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(54) **MOLD REPLACEMENT METHOD AND MOLD PLATFORM IN BENDING PRESS**

(57) When replacing an upper die of a leading end of a punch of a bending press machine that bends a steel plate on dies by a pair of dies and a punch vertically moving between the dies, carry-in of the upper die to just below the punch and carry-out of the upper die from just below the punch are performed, by the use of an upper die carriage that is movable between the pair of dies in a longitudinal direction of the punch and has an upper

die storing unit configured to store the upper die and a lifting/lowering mechanism capable of vertically lifting and lowering the upper die storing unit. Accordingly, provided are an upper die replacing method of the bending press machine capable of efficiently and safely performing the replacement of the upper die in a short time, and a carriage for upper die replacement used for the method.

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Description

Technical Field

[0001] The present invention relates to an upper die replacing method of a leading end of a punch in a bending press machine manufacturing a thick welded steel pipe having a large diameter used for a line pipe or the like by performing three-point bending press forming multiple times, and an upper die carriage used for replacing the upper die.

Background Art

[0002] Conventionally, as a thick steel pipe having a large diameter used for a line pipe, a steel structure or the like, in general, a so-called "UOE steel pipe" has been widely used. The UOE steel pipe is formed so that a material steel plate having predetermined width, length, and thickness is press-formed into a U-shape and then is press-formed into an O-shape, and thereafter, butted parts are welded to obtain a material steel pipe, and the material steel pipe is expanded (so-called pipe expansion) in a circumferential direction to improve roundness. Furthermore, in recent years, in terms of an improvement in safety and an increase in size, in the steel pipe used for the line pipe or the like, an increase in diameter, an increase in length, thickening, and strengthening of the material steel plate have been in progress.

[0003] However, in the method of manufacturing the above-described UOE steel pipe, in order to perform the press forming of the material steel plate having increased thickness, increased length and higher strength into a U-shape and an O-shape, there is a need for a great press load. Thus, there is a problem in that the production range is limited or productivity is significantly lowered in conventional UOE steel pipe manufacturing equipment.

[0004] Thus, as a technique of reducing the press load when manufacturing the thick steel pipe having a large diameter, long length, and high strength, a press bending method has been developed and put into practical use. According to such a method, after the application of bending (so-called end bending) to both width end portions of a material steel plate, the three-point bending press forming is performed multiple times while feeding the steel plates in the width direction by a predetermined amount to press-form the steel plate into a substantially cylindrical shape (open pipe) having an opening portion, then, the opening portion of the open pipe is subjected to butt welding and pipe expansion, and the shape thereof is corrected, thereby manufacturing a steel pipe.

[0005] Fig. 1 is a diagram that schematically illustrates a method of manufacturing a steel pipe using the above-described press bending method. In this manufacturing method, first, three-point bending press forming is performed multiple times toward a plate width center from one plate width end portion of a material steel plate 1 having both bent (crimping pressed) end portions by

combining a punch 2 with a pair of dies 3 to form one half into an arc shape except for the plate width center of the steel plate (first half press), next, similarly, the three-point bending press forming is performed multiple times toward the plate width center from the other plate width end portion to form the remaining one half except for the plate width center of the steel plate into an arc shape, thereby obtaining a substantially C-shape (second half press), finally, the remaining plate width center portion is subjected to press forming (final press) to obtain a substantially cylindrical shape (open pipe) having an opening portion, and thereafter, the steel pipe is generally manufactured by performing butt welding of the opening portion. In addition, in some cases, the material steel plate may not be subjected to the end bending.

[0006] A bending press machine used for the above-described three-point bending press forming has a pair of dies disposed in a feeding direction of a material steel plate at a predetermined gap, and a punch capable of vertically moving between the pair of dies, and is configured to press the material steel plate placed on the dies by the punch, thereby performing bending. The punch includes an upper die, attached to a leading end portion of a punch 2 directly coming into contact with the steel plate as a material to be machined, (hereinafter, simply referred to as a "upper die"), and a punch supporter (hereinafter, also referred to as a "beam") that is connected to a main body of a press machine and supports the upper die at a leading end thereof, and the upper die and the punch supporter are commonly fastened by fixing bolts in an attachable and detachable manner. Furthermore, the beam is an integral body, but the upper die is commonly constituted by a plurality of segments so that the attachment and detachment operation and the handling are easily performed.

[0007] In addition, as a method of replacing the upper die, several replacing methods of a tool in a small bending machine and a punch press machine have been suggested (for example, see Patent Literatures 1 to 4). However, these methods are techniques that can be used only for small bending machines and punch press machines and are not suitable for application to the replacement of the upper die of the bending press machine for manufacturing a large diameter pipe.

Citation List

Patent Literatures

[0008]

Patent Literature 1: JP 11-005131 A
 Patent Literature 2: JP 2001-276936 A
 Patent Literature 3: JP 2002-096120 A
 Patent Literature 4: JP 2001-150032 A

Summary of Invention

Technical Problem

[0009] Incidentally, there is a need to replace the upper die attached to the leading end portion of the punch depending on changes in sizes (inner diameter and outer diameter) of the steel pipe to be manufactured and in (thickness and strength of) the material steel plate.

[0010] However, there is a problem as follows. In the related art, as illustrated in Fig. 2(a), a relatively small radius of curvature R (leading end R) of an upper die surface coming into direct-contact with the steel plate is used, and then the range capable of coping with changes in the steel pipe size and the material steel plate is wide. At the same time, however, since the bending part is local, roundness of the steel pipe after forming is degraded, and since there is a need to perform the press forming little by little, the number of presses increases, and the productivity is degraded.

