

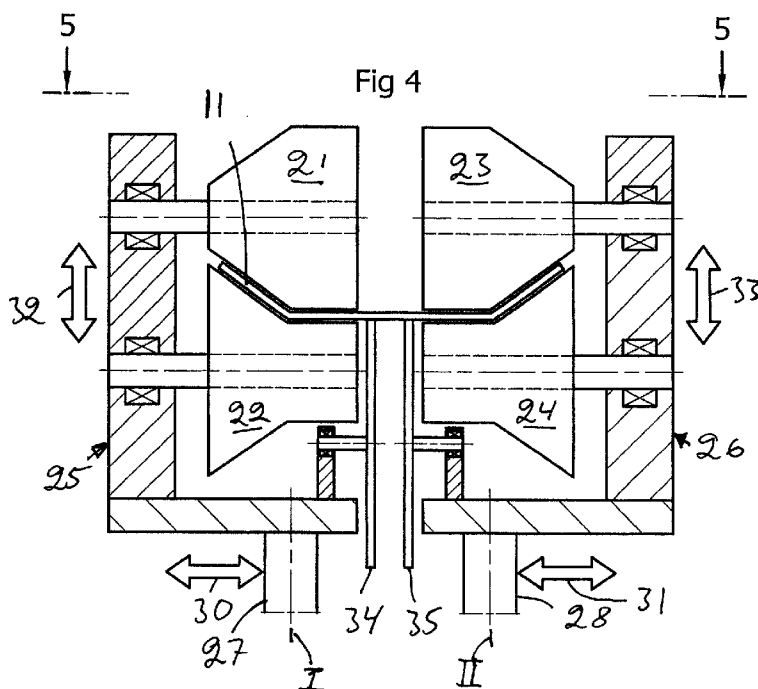


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(54) Title: ROLL FORMING MACHINE AND METHOD OF ROLL FORMING



(57) Abstract: When roll-forming a blank into a profile having varying width and upright sides, the vertical position of at least any one of the forming roll pairs (21, 22; 23, 24) is varied 5m either side during the roll-forming operation while the lateral and rotational positions thereof are simultaneously varied. The profile can thus be given a flat bottom during the roll-forming operation itself.

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Roll forming machine and method of roll forming

5Field of the invention

The invention relates to a method of forming a flat blank into a product with a central bottom part having a width that varies along the length of the product and upright sides and to a roll-forming machine comprising two rows of forming roll pairs which are movable laterally and rotationally.

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Background of the invention

Roll-forming machines for roll-forming operations of this kind are known from a number of publications. DE 20 2009 007 527 U1 describes a roll-forming machine of this kind provided with separate devices for making the central bottom part flat in the longitudinal direction since the roll-forming operation does not produce a flat central bottom part. Other patent publications also describe devices for making the bottom part flat with the aid of devices separate from the forming roll pairs.

Aim of the invention and brief description of the invention

20The aim of the invention is to reduce or completely eliminate the incidence of the roll-forming pairs producing a central bottom part that is not flat in the longitudinal direction. This is achieved in principle by varying the vertical position of any one or more of the forming roll pairs during the roll-forming operation while simultaneously varying the lateral and rotational positions thereof. The invention is defined by the 25claims.

Brief description of the drawings

Figure 1 shows several steps for the manufacture of a profile from a flat blank by roll-forming.

30**Figure 2** is a diagrammatic view showing four roll-forming pairs in two working positions.

Figure 3 is a diagrammatic view showing four roll-forming units in two working positions.

Figure 4 is a cross section through a roll-forming station as viewed in the direction indicated by the arrows 4-4 in Figure 5.

Figure 5 is a partly sectional top view as viewed in the direction indicated by the arrows 5-5 in Figure 4.

Figure 6 shows a flat blank for a product having a convexly curved shape by way of example.

Figure 7 is a longitudinal view of a finished product having a convex shape manufactured without using the invention.

Figure 8 shows a blank for a product having a concavely curved shape by way of example.

Figure 9 is a longitudinal view of a finished product having a concave shape manufactured without using the invention.

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Detailed description of the invention

Figure 1 shows by way of example three of the forming steps when roll-forming a flat blank 11 into a product in the form of a sheet-metal beam 12 with a flat bottom 13 and two upright sides 14, 15. In practice, there are often more steps than those shown. A product of this kind is normally bent in, e.g. six steps. **Figures 6 and 8** show blanks 11 the outer edges of which have a radius and the broken lines 18, 19 show the lines along which the corners 18, 19 in Figure 1 are to be bent.

