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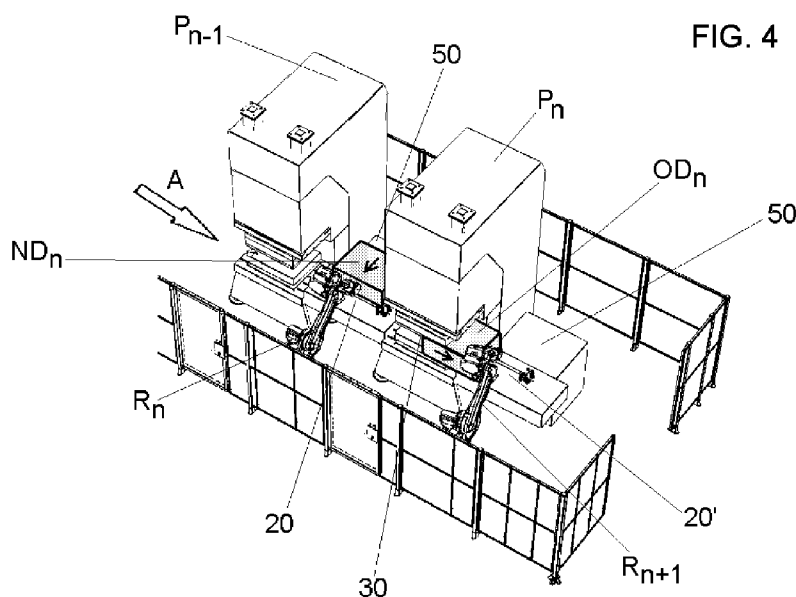
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(54) Title: LOADING DIES IN A PRESS**FIG. 4**

(57) Abstract: Systems and methods for loading and/or unloading a die (ODn) in a press (Pn) are disclosed. A handling system for loading a die (ODn) comprises a linear sliding path (10) between a supply position (20) outside the press (Pn) and a press position (30) on the press base, configured to support a die (ODn) such that the die (ODn) is displaceable while it is supported on the path (10), and a robot (Rn) configured to displace the die (ODn) between the supply position (20) and the press position (30) along the linear sliding path (10). A method may comprise providing a robot (Rn) for loading workpieces in the press (Pn), providing a linear sliding path (10) between a supply position (20) outside the press (Pn) and a press position (30) on the press base, placing a die (ODn) in the supply position, and displacing the die (ODn) on the linear sliding path (10), from the supply position (20) to the press position (30), by means of the robot (Rn).

Loading dies in a press

The present disclosure relates to systems and methods for loading or for replacing dies in a press.

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BACKGROUND

Press lines for the production of small parts or objects, for example telephone cases, housings for television sets and many others, may comprise several presses, each provided with a suitable forming die, which perform successive cutting and/or shaping operations on a blank or workpiece to give it the desired final configuration. The presses employed in such press lines may for example be C-frame presses.

15 The press lines may be provided with robots, for example serial robots with 4 axes or more, for transferring the workpieces, i.e. blanks or semi-formed parts, from one press to another. These robots may be relatively small, since they handle low weight workpieces and parts.

20 Each part or object to be manufactured in the press line requires a respective set of dies. Consequently, the dies of at least some of the presses of the line must be removed and replaced each time a new part or object is to be produced in the press line. The dies are much heavier than the workpieces and parts being manufactured; for example, a typical die for a part having a size of about 40 x 40 cm can have a weight of 1000 Kg.

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In order to perform the replacement, operators using forklifts or the like may unload existing dies from the presses, take them to a storing space, fetch the new dies, and load them to the presses. This is time consuming and requires operators to be available at the right moment, and therefore it is not efficient and involves long downtimes for the line.

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Another known die replacement system involves attaching to each press a pair of consoles, provided with rolling elements such as steel balls, and drive units e.g. one or more pistons. A new die to be loaded in a press is placed on the pair of consoles using e.g. a crane or a forklift truck, and displaced to the right position in the press by means of the drive unit. The existing die is previously unloaded from the press in using the same consoles and drive unit.

However, this requires providing not only the consoles and rolling elements but also the drive unit(s), which in addition must be connected to a power source.

It might be desirable to provide a simpler solution for the loading and unloading of dies, that allows reducing the downtime and the effort required for the operation and, hence, allows decreasing the cost and increasing the productivity.

SUMMARY

According to a first aspect, the present disclosure is related to a handling system for loading a die in a press, wherein the handling system comprises:

- a robot, and
- a first linear sliding path between a supply position outside the press and a press position on the press base, the first linear sliding path being configured to support a die such that the die is displaceable while it is supported on the path, and
- wherein the robot is configured to displace the die between the supply position and the press position along the first linear sliding path, while it is supported on the path.