[0011] Thus, as counter-measures of the above-described problems, as illustrated in Fig. 2(b), increasing the leading end R and widening a width of the punch in accordance with a steel pipe diameter are performed to improve the roundness or to improve the productivity. However, though widening the punch width or increasing the leading end R as described above leads to improvement in roundness and productivity, there is a need to frequently replace the upper die depending on changes in the steel pipe size and in the material strength. In particular, when the width of the upper die widens, not only the load required for pressing increases, but also a great bending moment is applied to the base of the beam attached to the upper die and the moment easily exceeds the endurance strength of the punch, in the case where a feed rate of the steel plate is small relative to a distance between the dies and a shape of the material steel plate on the dies is right-and-left asymmetric with respect to the axis center of the punch. For that reason, there is a need to frequently replace the upper die of the leading end portion of the punch depending on the changes in the steel pipe size, the material steel plate, and press conditions.

[0012] Conventionally, as a method of replacing the upper die, for example, the method is performed by a series of processes as follows. That is, after mounting a new upper die on a large dummy plate, the dummy plate is conveyed in a horizontal direction using conveyance facilities configured to supply a material steel plate to a press machine, the new upper die is moved to a vicinity just below a punch (beam), then, the punch is lowered to become a state of being in contact with the dummy plate of a position near the new upper die, fastening of bolts is released to detach the upper die from a beam leading end, then, the dummy plate is moved by the above-described conveyance facilities to move the new upper die to just below the beam, the new upper die is fitted to the beam leading end, and is attached thereto

by being fastened with bolts.

[0013] For that reason, in the conventional method of replacing the upper die, it is not possible to supply a new upper die to just below the beam, since it is not possible to accurately move the dummy plate in the horizontal direction, and since it is not possible to finely adjust the position of the upper die in the state of being mounted on the dummy plate. For this reason, it takes a long time for mounting the upper die to the beam leading end. Furthermore, since the upper die is divided into a plurality of segments, it is necessary to repeat the above-described replacement operation. Thus, a lot of time is required for one upper die replacement, which significantly reduces the operation efficiency. Furthermore, since it is not possible to turn off the power source of the press machine when replacing the upper die in view of the need to lift and lower the punch, there is a need to take multiple safety measures so as to ensure safety, and thus, the reduction in productivity cannot be avoided.

[0014] The methods described in Patent Literatures 1 to 4 are techniques that can be used only for small bending machines and punch press machines, but are not techniques that can be directly applied to replacement of the upper die of the bending press machine for manufacturing the large diameter.

[0015] The present invention has been made in view of the above-described problems of the related art, and an object thereof is to suggest an upper die replacing method by which the replacement of the upper die of a leading end of a punch in a bending press machine can be efficiently and safely performed in a short time, and to provide an upper die carriage for use in the method.

Solution to Problem

[0016] The inventors have extensively studied to find a solution of the above-described problems. As a result, the inventors found out that by providing an upper die carriage capable of collectively mounting a plurality of divided upper die segments, and moving the carriage between a pair of dies below a press machine along a longitudinal direction of a punch, it is possible to accurately position and supply the upper die just below the punch, and it is preferable that the movement of the carriage be performed using a steel pipe carrying-out device that is installed in the press machine to carry out the steel pipe after press forming, which has led to the development of the present invention.

[0017] That is, according to the present invention, there is provided an upper die replacing method of a leading end of a punch in a bending press machine that bends a steel plate on dies by a pair of dies and a punch vertically moving between the dies, wherein carry-in of the upper die to just below the punch and carry-out of the upper die from just below the punch are performed by mounting the upper die on an upper die carriage capable of moving between the pair of dies in a longitudinal direction of the punch.

[0018] In the upper die replacing method of the present invention, the carry-in of the upper die carriage to just below the punch and the carry-out from just below the punch are performed using a steel pipe carrying-out device disposed in the press machine.

[0019] Further, in the upper die replacing method of the present invention, detachment of the upper die from the leading end of the punch and attachment of the upper die to the leading end of the punch are performed in a state in which an upper die storing unit of the upper die carriage is lifted and is brought into contact with the leading end of the punch.

[0020] Further, in the upper die replacing method of the present invention, position adjustment of the upper die mounted on an upper die table in the upper die storing unit in a direction perpendicular to the longitudinal direction of the punch is performed by moving the upper die table while mounting the upper die.

[0021] Further, in the upper die replacing method of the present invention, when the upper die is divided into a plurality of segments, replacement of the upper die is collectively performed.

[0022] Further, in the upper die replacing method of the present invention, the plurality of segments are divided into a plurality of sets connected by a shim, and loading and unloading to the upper die carriage are performed in the unit of the set.

[0023] Further, according to the present invention, there is provided an upper die carriage used for upper die replacement of a leading end of a punch in a bending press machine that bends a steel plate on dies by a pair of dies and a punch vertically moving between the dies, wherein the upper die carriage is movable between the pair of dies in a longitudinal direction of the punch, by a device that is installed in the bending press machine and carries out a steel pipe after pressing.

[0024] Furthermore, the upper die carriage of the present invention further includes an upper die storing unit that stores an upper die, and a lifting/lowering mechanism that lifts and lowers the upper die storing unit.

[0025] Furthermore, the upper die carriage of the present invention further includes a position adjusting mechanism that performs position adjustment of the upper die stored in the upper die storing unit in a direction perpendicular to the longitudinal direction of the punch for each upper die table on which the upper die is mounted.

Advantageous Effects of Invention

[0026] According to the present invention, since it is possible to efficiently perform the replacement of the upper die in the bending press machine in a short time, it is possible to manufacture a welded steel pipe having a large diameter, thickness, length, and high strength with high productivity.

Brief Description of Drawings

[0027]

5 Fig. 1 is a diagram schematically illustrating a method of manufacturing a steel pipe according to a press bending method.

Figs. 2(a) and 2(b) are diagrams illustrating an influence of an upper die width of a leading end of a punch on manufacturing of the steel pipe.

10 Fig. 3 is an example view illustrating a structure of the punch of a bending press machine.

Fig. 4 is a diagram illustrating a cross-sectional structure of an upper die carriage.

