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(54) **A device for automating the process of bending workpieces of a metal sheet for a bending press**

(57) The invention relates to the device (1) for automating the process of bending workpieces of a metal sheet for a bending press, comprising a supporting frame (2) having a rear side for attaching the device to the press and the opposite front side and comprising two mutually parallel side walls (3) which are interconnected by at least one crosspiece (4), and means for setting the workpiece to be bent comprising: a top plate (8) with a cut-out (9), mounted on the supporting frame (2) pivotally upwards from the front side of the supporting frame (2) via at least one top plate guide (10) mounted on the side walls (3) of the supporting frame (2), a table (12) mounted slidably in the cut-out (9) of the top plate (8) on cross-guides (13) disposed along the side walls (3) of the supporting frame (2), and a rotatable plate (14) embedded rotatably in the table (12). The device (1) comprises guides (6a, 6b) for attaching the device (1) to the press along its entire length and means formed in the supporting frame (2) for slidably mounting of the supporting frame (2) on the guides (6a, 6b) and it comprises a driving device (7) mounted on the supporting frame (2) for moving the supporting frame (2) along the guides (6a, 6b).

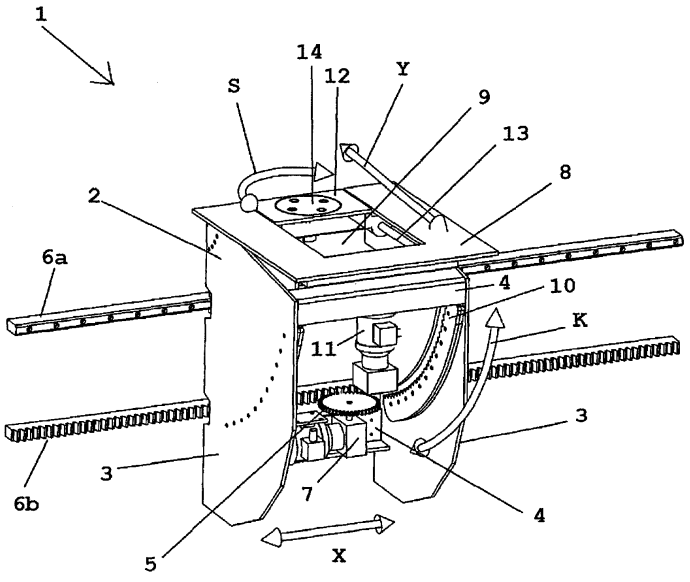

Fig. 1

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Description

Field of the invention

[0001] The invention relates to a device for automating the process of bending workpieces of a metal sheet for using in a bending press.

Background art

[0002] There are known various kinds of devices for automating the process for producing workpieces of a metal sheet. Manipulators, among others, are used for this purpose, including industrial robots, which enable bending of a workpiece in different planes. After bending in one plane, a robot rotates the workpiece in different planes by means of grippers arranged on the boom and then transfers it to the bending machine. A solution of this type is used in devices for bending edges of metal sheets produced by different manufacturers of press brakes and industrial robots, such as: Trumpf, Amada, Kuka, and Motoman. One disadvantage of that solution is a slow bending process and high price.

[0003] Another approach to the problem of bending processes was proposed by Salvagnini Italia S.p.a. One of the devices marketed by the company is an automated bending line for workpieces of metal sheets, equipped with a linear manipulator. The manipulator, after folding one edge, withdraws a workpiece from the machine and, in order to bend successive edge, it rotates and reintroduces the workpiece into the bending machine. The workpiece handling is carried out in one plane and bending of the workpiece edge entails the necessity to equip the bending machine with appropriate tools. The disadvantage of this solution is a limited thickness of bent workpieces to 2.5 mm and a very high price of the device.

[0004] The present Applicant has developed a device for automating the process of bending workpieces of a metal sheet for a bending press, which is the subject matter of the Polish patent application No. P.400138, and which allows bending several edges of the workpiece in different planes, without the necessity to move the workpiece away from the press in order to change its position.

