



CHAPTER 3

Operating Procedure Bending Machine

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In the following chapter we describe the cycle of a notched sheet and the individual operating sequences.

3.1 Sheet Transport

Step 1:

The connection beside the ACP brings the sheet onto the brush table of the ACP

Step 2:

the centering ruler is approaching the sheet.

Step 3:

after centering the convoyer moves the sheet into transfer position for the transport sledge.

Step 4:

the pincer of the transport sledge closes and the sheet is transported into the machine.

3.2. Centering Of The Sheet

Step 1:

left and right XZ-references are raised, pincer opens and the transport sledge moves to the right whereby the blank drops from the pincer. Simultaneously the finished sheet is pushed off in the stacking unit.

Step 2:

depending upon the sheet thickness, the right XZ-reference is moved slightly to the left. whereby the blank is pressed by spring force against the XZ-reference (X-pusher-function)

Step 3:

Z-pusher moves forwards and presses the sheet against the reference

Step 4:

The manipulator clamps the centered sheet between rotator and clamping rod in a position selected via program.

Step 5:

The XZ-reference and Z-pusher move into a waiting position beneath the working surface.

Step 6:

The transport sledge moves into the transfer position (with retracted swivelling off loading area)



3.3. Sheet Manipulation

The manipulator has the following function:

- clamping the centered sheet in a pre-selected position, between the rotator and the clamping device.
- convey the sheet to the bending machine
- removing the sheet from the bending machine (exception: last bend carried out downwards)
- rotating clockwise or anticlockwise by 90° or 180°

3.4. Sheet Bending:

This bending machine enables a flexible 3-dimensional processing of fine sheet metal.

The bending machine owes its flexibility to the blade holder. The blade holder is equipped with 3 bearings and is adjustable in vertical and horizontal direction.

The sheet is clamped between the blankholder and the counter blankholder and bent into the desired bending position by the bending tools. (Bending up or bending down)

The bending blade moves around the upper and lower blankholder tool.

The different bending possibilities are limited by the geometry resp. by the dimensions of the machine.

In principle it is possible to execute 4 different bending profiles on all 4 sides of a blank.

It is possible to bend only 1, 2 or 3 sides of the blank, provided that the inner dimensions of the panel, which is clamped by the clamping device, enables the evacuation of the blankholder.

For special cases a profile (2 opposite sides are bent) or a 3-side-bend can be evacuated via the raised blankholder tool.

As a rule, the short sides are bent first with 4-side-bends.

The blankholder which has been adjusted for the long side can then lower onto the long side which hasn't already been bent.

Exception to this rule >>>>> Option CLA!

Example:

The tabs of a staked joint are on the long side and the slots are on the short sides. In this case the long sides are bent first.

3.4.1. The Bending Cycle

Depending on the instructions of the bending program the blade holder moves to the position "ready to bend upwards" or "ready to bend downwards". The value y does not change.

Position 1: (fig. 3.4.1) "ready to bend upwards"

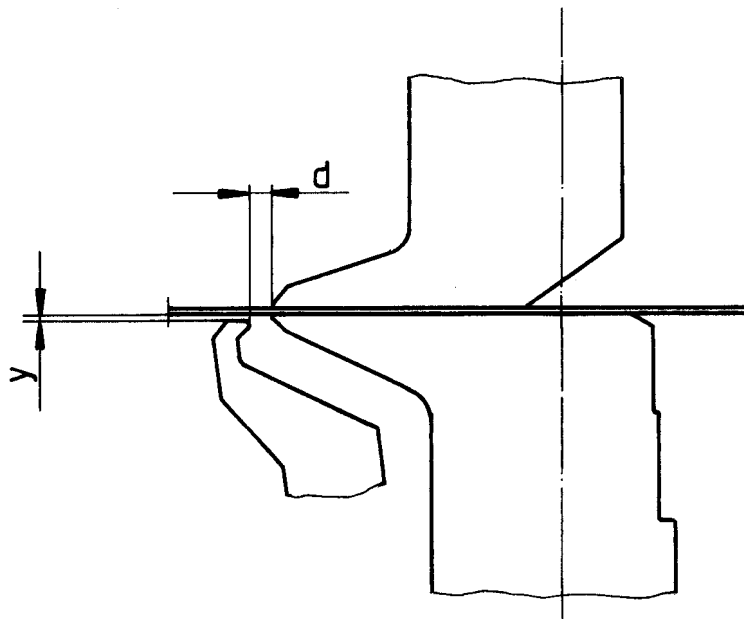


Fig.3.4.1

The distance bending tools - counter blankholder is adjusted by the horizontal bending cylinder. This distance mainly influences the bending radius and is automatically calculated by program.