Figure 4 shows one of the forming stations. It has two pairs of forming rolls 21, 22 and 23, 24 which clamp the semi-formed blank 11 between them. The forming station has two stand units 25, 26 and the forming roll pairs are mounted therein. The stand units have vertical journals 27, 28 which support the stand units and are mounted in a base (not shown) in such a manner that the stand units can rotate about vertical axes I and II. The journals 27, 28 can be displaced laterally in the base as indicated by the arrows 30, 31 and they are movable vertically as indicated by the arrows 32, 33. All of the movements are motor-driven and computer-controlled, although the driving devices are not shown. The forming roll pairs 21, 22 and 23, 24

can thus be displaced laterally and vertically during the roll-forming process and they can moreover be rotated about the axes I and II. Any one or more of the forming rolls is/are driven and advance/s the blank through the machine.

5The stand units are provided with measuring wheels 34, 35 mounted in the stand units in such a manner that they follow all of the movements of the forming roll pairs. The measuring wheels bear against the blank 11 and measure the displacement of the blank through the roll pairs. The positions of the forming roll pairs are controlled by the position of the blank in the respective roll pairs and at least the first and the
10last roll pairs should be provided with measuring wheels. The guiding operation is simplified if all of the roll pairs are provided with measuring wheels.

Figure 6 shows a blank 11 having a convex shape, wherein the lines along which the corners 18, 19 are to be formed are indicated by broken lines designated by the
15same reference numerals as the corners. In this example, the blank has a convexly curved shape with a constant radius. A blank of this kind having a convex shape in order to produce a profile 12 having upright sides as shown in Figure 1 tends to give the finished product an upwardly curved shape when viewed from the side, as shown in Figure 7.

20

Figure 8 shows a blank 11 which instead has a concave shape. A blank of this kind having a concave shape in order to produce a profile having upwardly bent sides tends instead to give the finished profile 12 according to Figure 1 a downwardly curved shape when viewed from the side, as shown in Figure 9.

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In order to prevent the finished product from being curved in the vertical plane, i.e. in order to prevent its bottom 13 in Figure 1 from being curved, as shown in Figures 7 and 9, according to the invention, any one or more of the forming roll pairs can be displaced vertically during the roll-forming process.

30

Figure 2 shows the roll-forming in four roll pairs 1, 2, 3, 4 of a blank having a convex shape according to Figure 6 which tends to be curved downwards, i.e. to result in an

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upwardly curved shape as shown in Figure 7. Raising the last forming roll pair in each row, i.e. the roll pairs 4, during the roll-forming operation and thereby bending the product upwards prevents the formation of the curved shape and the finished product has a flat bottom.

5

Figure 3 shows an alternative method of preventing the product from being curved. Instead of raising the last roll pairs 4, the roll pairs 2 and 3 situated between the first and the last roll pairs are lowered, thereby bending the blank upwards during the forming operation, i.e. into a downwardly curved shape, before it is given its final shape and the finished product has a flat bottom.

When roll-forming a blank having a concave shape according to Figure 8 instead of a blank having a convex shape according to Figure 6, the forming roll pairs are guided in the opposite manner to that shown in Figures 2 and 3.

Claims

1. Roll-forming machine comprising two rows of forming roll pairs (21, 22; 23, 24)
5 for forming a flat blank (11) into a product (12) with a central bottom part (13)
having a width that varies along the length of the product and upright sides
(14, 15), the forming roll pairs being movable laterally and rotationally,
characterised in that
at least any one of the forming roll pairs (21, 22; 23, 24) in each row is
10 movable vertically and is designed in such a manner that it can be guided
vertically while simultaneously being guided laterally and rotationally and in
that a measuring device (34, 35) for recording the advance of the blank is
associated with this forming roll pair and is designed to follow the vertical
movement thereof.
2. Roll-forming machine according to claim 1, **characterised in that** the said any
one of the roll-forming pairs (21, 22; 23, 24) is the last roll-forming pair.
3. Roll-forming machine according to claim 1, **characterised in that** the said any
20 one of the roll-forming pairs (21, 22; 23, 24) is formed by the roll-forming pairs
situated between the first and the last roll-forming pairs.
4. Roll-forming machine according to any one of the preceding claims,
characterised in that the measuring devices are measuring wheels (34, 35)
25 in contact with the blank (11).
5. Method of roll-forming a flat blank (11) into a product (12) with a bottom part
(13) having a varying width and upright sides (14, 15) in two rows of
roll-forming units each comprising one forming roll pair (21, 22; 23, 24),
30 **characterised in that**
the vertical position of at least any one of the forming roll pairs is varied on
either side during the roll-forming operation while the lateral and rotational

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positions thereof are simultaneously varied and in that the advance of the blank (11) is recorded by measuring wheels (34, 35) which follow the vertical movements of the forming roll pairs.

