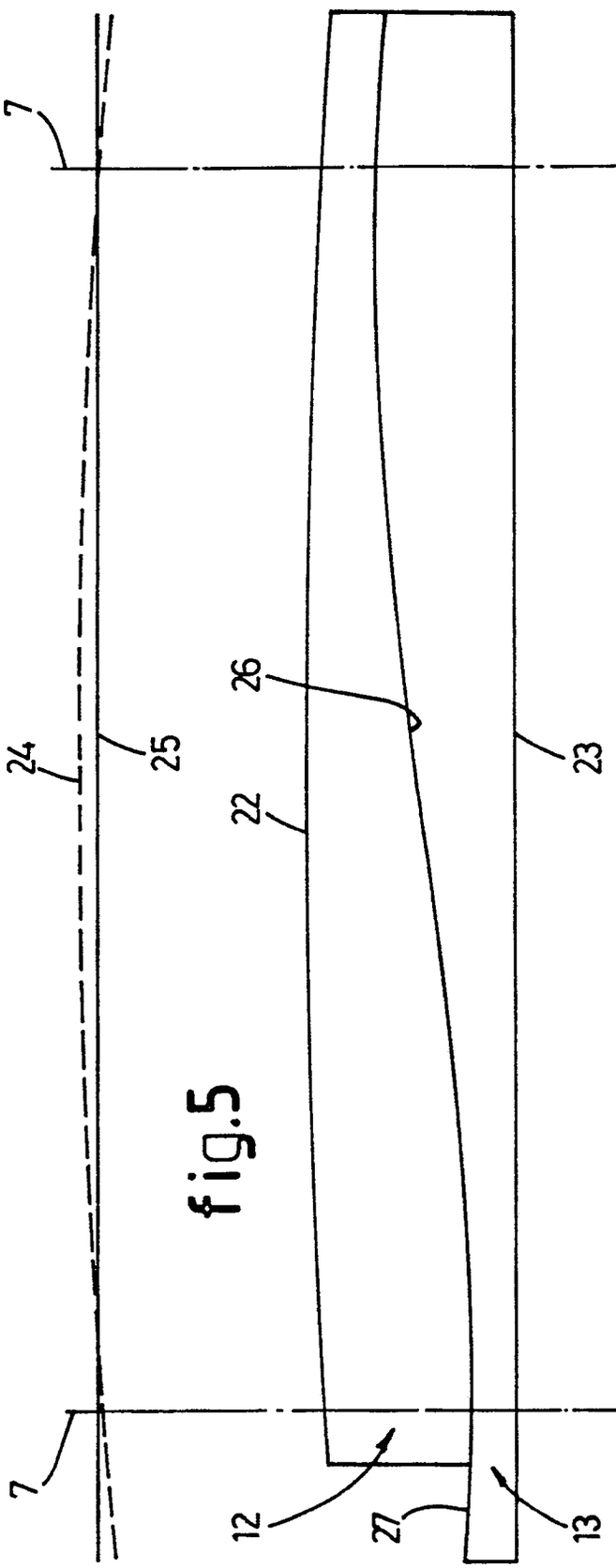

fig.5

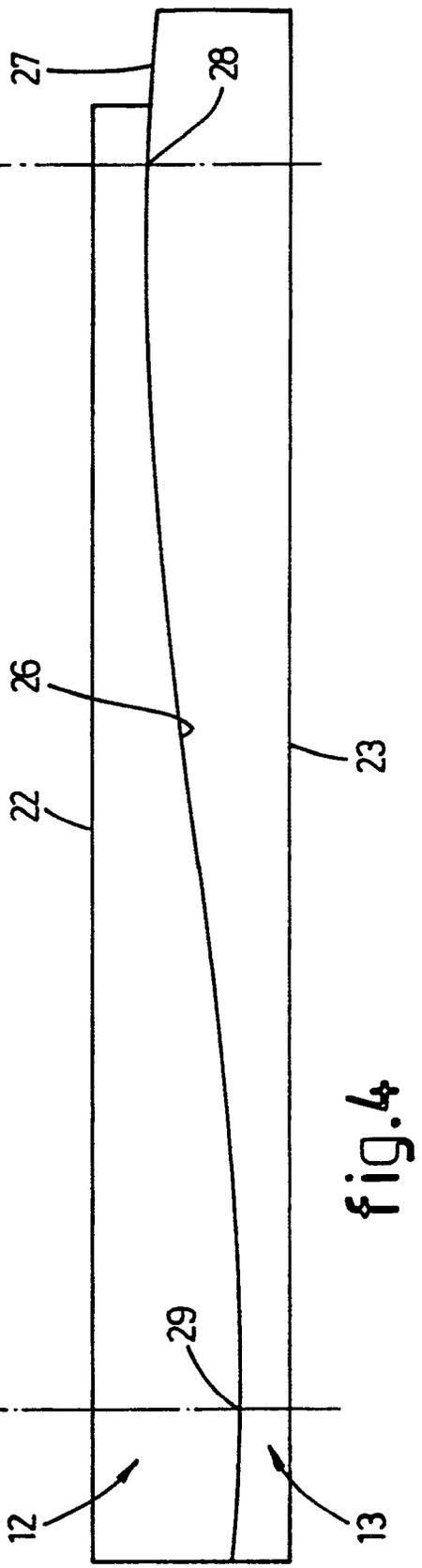

fig.4

