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(54) Three-roll-type reducing mill for electro-resistance-welded tube

Reduzierwalzwerk mit drei Walzen zum Reduzieren eines durch Elektro-Widerstandsschweissung
erzeugten Rohres

Laminoir réducteur a trois rouleaux pour tubes soudés par électro-résistance

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- **PATENT ABSTRACTS OF JAPAN** vol. 009, no. 135 (M-386), 11 June 1985 (1985-06-11) -& JP 60 018208 A (SHIN NIPPON SEITETSU KK; OTHERS: 01), 30 January 1985 (1985-01-30)

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a reducing mill according to the preamble portion of claim 1, to be disposed at the rear of a plant for manufacture of electro-resistance-welded steel tubes wherein a narrow and long successive steel plate (a strip) is gradually formed into a cylindrical shape, seam-welded, and then, reduced with its diameter by the reducing mill.

Related Art

[0002] A previous reducing mill having three rolls (three-roll-type reducing mill) comprised a stand supporting three rolls exclusive to each product size. If the rolls have worn away, the stand supporting the rolls is replaced with another stand supporting three new rolls. The worn rolls are ground and the stand having the rolls is used for diametrically larger products.

[0003] Later, the three-roll-type reducing mill has been improved so that its stand is provided with mechanisms for adjusting the position of the roll to mill a formed electro-resistance-welded tube into various sizes, as disclosed in an earlier application on which the preamble is based (Japanese Patent Application Laid-Open No. 9-262620) filed by the present applicant.

[0004] For the purpose of prevention of an irregularity or a flaw on an outer surface of a finished tube caused by positional difference between adjacent rolls in a radial direction of the tube, it is important for adjustment of a caliber formed by the three forming rolls of the three-roll-type reducing mill corresponding to a reduced diameter of a steel tube that each of two positionally-adjustable forming rolls is moved along a tangent to a curve of a positionally-fixed forming roll adjacent thereto for abutting against an objective tube at each of opposite ends of the positionally-fixed forming roll, in other words, along a direction at a 30° angle from a radial line of the positionally-fixed forming roll across the center of the objective tube.

[0005] This reducing mill comprises three rotary shafts; one is a drive shaft for one positionally-fixed main forming roll, and the other two are follower shafts for respective positionally-adjustable follower forming rolls which are driven by the drive shaft through respective bevel gears. Each rotary shaft is disposed in parallel to a shaft serving as an axis of a roll (a roll-axis shaft) on which each roll is fixed and drivingly connected with the roll-axis shaft through gears, so that the roll-axis shaft can be axially moved within the backlash between the gears. Also, the roll-axis shaft can be moved in perpendicular to its axis (radially) by sliding means. A movement of each of the follower forming rolls along a tangent to the curve of the main forming roll for abutting against

an objective tube at each of the opposite ends of the main forming roll results from the two axial and radial movements of the roll-axis shaft.

[0006] However, since the axial movement of the roll-axis shaft and the radial movement thereof are independent of each other, each of the follower forming rolls, actually, cannot move straightly along the above-mentioned tangent. It is difficult to adjust the position of each of the follower forming rolls along the tangent exactly and for a short time by two operations for different movements of the roll-axis shaft of the follower forming roll. Furthermore, a proper positional adjustment of the follower forming rolls for the moment cannot be made during the processing of the reducing mill under inspection of finished products, even if any problem is found on the product finished by the reducing mill. It is only possible that a stand structure supporting the three forming rolls is adjusted with its two follower forming rolls in their positions before its incorporation into the plant for manufacture of electro-resistance-welded steel tubes or while the reducing mill or the entire plant is shut down in power for required adjustment thereof.

