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(71) Applicant (for all designated States except US): **AUTOMATION, PRESS AND TOOLING, A.P.& T AB**
[SE/EC]; Industrigatan 5, S-514 32 Tranemo (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MATTSSON, Per-Arne** [SE/SE]; Box 128, S-520 24 Blidsberg (SE).

(74) Agents: **NILSSON, Camilla** et al.; Patentbyrå Y Wallengren AB, Box 116, S-331 21 Värnamo (SE).

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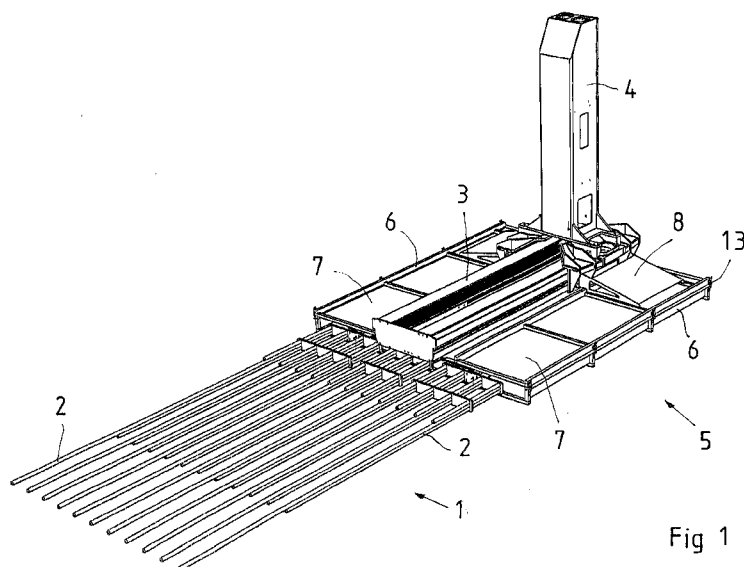


Fig 1

(57) Abstract: A method of reducing the heat loss of a workpiece when the workpiece is displaced from a furnace to a tool comprises the steps that: the workpiece resting on a carrier (1) is displaced to the tool. According to the invention, the displacement takes place with the workpiece and the carrier (1) located internally in a box with a heat reflecting inner side. At the tool, the workpiece is exposed. An apparatus for carrying the method into effect has, according to the present invention, a box (5) with a heat reflecting inner side and a linear conveyor (3) for insertion and removal of the carrier and the workpiece into and out of the box (5), respectively.

A METHOD AND AN APPARATUS FOR REDUCING THE HEAT LOSS IN A HEATED WORKPIECE

TECHNICAL FIELD

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The present invention relates to a method for reducing the heat loss in a heated workpiece, when the workpiece is moved from a furnace to a processing tool, the workpiece being removed from the furnace and displaced on a carrier device to the processing tool, in which it is inserted.

10

The present invention also relates to an apparatus for reducing the heat loss in a workpiece, when the workpiece is displaced by means of a carrier device from a furnace to a processing tool.

BACKGROUND ART

Press hardening is a technique which has become increasingly common, for example as regards the manufacture of car body parts in the automotive industry. Press hardening entails that a workpiece is placed in a furnace, where the workpiece is heated to the intended temperature, often of the order of magnitude of 900° C or more. As regards car body parts, the workpiece is often a sheet metal piece of a thickness of the order of magnitude of between 0.6 and 2.0 mm. When the workpiece has reached the intended temperature, it is removed from the furnace and placed in a press tool where pressing to the intended configuration is carried out. In that the tool is cooled and in that there is extremely good contact between the workpiece and the processing surfaces of the tool, a very rapid temperature reduction takes place of the workpiece so that this is hardened simultaneously with the forming operation.

On inserting the workpiece in the furnace, use is made of a carrier on which the workpiece rests. This carrier may either be permitted to remain in the furnace during the heating time, or alternatively be removed immediately after insertion of the

workpiece. In the latter case, the carrier is placed in the furnace again after completed heating and lifts out the workpiece and transfers it to a processing tool.

