(19) Europäisches Patentamt
European Patent Office
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(11) **EP 4 176 987 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.05.2023 Bulletin 2023/19

(21) Application number: **22203721.0**

(22) Date of filing: **26.10.2022**

(51) International Patent Classification (IPC):
B21D 5/02 *(2006.01)* ***B21D 37/02*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B21D 5/02; B21D 5/0209; B21D 37/02

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **05.11.2021 FI 20216143**

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(54) BOTTOM TOOL OF A PRESS BRAKE AND A PRESS BRAKE

(57) A bottom tool (7) of a press brake (1), comprising: a lower frame (8), two movable upper frames (9) arranged over the lower frame (8), between which upper frames there is an elongate slot (10) with a bending axis (15) about which a plate for press-brake bending is arranged to be bent during the press-brake bending, and a moving mechanism (12) for moving the upper frames (9) toward each other and away from each other to change the width of the slot (10). The moving mechanism (12) comprises, in connection with each upper frame (9), a first wedge row (13) with wedges (14) arranged one after another, their front faces (14.1) fastened to the upper frame (9) and their back faces (14.2) being inclined relative to the bending axis (15) of the slot (10), and a second wedge row (16) with wedges (17) arranged one after another, their front faces (17.1) being inclined relative to the bending axis (15) of the slot (10) and which front faces (17.1) are arranged against the back faces (14.2) of the wedges (14) of the first wedge row (13). The moving mechanism (12) comprises a moving device (18) for moving the second wedge rows (16) parallel to the bending axis (15). On the inclined back faces (14.2) of the wedges (14) of the first wedge rows (13) there are stepped ridges (21), and on the inclined front faces (17.1) of the wedges (17) of the second wedge rows (16) there are stepped ridges (21) arranged to be supported to the ridges (21) of the wedges (14) of the first wedge rows (13).

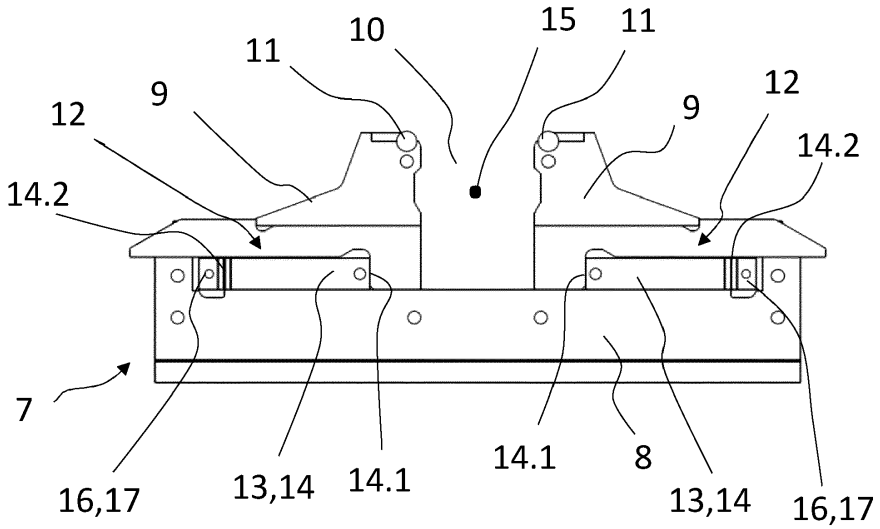

Fig. 2

EP 4 176 987 A1

Description

[0001] The present invention relates to an adjustable-opening bottom tool, i.e. a die, of a press brake according to claim 1. The invention also relates to a press brake.

[0002] Press-brake bending refers to the bending of metal plates, typically sheet metal, by a press brake. The press brake comprises a frame to which an upper and a lower beam have been mounted, at least one of which beams may be moved relative to the frame. Press-brake bending tools, i.e. a top tool and a bottom tool, between which the plate is bent, are fastened to the upper and to the lower beam. The top tool comprises an elongate punch and the bottom tool comprises an elongate die. The plate to be bent is placed between the punch and the die, after which the plate is pressed by the punch into an elongate slot in the die, whereby the plate bends to a desired bend angle and radius.

[0003] Currently in press brakes the most common bending method is so-called air bending, in which the plate is supported during the bending to the edges of the slot of the die and to the tip of the punch. The bend radius and the bend angle of the plate may be adjusted by changing the working length of the punch and/or the width of the slot of the die. In a so-called adjustable-opening bottom tool, the width of the slot may be adjusted manually by spacers placed on the sides of the slot, such that by changing the number and/or thickness of the spacers, a desired width can be obtained for the slot. There are also other adjustment mechanisms for adjusting the width, for example different types of tooth configurations and a groove. The width of the slot of the die may also be adjusted automatically, whereby the die comprises a lower frame fixedly mounted to the lower beam, and two upper frames movable relative to the lower frame which delimit the slot from the sides. The die comprises a moving mechanism by which the upper frames may be moved toward and away from each other to change the width of the slot.