SUMMARY OF THE INVENTION

[0007] According to the present invention, there is provided a three-roll-type reducing mill as defined in claim 1 including three forming rolls disposed at regular intervals so as to arrange their axes in an equilateral triangle shape and brought into contact with an outer periphery of an electro-resistance-welded steel tube so as to mill the tube into round while reducing the diameter thereof, wherein one of the three forming rolls is a main forming roll fixed in position, the other two forming rolls are follower forming rolls drivingly following the main forming roll, and both of the follower forming rolls can be moved simultaneously with each other and symmetrically with respect to a center of the main forming roll along respective tangents to a curve of the main forming roll for abutting against the electro-resistance-welded steel tube at two opposite ends of the main forming roll. Thus, positions of the follower forming rolls can be changed while transmitting rotation driving force from the main forming roll to the follower forming rolls and the diametrical reduction of the steel tube can be adjusted without generating an irregularity or a flaw in an outside shape of the milled steel tube.

[0008] Furthermore, according to the invention, the pair of left and right follower forming rolls are respectively supported by sliding brackets, both the sliding brackets are respectively in slidable contact with a pair of left and right tapered blocks screwed onto an adjusting screw shaft, and the tapered blocks are simultaneously moved oppositely to each other along said adjusting screw shaft whether toward each other or away from each other by rotation of the adjusting screw shaft. Thus, it is possible to slide the sliding brackets symmetrically concerning a center of the main forming roll and in the

same movements by only rotating the single adjusting screw shaft, so that a fine adjustment of the diameter of the finished product can be made swiftly while inspecting the diameter during the process by the reducing mill.

[0009] Additionally, according to the present invention, each of the sliding brackets is formed with a sliding face in parallel to each of the tangents, and a stand structure supporting the three forming rolls is formed with a pair of left and right sloped faces in parallel to the respective tangents, so that the sloped faces are brought into slidable contact with the sliding faces of the respective sliding brackets. Therefore, the sliding brackets are moved along the respective tangents while their sliding faces slide on the respective sloped faces during the movement of the tapered blocks by rotational operation of the adjusting screw shaft.

[0010] In addition to the above adjustment on basis of the inspection of the diameter on-line, the adjustment of roll positions can be also made corresponding to a difference of a springback caused by variation of the steel in material, thereby maintaining an extremely satisfactory accuracy of the finished diameter of the product.

[0011] Other objects, features and advantages of the present invention will become clear from the following description by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a sectional front view of a three-roll-type reducing mill provided with a roll-positioning structure according to the present invention;

FIG. 2 is a right side view of the same;

FIG. 3 is a front view of a main frame 2 of the reducing mill;

FIG. 4 is a front view of a rear cover 4 of the reducing mill;

FIG. 5 is a front view of a front cover 5 of the reducing mill;

FIG. 6 is a sectional front view of a principal portion of a right follower roll 23 with its positioning mechanism and its surroundings in the reducing mill;

FIG. 7 is a front view of a follower shaft 26 of the reducing mill;

FIG. 8 is a sectional front view of a collar 25 of the reducing mill;

FIG. 9 is a front view, partly in section, of a follower bevel gear 21 of the reducing mill;

FIG. 10 is a front view of a follower forming roll 23 of the reducing mill;

FIG. 11 is a front view of a sliding bracket (chock) 22 of the reducing mill;

FIG. 12 is an exploded view taken in a direction of an arrow XII in FIG. 11;

FIG. 13 is a view taken in a direction of an arrow XIII in FIG. 11, wherein a stay 40 is drawn in phantom lines;

FIG. 14 is a view taken in a direction of an arrow XIV in FIG. 11, wherein a stay 41 is drawn in phantom lines, and

FIG. 15 is a sectional front view of a tapered block 24R of the reducing mill.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] As shown in FIG. 1, a three-roll-type reducing mill 1 of the present invention having one main forming roll 19 and two follower forming rolls 23 is provided for reducing a diameter of an electro-resistance-welded steel tube P by use of rotation of the three forming rolls 19 and 23.

[0014] First, description will be given on a stand structure of a three-roll-type reducing mill 1 of the present invention comprising a main frame 2, a rear cover 4 and a front cover 5 in accordance with FIGS. 1 to 5.