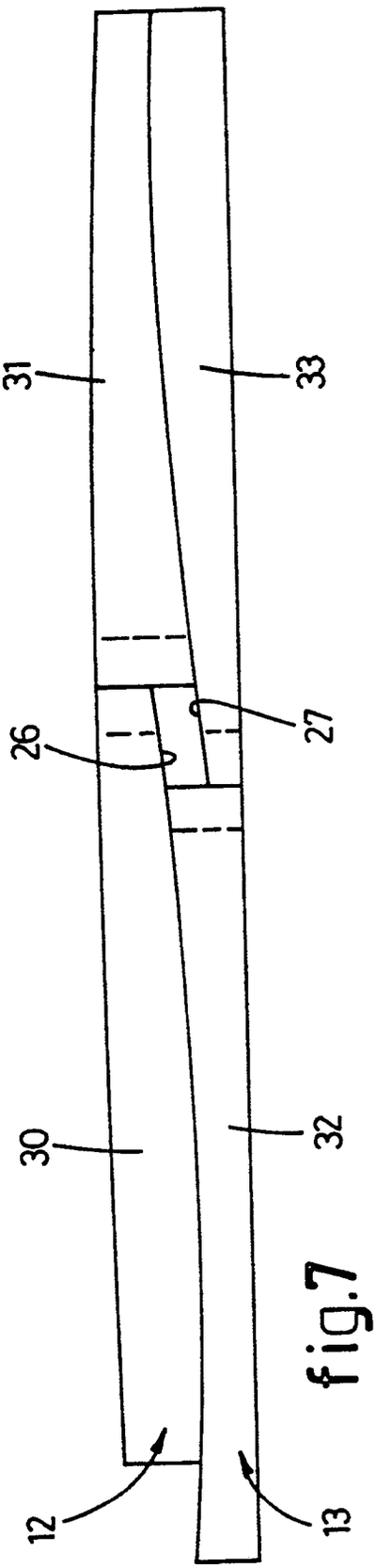

fig.7

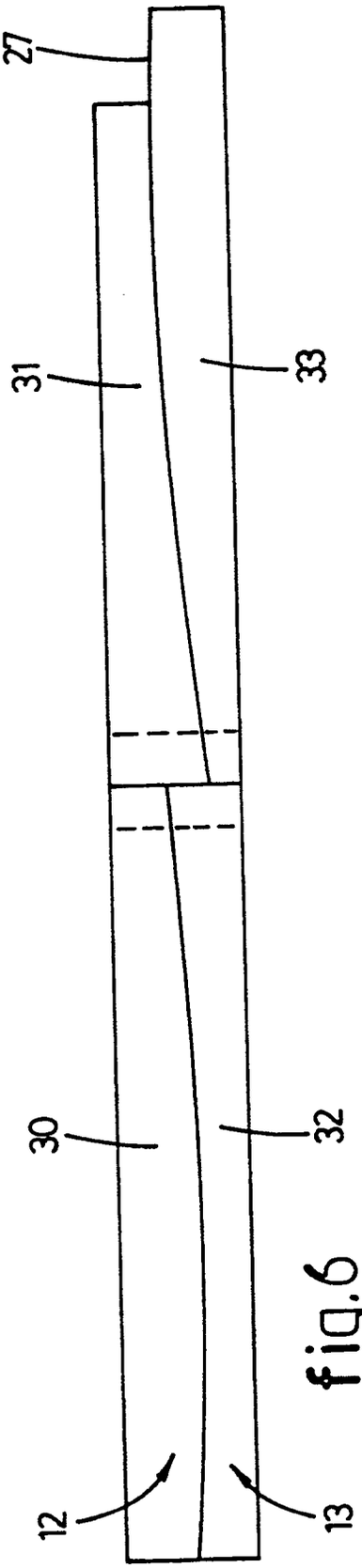

fig.6