[0004] A problem in automatic adjustment is the push forces exerted on the upper frames of the die during the press-brake bending, tending to push the upper frames away from each other. The push forces are great, for which reason the mechanisms moving the upper frames must be strong in construction.

[0005] In some prior-art press brakes the upper frames are moved by a wedge arrangement comprising two wedge rows, of which wedge rows the triangular wedges of the first wedge row are fastened to the upper frame from their front faces and the triangular wedges of the second wedge row rest against the inclined back faces of the wedges of the first wedge row. When the second wedge row is moved in the longitudinal direction, the first wedge row and the upper frame move in the lateral direction of the slot of the die. The wedges must be self-locking so that the mechanism moving the wedges would not become too heavy in construction. To make the wedges self-locking, the angles of inclination of their oblique faces must be rather small. This is why the wedges are long, to obtain a sufficient movement for the upper frame. A problem in the use of long wedges is that when the upper frames are in the extreme position closest to each other, a long empty space forms between the opposite wedges of the wedge rows, at which empty space the wedges do not support each other. This in turn weakens the rigidity of the wedge rows, whereby the upper frame bends during the press-brake bending and unwanted bends are formed in the plate being bent.

[0006] It is an object of the present invention to provide an improved bottom tool of a press brake and a press brake by which the above-described problems may be reduced.

[0007] The object according to the invention is achieved by a bottom tool according to claim 1, comprising a lower frame, two movable upper frames arranged over the lower frame, between which upper frames there is an elongate slot with a bending axis about which the plate for press-brake bending is arranged to be bent during the press-brake bending, and a moving mechanism for moving the upper frames toward each other and away from each other to change the width of the slot. The moving mechanism comprises, in connection with each upper frame, a first wedge row with wedges arranged one after another, their front faces fastened to the upper frame and their back faces being inclined relative to the bending axis of the slot, and a second wedge row with wedges arranged one after another, their front faces being inclined relative to the bending axis of the slot and which front faces are arranged against the back faces of the wedges of the first wedge row. The moving mechanism comprises a moving device for moving the second wedge rows parallel to the bending axis. On the inclined back faces of the wedges of the first wedge rows there are stepped ridges, and on the inclined front faces of the wedges of the second wedge rows there are stepped ridges arranged to be supported to the ridges of the wedges of the first wedge rows.

[0008] According to one embodiment of the invention, the ridges of the wedges of the second wedge rows are arranged to slide against the ridges of the wedges of the first wedge rows, when the second wedge rows are moved by the moving device.

[0009] According to one embodiment of the invention, the ridges of the wedges of the first wedge rows comprise support surfaces and the ridges of the wedges of the second wedge rows comprise support surfaces arranged against each other against the support surfaces of the wedges of the first wedge rows during press-brake bending.

[0010] According to one embodiment of the invention, the support surfaces of the wedges of the first wedge rows and the support surfaces of the wedges of the second wedge rows are perpendicular to the direction of movement of the upper frames.

[0011] According to one embodiment of the invention, a distance between the support surfaces of adjacent ridg-

es of the wedges of the first wedge rows and the support surfaces of adjacent ridges of the wedges of the second wedge rows in the direction of movement of the upper frames is 2-15 mm, typically 5-10 mm.

[0012] According to one embodiment of the invention, the moving device comprises a lead screw, for example a ball screw or a roller screw, and a motor for moving the lead screw.

[0013] According to one embodiment of the invention, the wedges of the first wedge rows and the wedges of the second wedge rows are in the shape of a triangle, for example in the shape of a right-angled triangle.

[0014] According to one embodiment of the invention, the ridge comprises a support surface and a side surface, an angle therebetween being 120-150°, for example 130-140°, typically 135°.

[0015] According to one embodiment of the invention, the back surfaces of the wedges of the first wedge row are formed of the ridges arranged one after another, i.e. of the side surfaces and the support surfaces arranged one after another, and the front surfaces of the wedges of the second wedge row are formed of the ridges arranged one after another, i.e. of the side surfaces and the support surfaces arranged one after another.

[0016] According to one embodiment of the invention, the back surfaces of the wedges of the first wedge row and the front surfaces of the wedges of the second wedge row are serrated.

[0017] According to one embodiment of the invention, ends of the wedges of the first wedge row fastened to the upper frame are, in the direction of the bending axis, disposed between ends of the wedges of the first wedge row fastened to the opposite upper frame, typically at midpoints of the wedges.

[0018] According to one embodiment of the invention, ends of the wedges of the second wedge row are, in the direction of the bending axis, disposed between ends of the wedges of the opposite second wedge row, typically at midpoints of the wedges.