[0015] As shown in FIG. 3, the main frame 2, which is formed of cast steel material, is provided with a main chamber 2a and a pair of left and right coaxial drive shaft holes 2b by machine work. The main chamber 2a is open at both the front and rear surfaces of the main frame 2. The drive shaft holes 2b are extended laterally from an upper portion of the main chamber 2a to be open at respective left and right surfaces of the main frame 2. The main chamber 2a is partly extended downward so as to form a lower chamber 2c, which is open at one of left and right sides of the main frame 2. Left and right outer sides of the main frame 2 are symmetrically notched slantwise so as to make left and right stays 49, at which respective female screws 49a are open and bored through the main frame 2 to the main chamber 2a.

[0016] As shown in FIG. 4, the rear cover 4 is provided at the center portion thereof with a central hole 4a, through which an electro-resistance-welded steel tube P is passed and drawn, and three holes 4b for inspection and repair of the forming rolls 19 and 23 around the central hole 4a. To opposite sides of the rear cover 4 are further formed a pair of triangular stays 45 in a three-dimensional manner by skiving. A sloped face 44 of each of the triangular stays 45 is to be a slide guide for a sliding bracket (chock) 22 serving as a part of a positioner of the follower forming roll 23, as discussed below. There is made a 30° angle between the sloped face 44 and a vertical line.

[0017] The front cover 5 has a shape corresponding to the rear cover 4 as shown in FIG. 5 but is not provided with the triangular stays 45.

[0018] Onto rear and front surfaces of the main frame 2 are screwed the rear cover 4 and the front cover 5. Left and right surfaces of the main frame 2 are respectively covered with side covers (not shown) which have respective openings in direct connection with outer ends of the drive shaft holes 2b.

[0019] Description will now be given on the arrangement of the three forming rolls 19 and 23 in the above-

mentioned stand structure.

[0020] As shown in FIGS. 1 and 6, in both the drive shaft holes 2b of the main frame 2 are fixedly disposed cylindrical shaft casings 12 and 13. A drive shaft 11 is laterally extended through both the shaft casings 12 and 13 and through the upper portion of the main chamber 2a between the shaft casings 12 and 13. Between each of the shaft casings 12 and 13 and the drive shaft 11 is interposed each of taper roller bearings 14 and 15, so that the drive shaft 11 is rotatably supported in the main frame. In the upper portion of the main chamber 2a are disposed a pair of main bevel gears 20 which are fixed on the drive shaft 11. The main forming roll 19 is fixedly fitted between the main bevel gears 20. The drive shaft 11 is rotated by power of a motor (not shown).

[0021] In the lower left and right symmetrical portions of the main chamber 2a are disposed a pair of follower shafts 26, respectively, so that the drive shaft 11 and the two follower shafts 26 are arranged in an equilaterally triangular shape. On each of the follower shafts 26 is rotatably disposed a follower bevel gear 21. Onto the follower bevel gear 21 is fixedly fitted the follower forming roll 23. Therefore, the follower forming roll 23 is rotatable together with the follower bevel gear 21 around the follower shaft 26.

[0022] In detail, as shown in FIGS. 6 and 9, a cylindrical barrel portion is integrally extended from each of the follower bevel gears 21. A collar 25 (as shown in FIG. 7) is screwed to an end of the barrel portion of the follower bevel gear 21 by using bolts 72 as shown in FIG. 6. The collar 25 and the follower bevel gear 21 are rotatably disposed around each of the follower shafts 26 through a taper roller bearing 35. A key groove 60a is formed at an outer surface of the barrel portion of the follower shaft 26 as shown in FIG. 9, and a key groove 60b is formed at an inner peripheral surface of the follower forming roll 23 as shown in FIG. 10. The follower forming roll 23 is substantially fixedly disposed around the barrel portion of the follower bevel gear 21 through a key disposed in the key grooves 60a and 60b coinciding with each other, so that the follower forming roll 23 is sandwiched between the follower bevel gear 21 and the collar 25. As shown in FIG. 6, an O-ring 36 is interposed between the follower bevel gear 21 and the follower forming roll 23, and an O-ring 37 is between the follower forming roll 23 and the collar 25.

[0023] The pair of main bevel gears 20 mesh with the respective follower bevel gears 21 so as to transmit the rotation of the drive shaft 11 to the left and right follower forming rolls 23. Therefore, when the drive shaft 11 is rotated by the motor, the main forming roll 19 rotates together with the drive shaft 11, and simultaneously, the left and right follower forming rolls 23 rotate around the respective follower shafts 26 by the meshing of bevel gears 20 and 21.