15 Figs. 5(a) to 5(f) are diagrams illustrating the procedure of a replacement of the upper die (detaching method).

Figs. 6(a) to 6(d) are diagrams illustrating an upper die detaching operation in the upper die carriage.

20 Figs. 7(a) and 7(b) are diagrams illustrating a handling method of the upper die divided into a plurality of segments.

Description of Embodiments

25 **[0028]** The present invention relates to a method of replacing an upper die attached to a leading end of a punch supporter in a bending press machine for bending a steel plate on dies by a pair of dies and a punch vertically moving between the dies.

30 **[0029]** Fig. 3 is a diagram illustrating a structure of the punch of a bending press machine used in the present invention. The punch is constituted by a punch supporter 4 (beam) attached to a main body of a press machine 7, and an upper die 5 attached to a leading end (lower end) of the beam by fixing bolts 6. On a side of the upper die coming into contact with the beam leading end, grooves 8 to which a beam lower portion is fitted is formed, and a spacer 9 is inserted between the groove portion and the beam leading end.

35 **[0030]** The upper die may be a single body, but is typically divided into a plurality of segments in consideration of productivity and handling properties of the upper die. As described previously, in a conventional method of the replacement of the upper die, carry-in of the upper die to a lower position of the press machine and carry-out from the lower position of the press machine are performed by moving the upper die while being mounted on a dummy plate. However, in the above-described method, it has not been possible to accurately position the upper die just below the beam leading end, and it has taken a great deal of time for mounting, which has been a cause of impeding the productivity. In addition, from the necessity to move the punch, it was necessary to perform the replacement operation while keeping the power of the press machine on. For this reason, there was also need for multiple safety measures to ensure safety, and adverse effects on productivity were inevitable.

[0031] Thus, according to the present invention, carry-in of the upper die to just below the punch and carry-out of the metal from just below the punch are performed by being mounted on the upper die carriage that moves between the pair of dies installed below the press machine in a longitudinal direction of the punch.

[0032] The upper die carriage is placed at a position different from the press machine during press operation, and when performing the replacement of the upper die, the upper die carriage is mounted on a carry-out line to which the steel pipe (open pipe) after the press forming is carried out, by a crane or the like. The upper die carriage has a length that is able to collectively mount the upper die divided into the plurality of segments, and at a press machine side end portion in the longitudinal direction of the carriage, for example, an upward (or downward) hook is provided. Meanwhile, in the steel pipe carrying-out device that is provided in the press machine and carries out the steel pipe after the press forming, another connection mechanism connected to the connection mechanism of the upper die carriage, for example, a downward (or upward) hook is provided.

[0033] Moreover, the carry-in of the upper die carriage from the press machine to just below the press machine can be performed, by connecting the connection mechanism of the upper die carriage side with the connection mechanism of the steel pipe carrying-out device side, and by moving the steel pipe carrying-out device in an opposite direction to the direction at the time of carrying out the steel plate.

[0034] Meanwhile, carry-out of the upper die carriage from just below the press machine to the outside of the press machine can be performed, by bringing an extruding tool provided in the steel pipe carrying-out device for carrying out the steel pipe after the press forming into contact with the upper die carriage, or by connecting the connection mechanism of the upper die carriage side with the connection mechanism of the steel pipe carrying-out device side, and by moving the steel pipe carrying-out device in the carrying-out direction of the steel pipe.

[0035] Thus, moving means (driving source) of the steel pipe carrying-out device is not particularly limited, and may be driven by, for example, a chain, a belt or the like connected to a power source such as a motor.

[0036] Furthermore, for example, as illustrated by broken lines in a lower part of Fig. 4, the upper die carriage may run on a conveyance line constituted by a V roll, or may run on a rail by mounting wheels to the lower part of the upper die carriage, both may be used in combination with each other, and may not be particularly limited. In addition, when adopting the V roll, it is preferred to adopt a structure in which during the press operation, the V roll below the press machine moves downwards and retracts so as not to disturb the operation, and the V roll is lifted only when replacing the upper die.

[0037] Furthermore, Fig. 4 illustrates a cross-section in a direction (hereinafter, referred to as a "width direction") perpendicular to the longitudinal direction of the

punch, the upper die carriage 10 is constituted by a carriage base 11, and an upper die storing unit 12 in the upper portion, the cross-sectional shape in the width direction of the upper die storing unit 12 is a H-shape, and an upper die table 13 for mounting the upper die is provided in an upper concave part. Furthermore, on both sides of the upper die storing unit, a position adjusting bolt 14 as a position adjusting mechanism of the upper die table 13 is provided, and by rotating the bolt, the width direction position of the upper die table 13 in the concave part of the upper die storing unit can be finely adjusted in the state of attaching the upper die. By using the position adjusting bolt 14, it is possible to easily, quickly, and accurately fit a new upper die at the leading end of the punch supporter (beam).

[0038] Furthermore, the carriage base 11 and the upper die storing unit 12 are separated from each other, and it is possible to lift and lower the upper die storing unit 12 by a hydraulic jack 15 as a lifting/lowering function disposed on the carriage base side. Thus, when attaching the new upper die to the punch lower end, it is possible to bring the upper die into contact with the leading end of the punch (beam leading end) by lifting the upper die in the state of being mounted on the upper die table in the upper die storing unit. Furthermore, when detaching the upper die from the leading end of the punch, it is possible to detach the upper die, after bringing the upper die into contact with the upper die table by lifting the upper die storing unit. Therefore, during the upper die replacing operation, for example, even when an operator performs the operation of fastening the leading end portion of the punch and the upper die by the fixing bolts or releasing the fastening below the press machine, it is possible to more safely perform the replacement of the upper die, since there is no need to operate the main body of a press machine.

[0039] The method of replacing the upper die of the present invention using the above-described upper die carriage is carried out in the following procedures.