The use of robots for loading dies in a press allows automated loading of the dies without the need of external or additional driving units, by employing the robots that are already present in a press line for serving each press, i.e. the

robots that feed workpieces to the press. Consequently, it provides an efficient and cost-effective solution for handling the dies.

Employing robots for loading the dies is also a particularly versatile solution: while other driving units are limited to very simple movements, robots can be programmed to perform any movement to bring a die from a suitable position in the vicinity of a press to the press position, and therefore allows choosing different initial positions from which the dies are to be automatically loaded in the press, depending on the needs of each particular press line or press.

Furthermore, dies may be provided at the initial positions in the vicinity of the presses during the normal manufacturing operation of the press line, such that when the press line completes a manufacturing batch and has to be prepared to manufacture a different object or part, and a dies need to be loaded in the presses, this step can be done without the intervention of human operators and only requires a minimum downtime.

Even though the robots that feed workpieces to presses in the production of small parts or objects are relatively small, due to the low weight of the parts to be handled, while the dies for these lines generally have a higher weight that the robots could not handle, this problem is solved by the provision of suitable sliding paths on which the die is supported during the loading operation, such that the robot does not need to lift the die, and only needs to displace it horizontally. The weight of the dies is supported by the sliding path.

By sliding path it is herein meant a path that is configured to reduce the friction between the die and the surfaces on which the die has to move, and therefore to allow it to slide. In some embodiments the path may comprise for example rolling elements such as bearing balls or bearing rollers.

According to another aspect, the disclosure is related to a press line comprising at least one press and a handling system as disclosed above, in

which the robot of the handling system is also the robot for loading workpieces in the press.

5 According to further aspects, the disclosure is related to a method for loading a die in a press as claimed in claim 11, to a complementary method for unloading a die from a press as claimed in claim 14, and to a method for loading and unloading dies from presses in a press line as claimed in claim 15.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

15 Figures 1, 2 and 3 schematically show in plan view several embodiments of a handling system for loading a die in a press as disclosed herein; Figure 4 shows schematically in perspective view an example press line in which an embodiment of a system as disclosed herein is employed; and Figure 5 is another view of the press line of Figure 4, in a different moment of a die loading and unloading operation.

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DETAILED DESCRIPTION OF EXAMPLES

Figure 1 shows very schematically in plan view a press P_n in a press line. Part of the press line is sketched in dotted lines at both sides of press showing presses P_{n-1} and P_{n+1} , respectively upstream and downstream of press P_n in the direction of advance of a workpiece along the line.

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Robots R_n , R_{n-1} and R_{n+1} are arranged in the press line for transferring workpieces (not shown) from one press to another during a manufacturing operation: for example robot R_n may remove workpieces from press P_{n-1} and feed them to press P_n . Suitable robots for such an operation may be for

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example models IRB1200, IRB1400, IRB1600 or IRB4600, available from ABB (www.abb.com), amongst others.

Figure 1 also shows very schematically a first embodiment of a handling system for loading a die (not shown) in press P_n . A die to be employed in a press usually comprises an upper die member and a lower die member. The assembly of the upper and lower die members is loaded in the right position in the press, and then the die members are each attached in known manner to the press ram and press base. In the present specification, the expression "a die" is meant to comprise such a die having an upper die member and a lower die member, which are loaded to the press and unloaded from the press as an assembly.

In the embodiment of Figure 1, the handling system for loading a die comprises the robot R_n and a linear sliding path 10 between a supply position 20 outside the press and a press position 30 on the press base.

The robot R_n may be programmed to displace a die between the supply position 20 and the press position 30 along the linear sliding path 10, while it is supported by the path 10 itself.

In some embodiments the robot R_n may engage a side surface or a top surface of the die at the supply position 20, and push it along the path 10 until it reaches the press position 30, where the upper die member and the lower die member may be clamped or otherwise fixed in position in the press, as known.

The robot may engage the die in several possible ways, depending on the requirements of each case. For example, the robot wrist may be rotated such that the tooling for picking the workpieces during normal operation is moved out of the way, and the robot wrist itself may engage the die; alternatively, the tooling may be changed, and a tooling suitable to engage the die may be mounted on the robot before the die loading operation.

In some embodiments the robot wrist and/or the die may be provided with suitable mechanical means for a mutual engagement that allows the robot to push and/or pull the die; in other embodiments, the robot wrist may be
5 provided with an electromagnet to be temporarily attached to the die.

In embodiments wherein the robot only needs to push the die, the robot wrist or tooling may simply be brought in contact with a suitable point of the die without being attached to it.

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Figures 4 and 5 are perspective views of a press line such as that of Figure 1, in two different moments of the process of replacing the dies of the presses to change from a manufacturing batch of a certain part, such as a telephone casing, to a manufacturing batch of a different part. The path 10 has not been
15 depicted in Figures 4 and 5 to avoid confusion: it will be understood that it is substantially parallel to the direction of advance of the workpieces in the press line, indicated by arrow A, and extends between the press position 30 on the base of the press P_n and the supply position 20 between presses P_{n-1} and P_n .