[0024] As shown in FIG. 1, the three forming rolls 19 and 23 are disposed at regular intervals, so that a curve 65 of the main forming roll 19 and curves 66 of the two

follower forming rolls 23, when viewed in front, for abutting against an electro-resistance-welded steel tube P are arranged so as to form a longitudinally cylindrical pathway corresponding to a predetermined caliber through which the steel tube P is drawn so as to be reduced with respect to its diameter. As shown in FIG. 6, a tangent T to an outer periphery of the pathway (the curve 65) when viewed in front at each of opposite end points of the main forming roll 19 adjacent to the end of each of the follower forming rolls 23 is directed at a 30° angle from a vertical line, thereby being parallel to the sloped face 44 of the triangular stay 45.

[0025] An electro-resistance-welded steel tube P is supplied into the pathway formed by the three forming rolls 19 and 23, so that, during its longitudinal movement through the pathway, the diameter of the steel tube P is gradually reduced by the three rotating forming rolls 19 and 23. The caliber of the pathway can be adjusted by the positioning of the follower forming rolls 23 with respect to the positionally-fixed main forming roll 19, so as to adjust the reduced diameter of the steel tube P. Moreover, in the positional adjustment of the follower forming rolls 23, the follower forming rolls 23 are slid along the respective sloped faces 44, i.e., the respective tangents T, whereby the main forming roll 19 and each of the follower forming rolls 23 are prevented from positional difference therebetween in a radial direction of the pathway, thereby preventing the milled steel tube P from irregularities or flaws thereon.

[0026] The positioning mechanisms for the two follower forming rolls 23 will be described. In the description, only a reference to a right sliding bracket 22 and a right tapered block 24R in accordance with FIGS. 6 and 11 to 15 is to be applied to description of a left sliding bracket 22 and a left tapered block 24L, because the two follower forming rolls 23 and the positioning mechanisms thereof are laterally symmetrically constructed and disposed in the main chamber 2a and the lower chamber 2c of the main frame 2 with respect to the positionally-fixed main forming roll 19.

[0027] The follower shaft 26 is supported by the C-shaped sliding bracket 22 as shown in FIGS. 11 to 14 comprising a base member 22a and two stays 40 and 41. As shown in FIGS. 13 and 14, two opposite end portions of the base member 22a are cut away so as to be narrowed. The cutaway surface of each end portion of the base member 22a is provided therein with a sectionally semicircular groove in which each end of the follower shaft 26 is held. Each of the stays 40 and 41 is also provided therein with a sectional semicircular groove for coinciding with that of each end portion of the base member 22a.

[0028] For attaching the follower shaft 26 to the sliding bracket 22, each of opposite ends of the follower shaft 26 is inserted into the sectional semicircular groove on each of the end portions of the base member 22a, and each of the stays 40 and 41 is fitted into the vacant space adjacent to each end portion of the base member 22a

so as to fit its sectional semicircular groove onto each end of the follower shaft 26 held in each of the sectional semicircular grooves of the base member 22a. Thus, each end of the follower shaft 26 is sandwiched between each of the end portions of the base member 22a and each of the stays 40 and 41. Finally, the stays 40 and 41 are screwed to the base member 22a so as to complete the sliding bracket 22 with the follower shaft 26 fixed thereto.

[0029] As shown in FIG. 12, the two ends of the follower shaft 26 are partly cut away for prevention of interference with the shaft casing 12 (13) and the later-discussed tapered block 24R (24L). Therefore, the follower shaft 26 are to be correctly disposed in its radial direction and fixed to the sliding bracket 22.

[0030] In FIGS. 11 and 12, the base member 22a of the sliding bracket 22 is provided at an approximately vertical and longitudinal middle portion thereof with a through hole 43 through which a bolt 28 is freely passed as discussed below. The diameter of the through hole 43 is sufficiently larger than that of the bolt 28 so as to allow the sliding bracket 22 to move crosswise to the bolt 28 during its sliding along the sloped face 44 of the triangular stay 45.