[0005] The device comprises:

- a supporting frame having a rear side for attaching the device to the press and the opposite front side and comprising two mutually parallel side walls which are interconnected by at least one crosspiece, and
  means for setting a workpiece for bending comprising

- a top plate with a cut-out, mounted on the supporting frame pivotally upwards from the front side of the supporting frame by means of at least one top plate guide mounted on the side walls of the supporting frame,

- a table mounted slidably in the cut-out of the top plate on cross-guides disposed along the side walls of the supporting frame,

- a rotatable plate (14) embedded rotatably in the table.

[0006] The device is fixed to the bending press in one fixed position.

Summary of the invention

[0007] The purpose of the present invention is to further improve this known device by providing it with additional features and advantages.

[0008] This purpose was achieved by the device for automating the process of bending workpieces of a metal sheet for a bending press having the features defined in claim 1. Preferred and advantageous features of the present invention are defined in the dependent claims.

[0009] According to the invention the device comprises guides for attaching the device to the press along its entire length and means formed in the supporting frame for slidably mounting of the supporting frame on the guides and it comprises a driving device mounted on the supporting frame for moving the support frame along the guides.

[0010] Due to the ability to move the device along the press on the guides the following beneficial effects are obtained:

1. The ability to automatically unload the workpiece after the bending process into a container placed on one side of the press by the inertial force, i.e., after completion of the workpiece the supporting frame is moved along the guides at a certain speed in the direction of one end of the press, it is braked, the attachment of the workpiece is released and the workpiece falls into the container due to the inertial force;

2. Because of the movement of the device along the press the bending can be carried out on several types of tools (dies, punches) attached along the press.

3. It is also possible to move the device to one end of the press and have free space for manual bending of the workpiece.

Brief description of the drawing

[0011] The subject matter of the invention is illustrated in the embodiment in Fig. 1, which shows schematically the construction of the device for automating the process of bending workpieces of metal sheet for bending press in a front and side perspective view.

Detailed description of an embodiment

[0012] The terms: front, rear, bottom, top, right, left, as used in the following description, relate to the device shown in the accompanying drawing, as it is fixed relative to the bending press.

[0013] The device 1 for automating the process of bending workpieces of metal sheet for bending press comprises a supporting frame 2 having a rear side for attaching the device 1 to the press (not shown) and an opposite front side. The supporting frame 2 comprises two mutually parallel side walls 3, which are connected to one another by at least one crosspiece 4, in the example shown by means of an upper crosspiece and lower crosspiece. The device 1 comprises guides 6a, 6b for attaching the device 1 to the press along its entire length and means formed in the supporting frame 2 for a slidable mounting of the supporting frame 2 on the guides 6a, 6b. A driving device 7 is mounted on the supporting frame 2 for moving the supporting frame 2 along the guides 6a, 6b in the X direction along the length of the press (to the left and right in the drawing).

[0014] In the illustrated embodiment the driving device 7 is attached to the lower crosspiece 4.

[0015] The guides 6a, 6b comprise an upper guide 6a and a lower guide 6b parallel to it. In the illustrated embodiment the lower guide 6b is a toothed bar, and the driving device 7 is coupled with the toothed bar via the gear wheel 5 for moving the supporting frame 2 in the X direction along the length of the press.

[0016] On the supporting frame 2 is pivotally arranged a top plate 8 with a cut-out 9, mounted on the supporting frame 2 pivotally upwards from the front side of the supporting frame 2 by means of at least one top plate guide 10 mounted on the side walls 3 of the supporting frame 2. The top plate 8 is connected to a top plate driving device 11, which ensures the movement of the top plate 8 along the guides 10, whereby the top plate 8 can be displaced upwards as shown by the arrow K. An axis of rotation of the top plate 8 is arranged in the bending line of the metal sheet.

[0017] A table 12 is arranged in the cut-out 9 of the top plate 8, the table 12 is mounted on cross-guides 13, connected to the top plate 8 and extending along the side walls 3 of the supporting frame 2. The cross-guides 13 are perpendicular to the press at a rest condition. The cut-out 9 in the top plate 8 has a rectangular shape. The table 12 has a rectangular shape and dimensions smaller than the dimensions of the cut-out 9 in the top plate 8. The table 12 is connected to a table driving device (not shown) moving the table 12 in the Y direction on cross-guides 13.

[0018] A rotatable plate 14 is rotatably mounted in the plane of the table 12. The rotatable plate 14 is connected to the driving device (not shown) carrying out the rotational movement of the rotatable plate 14, as shown by the arrow S.