20 In Figures 4 and 5, a die OD_n that has been used in press P_n during a completed manufacturing batch is being unloaded from the press P_n by robot R_{n+1} , and a new die ND_n that will be used in the same press P_n in the next manufacturing batch is being loaded to press P_n by robot R_n . The complete operation illustrated by Figures 4 and 5 will be described with more detail later
25 on.

The linear sliding path 10 is configured in such a way that it can support a die allowing it to slide, such that the die is displaceable while it is resting on the path. The path may comprise for example a plurality of bearing balls, or
30 bearing rollers, which may be arranged on two parallel lines as depicted in Figure 1.

The rolling elements such as balls or rollers of the path 10 protrude upwards from an underlying surface, so a die may rest on them. In some parts of the path the underlying surface is the press base, for example in the press position 30. In other parts of the path the underlying surface may be any frame
5 part or auxiliary support surface of the press line, for example in the supply position 20.

In some embodiments, at least some portions of the sliding path 10 may be movable vertically between a higher, active position, in which the ball bearings
10 or other elements protrude upwards from the underlying base, and an inactive position, in which they remain flush with the underlying base, or at a lower level. In the active position the die rests on the elements of the path 10 and can be displaced easily; once the die has been placed in the desired position, the path 10 may be shifted to the lower, inactive position such that the die also
15 descends until it rests on the underlying, stationary surface. The surfaces underlying the path 10 may be provided with suitable grooves, recesses etc. to arrange the path elements and allow this operation.

The embodiment of Figure 1 shows that the handling system may comprise
20 another linear sliding path 40, which may have a configuration similar to that described for path 10.

Sliding path 40 extends between the supply position 20 and a waiting position 50, which like position 20 is outside the press, where a die may be placed, for
25 example by means of a forklift truck, crane or the like, during a normal manufacturing process of the press line.

As shown in the figure, the sliding path 40 may be substantially perpendicular to the sliding path 10, and the waiting position 50 may be located between two
30 presses of the line but towards the back side of the presses, and therefore outside the space through which the workpieces are transferred from one

press to another by the robots. A die in the waiting position therefore does not interfere with the normal operation of the press line.

It will be understood that providing a waiting position 50, and a sliding path 40
5 between this position and the supply position 20, allows preparing the die change during the normal manufacturing operation of the line, such that this time does not add to the time needed for the dies change itself, and the downtimes for the die change operation may therefore be reduced. Furthermore, the waiting position 50 may be located such as to facilitate the
10 operations of placement of the die, taking into account the layout and dimensions of the press line, the tools used to transport the die, etc.

Referring to Figures 1, 4 and 5, an embodiment of a method for loading a die in a press P_n may therefore comprise:

- 15 - placing a die (not shown in Figure 1) in the waiting position 50, for example during normal operation of the press line, and then, once the current manufacturing batch is complete,
- engaging the new die at the waiting position with the robot R_n , for example on the front side of the die,
- 20 - by means of the robot pulling the new die to displace it on the linear sliding path 40 until it reaches the supply position 20,
- changing the engagement of the robot with the die if convenient, for example to engage a different side of the die, and
- pushing the die to displace it on the linear sliding path 10, from the
25 supply position 20 to the press position 30 in press P_n .

The old die may be removed or unloaded from the press P_n in the same operation in a way that leaves the press position 30 free to receive the new die, as will be described later on; alternatively, it may be removed before the
30 loading operation of the new die is started.

Figure 2 illustrates very schematically in plan view a press line with a number of presses P_{n-1} , P_n and P_{n+1} and with robots R_n , R_{n-1} and R_{n+1} for transferring workpieces from one press to another, as in Figure 1, and another embodiment of a handling system for loading a die (not shown) in a press.

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Like in Figure 1, the handling system shown in Figure 2 comprises the robot R_n and the linear sliding path 10 between a supply position 20 and a press position 30. The supply position 20 is a geometrical position outside the press, for example located in the space between two presses, and substantially aligned with the press position in the direction of advance of the workpieces in the press line, as in Figure 1.

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Furthermore, in the embodiment shown in Figure 2 the handling system comprises a rotatable table 60 with two stations 61, 62 each adapted for receiving a die (not shown). As may be appreciated in the figure, the rotatable table 60 is arranged such that one of its stations may be in the supply position 20. The rotatable table has formed on the stations a portion or length of the sliding path 10, while another portion is formed on a stationary frame between the press and the rotatable table, and another portion is on the press base.

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When one station of the table 60 is in the supply position 20, the other station is in a waiting position 70, and the rotatable table 60 may be rotated to move a die (not shown) between the waiting position 70 and the supply position 20.