[0031] The base member 22a is provided at its suitable surface with an oil groove 42 and a drilled hole 63 in communication with the oil groove 42, such that lubricating oil can flow therethrough.

[0032] The base member 22a of the sliding bracket 22 is formed with two notches functioning as sliding surfaces during its motion almost along the bolt 28. One is a sliding surface 38 for slidably abutting against the sloped surface 44 of the triangular stay 45 secured onto the rear cover 4, and the other is a sliding surface 39 for slidably abutting against the tapered block 24R (24L) disposed under the sliding bracket 22. The through hole 43 is substantially a bisector of an angle made by the two sliding surfaces 38 and 39, i.e., an angle made by the sloped surface 44 of the triangular stay 45 and the sloped top surface of the tapered block 24R (24L). Also, the through hole 43 is perpendicular to the axis of the follower shaft 26. A top of one end of the sliding bracket 22 (the stay 40 and one end of the base member 22a) is partly cut away for prevention of interference with the shaft casing 12 (13). The other end of the sliding bracket 22 (the stay 41 and the other end of the base member 22a) is cut away so that, if the sliding bracket 22 is correctly located, the cutaway end surface is directed vertically, thereby preventing the corresponding ends of both the sliding brackets 22 from interference with each other.

[0033] Referring to the right tapered block 24R as shown in FIG. 15, the tapered blocks 24L and 24R are sloped at their upper surfaces so as to slidably contact with the sliding surfaces 39 of the respective sliding brackets 22. A right-hand female 51 screw is processed in the right tapered block 24R and a left-hand female screw 51 is processed in the left tapered block 24L. As

shown in FIG. 15, each of the tapered blocks 24L and 24R is provided at its top and bottom faces with oil grooves 52 and 53, respectively. The oil groove 52 is used for supplying lubricating oil between each of the sliding brackets 22 and each of the tapered blocks 24L and 24R. The oil groove 53 is for supplying that between each of the tapered blocks 24L and 24R and the main frame 2. Also, each of the tapered blocks 24L and 24R is vertically drilled by an oil hole 54 through its female-screw hole for supplying lubricating oil between an adjusting screw shaft 27 disposed in the female-screw hole and each of the tapered blocks 24L and 24R.

[0034] As shown in FIGS. 1 and 6, the tapered blocks 24L and 24R are mounted on the bottom surface of the lower chamber 2c of the main frame 2 so that their female-screw holes are directed laterally and co-axially and their upper portions protrude into a lower space of the main chamber 2a. The top of outside end of each of the tapered blocks 24L and 24R is higher than the top of the inside end thereof, so that the top sloped surfaces of both the tapered blocks 24L and 24R are arranged in a laterally-widened V-like shape when viewed in front. An inner stopper 69 is disposed between the tapered blocks 24L and 24R so as to limit inward movements of the tapered blocks 24L and 24R against each other. The adjusting screw shaft 27 is laterally inserted from the left or right (in this embodiment, left) opening of the lower chamber 2c into the lower chamber 2c so as to penetrate both the tapered blocks 24L and 24R through their female-screw holes. A pair of outer stoppers 47 are fixed onto the adjusting screw shaft 27 so as to limit outward movements of the tapered blocks 24L and 24R away from each other.

[0035] The adjusting screw shaft 27 is provided thereon with a pair of left-hand and right-hand screws arranged symmetrically with respect to its intermediate portion disposed between the tapered blocks 24L and 24R. The two screws of the adjusting screw shaft 27 coincide with the respective female screws 51 of the left and right tapered blocks 24L and 24R. Therefore, if the adjusting screw shaft 27 is rotated in either of its opposite rotational directions, the tapered blocks 24L and 24R are moved simultaneously with each other along the adjusting screw shaft 27 in opposite directions.