In the above-mentioned technology, it is vital that the workpiece is at the intended temperature when it arrives in the processing tool. Heat losses during the displacement from the furnace to the processing tool may be considerable in that a workpiece produced from sheet metal has a large surface area in relation to the mass which is heated. At those temperature levels which are under consideration, a considerable proportion of the heat losses is caused by radiation. Nevertheless, the temperature loss may also be influenced by the ambient temperature, variations in the displacement time, draughts and similar factors. In order for the end result to be of the requisite standard, it is necessary that the temperature of the workpiece when it is placed in the processing tool can be kept at the correct level and within narrow tolerances. However, the vital point is that the workpiece does not cool more than from about 930° C down to approx. 800° C.

PROBLEM STRUCTURE

The present invention has for its object to design the method intimated by way of introduction such that the heat loss during displacement of the workpiece from the furnace to the processing tool is kept to a minimum and as far as possible without influence from the ambient surroundings.

Concerning the apparatus, the present invention has for its object to resolve corresponding or analogous problems and in addition to realise an apparatus which is simple and economical in manufacture and economical in operation.

SOLUTION

The objects forming the basis of the present invention will be attained concerning the method if the method is characterised in that the carrier device and workpiece are brought to a position substantially internally in an enclosure with a heat reflecting

interior, that the enclosure and the carrier device with the workpiece are moved to the processing tool where the carrier device is exposed and the workpiece is passed into the processing tool.

- 5 The objects forming the basis of the present invention will be attained concerning the apparatus if the apparatus is characterised by an enclosure with a heat reflecting interior, the carrier device and the workpiece being moveable to and from a position substantially internally in the enclosure, and the enclosure together with the carrier device is moveable from the furnace to the processing tool.

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BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The present invention will now be described in greater detail hereinbelow, with reference to the accompanying Drawings. In the accompanying Drawings:

15

Fig. 1 is a perspective view of the subject matter of the present invention in a position where the carrier device is located outside the enclosure;

Fig. 2 shows the subject matter of the present invention in another position where the carrier device is located interiorly in the enclosure;

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Fig. 3 is a perspective view of the enclosure included in the subject matter of the present invention; and

25 Fig. 4 is an end elevation of the enclosure according to Fig. 3.

DESCRIPTION OF PREFERRED EMBODIMENT

It will be apparent from Fig. 1 that the subject matter of the present invention consists of a carrier device 1 with a number of elongate, mutually spaced apart carrier members 2, which define a stacking surface for a workpiece (not shown on the Drawing). The carrier device 1 is moveable as a rigid unit under the action of a

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first prime mover 3, such as a linear feeder or an industrial robot, from the position illustrated in Fig. 1 to the position illustrated in Fig. 2. Further, the subject matter of the present invention includes a retainer 4 which is connected to a prime mover, a linear feeder or an industrial robot, for displacing the entire subject matter of the present invention. Finally, the subject matter of the present invention includes an enclosure 5, into which the carrier device 1 is insertable under the action of the first prime mover 3.

The subject matter of the present invention may also include a second prime mover of the same or other type than those described above, by means of which the enclosure 5 is displaceable in relation to the retainer 4.

When the subject matter of the present invention is reduced into practice, it is displaced into the immediate proximity of a furnace in which a workpiece is to be heated to suitable temperature, generally of the order of magnitude of 900° C or more, typically approx. 930° C. The furnace is opened, whereafter the carrier device 1 is moved into the furnace for insertion of the workpiece therein. Thereafter, the carrier device is withdrawn either by retraction of the carrier device to the position illustrated in Fig. 2 or by displacement of the entire subject matter of the invention. Movements in the vertical direction may also come into consideration, in particular if the furnace has several storeys.

When the workpiece has reached the correct temperature, the carrier device is once again slid into the furnace for removal of the workpiece. In such instance, the workpiece is at a temperature of the order of magnitude of 900°C or more and because of its slight material thickness it will rapidly cool, initially by thermal radiation and later, when the temperature has fallen, via convection.

In order to reduce the action of the ambient surroundings on the workpiece, the carrier device 1 and the workpiece resting thereon are withdrawable into the enclosure 5 as is apparent from Fig. 2. The position internally, or at least

substantially internally, in the enclosure 5 entails that the workpiece is screened off from the surroundings so that the ambient temperature, air draughts or similar factors cannot, or to but an insignificant degree, affect the workpiece.

- 5 According to the present invention, the enclosure 5 has its interior surfaces designed for high thermal reflection by being ground, polished or coated with a heat reflecting surface coating, for example chrome-plated. Naturally, the defining surfaces of the enclosure may also be made in their entirety from a heat reflecting material, for example stainless steel, polished or chrome-plated sheet metal.