<Detachment of Upper Die >

[0040] The method of detaching the upper die will be described with reference to Figs. 5 and 6.

[0041] Step 1: the empty upper die carriage 10 is mounted on the steel pipe carry-out line 16 from the carriage storage space (Fig. 5(a))

[0042] Step 2: the steel pipe carrying-out device 17 is moved up to the position of the upper die carriage 10 and connected thereto (Fig. 5(b)).

[0043] Step 3: the upper die carriage 10 is moved up to just below the punch 2 of the press machine 7 by the steel pipe carrying-out device 17 (Figs. 5(c) and 6(a)).

[0044] Step 4: the upper die storing unit 12 over the upper die carriage is lifted by the hydraulic jack 15 to bring the upper die table 13 in the storing unit into contact with the upper die 5 of the leading end of the punch (Figs. 5(d) and 6(b)).

[0045] Step 5: fastening of the fixing bolt 6 is released to detach the upper die 5 from the leading end of the punch (leading end of the beam) (Figs. 5(d) and 6(c)).

[0046] Step 6: the upper die 5 and the upper die storing unit 12 are lowered and stored on the upper die carriage base 11 (Figs. 5(e) and 6(d)).

[0047] Step 7: the upper die carriage 10 is extruded to the outside of the press machine by the steel pipe carrying-out device 17 and mounted on the steel pipe carry-out line 16 (Fig. 5(f)).

[0048] Step 8: the upper die carriage 10 is detached from the steel pipe carry-out line 16.

<Attachment of Upper Die >

[0049] Next, the method of attaching the upper die will be described. In addition, since this method only needs to be performed substantially in reverse order of the above-described method of detaching the upper die, the description diagram thereof will not be provided.

[0050] Step 1: the upper die carriage 10 with the new upper die 5 mounted thereon is mounted on the steel pipe carry-out line 16.

[0051] Step 2: the steel pipe carrying-out device 17 is moved up to the position of the upper die carriage 10 and connected thereto.

[0052] Step 3: the upper die carriage 10 is moved to just below the punch 2 of the press machine 7 by the steel pipe carrying-out device 17.

[0053] Step 4: the upper die storing unit 12 above the upper die carriage is lifted by the hydraulic jacks 15 to fit the groove portions 8 of the new upper die 5 in the storing unit and the leading end (beam) of the punch supporter 4 to each other. At this time, the width direction position of the upper die is finely adjusted using the position adjusting bolt 14 of the upper die table 13.

[0054] Step 5: the fixing bolt 6 is fastened and the upper die 5 is attached to the leading end of the beam 4.

[0055] Step 6: the upper die storing unit 12 is lowered and stored in the upper die carriage base 11.

[0056] Step 7: the upper die carriage 10 is extruded by the steel pipe carrying-out device 17 and mounted on the steel pipe carry-out line 16.

[0057] Step 8: the upper die carriage 10 is removed from the steel pipe carry-out line 16.

[0058] In addition, in the method of replacing the punch in the bending press machine of the present invention, when the upper die is divided into the plurality of segments, the replacement of the plurality of segments is preferably performed integrally and collectively rather than the individual replacement, in view of the operating efficiency. However, when the length of the upper die is long, it may be difficult to mount the upper die on the upper die carriage at a time. In such a case, it is preferred that the upper die constituted by the plurality of segments is divided into a plurality of sets obtained by connecting the small number of the plurality of segments and be mounted on the upper die carriage by the set unit.

[0059] In this case, the set preferably has a structure in which parallel pins are embedded in a joint part of each segment and the segments are fastened by the bolts, where the length of the set is based on the length of the spacer inserted into the groove portions 8 formed on the upper die. Furthermore, the connection part between each of the sets is preferably configured so that the spacer of one set protrudes from the end portion of the set, the end portion of the other set has a spacer omission unit to which the protruded spacer is fitted, and both sets are connected to each other via the spacer.

[0060] In this way, it is possible to mount the upper die having a plurality of segments on the upper die carriage without the position deviation in the width direction, and it is possible to accurately attach the upper die to the punch supporter (beam). Figs. 7(a) and 7(b) illustrate an example in which one upper die divided into nine segments is divided into three sets made up of three segments. In addition, it is preferred that the order of mounting the plurality of sets on the upper die carriage be carried out first from the set provided with the spacer omission unit.

Examples

[0061] The upper die replacement of the bending press machine capable of manufacturing a welded steel pipe having an outer diameter of 20 to 56 inches and a pipe wall thickness of 12.7 to 50.8 mm is performed by the use of two methods of the method (Comparative Example) of the related art using the dummy plate described in [0011] and the method (Example of the present invention) of replacing the upper die of the present invention, and the required times thereof are compared. The upper die has a total length of 13.5 m, and is divided into nine segments as illustrated in Figs. 7(a) and 7(b), and three segments are used as one set to perform handling.

[0062] As a result, the upper die replacement time of Example of the present invention can be reduced to about 1/3 as compared to Comparative Example of the related art.

Reference Signs List

[0063]

- 1: material steel plate
- 2: punch
- 3: die
- 4: punch supporter (beam)
- 5: upper die
- 6: fixing bolt
- 7: main body of press machine
- 8: fitting groove
- 9: spacer
- 10: upper die carriage
- 11: upper die carriage base
- 12: upper die storing unit

13: upper die table
 14: position adjusting mechanism (position adjusting bolt)
 15: lifting/lowering mechanism (hydraulic jack)
 16: steel pipe carry-out line
 17: steel pipe carrying-out device
 18: parallel pin