[0019] The invention provides significant advantages.

[0020] The ridges of the wedges of the first wedge row and of the wedges of the second wedge row supported to each other prevent the inclined surfaces of the wedges arranged against each other from moving relative to each other during bending. Thus, the moving mechanism of the bottom tool may be arranged to be self-locking even at relatively large angles of inclination of the inclined surfaces, whereby the wedges may be shorter to achieve the desired movement of the upper frames. As a result, the wedges may be arranged more densely than before in the direction of the slot of the bottom tool. This in turn improves the rigidity of the upper frames and thereby improves the bending result.

[0021] The invention will now be described in more detail by way of examples with reference to the accompanying drawings, in which

Fig. 1 illustrates a press brake according to one embodiment of the invention,

Fig. 2 shows a cross-section of a bottom tool of the press brake of the figure,

Fig. 3 illustrates wedge rows of a moving mechanism of the bottom tool of Fig. 2 as a top view when the slot width is at its largest,

Fig. 4 illustrates wedge rows of a moving mechanism of the bottom tool of Fig. 2 as a top view when the slot width is at its smallest, and

Fig. 5 illustrates a wedge of the wedge rows of Fig. 3 and 4.

[0022] Fig. 1 illustrates a press brake 1 for bending metal plates, typically sheet metal. The press brake 1 comprises a frame 2 comprising two ends. A movable upper beam 3 and a fixed lower beam 4 have been mounted to the ends. The upper beam 3 and the lower beam 4 are elongate. The upper beam 3 is movable in the vertical direction relative to the frame 2 and to the lower beam 4. The press brake 1 comprises an actuator 5 for moving the upper beam 3. The actuator 5 comprises hydraulic cylinders by which the upper beam 3 is moved in the vertical direction toward the lower beam 4 during press-brake bending and away from the lower beam 4 during a return movement of the upper beam 3. The press brake 1 comprises an elongate top tool 6, i.e. a punch, fastened to the upper beam 3, and an elongate bottom tool (not illustrated in Fig. 1), i.e. a die, fastened to the lower beam 4 or mounted over the lower beam 4. Typically, the top tool 6 and the bottom tool are 1-10 meters long.

[0023] The structure of a bottom tool 7, i.e. the die, is illustrated more specifically in Fig. 2-5. The bottom tool 7 comprises a lower frame 8 over which two movable upper frames 9 are arranged. The upper frames 9 are movable against the lower frame 8. Between the upper frames 9 there is an elongate opening or slot 10 into which the plate to be bent is pressed by the top tool 6 during press-brake bending. The upper frames 9 delimit the slot 10 from the sides. The lower frame 8 forms the bottom of the slot 10. In the lateral direction in the middle of the slot 10 there is a bending axis 15, about which the plate for press-brake bending is bent. Rollers 11 running parallel to the bending axis 15 of the slot 10 have been mounted in upper parts of the upper frames 9. By means of the rollers 11, the forces needed in the bending may be reduced, and thereby the lifetime of the bottom tool 7 may be improved.

[0024] The width of the slot 10 may be changed by moving the upper frames 9 toward and away from each other. The bottom tool 7 is provided with a moving mechanism 12 for moving the upper frames 9 to change the width of the slot 10. The moving mechanism 12 comprises, in connection with each upper frame 9, a first wedge

row 13 with wedges 14 arranged one after another. The wedges 14 arranged one after another are fastened to each other. Front faces 14.1 of the wedges 14 of the first wedge row 13 are fastened to the upper frame 9. Back faces 14.2 of the wedges 14 of the first wedge row 13 are inclined relative to the bending axis 15 of the slot 10.

[0025] The moving mechanism 12 also comprises, in connection with each upper frame 9, a second wedge row 16 with wedges 17 arranged one after another. The wedges 17 arranged one after another are fastened to each other. Front faces 17.1 of the wedges 17 of the second wedge row 16 are inclined relative to the bending axis 15 of the slot 10. The front faces 17.1 of the wedges 17 of the second wedge row 16 are arranged against the back faces 14.2 of the wedges 14 of the first wedge row 13. The moving mechanism 12 comprises at least one moving device 18 for moving the second wedge rows 16 parallel to the bending axis 15. The moving device 18 comprises a lead screw 19, such as a ball screw or a roller screw, and a motor 20, for example a servo motor, connected to the lead screw 19 for moving the lead screw 19 in the longitudinal direction thereof. Both of the second wedge rows 16 are moved by the same moving device 18. In this case the longitudinal movement of the lead screw 19 is transmitted to the second wedge rows 16 for example by means of a connector 24. Alternatively each of the second wedge rows 16 may be provided with a separate moving device 18.