10

- Once the carrier device 1 has been brought to the position illustrated in Fig. 2, or substantially internally in the enclosure 5, the subject matter of the present invention, or at least the carrier device and the enclosure, is displaced to a position adjacent the processing tool where the carrier device 1 is exposed so that the workpiece may be applied in the processing tool. This may be put into effect either directly with the carrier device or by the intermediary of some additional displacement device.

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- Displacement of the carrier device 1 and the enclosure 5 between the furnace and the tool, and vice versa, may either be realised by the intermediary of an industrial robot connected to the retainer 4, a linear feeder or by a second prime mover, which as a rigid unit displaces the carrier device and the enclosure when the carrier device is located interiorly therein.

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- In a process of the type under consideration here, the intention is to achieve as high a work rate as possible, i.e. rapid accelerations, high average speeds and rapid retardations. For this reason, the moveable masses must be kept as low as possible.

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- According to the present invention, the enclosure 5 includes a framework 6 suitably consisting of square tubes. This framework 6 is coated with sheet metal panels 7 or panels of other refractory and heat resistant material.

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The enclosure 5 further displays, in its distal end in Fig. 4, anchorages 8 by means of which it may be fixed in the retainer 4 or in a second prime mover (not shown on the Drawing) which connects the enclosure 5 to the retainer 4. Possibly, the first prime mover and the second prime mover may be designed as a common, possibly linear,
5 prime mover where the first prime mover 2 has a greater movement range than the second prime mover.

It will be apparent from Fig. 2 that the carrier device 1 in its distal end in the figure has a connection by means of which it is connected to the first prime mover 3.
10 Further, the enclosure 5 has, in its upper surface, an elongate opening 10 through which extend those components which connect the connection 9 to the first prime mover 3.

It will be particularly apparent from Figs. 3 and 4 that the enclosure 5 consists of an
15 upper portion 11 and a lower portion 12 which are interconnected by means of a number of connections 13. Hereby, the lower portion 12 may be separated from the upper portion 11 and possibly be replaced by an otherwise dimensioned lower portion, which may prove necessary depending upon the appearance of the carrier device 1 and the workpiece which is to be processed. However, the most important
20 reason for the enclosure 5 to be openable is that it may need to be cleaned internally in order to retain its pristine reflecting capacity. Correspondingly, the carrier device 1 is connected by the intermediary of quick coupling to the first prime mover 3.

The function of the subject matter of the present invention and in particular the
25 enclosure 5 is based on the concept that heat which radiates out from a workpiece disposed interiorly in the enclosure will impinge upon the heat reflecting interior surfaces therein in order to be redirected back to the workpiece. Practical measurements have demonstrated that the temperature loss of a workpiece may be reduced by as much as 80-90° C in a typical press hardening line or in a typical press
30 hardening process.

Possibly, the action of the enclosure 5 may be further improved if the enclosure is provided with a thermal insulation, so long as this is not heavy, since in such an event the mass would increase and the work rate reduce.

WHAT IS CLAIMED IS:

1. A method of reducing the heat loss in a heated workpiece when the workpiece
5 is displaced from a furnace to a processing tool, comprising the steps:
that the workpiece is removed from the furnace and, on a carrier device (1), is
displaced to the processing tool, in which it is inserted, **characterised in that** the
carrier device (1) and the workpiece are brought to a position substantially internally
in an enclosure (5) with a heat reflecting inner side, that the enclosure and the carrier
10 device with the workpiece are moved to the processing tool, where the carrier device
is exposed and the workpiece is inserted in the processing tool.

2. The method as claimed in Claim 1, **characterised in that** the carrier
device (1) is moved into the furnace for withdrawing the workpiece.

15

3. The method as claimed in Claim 1 or 2, **characterised in that** the carrier
device (1) is displaced into and out of the furnace and to the interior of the enclosure
by means of a first prime mover (3).

20 4. The method as claimed in any of Claims 1 to 3, **characterised in that** the
carrier device (1) and the enclosure (5) are displaced together between the furnace
and the processing tool, and vice versa, by means of at least one second prime
mover.

25 5. The method as claimed in Claim 3 or 4, **characterised in that** the first prime
mover (3) moves through an elongate opening (10) in the upper side of the
enclosure (5).