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A further embodiment of a handling system according to the present disclosure is illustrated very schematically in plan view in Figure 3: like Figures 1 and 2, in the figure a press line with a number of presses P_{n-1} , P_n and P_{n+1} and with robots R_n , R_{n-1} and R_{n+1} for transferring workpieces from one press to another.

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The handling system shown in Figure 3 also comprises the robot R_n , and a linear sliding path 10 between a supply position 90 and a press position 30,

which in this case is not in the direction of advance of the workpieces through the press line but in a perpendicular direction. The supply position 90 is therefore a geometrical position outside the press, but it is not located in the space between two presses as in Figures 1 and 2, but in the space in front of the press P_n .

In the embodiment shown in Figure 3 the handling system also comprises a rotatable table 60 with two stations 61, 62 and arranged such that one of its stations may be in the supply position 90. Like in Figure 2, the rotatable table has formed on the stations a portion or length of the sliding path 10, while another portion is formed on a stationary frame between the press and the rotatable table, and another portion is on the press base.

When one station of the table 60 is in the supply position 90, the other station is in a waiting position 100, and the rotatable table 60 may be rotated to move a die (not shown) between the waiting position 90 and the supply position 100.

In the embodiments of Figures 2 and 3 a method for loading a die in a press P_n may therefore comprise:

- placing a die (not shown) on the station of the rotating table 60 that is in the waiting position 70 or 100, for example during normal operation of the press line, and then, once the current manufacturing batch is complete,
- rotating the rotatable table 60 such that the die is moved from the waiting position to the supply position 20 or 90,
- by means of the robot R_n engaging the die and displacing it on the linear sliding path 10 from the supply position 20 or 90 to the press position 30 in press P_n .

In some embodiments, the handling system may also comprise a centering system (not shown) for the die, for example suitable abutments, at the waiting position 50, 70 or 100. In the embodiments of Figures 2 and 3 each station of the rotatable table 60 may comprise such a die centering system. An operator

can therefore accurately place the die on the station 62, in the waiting position 70 or 100. Since the die is in a precise and known position, when the table 60 is rotated and the die comes to be in the supply position 20 or 90, the robot R_n can engage it and displace it towards the press position 30 accurately.

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In some embodiments, a short additional linear sliding path (not shown) may be provided at the waiting position, perpendicular to the main sliding path existing at this position, to assist in placing and centering the die accurately.

10 For example, such a short additional sliding path may be provided in Figure 1 at waiting position 50, perpendicular to path 40; or in Figures 2 and 3 a short path may be provided on each station 61, 62 of the rotatable table 60, perpendicular to path 10, so that it is available at waiting positions 70 or 100.

15 A fine centering system may also be provided in any of the above embodiments in the press position 30 on the press base, in order to correct potential positioning errors of the die in the waiting position and/or arising during its travel.

20 A handling system according to the present disclosure may also be employed for unloading a die from a press.

In order to unload a die from the press P_n in the embodiments of Figures 1 and 2, for example, another linear sliding path 10' may be provided between
25 the press position 30 on the press base and a discharge position 20' outside the press, in this case downstream of the press P_n itself, and the robot R_{n+1} may be employed to engage a die in the press position 30 and displace it to the discharge position 20' on the sliding path 10'.

30 In the embodiments of Figures 1 and 2 the path 10' is aligned with the path 10 (located upstream of the press P_n) that has been described above and that is employed for loading the die. It will be appreciated that the discharge position

20' for press P_n may be the same position as the supply position 20 for loading the die in the next press P_{n-1} of the line.

5 In the embodiment of Figures 1, 4 and 5, the robot R_{n+1} may also displace the die from the discharge position 20' (or supply position 20) to the waiting position 50 over the sliding path 40, wherein robot R_{n+1} , path 40 and position 50 may at the same time be part of the handling system for loading a die to press P_{n+1} .

10 It will therefore be understood that, in embodiments such as shown in Figures 1, 4 and 5, a method for loading and unloading dies from presses in a press line, such as P_{n-1} , P_n and P_{n+1} , may comprise loading dies in each press and unloading dies from each press with methods as disclosed above in relation to Figures 1 or 2, wherein each robot such as R_n unloads dies from the press
15 P_{n-1} arranged immediately upstream of it in the press line, and loads dies in the press P_n arranged immediately downstream of it in the press line, and wherein the supply position 20 corresponding to one press P_n is the same as the discharge position 20' of the press P_{n-1} immediately upstream in the press line.

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Figures 4 and 5 best illustrate such a method for loading and unloading dies.

In Figure 4, downstream of the press P_n , robot R_{n+1} is displacing the old die OD_n from the press position 30 in press P_n towards the discharge position 20'
25 on sliding path 10'. Simultaneously, upstream of the press P_n , robot R_n is displacing the new die ND_n on sliding path 40 from the waiting position 50 to the supply position 20.