[0026] The wedges 14 of the first wedge row 13 and/or the wedges 17 of the second wedge row 16 are in the shape of a triangle or triangular, typically in the shape of a right-angled triangle. Third faces 14.3 of the wedges 14 are arranged at a desired angle, for example at a right angle, to the front faces 14.1. The third faces 14.3 may be perpendicular to the bending axis 15. The wedges 14 are arranged in the first wedge row 13 facing the same direction. The wedges 14 arranged one after another are fastened to each other in such a way that the corner between the front face 14.1 and the back face 14.2 is fastened to the corner between the front face 14.1 and the third face 14.3 of the next wedge 14. An angle of inclination α of the back faces 14.2 of the wedges 14 of the first wedge row 13, i.e. the angle between the back face 14.2 and the front face 14.1, is 18-28°, typically 21-25°. In the embodiment according to the drawings the angle of inclination α of the back face 14.2 is 23°.

[0027] The wedges 17 of the second wedge row 16 are in the same shape as the wedges 14 of the first wedge row 13. Back faces 17.2 of the wedges 17 of the second wedge row 16 are directed away from the slot 10. The front faces 17.1 of the wedges 17 of the second wedge row 16 are arranged against the back faces 14.2 of the wedges 14 of the first wedge row 13. The front faces 17.1 of the wedges 17 of the second wedge row 16 are inclined relative to the bending axis 15. Third faces 17.3 of the wedges 17.3 are arranged at a desired angle, for example at a right angle, to the back faces 17.2. The third faces 17.3 may be perpendicular to the bending axis 15. The wedges 17 are arranged in the second wedge row 16 facing the same direction. The wedges 17 of the second wedge row 16 arranged one after another are fastened to each other. The wedges 17 arranged one after another are fastened to each other in such a way that the corner between the front face 17.1.1 and the back face 17.2.2 is fastened to the corner between the back face 17.2 and the third face 17.3 of the next wedge. The angle of inclination of the front faces 17.1 of the wedges 17 of the second wedge row 16, i.e. the angle between the front face 17.1 and the back face 17.2, is 18-28°, typically 21-25°. In the embodiment according to the drawings the angle of inclination of the front face 17.1 is 23°. The angle of inclination α of the front faces 17.1 of the wedges 17 of the second wedge row 16 is equal to the angle of inclination of the back faces 14.2 of the wedges 14 of the first wedge row 13.

[0028] Fig. 5 illustrates a wedge 14, 16 that may be used in both of the first wedge row 13 and the second wedge row 16. On the back faces 14.2 of the wedges 14 of the first wedge row 13 there are ridges 21, typically stepped ridges. On the front faces 17.1 of the wedges 17 of the second wedge row 16 there are ridges 21, typically stepped ridges. The ridges 21 of the wedges of the first wedge row 13 and of the second wedge row 16 are in the same shape. The ridges 21 of the wedges 17 of the second wedge row 16 are arranged between the ridges 21 of the wedges 14 of the first wedge row 13 to be supported to the ridges 21 during bending. Thereby the ridges 21 prevent sliding between the back faces 14.2 of the wedges 14 of the first wedge row 13 and the front faces 17.1 of the wedges 17 of the second wedge row 16 during the bending. This improves the self-locking capability of the moving mechanism 12 compared to even back and front surfaces. The ridges 21 of the wedges 17 of the second wedge row 16 are arranged to slide against the ridges 21 of the wedges 14 of the first wedge row 13, when the second wedge row 16 is moved by the moving device 18. The tips of the ridges 21 are rounded to facilitate the sliding of the second wedge row 16.

[0029] The ridges 21 comprise support surfaces 22 arranged against support surfaces 22 of the ridges 21 of the opposite wedge during bending. Thereby the support surfaces 22 of the ridges 21 of the wedges 17 of the second wedge row 16 are fitted against the support surfaces 22 of the ridges 21 of the wedges 14 of the first wedge row 13 during the bending. The support surfaces 22 are perpendicular to the direction of movement of the upper frames 9. A distance d between adjacent support surfaces 22 of a wedge 14,17 in the direction of movement of the upper frames 9 is 2-15 mm, typically 5-10 mm, most suitably 5 mm. Thereby displacement of the ridges 21 of the wedges 17 of the second wedge rows 16 by one support surface 22 to the next support surface 22 of the wedge 14 of the first wedge row 13 changes the width of the slot 10 two times the distance d between adjacent support surfaces 22.

[0030] Each ridge 21 comprises a support surface 22

and a side surface 23 extending from the support surface 22. An angle (b) between the support surface 22 and the side surface 23 is 120-150°, for example 130-140°, typically 135°. The angle (b) between the support surface 22 and the side surface 23 may be rounded. Correspondingly, an angle of elevation (c) of the ridges 21, i.e. the angle between a line parallel to the support surface 22 and the side surface 23 of the ridge adjacent to the support surface 22, is 30-60°, for example 40-50°, typically 45°.