6. An apparatus for reducing the heat loss of a heated workpiece, when the
30 workpiece is, by means of a carrier device (1), displaced from a furnace to a
processing tool, **characterised by** an enclosure (5) with a heat reflecting inner side,
the carrier device (1) and the workpiece being insertable into and withdrawable from

a position substantially internally in the enclosure, and the enclosure together with the carrier device is displaceable from the furnace to the processing tool, and vice versa.

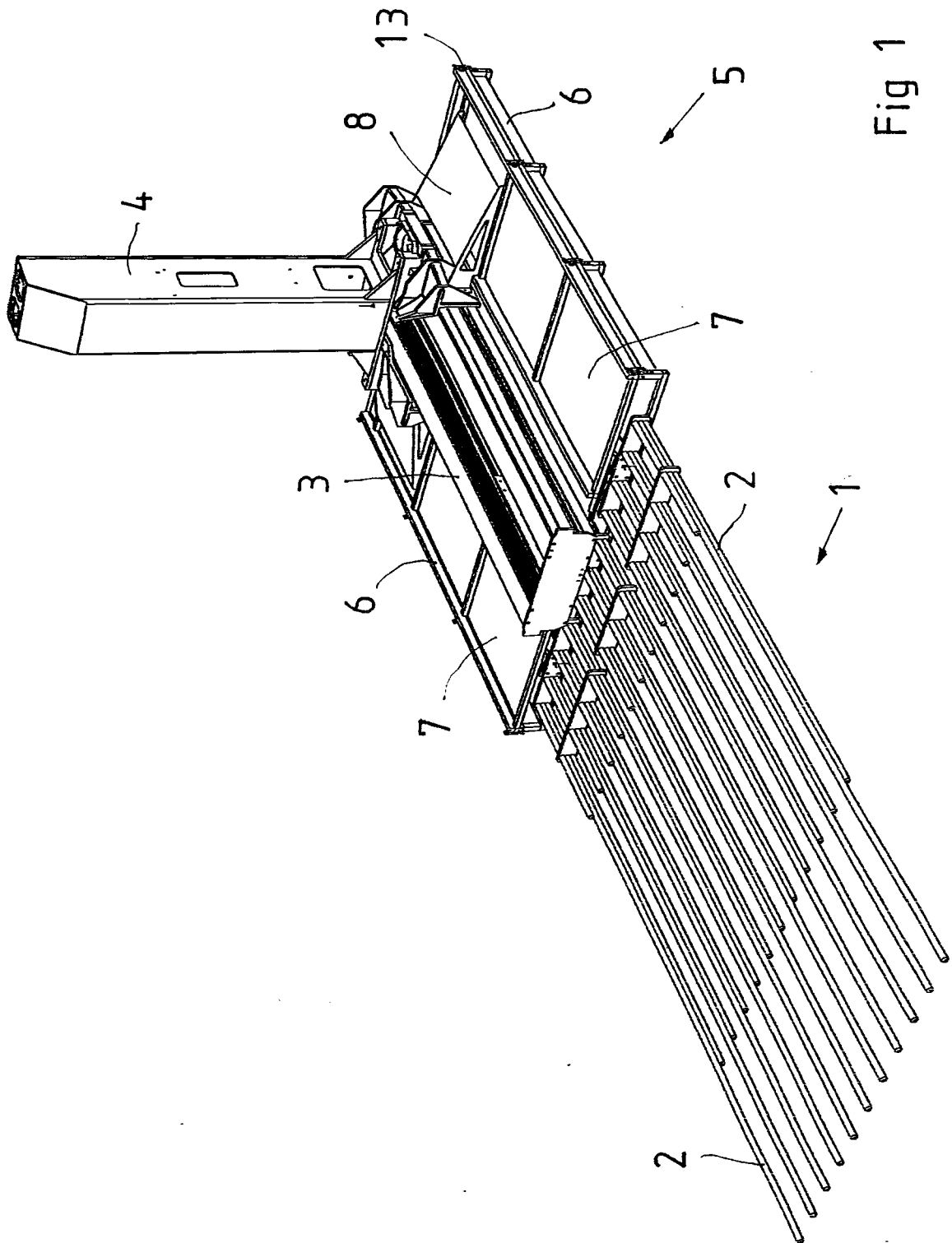
5 7. The apparatus as claimed in Claim 6, **characterised in that** the carrier device (1) is connected to a first prime mover (3) which is configured to displace the carrier device into and out of the furnace for inserting and withdrawing, respectively, of a workpiece.