- 5 6. Method according to claim 5, **characterised in that** the forming roll pairs (21, 22; 23, 24) situated between the first and the last roll-forming pairs are lowered while simultaneously being guided laterally in a convexly curved shape and/or in that these forming roll pairs are raised while simultaneously being guided laterally in a concavely curved shape.
7. Method according to claim 5, **characterised in that** the last forming roll pair (21, 22; 23, 24) is raised on either side while simultaneously being guided laterally in a convexly curved shape and/or is lowered while simultaneously being guided laterally in a concavely curved shape.

Fig 1

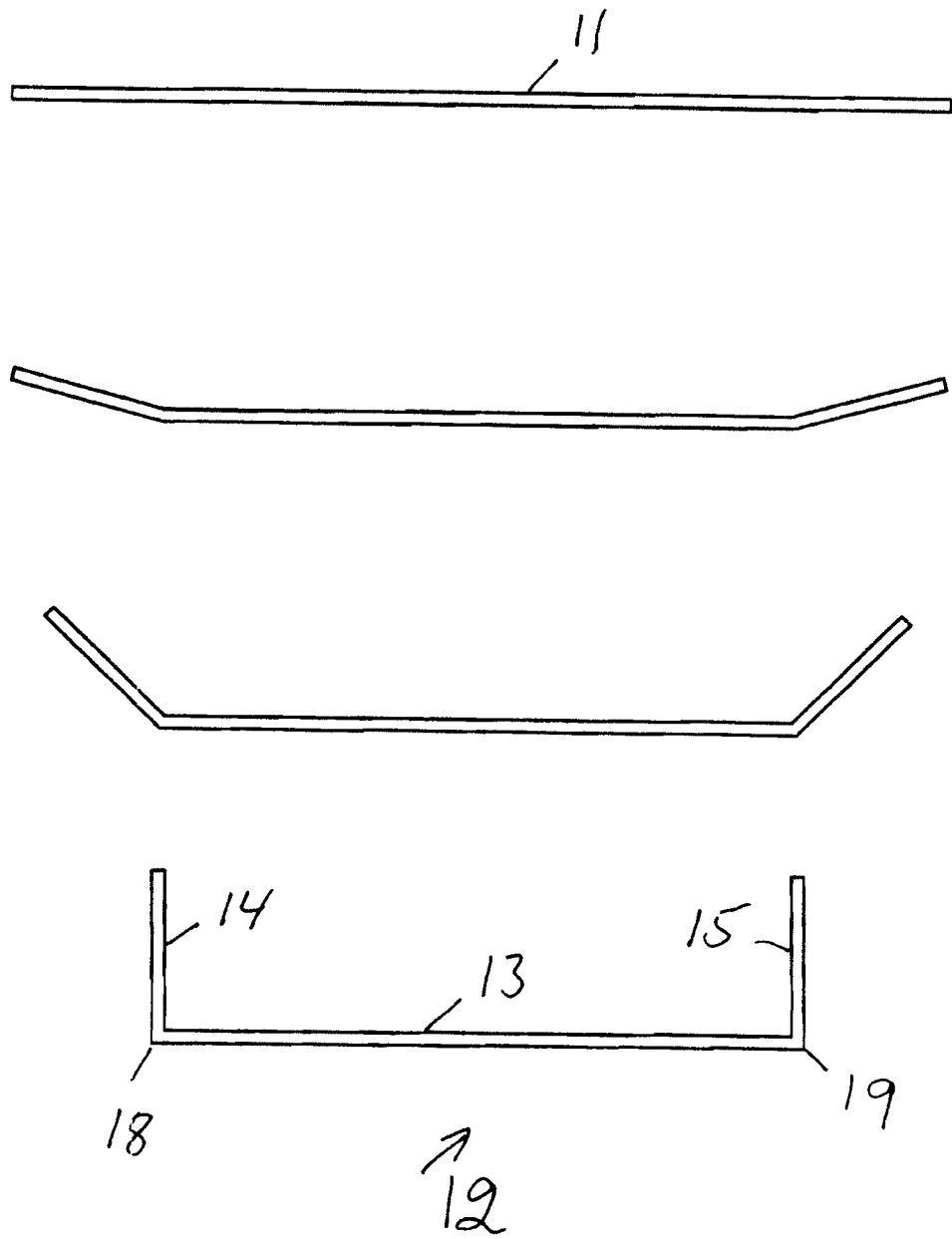


Fig 2

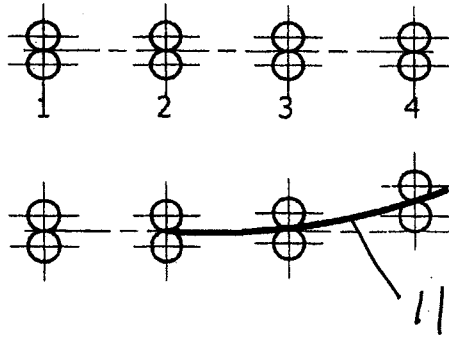
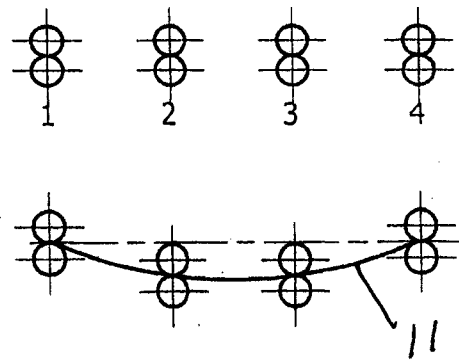