Position 2 (fig.3.4.2): "bent upwards"

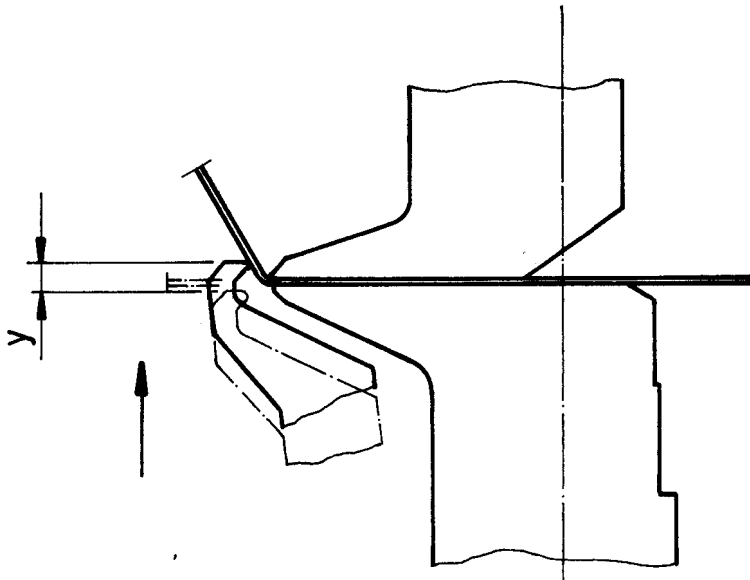


Fig. 3.4.2

Position 3 (fig.3.4.3): "bending process finished"

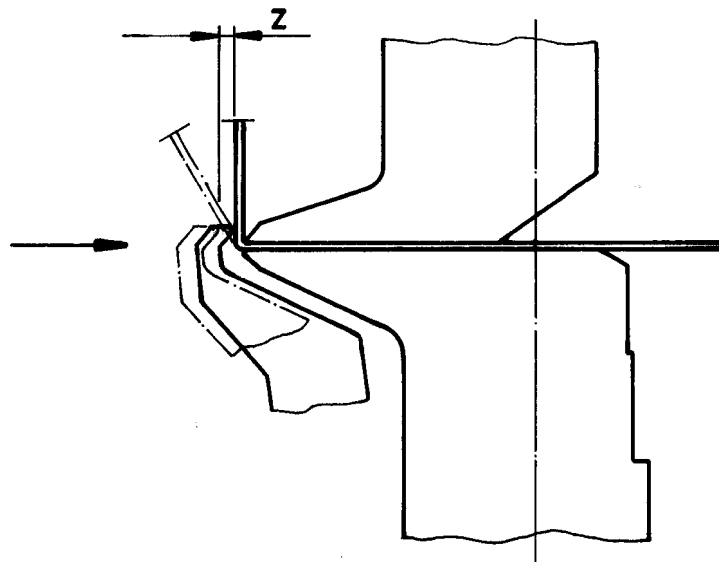


Fig. 3.4.3

The procedures y and z (drawing 2 and 3) are effected by the vertical and horizontal bending unit. Hydraulic cylinders with servo valves and measuring systems move exactly to the end position of the respective procedure.

3.4.2. Sheet Movement In Z-Direction During Bending Process

If, for example, you want to effect 2 upwards/downwards bends first and then a third bend downwards/upwards, it is important to consider the space the bending tool requires. If the bending tool cannot reach its proper position for the 3rd bend without damaging the bends already effected, the sheet is moved in Z-direction, then the bending tool moves to its standard position and finally the sheet returns to the bending position.

Bending sequence with additional function for sheet movement in Z-direction (fig. 3.4.4)

- 1 - last bend downwards completed
 - blankholder lifts
- 2 - manipulator is positioned
- 3 - Bending blade is in bending position (positive)
- 4 - manipulator moves back into bending position
 - blankholder clamps
 - bend (positive)
 - blankholder lifts
 - ready for further processing