10 8. The apparatus as claimed in Claim 7, **characterised in that** the first prime mover (3) is also configured to displace the carrier device (1) into and out of the enclosure (5), respectively.

15 9. The apparatus as claimed in any of Claims 7 or 8, **characterised in that** at least one second prime mover is configured so as together to displace the carrier device (1) and the enclosure (5) between the furnace and the processing tool, and vice versa.

20 10. The apparatus as claimed in any of Claims 6 to 9, **characterised in that** the heat reflecting inner side of the enclosure (5) is realised by grinding, polishing or coating with a heat reflecting surface layer.

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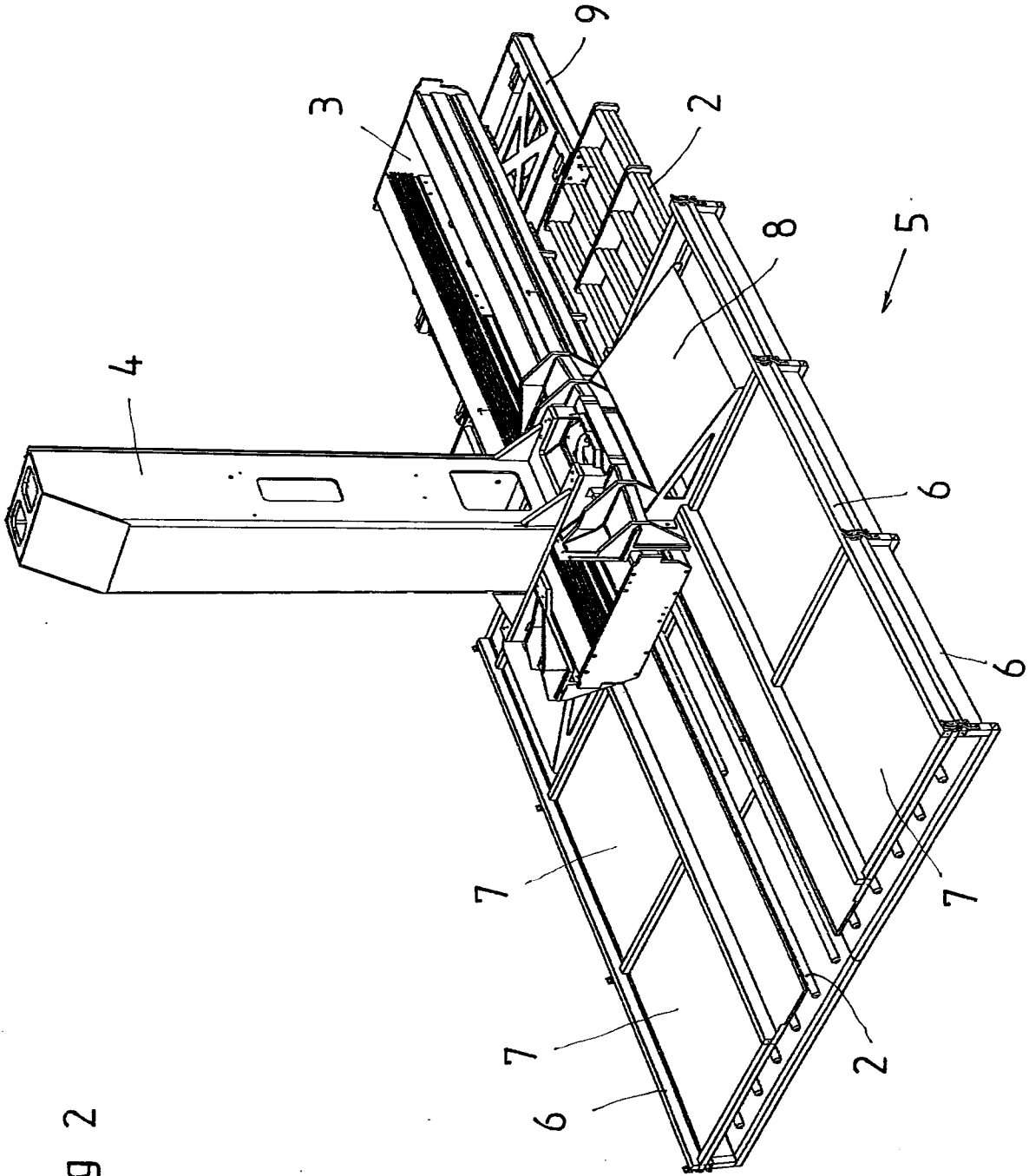