[0019] The workpiece to be bent is attached to the device by means of fasteners known in the art, for example suction cups or magnetic elements that are arranged in a rotatable plate 14. All the above mentioned driving devices, that is, drives of the supporting frame 2, the top plate 8, the table 12 and the rotatable plate 14, carrying out the above described movements of the device are connected to and controlled by an external control device connected to the control desk.

[0020] Thus, the workpiece to be bent, arranged on the device 1, because of the above-described construction of the device according to the invention, can be rotated in the direction of the arrow S, moved in the direction shown by the arrow Y, it can be inclined on the top plate 8, as shown by the arrow K, as well as the supporting frame 2 can move along the entire length of the press in the directions indicated by the arrow X. The combination of the movements of the device allows precise positioning of the workpiece in relation to the edge of the bending press.

[0021] The workpiece to be bent is placed on the top plate 8 of the device and it is secured by means of fastening elements, arranged in the rotatable plate 14. Next, the workpiece can be rotated by means of above mentioned mechanisms in relation to the press by the rotatable plate 14, inclined on the top plate 8, moved by the table 12 in a direction perpendicular to the press and on the guides 6a, 6b in a direction parallel to the press. After positioning the workpiece it is bent in a die mounted to the press, and next the workpiece can be, for example, moved, due to the movement of the table in the X direction, into the second die located in the press and suitably positioned in the directions S, Y and K for carrying out another bending operation. After completion of all bending operations of the particular workpiece due to the ability to move the supporting frame 2 along the press on the guides 6a, 6b, there is a possibility to automatically unload the workpiece after the bending process into a container placed on one side of the press by means of the inertial force, i.e., after completion of the workpiece, the supporting frame 2 is moved along the guides 6a, 6b at a certain speed in the direction of one end of the press, it is braked, the attachment of the workpiece is released and the workpiece falls into the container due to the inertial force.

Claims

1. A device (1) for automating the process of bending workpieces of a metal sheet for a bending press, comprising:

- a supporting frame (2) having a rear side for attaching the device to the press and the opposite front side and comprising two mutually parallel side walls (3) which are interconnected by at least one crosspiece (4), and

means for setting a workpiece for bending comprising:

- a top plate (8) with a cut-out (9), mounted on the supporting frame (2) pivotally upwards from the front side of the supporting frame (2) by means of at least one top plate guide (10) mounted on the side walls (3) of the supporting frame (2),
- a table (12) mounted slidably in the cut-out (9) of the top plate (8) on cross-guides (13) disposed along the side walls (3) of the supporting frame (2),
- a rotatable plate (14) embedded rotatably in the table (12).

characterized in that it comprises guides (6a, 6b) for attaching the device (1) to the press along its entire length and means formed in the supporting frame (2) for slidably mounting of the supporting frame (2) on the guides (6a, 6b) and it comprises a driving device (7) mounted on the supporting frame (2) for moving the supporting frame (2) along the guides (6a, 6b).

2. The device according to claim 1, **characterized in that** the guides (6a, 6b) comprise an upper guide (6a) and a lower guide (6b) parallel to it, wherein one of the guides (6b) is a toothed bar, and the driving device (7) is coupled with the toothed bar via a gear wheel (5) for moving the supporting frame (2) in the (X) direction along the length of the press.

3. The device according to claim 1 or 2, **characterized in that** said top plate (8) is connected to a top plate driving device (11) for moving the top plate (8) on the top plate guides (10), and the table (12) is connected to a table driving device for moving the table (12) on the cross-guides (13), while the rotatable plate (14) is connected to a driving device for carrying out the rotary motion of the rotatable plate (14).

4. The device according to any one of the preceding claims, **characterized in that** the driving devices of the supporting frame (2), the top plate (8), the table (12) and the rotatable plate (14) are connected to a programmable control device.