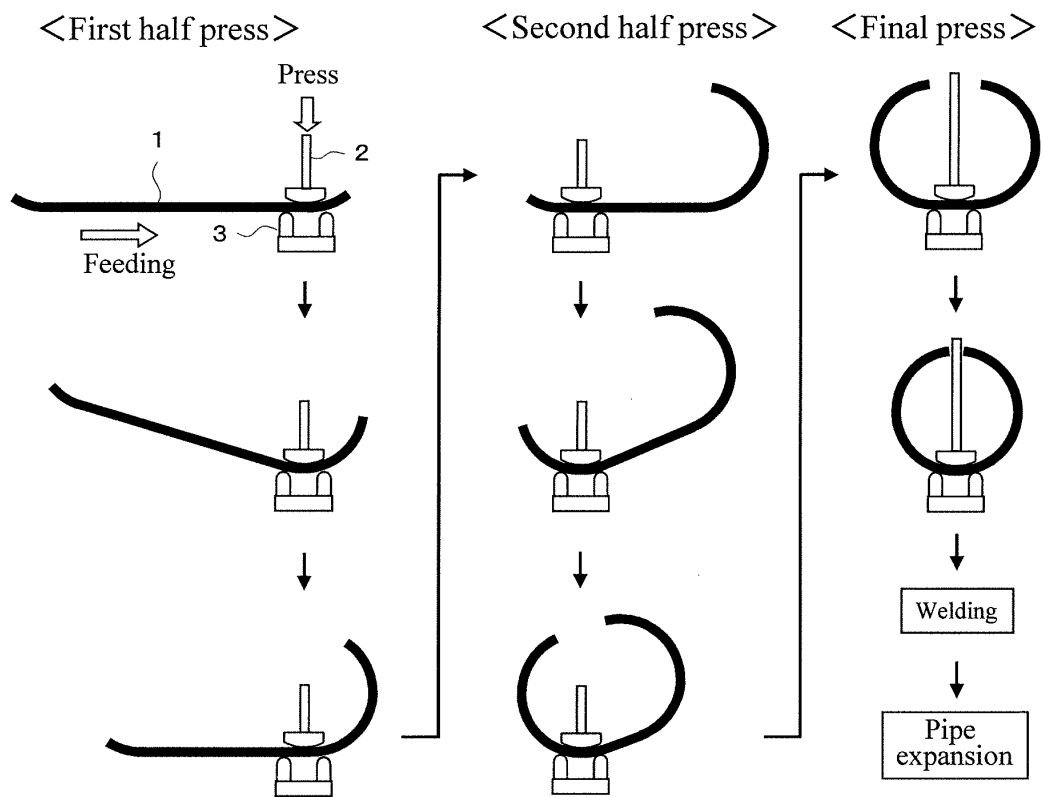
Claims

1. An upper die replacing method of a leading end of a punch in a bending press machine that bends a steel plate on dies by a pair of dies and a punch vertically moving between the dies, wherein carry-in of the upper die to just below the punch and carry-out of the upper die from just below the punch are performed by mounting the upper die on an upper die carriage capable of moving between the pair of dies in a longitudinal direction of the punch. 5
2. The upper die replacing method in a bending press machine according to claim 1, wherein the carry-in of the upper die carriage to just below the punch and the carry-out from just below the punch are performed using a steel pipe carrying-out device disposed in the press machine. 15
3. The upper die replacing method in a bending press machine according to claim 1 or 2, wherein detachment of the upper die from the leading end of the punch and attachment of the upper die to the leading end of the punch are performed in a state in which an upper die storing unit of the upper die carriage is lifted and is brought into contact with the leading end of the punch. 20
4. The upper die replacing method in a bending press machine according to any one of claims 1 to 3, wherein position adjustment of the upper die mounted on an upper die table in the upper die storing unit in a direction perpendicular to the longitudinal direction of the punch is performed by moving the upper die table while mounting the upper die. 25
5. The upper die replacing method in a bending press machine according to any one of claims 1 to 4, wherein when the upper die is divided into a plurality of segments, replacement of the upper die is collectively performed. 30
6. The upper die replacing method in a bending press machine according to claim 5, wherein the plurality of segments are divided into a plurality of sets connected by a shim, and loading and unloading to the upper die carriage are performed in the unit of the set. 35
7. An upper die carriage used for upper die replace- 40

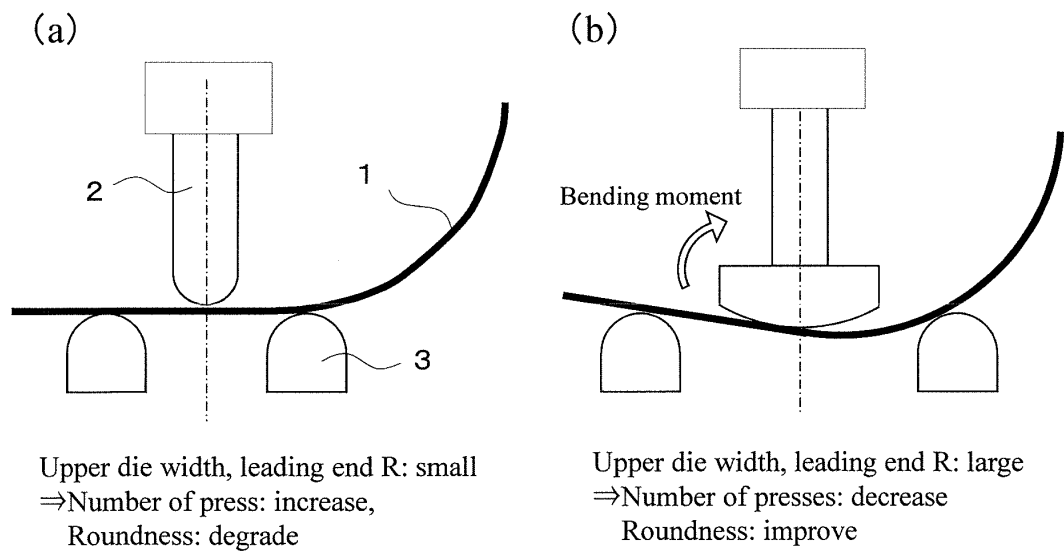
ment of a leading end of a punch in a bending press machine that bends a steel plate on dies by a pair of dies and a punch vertically moving between the dies, wherein the upper die carriage is movable between the pair of dies in a longitudinal direction of the punch, by a device that is installed in the bending press machine and carries out a steel pipe after pressing. 45