[0031] The back surfaces 14.2 of the wedges 14 of the first wedge row 13 are formed of the ridges 21 arranged one after another, i.e. of the side surfaces 23 and of the support surfaces 22 arranged one after another. The front surfaces 17.1 of the wedges 17 of the second wedge row 14 are formed of the ridges 21 arranged one after another, i.e. of the side surfaces 23 and of the support surfaces 22 arranged one after another. The back surfaces 14.2 of the wedges of the first wedge row 13 and the front surfaces 17.1 of the wedges 17 of the second wedge row 16 are serrated.

[0032] Ends of the wedges 14 of the first wedge row 13 fastened to the upper frame 9 may be disposed, in the direction of the bending axis 15, between ends of the wedges 14, typically at midpoints of the wedges 14, of the first wedge row 13 fastened to the opposite upper frame 9, as indicated in Fig. 3 and 4. The wedges 17 of the second wedge rows 16 may be arranged in a corresponding manner, i.e. ends of the wedges 17 of the second wedge row 16 are disposed, in the direction of the bending axis 15, between ends of the wedges 17, typically at midpoints of the wedges 17, of the opposite second wedge row 16. Thereby the weakest points of the first wedge rows 13, i.e. the ends of the wedges, are disposed at different points in the direction of the bending axis 15. Correspondingly the weakest points of the second wedge rows 16, i.e. the ends of the wedges, are disposed at different points in the direction of the bending axis 15. By means of the arrangement, the bending result may be improved. The above-described staggering of wedges of the wedge rows 13, 16 may also be used in solutions where the back surfaces 14.2 of the wedges of the first wedge row 13 and the front surfaces 17.1 of the wedges 17 of the second wedge row 16 are even, i.e. do not comprise the stepped ridges 21.

[0033] The width of the slot 10 of the bottom tool 7 is changed as follows. In Fig. 3, the width of the slot 10 is at its largest. Thereby the back faces of the first wedge rows 13 and the front faces of the wedges of the second wedge rows 16 are arranged against each other over their entire length. The third faces of the wedges 14 of the first wedge rows 13 and of the wedges 17 of the second wedge rows 16 are arranged against each other. The ridges 21 of the wedges 17 of the second wedge rows 16 are located between the ridges 21 of the wedges 14 of the first wedge rows 13 and are supported to the ridges 21. The support surfaces 22 of the ridges 21 of the second wedge rows 16 are arranged against the support surfaces 22 of the ridges 21 of the first wedge rows 13.

[0034] The width of the slot 10 is reduced by moving the second wedge rows 16 with the moving device 18 in a direction parallel to the bending axis 15. In Fig. 3 the second wedge rows 16 are moved to the right. The second wedge rows 16 are moved simultaneously. The inclined front surfaces of the wedges 17 of the second wedge rows 16 slide against the inclined back surfaces of the wedges 14 of the first wedge rows 13. At the same time, the ridges 21 of the second wedge rows 16 slide along the ridges 21 of the first wedge rows 13 and along the recesses between the ridges 21. Displacement of the support surfaces 22 of the ridges 21 of the second wedge rows 16 against the support surfaces 22 of the next ridges 21 reduces the width of the slot 10 two times the distance d between adjacent support surfaces 22. The movement of the second wedge rows 16 is stopped, when a desired width for the slot 10 has been reached. Thereby the support surfaces 22 of the ridges 21 of the wedges 14 of the first wedge rows 13 and of the wedges 17 of the second wedge rows 16 are supported against each other. After this, the plate is bent by pressing it with the top tool 6 into the slot 10 of the bottom tool 7. After bending, the top tool 6 and the bent plate are removed from the slot 10. The width of the slot 10 is increased by displacing the second wedge rows 16 in opposite directions than when reducing the width of the slot 10 and by moving the first wedge rows 13 against the second wedge rows 16.

[0035] It is obvious to a person skilled in the art that the invention is not limited solely to these solutions. The invention and its embodiments may thus vary within the claims.

Claims

1. A bottom tool (7) of a press brake (1), comprising:

- a lower frame (8), and
- two movable upper frames (9) arranged over the lower frame (8), between which upper frames there is an elongate slot (10) with a bending axis (15) about which a plate for press-brake bending is arranged to be bent during the press-brake bending, and
- a moving mechanism (12) for moving the upper frames (9) toward each other and away from each other to change the width of the slot (10), which moving mechanism (12) comprises, in connection with each upper frame (9):
- a first wedge row (13) with wedges (14) arranged one after another, their front faces (14.1) fastened to the upper frame (9) and their back faces (14.2) being inclined relative to the bending axis (15) of the slot (10), and
- a second wedge row (16) with wedges (17) arranged one after another, their front faces

(17.1) being inclined relative to the bending axis (15) of the slot (10) and which front faces (17.1) are arranged against the back faces (14.2) of the wedges (14) of the first wedge row (13), and
- which moving mechanism (12) comprises a moving device (18) for moving the second wedge rows (16) parallel to the bending axis (15),

characterized in that on the inclined back faces (14.2) of the wedges (14) of the first wedge rows (13) there are stepped ridges (21), and on the inclined front faces (17.1) of the wedges (17) of the second wedge rows (16) there are stepped ridges (21) arranged to be supported to the ridges (21) of the wedges (14) of the first wedge rows (13).