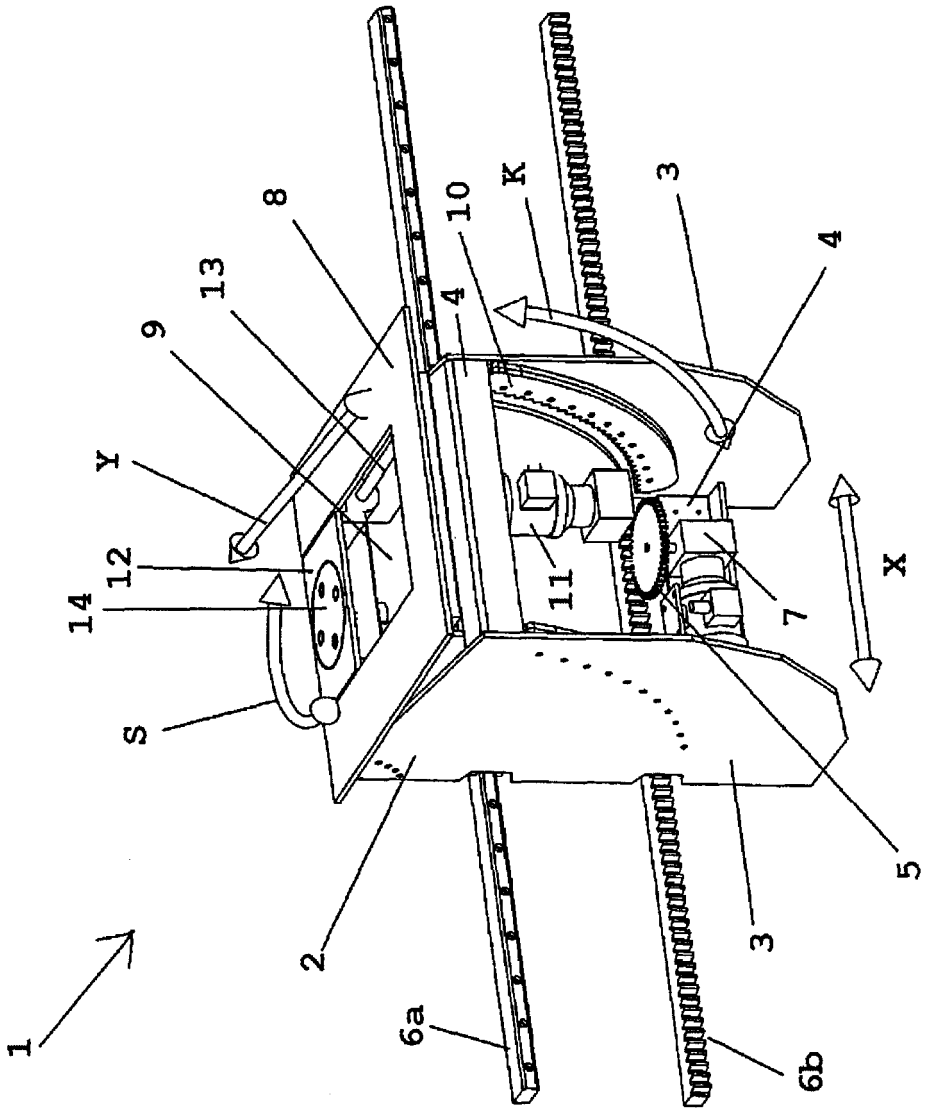

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 15 46 1510

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2005 004407 U1 (TRUMPF MASCHINEN AUSTRIA GMBH [AT]) 25 May 2005 (2005-05-25) * paragraph [0039] - paragraph [0041]; figures 4,5 *	1-4	INV. B21D5/00
A	EP 1 221 348 A1 (AMADA EUROP [FR]) 10 July 2002 (2002-07-10) * paragraph [0013]; figure 1 *	1	
A	EP 0 542 610 A1 (CAPELLE MICHEL [FR]; TREILLET JEAN PAUL HENRI [FR] AMADA SA [FR]) 19 May 1993 (1993-05-19) * column 4, line 51 - line 57; figure 3 *	1	
A	US 6 722 178 B1 (ITO KATSUHIDE [IT] ET AL) 20 April 2004 (2004-04-20) * column 3, line 61 - line 67; figures 6-9 *	1	
A	BE 790 201 A1 (HIRSCH ROGER B) 15 February 1973 (1973-02-15) * figure 1 *	1	TECHNICAL FIELDS SEARCHED (IPC) B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 June 2015	Pieracci, Andrea

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 46 1510

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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