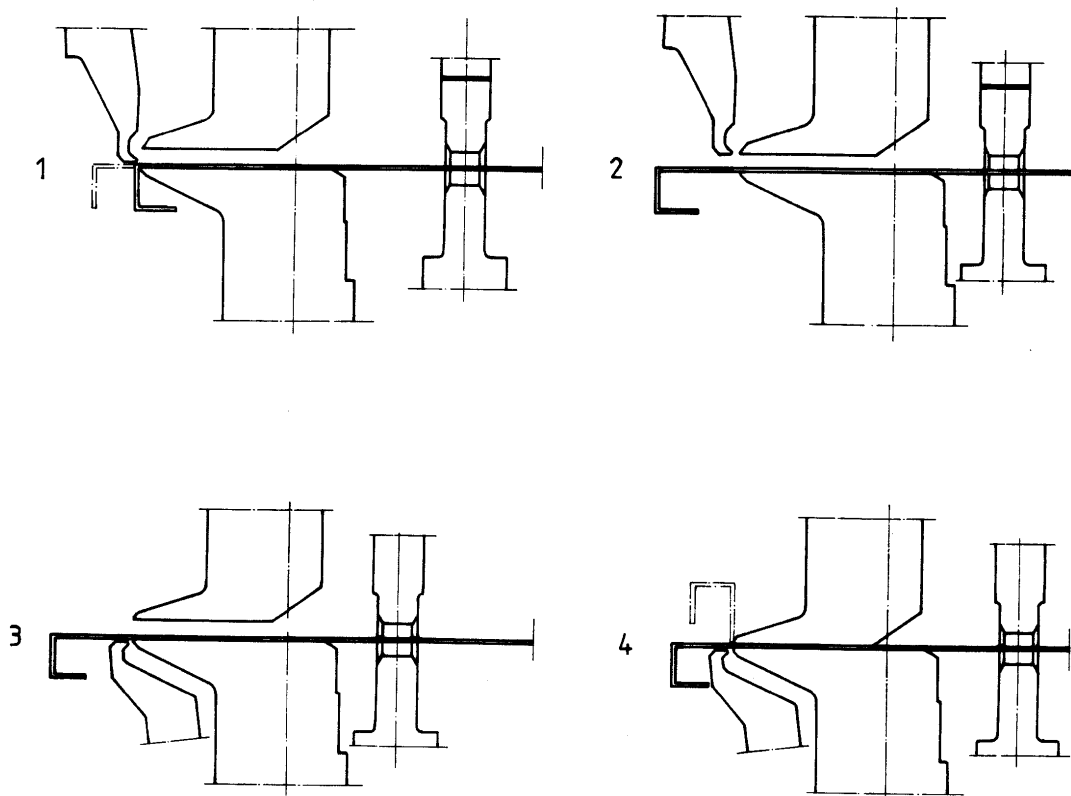


Fig. 3.4.4

3.4.3. Repositioning During Bending Process

(when bending small profiles and panels)

If the inner dimensions of a panel are too small for bending when symmetrically clamped (in the middle), it is necessary to "alter" the position of the clamping device.

Step 1:

Normally when the blanks are very small they are not clamped in the middle (by the clamping device).

Step 2:

Manipulator moves blank into bending position.

Step 3:

Bend first side (i.e. 2 upwards bends) fig. 3.4.5

Disengagement of bending tool (sheet is pushed forwards by manipulator)