In Figure 5, which corresponds to a later time, robot R_{n+1} is displacing the old die OD_n from the discharge position 20' towards the waiting position 50
30 downstream of the press P_n , on sliding path 40. Simultaneously, upstream of

the press P_n , robot R_n is displacing the new die ND_n on sliding path 10 from the supply position 20 to the press position 30 in the press P_n .

5 A similar method may be performed for example in an embodiment such as shown in Figure 2, except that the displacement between the waiting position 70 and the supply position 20, as well as the displacement between the discharge position 20' and the waiting position 70, are performed by turning 180° the rotatable table 60, instead of being performed by the robots.

10 In order to change the dies in the presses of all the line, and during a normal manufacturing operation of the press line, new dies are prepared at the waiting positions upstream of each press of the line, such that there is an empty waiting position, downstream of the last press.

15 Once the normal manufacturing operation is finished, the dies in each press are changed as described above, starting with the last press of the line: when the dies of the last press have been changed, there is an empty waiting position between the last press and the next-to-last press, and therefore the dies of the next-to-last press may be changed. The process is repeated until
20 the dies in all the presses have been changed, and the empty waiting position is upstream of the first press of the line. All this process may be performed automatically, without the need of operators intervening at each press.

25 In a subsequent operation, which can take place while the press line is again performing a normal manufacturing operation, the old dies may be removed from the waiting positions, for example by an operator with a forklift.

In the embodiment of Figure 2, rotatable tables 60 are shared between two presses, such that the same table is employed for loading the die in one
30 press, and for unloading the die in an adjacent press.

On the contrary, in the embodiment of Figure 3 each table 60 serves only one

press, for both the die loading and the die unloading operations; the discharge position is the same as the supply position 90 for each press, and therefore the sliding path between the press position 30 and the discharge position 90 is the same as the sliding path between the supply position 90 and the press position 30.

Consequently, in the embodiment of Figure 3, dies may be changed simultaneously in all the presses in the line, but in each press the loading operation of the new die is performed after the unloading operation of the old die, and the same robot may perform all the operations related to one press.

For example, in the case of Figure 3, in the first place the new dies are prepared in the waiting positions 100 corresponding to each press, during a normal manufacturing operation. Then, simultaneously for all the presses, the old die is displaced by a robot from the press position 30 to the discharge position 90, along path 10; the rotatable table is turned 180°, such that the two dies swap places, the old die being moved to the waiting position 100 and the new die being moved to the supply position 90; and finally, the new die is displaced by the same robot on path 10 from the supply position 90 to the press position 30.

Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the claims that follow.

CLAIMS

1. A handling system for loading a die in a press, wherein the handling system comprises:
- 5 - a robot, and
- a first linear sliding path between a supply position outside the press and a press position on the press base, the first linear sliding path being configured to support a die such that the die is displaceable while it is supported on the path, and
- 10 - wherein the robot is configured to displace the die between the supply position and the press position along the first linear sliding path, while it is supported on the path.
2. A handling system according to claim 1, further comprising a second linear
- 15 sliding path between a waiting position outside the press and the supply position, the second linear sliding path being configured to support a die such that the die is displaceable while it is supported on the path.
3. A handling system according to claim 2, wherein the second linear sliding
- 20 path is substantially perpendicular to the first linear sliding path.
4. A handling system according to claim 1, further comprising a rotatable table with two stations each adapted for receiving a die, wherein the rotatable table is arranged such that one station is in the supply position while the other
- 25 station is in a waiting position, and wherein the rotatable table may be rotated to move a die between the waiting position and the supply position.
5. A handling system according to claim 4, wherein each station of the rotatable table comprises a length of the first linear sliding path.
- 30 6. A handling system according to claim 5, wherein each station of the rotatable table has formed on it an additional linear sliding path, perpendicular to the first linear sliding path.

7. A handling system according to any of claims 2 to 6, wherein a die centering system is provided at the waiting position.

5 8. A handling system according to any of the preceding claims, wherein each sliding path comprises a plurality of rolling elements.

9. A handling system according to any of the preceding claims, wherein at least a portion of at least one sliding path is movable between a higher active
10 position in which it protrudes upwards from a stationary underlying base, and a lower inactive position in which it does not protrude from the stationary underlying base.

10. A press line comprising at least one press and a handling system as
15 claimed in any of the preceding claims, wherein the robot of the handling system is also the robot for loading workpieces in the press.

11. A method for loading a die in a press, comprising:
- providing a robot for loading workpieces in the press,
20 - providing a first linear sliding path between a supply position outside the press and a press position on the press base,
- placing a die in the supply position, on the first linear sliding path, and
- displacing the die on the first linear sliding path, from the supply position to the press position, by means of the robot.