8. The upper die carriage for upper die replacement in a bending press machine according to claim 7, comprising an upper die storing unit that stores an upper die, and a lifting/lowering mechanism that lifts and lowers the upper die storing unit. 50
9. The upper die carriage for upper die replacement in a bending press machine according to claim 7 or 8, further comprising a position adjusting mechanism that performs position adjustment of the upper die stored in the upper die storing unit in a direction perpendicular to the longitudinal direction of the punch for each upper die table on which the upper die is mounted. 55

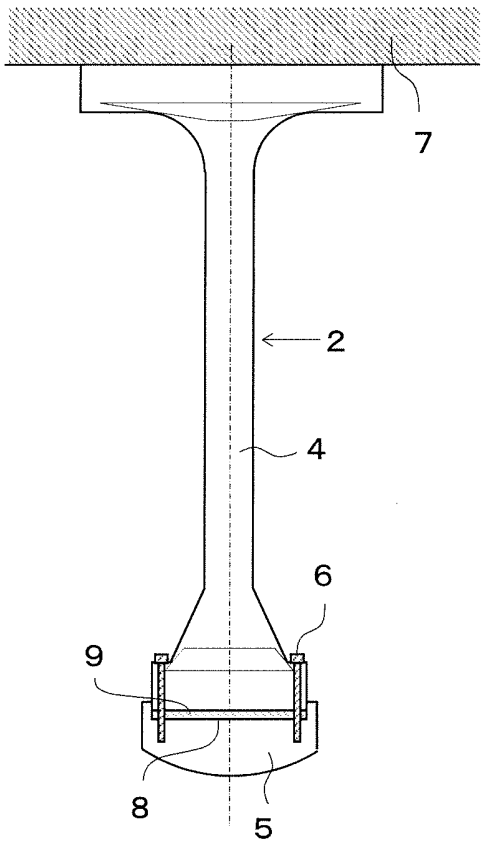
【Fig.1】



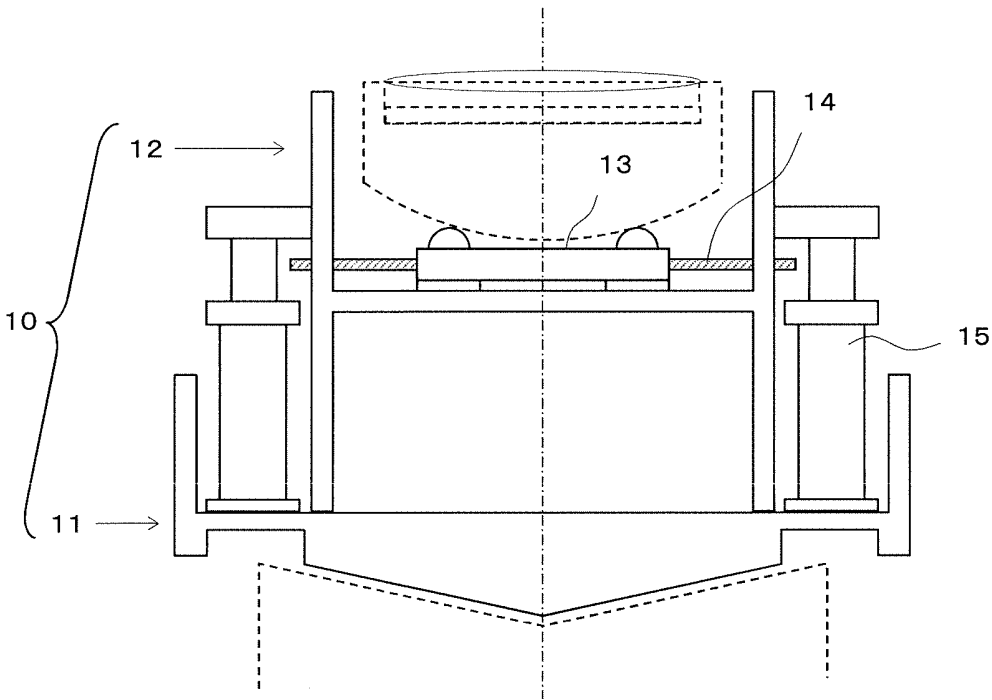
【Fig. 2】



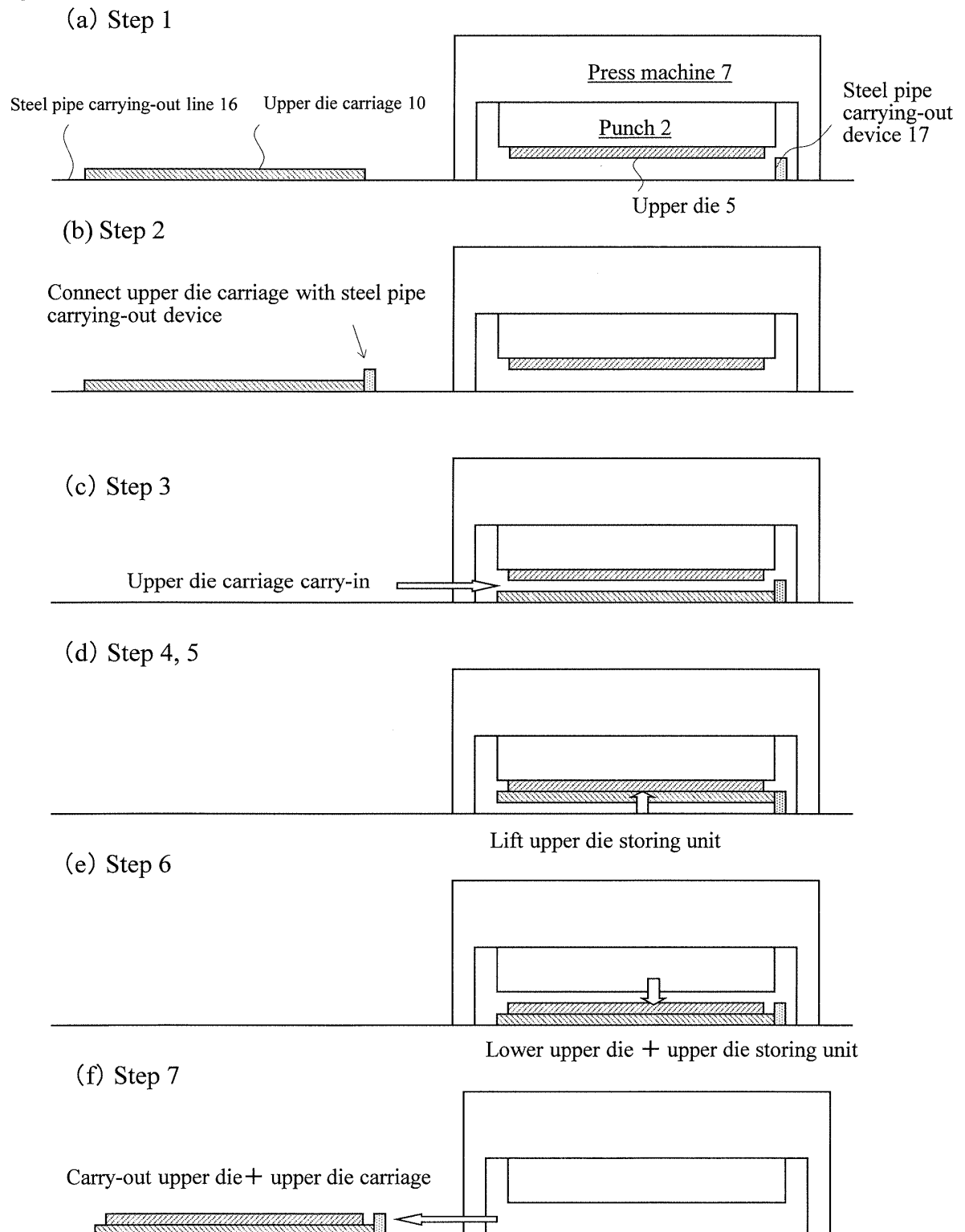