- see distance a fig. 3.4.6

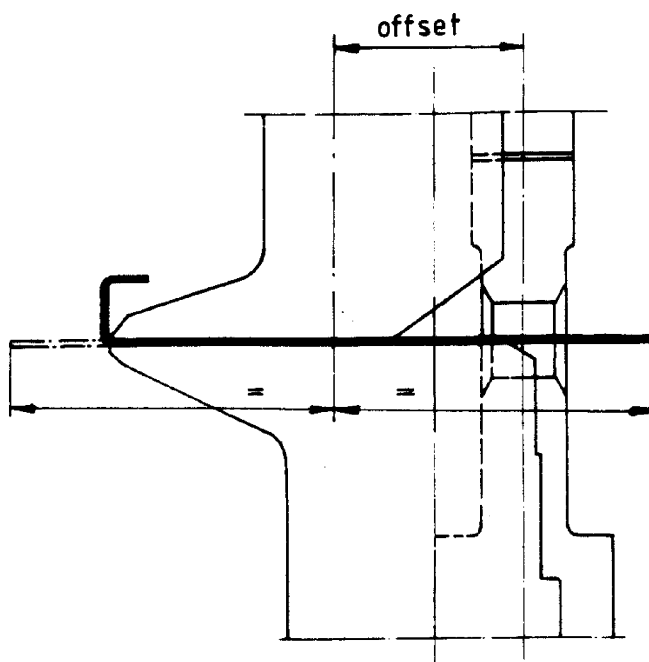


Fig. 3.4.5

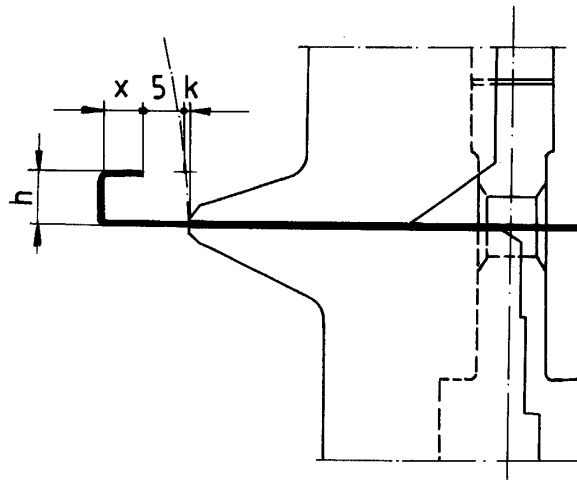


Fig. 3.4.6

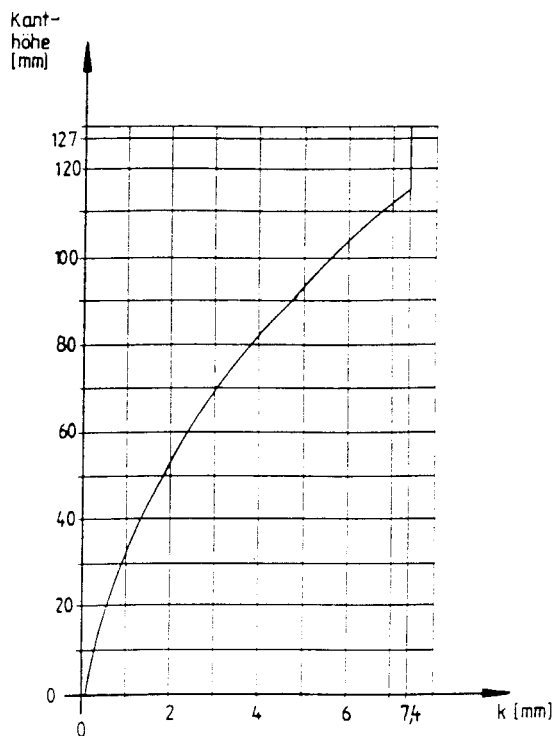
When moving upwards the blankholder segments describe a curve the result of which is the following formula for the value a:

$$a = x + 5 \text{ mm} + k$$

x ... length of the inward bend + 5 mm safe distance

k ... correction value, depending on the bending length (fig.3.4.7)

The distance a is calculated automatically.



Step 4:

Blankholder moves upwards, the manipulator moves back and turns the blank by 180°.

Step 5 (fig. 3.4.8):

The blank is moved into a position which is clamped by the blankholder and counter blankholder of at least 10 mm.

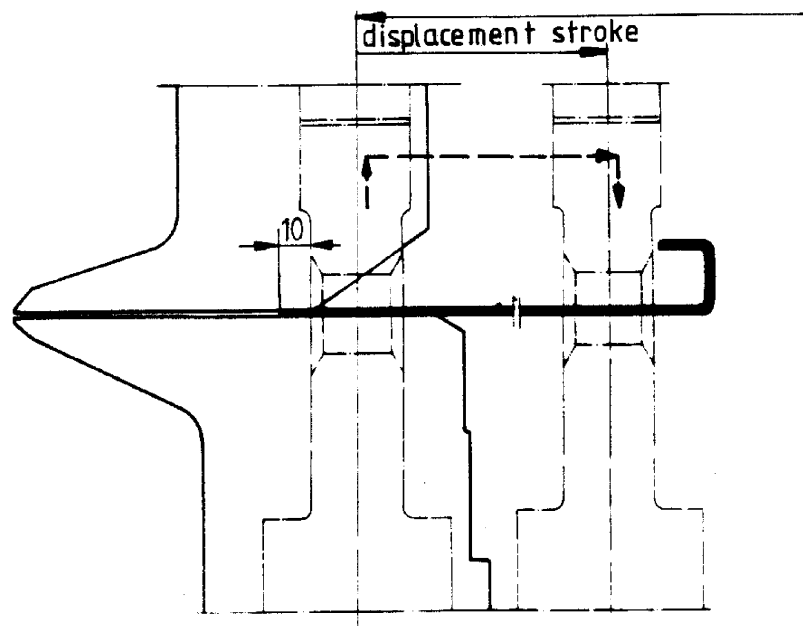


Fig. 3.4.8

Step 6 (fig. 3.4.8):

After the blankholder and the counter blankholder have clamped the blank, the plug of the clamping device moves upwards by approx. 6 mm (lifting stroke) and the manipulator changes the position of the clamping device by the pre-selected distance and then clamps the blank there.

Step 7:

Manipulator moves the blank to the bending position.

Step 8:

Bending of the second side.

3.5 Panel Evacuation

After the whole bending process is completed, the blankholder is lifted so that the panel can be evacuated. This works only if there are no inside bends. Otherwise the rotatable segments have to be turned out (i.e. for certain products they have to be positioned manually).

After lifting of the blankholder the manipulator moves the panel to a position where the transport sledge can evacuate the panel.

Exception:

- 1) If the last bend is effected downwards the panel is evacuated via the counter blankholder.
- 2) If the inner dimensions of a profile (2-sides-bent) or a profile with 3 sides bent does not allow the evacuation of the panel, then evacuation is effected via the raised blankholder tool.