25 12. A method as claimed in claim 11, wherein the step of placing a die in the supply position comprises:
- providing a second linear sliding path perpendicular to the first linear sliding path, between a waiting position and the supply position,
30 - placing a die in the waiting position, and
- displacing the die on the second linear sliding path, from the waiting position to the supply position, by means of the robot.

13. A method as claimed in claim 11, wherein the step of placing a die in the supply position comprises:

- providing a rotatable table with two sides, such that one side of the table is in the supply position and another side of the table is in a waiting position,
- placing a die on the side of the rotating table that is in the waiting position, and
- turning the rotatable table to place the die in the supply position.

14. A method for unloading a die from a press comprising:

- providing a robot for loading workpieces in the press,
- providing a third sliding path in a linear direction between a press position on the press base and a discharge position outside the press, and
- displacing a die on the third sliding path from the press position to the discharge position by means of the robot.

15. A method for loading and unloading dies from presses in a press line, comprising loading dies in each press with a method according to any of claims 11 to 13, and unloading dies from each press with a method according to claim 14, wherein each robot unloads dies from the press arranged immediately upstream of it in the press line and loads dies in the press arranged immediately downstream of it in the press line, and wherein the supply position corresponding to one press is the same as the discharge position of the press immediately upstream in the press line.

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FIG. 1

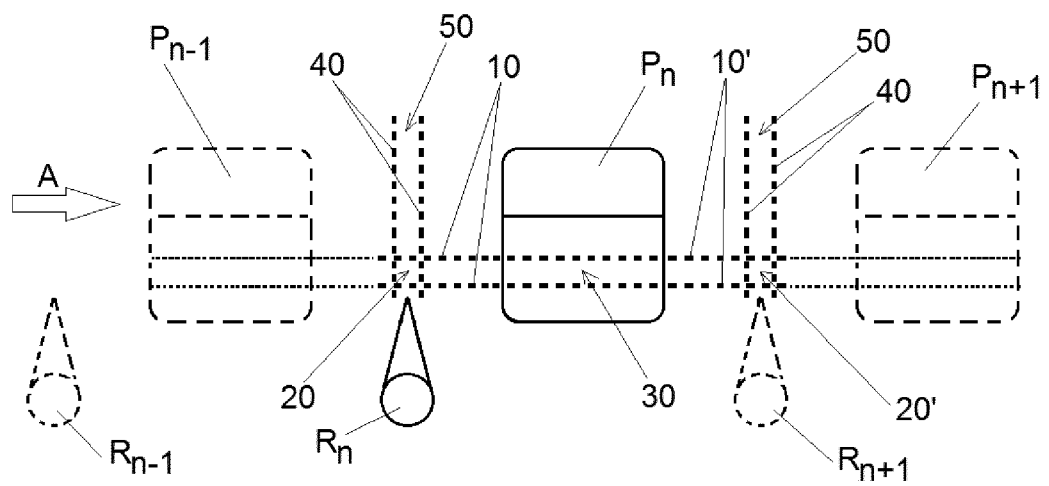


FIG. 2

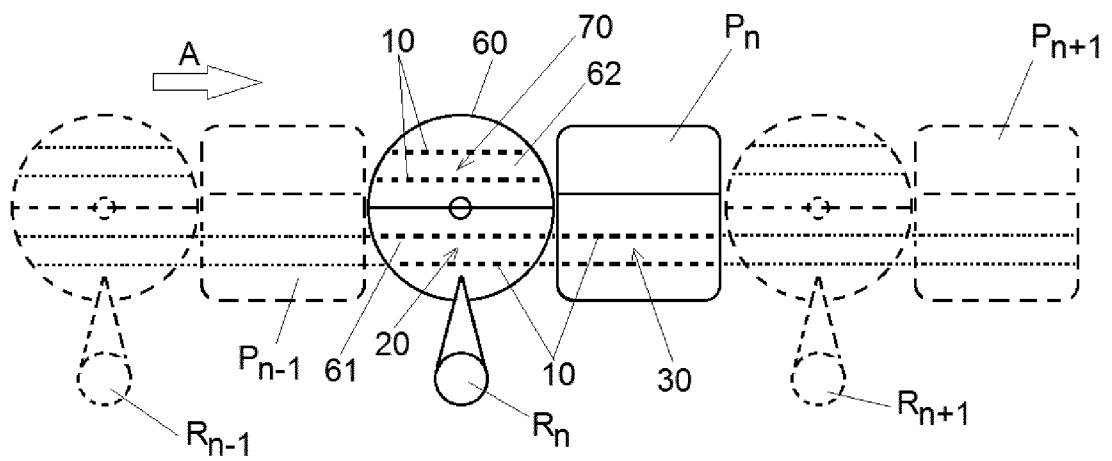
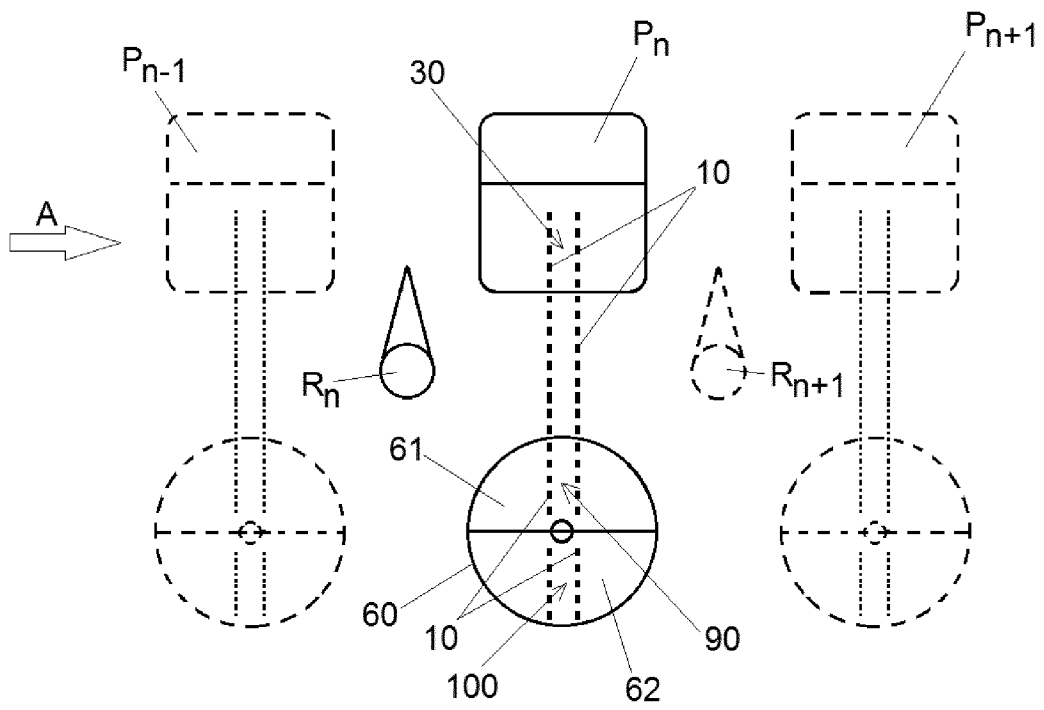