【Fig. 3】



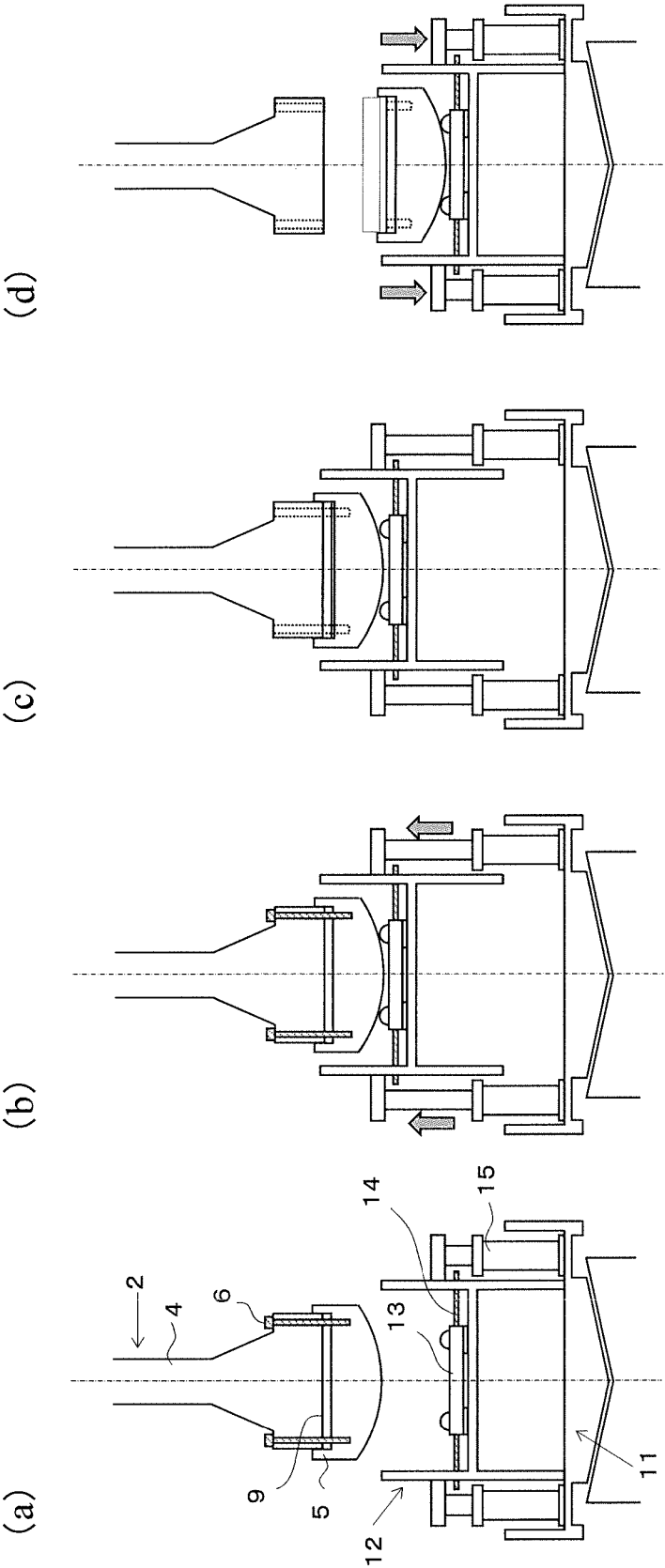
【Fig.4】



【Fig.5】

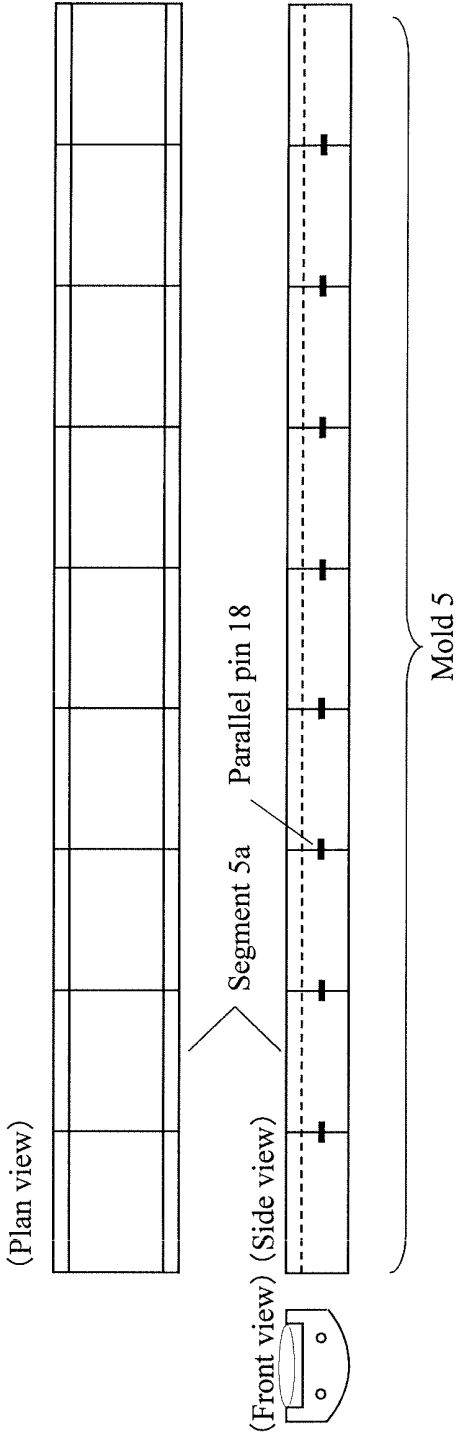


【Fig.6】

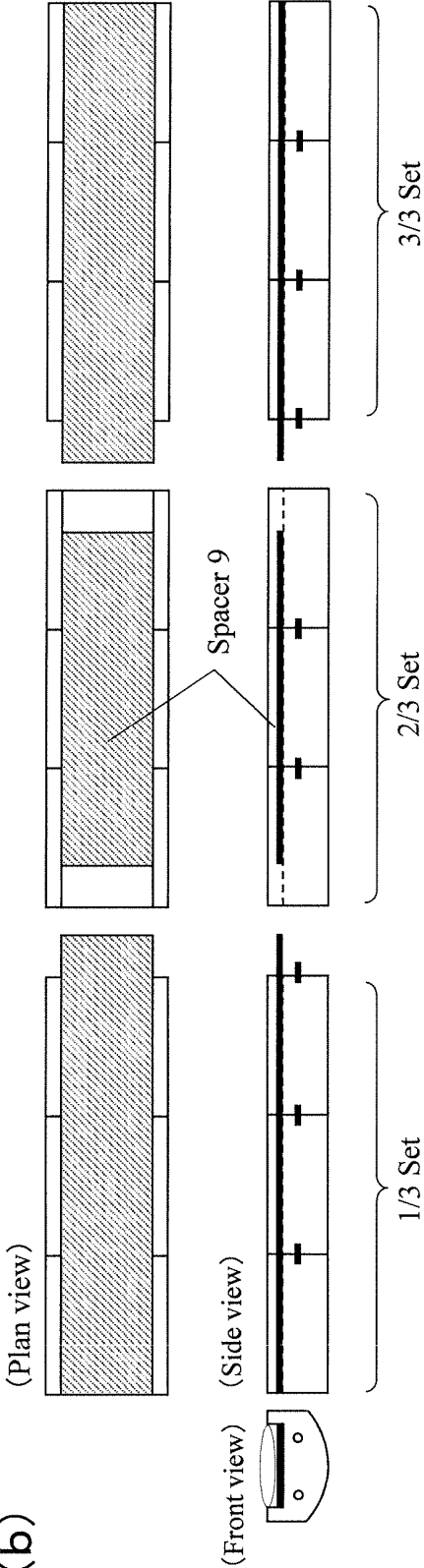


【Fig. 7】

(a)



(b)



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/065141

A. CLASSIFICATION OF SUBJECT MATTER

B30B15/02(2006.01)i, B21C37/08(2006.01)i, B21D37/04(2006.01)i

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)

B30B15/02, B21C37/08, B21D37/04

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 174103/1980(Laid-open No. 97625/1982) (Sumitomo Metal Industries, Ltd.), 16 June 1982 (16.06.1982), page 3, line 5 to page 5, line 20; fig. 1 to 4 (Family: none)	1, 3, 4 2, 5-9
Y	JP 9-1234 A (Sumitomo Metal Industries, Ltd.), 07 January 1997 (07.01.1997), paragraph [0008]; fig. 6 (Family: none)	5, 6

☒ 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
16 August, 2013 (16.08.13)Date of mailing of the international search report
03 September, 2013 (03.09.13)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/065141

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 60-68114 A (Nippon Steel Corp.), 18 April 1985 (18.04.1985), page 2, upper right column, line 6 to page 3, upper right column, line 13; fig. 1 to 5 (Family: none)	1-9
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 113802/1991 (Laid-open No. 54432/1993) (Aioi Seiki Inc.), 20 July 1993 (20.07.1993), paragraphs [0013] to [0019]; fig. 1 to 7 (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11005131 A [0008]
- JP 2001276936 A [0008]
- JP 2002096120 A [0008]
- JP 2001150032 A [0008]