Fig 3



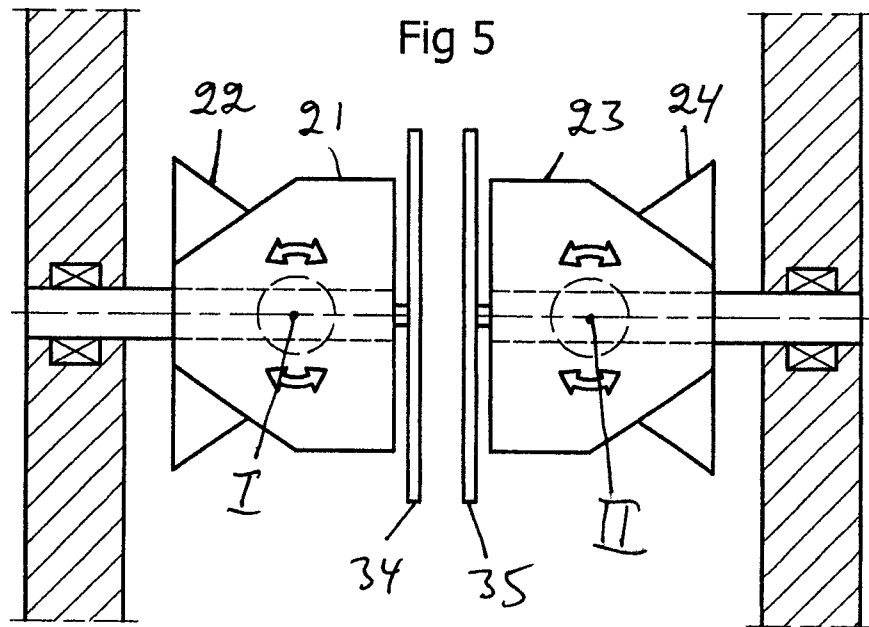
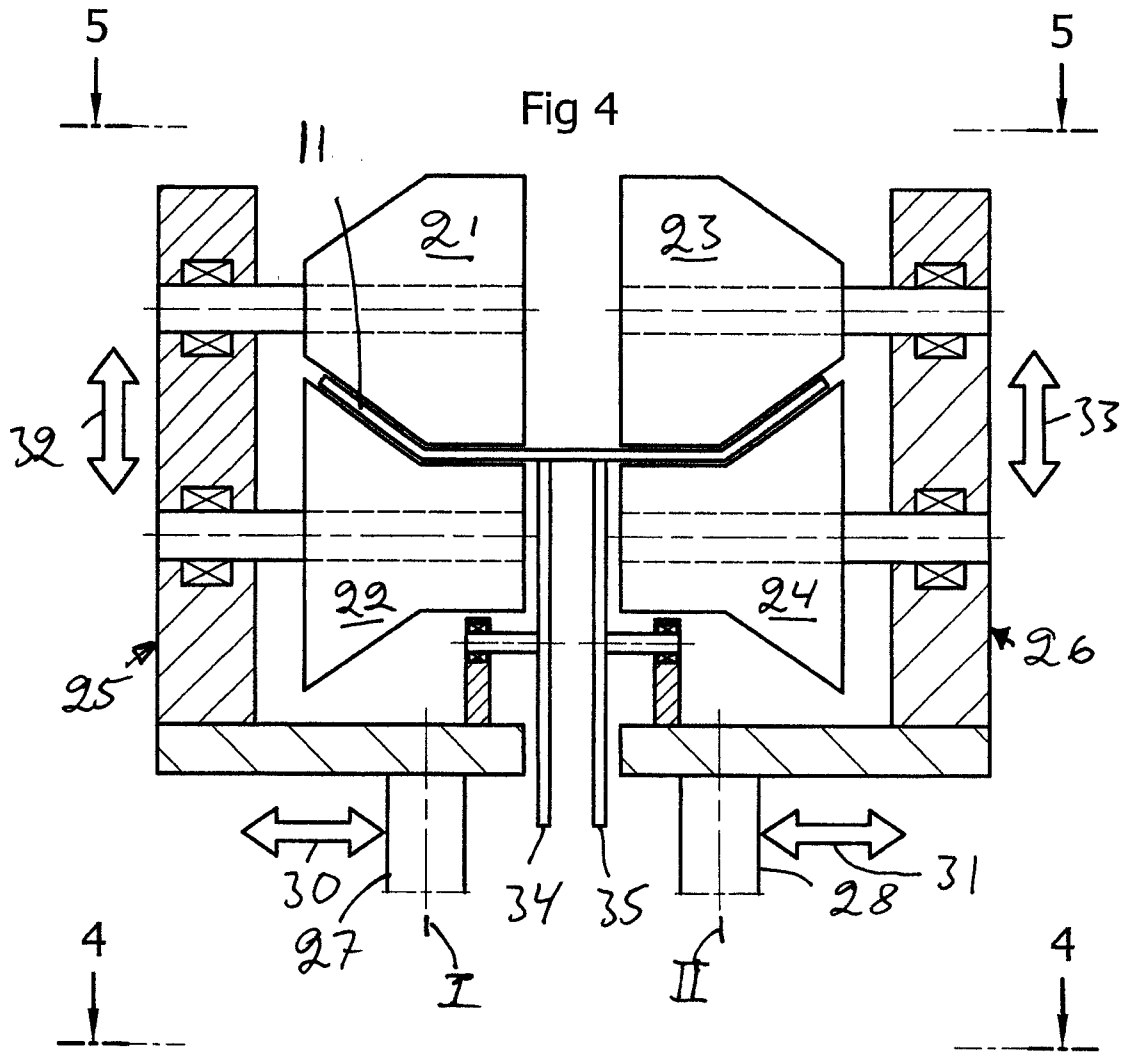