FIG. 3



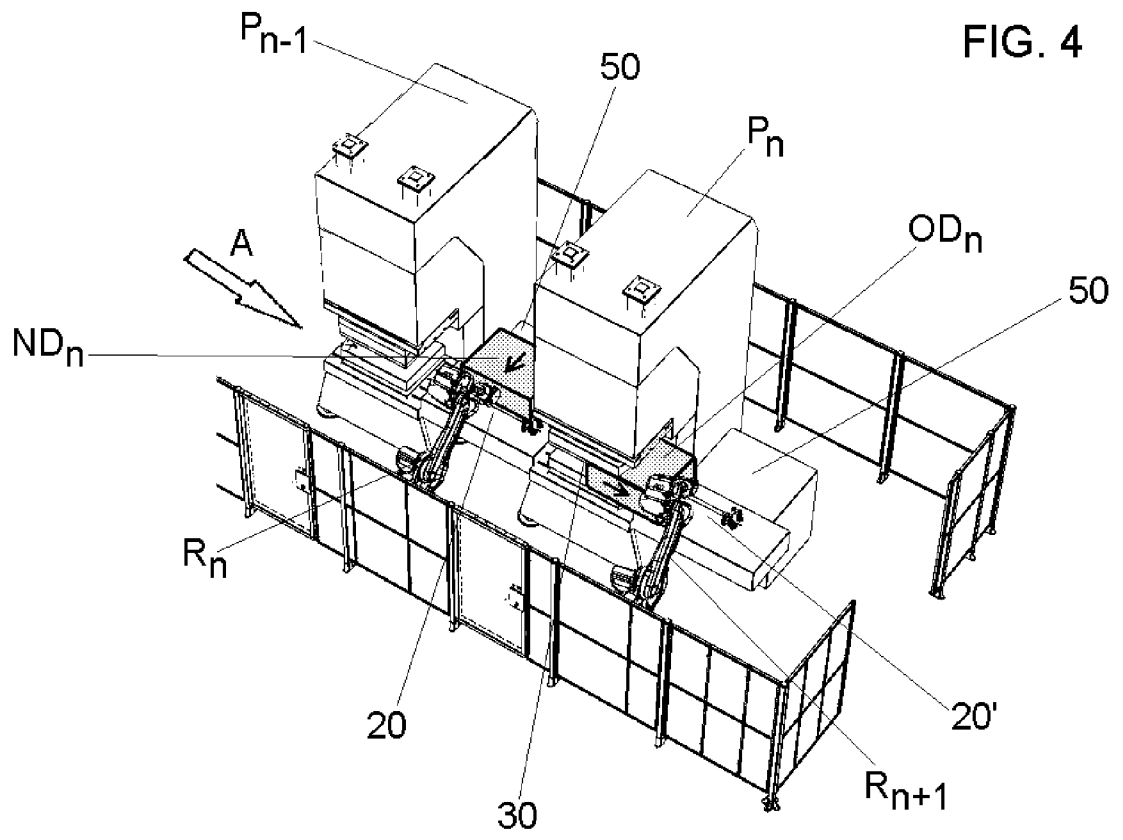
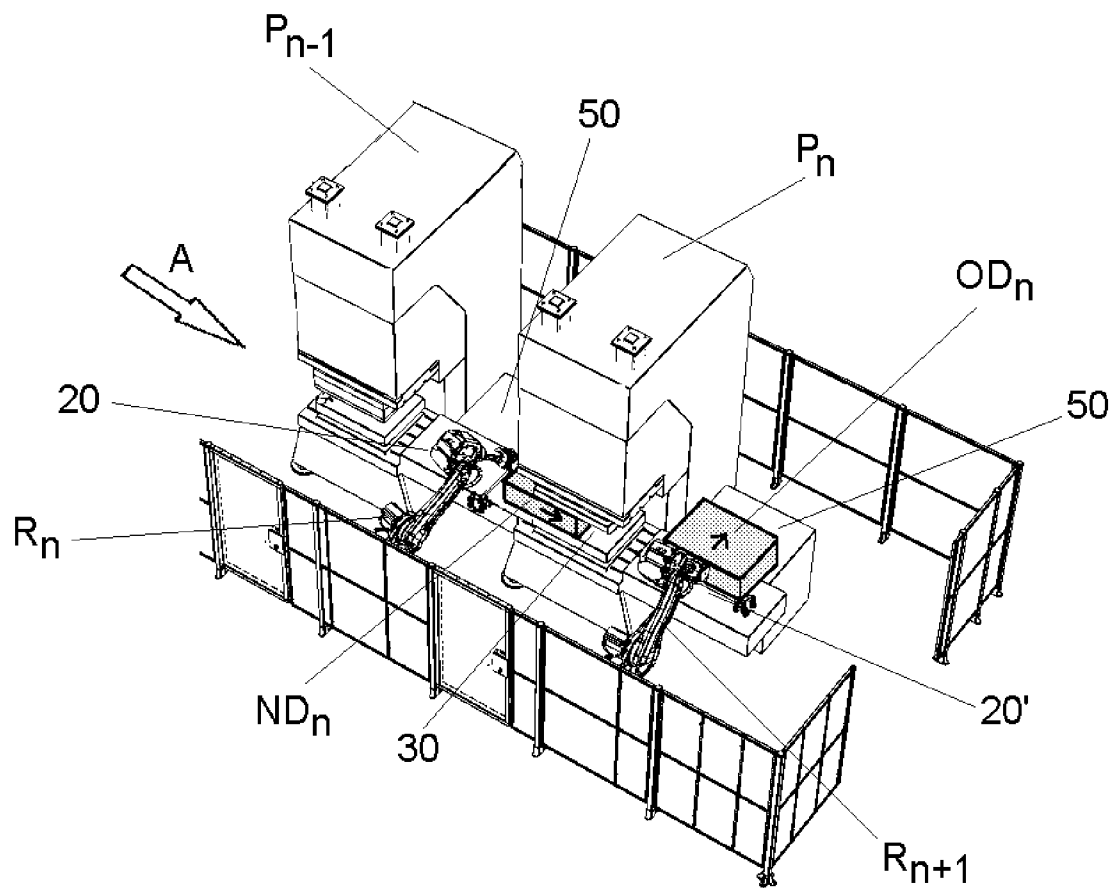


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2015/067434

A. CLASSIFICATION OF SUBJECT MATTER

INV. B21D43/02 B21D37/14
ADD.

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)

B21D B25J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/126452 A1 (TOENISKOETTER JAMES [US]) 21 May 2009 (2009-05-21)	1-10
A	abstract; figures 1-9	11-15
X	US 5 120 179 A (HENDERSON ROBERT E [US] ET AL) 9 June 1992 (1992-06-09)	1-3,7-10
A	abstract; figures 1-10	4-6, 11-15
X	US 5 582 062 A (SOMMER GORDON M [US]) 10 December 1996 (1996-12-10)	1-3,7-10
A	abstract; figures 1-11	4-6, 11-15
A	EP 0 128 487 A1 (TRUMPF GMBH & CO [DE]) 19 December 1984 (1984-12-19) the whole document	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

8 April 2016

Date of mailing of the international search report

20/04/2016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/067434

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