2. The bottom tool (7) according to claim 1, **characterized in that** the ridges (21) of the wedges (17) of the second wedge rows (16) are arranged to slide against the ridges (21) of the wedges (14) of the first wedge rows (13), when the second wedge rows (16) are moved by the moving device (18).

3. The bottom tool (7) according to claim 1 or 2, **characterized in that** the ridges (21) of the wedges (14) of the first wedge rows (13) comprise support surfaces (22) and the ridges (21) of the wedges (17) of the second wedge rows (16) comprise support surfaces (22) arranged against each other against the support surfaces (22) of the wedges (14) of the first wedge rows (13) during press-brake bending.

4. The bottom tool (7) according to claim 3, **characterized in that** the support surfaces (22) of the wedges (14) of the first wedge rows (13) and the support surfaces (22) of the wedges (17) of the second wedge rows (16) are perpendicular to the direction of movement of the upper frames (9).

5. The bottom tool (7) according to claim 3 or 4, **characterized in that** a distance (d) between the support surfaces (22) of adjacent ridges (21) of the wedges (14) of the first wedge rows (13) and the support surfaces (22) of adjacent ridges (21) of the wedges (17) of the second wedge rows (16) in the direction of movement of the upper frames (9) is 2-15 mm, typically 5-10 mm.

6. The bottom tool (7) according to any one of the preceding claims, **characterized in that** the moving device (18) comprises a lead screw (19), for example a ball screw or a roller screw, and a motor (20) for moving the lead screw (19).

7. The bottom tool (7) according to any one of the preceding claims, **characterized in that** the wedges (14) of the first wedge rows (13) and the wedges (17) of the second wedge rows (16) are in the shape of a triangle, for example in the shape of a right-angled triangle.

8. The bottom tool (7) according to any one of the preceding claims, **characterized in that** the ridge (21) comprises a support surface (22) and a side surface (23), an angle (b) therebetween being 120-150°, for example 130-140°, typically 135°.

9. The bottom tool (7) according to any one of the preceding claims, **characterized in that** the back surfaces (14.2) of the wedges (14) of the first wedge row (13) are formed of the ridges (21) arranged one after another, i.e. of the side surfaces (23) and of the support surfaces (22) arranged one after another, and the front surfaces (17.1) of the wedges (17) of the second wedge row (14) are formed of the ridges (21) arranged one after another, i.e. of the side surfaces (23) and of the support surfaces (22) arranged one after another.

10. The bottom tool (7) according to any one of the preceding claims, **characterized in that** the back surfaces (14.2) of the wedges (14) of the first wedge row (13) and the front surfaces (17.1) of the wedges (17) of the second wedge row (14) are serrated.

11. The bottom tool (7) according to any one of the preceding claims, **characterized in that** ends of the wedges (14) of the first wedge row (13) fastened to the upper frame (9) are disposed, in the direction of the bending axis (15), between ends of the wedges (14), typically at midpoints of the wedges (14), of the first wedge row (13) fastened to the opposite upper frame (9).

12. The bottom tool (7) according to any one of the preceding claims, **characterized in that** ends of the wedges (17) of the second wedge row (16) are disposed, in the direction of the bending axis (15), between ends of the wedges (17), typically at midpoints of the wedges (17), of the opposite second wedge row (16).

13. A press brake (1) for the press-brake bending of plates, which press brake (1) comprises a frame (2) to which un upper beam (3) and a lower beam (4) have been mounted, at least one of the beams being movable relative to the frame (2), a top tool (6) fastened to the upper beam (3), and a bottom tool (7) fastened to the lower beam, between which tools a plate for press-brake bending is bent, **characterized in that** the bottom tool (7) is in accordance with any one of claims 1-12.