Fig 6

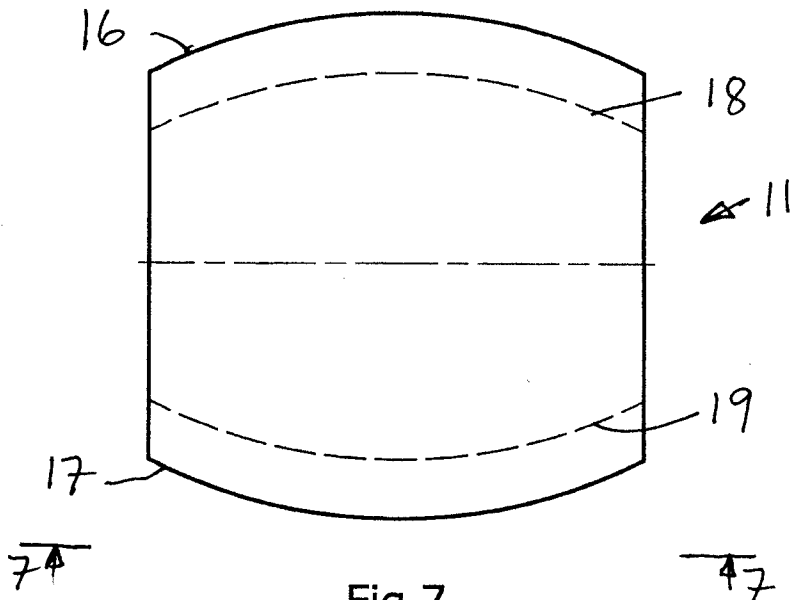


Fig 7

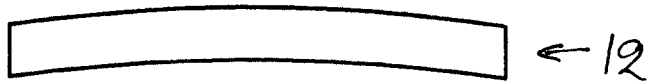


Fig 8

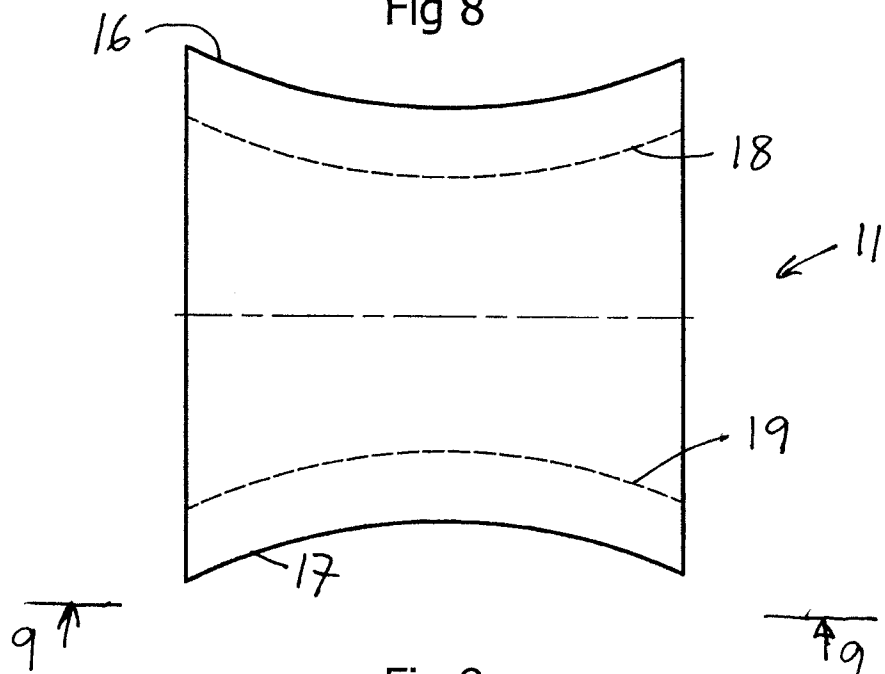
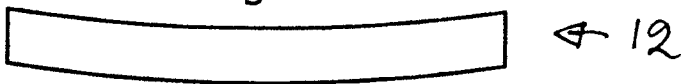


Fig 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/000208

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: see extra sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: B21D		
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EPO-Internal, PAJ, WPI data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20040244454 A1 (MCDONALD DANIEL J), 9 December 2004 (2004-12-09); paragraph [0077]; claims 1, 3, 26 --	1-7
A	US 5142894 A (GUTOWSKI TIMOTHY A), 1 September 1992 (1992-09-01); abstract; column 2, line 20 - line 25 --	1-7
A	US 4354372 A (INOUE TAKESI ET AL), 19 October 1982 (1982-10-19); abstract; column 2, line 46 - column 3, line 33; column 7, line 17 - line 29; figures 7A,B, 12B --	1-7
A	US 5862694 A (HORNING VINCENT R), 26 January 1999 (1999-01-26); claim 1 --	1-7
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Date of the actual completion of the international search 23-03-2012		Date of mailing of the international search report 26-03-2012
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/000208

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 59179228 A (SHIRAKI KINZOKU KOGYO KK), 11 October 1984 (1984-10-11); (abstract) Retrieved from: PAJ database; Original document: Figure 4 -- -----	1-7

Continuation of: second sheet

International Patent Classification (IPC)

B21D 5/08 (2006.01)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE2011/000208

US	20040244454 A1	09/12/2004	US	7096702 B2	29/08/2006
			US	20050252265 A1	17/11/2005
US	5142894 A	01/09/1992	NONE		
US	4354372 A	19/10/1982	CA	1105328 A1	21/07/1981
			GB	2016326 B	21/04/1982
			JP	54119368 A	17/09/1979
			JP	1309059 C	26/03/1986
			JP	60032532 B	29/07/1985
US	5862694 A	26/01/1999	NONE		
JP	59179228 A	11/10/1984	JP	2061332 B	19/12/1990
			JP	1631677 C	26/12/1991