Fig 2

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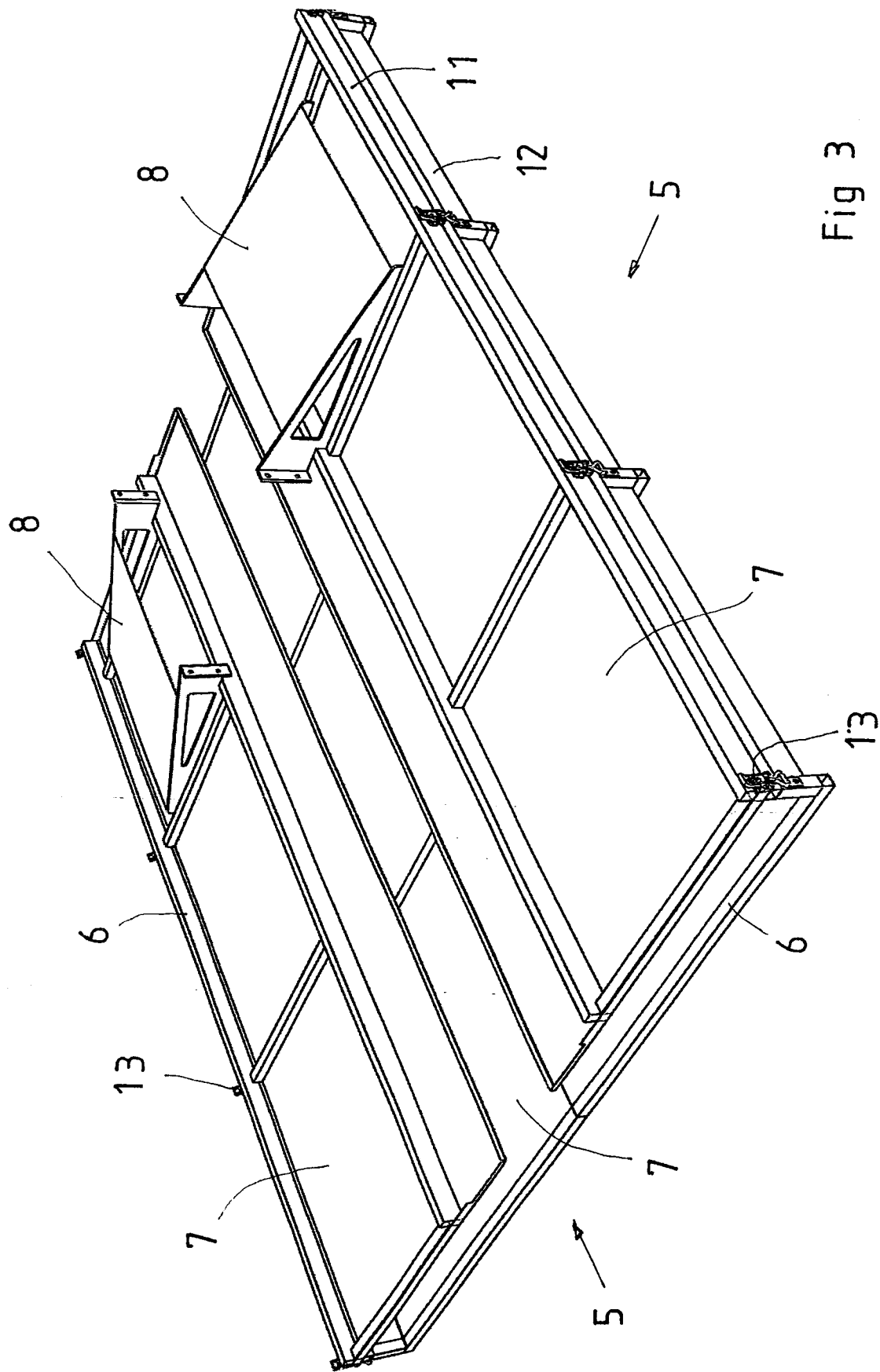
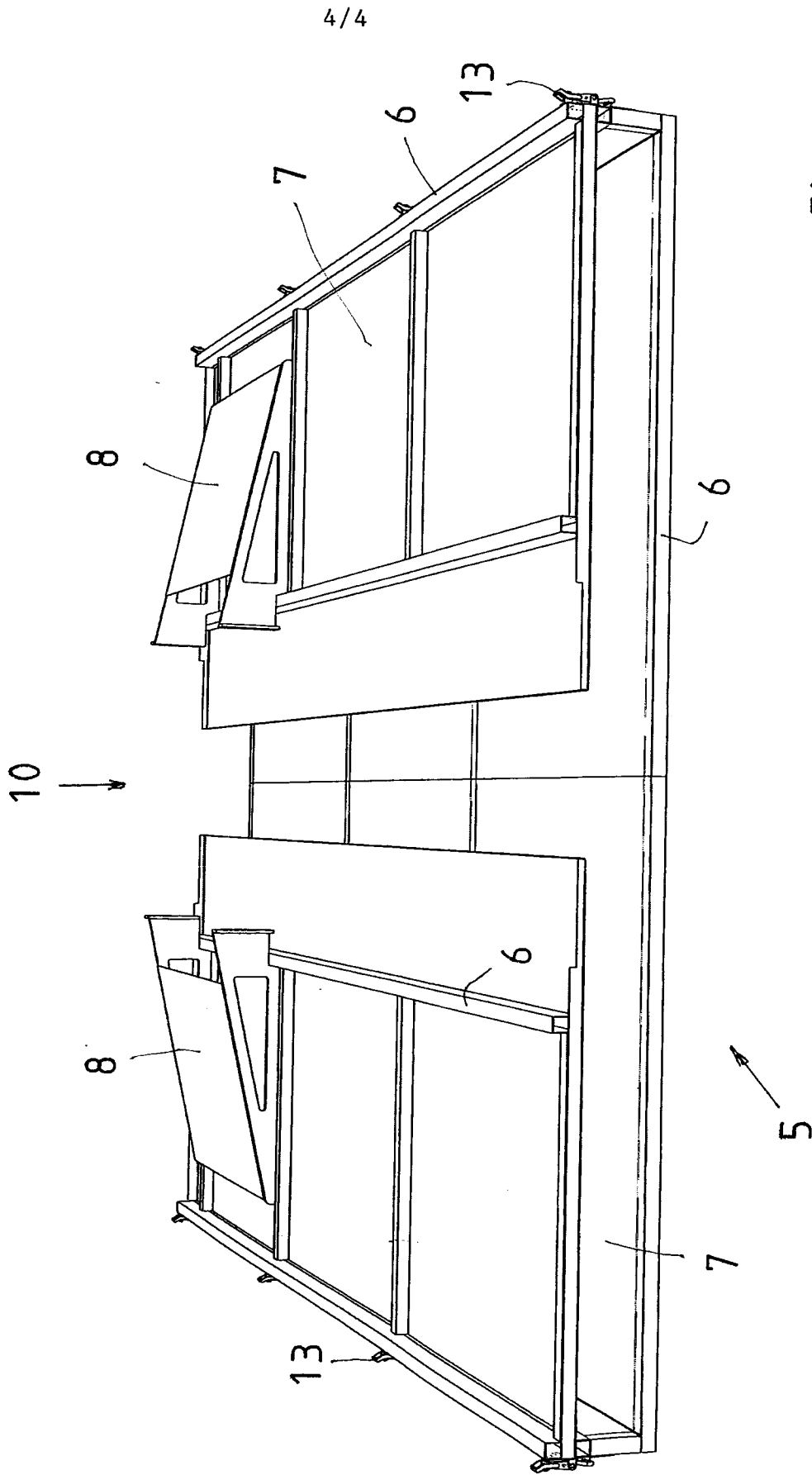


Fig 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/000080

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, C21D, F27D Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched SE, DK, FI, NO classes as above Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) 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 5402994 A1 (EGGER HELMUT), 4 April 1995 (1995-04-04); column 4, line 63 - column 5, line 3; claim 1 --	1-10		
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A	SU 1538002 A1 (INST CHERNOI METALLURGII), 23 January 1990 (1990-01-23); abstract; figure 1 --	1-10		
A	KR 20100096832 A (HYUNDAI STEEL CO), 2 September 2010 (2010-09-02); abstract; figure 1 --	1-10		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.				
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/000080

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Continuation of: second sheet

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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