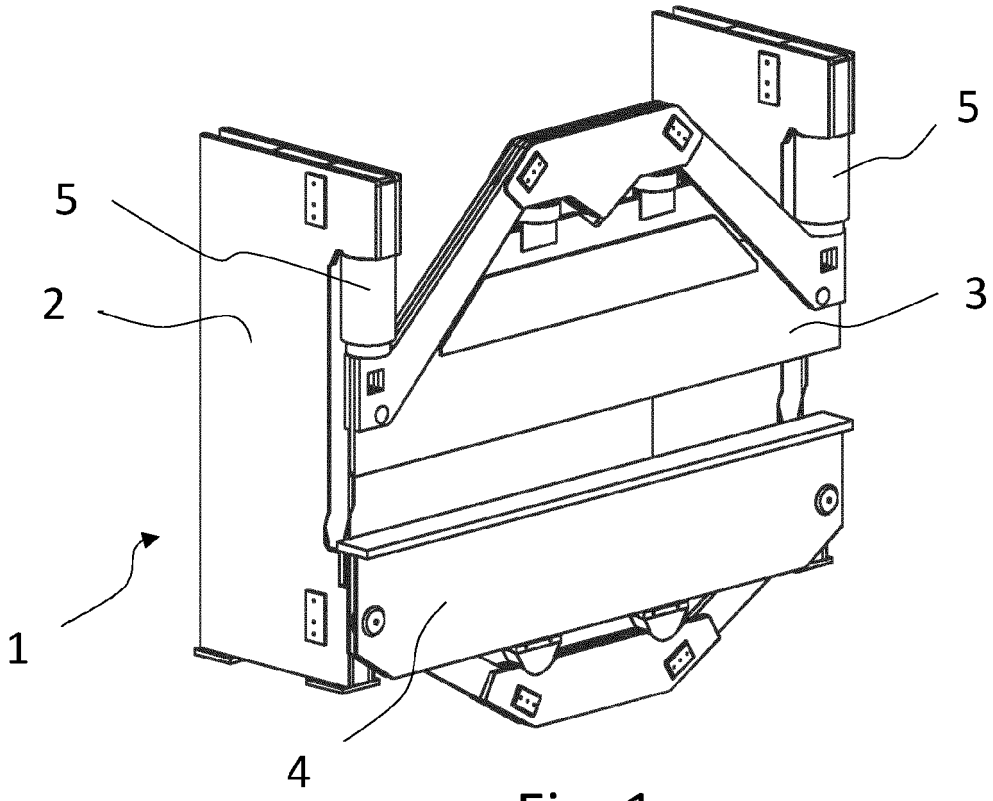
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Fig. 1

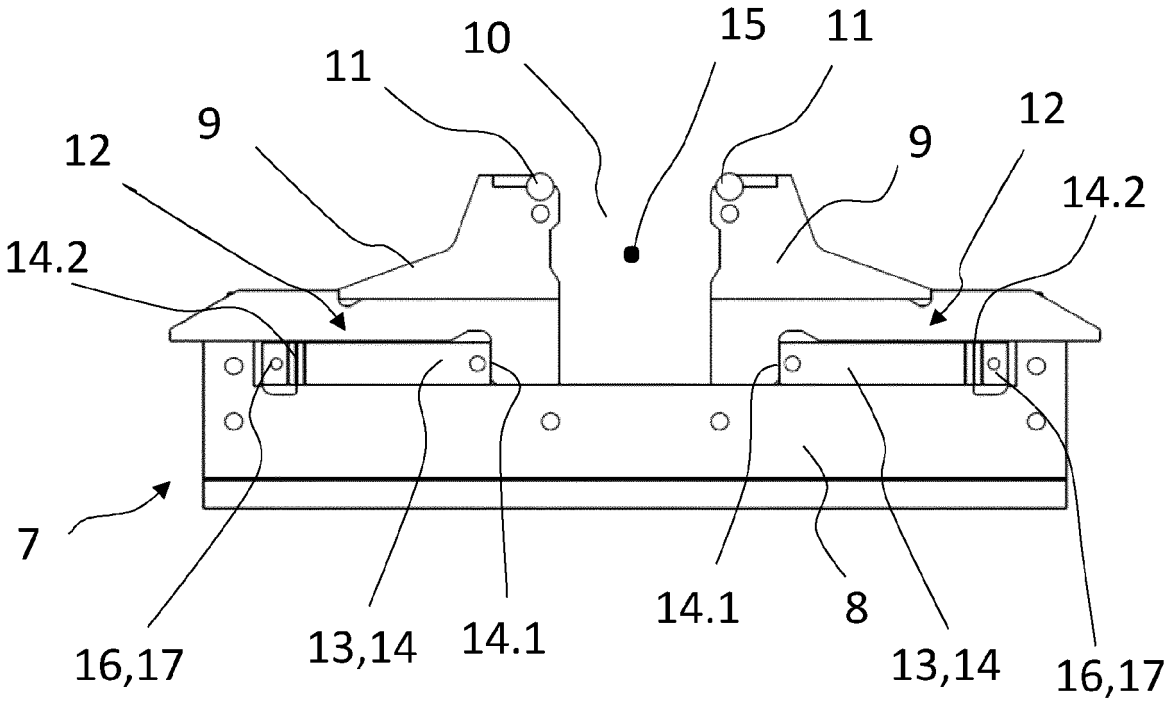
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Fig. 2

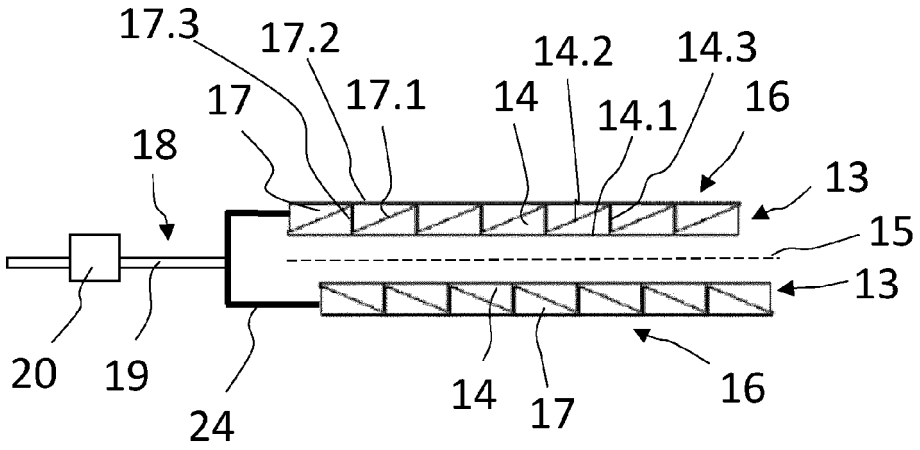

Fig. 3

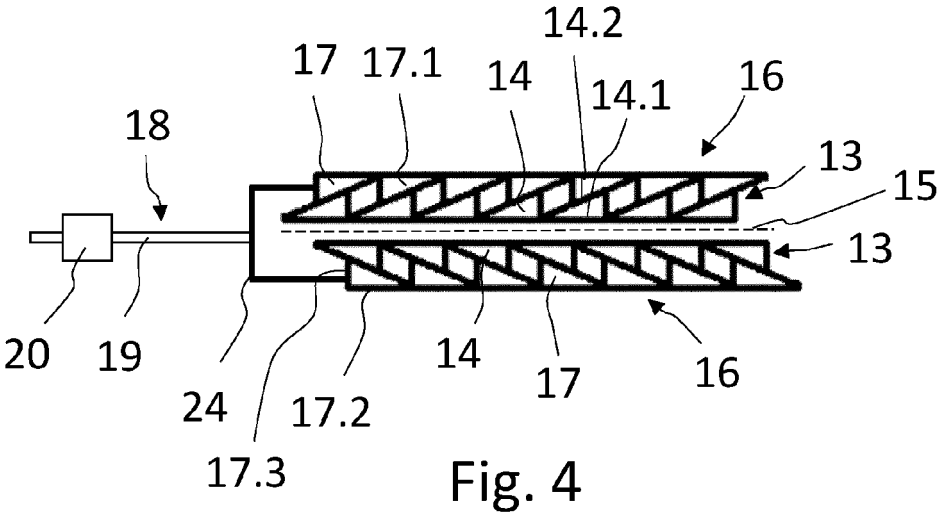

Fig. 4

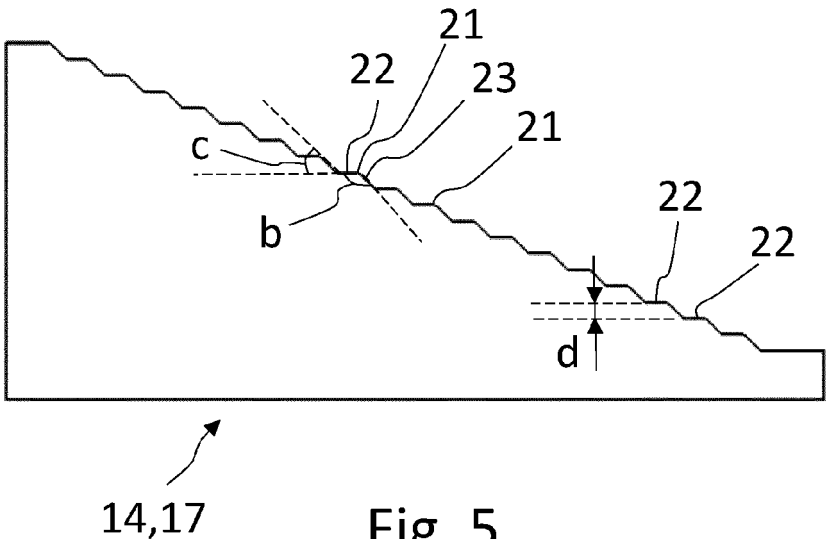

Fig. 5

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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 March 2023	Vassoille, Philippe

CATEGORY OF CITED DOCUMENTS

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