[0036] When each of the left and right follower forming rolls 23 is disposed in each of the lower left and right portions of the main chamber 2a so as to make its follower bevel gear 21 mesh with each of the main bevel gears 20, the through hole 43 is approximately directed toward the axis of the pathway for the steel tube P and co-axially with the female screw 49a of the main frame 2. Then, the bolt 28 is directed radially of the follower shaft 26 (perpendicularly to the axis of the follower shaft 26), freely disposed through a spring 46 and the through hole 43 and screwed into the female screw 49a of the main frame 2 so as to project outwardly from the stay 49. The projecting end portion of the bolt 28 is thread-

cut and provided thereon with a nut 28a, thereby being fastened onto the stay 49. The thickness of the sliding bracket 22 coincides with the distance between the front and rear covers 5 and 4, i.e., the thickness of the main frame 2, so that the sliding bracket 22 is prevented from a longitudinal slippage.

[0037] The spring 46 interposed between the head of the bolt 28 and the sliding bracket 22 biases the sliding bracket 22 downwardly slantwise toward the stay 49. Thus, if the tapered blocks 24L and 24R are moved away from each other, each of the sliding brackets 22 becomes movable downwardly to the degree corresponding to the lateral motion of each of the tapered blocks 24L and 24R, and each of the sliding brackets 22 naturally moves toward the stay 49 by the biasing force of the spring 46 along the sloped face 44 of the triangular stay 45 while the sliding surfaces 38 and 39 slide on the triangular stay 45 and the tapered block 24L or 24R, thereby moving the follower forming rolls 23 away from the main forming roll 19 along the tangents T. On the other hand, if the tapered blocks 24L and 24R are moved toward each other, the top sloped surface of each of the tapered blocks 24L and 24R pushes upwardly the bottom end of the sliding bracket 22, thereby sliding the sliding bracket 22 along the sloped face 44 toward the axis of the pathway for the steel tube P against the biasing force of the spring 46 so as to make the follower forming rolls 23 approach the main forming roll 19 along the tangents T.

[0038] As described above, the two sliding brackets 22 respectively incorporated into the left and right follower systems are slidden symmetrically with respect to the center of the main forming roll 19 and in the same movements by the rotation of the adjusting screw shaft 27. The range of the motion of the sliding bracket 22 toward the stay 49 is limited within a range of backlash of the meshing bevel gears 20 and 21 for prevention of cut of power transmission between the main and follower forming rolls 19 and 23.

[0039] When the left and right follower forming rolls 23 are located for determination of a caliber corresponding to the objective steel tube P, it is preferable that the tapered blocks 24L and 24R are previously set away from each other to some degree. A gauge stick having a diameter coinciding with the caliber is located just beneath the main forming roll 19, and then, the adjusting screw shaft 27 is rotated so as to move tapered blocks 24L and 24R toward each other, thereby moving the left and right follower forming rolls 23 together with their sliding brackets 22 toward the axis of the gauge stick till the left and right follower rolls 23 abut against the gauge stick.

[0040] During the process by the reducing mill 1, both the positions of the follower forming rolls 23 can be simultaneously adjusted only by rotation of the adjusting screw shaft 27 which is operated whether manually or automatically, whereby a diametrical reduction of the processed steel tube P can be adjusted easily and swift-

ly.

[0041] Although the preferred embodiment of the present invention in a state that is special to some extent has been described above, it will be obvious to those skilled in the art that the disclosure of the preferred embodiment may be changed in details of the structure, combinations and arrangement of parts, and the like without departing from the scope of the invention defined in the following claim.

Claims

1. A three-roll-type reducing mill (1) for manufacture of electroresistance-welded steel tubes (P), comprising:

three forming rolls (19,23) including one positionally-fixed main forming roll (19) and two positionally-adjustable follower forming rolls (23) drivingly following said main forming roll (19), said three forming rolls (19,23) being supported by a stand structure (2) and disposed at regular intervals such that their axes (11,26) are arranged in an equilaterally triangular shape, said three forming rolls (19,23) having respective curved surfaces (65,66) adapted to be brought into contact with an outer periphery of a steel tube (P) to be reduced with respect to its diameter when drawn through the mill, said curved surfaces (65,66) of said three forming rolls (19,23) defining a cylindrical pathway corresponding to a predetermined calibre for said steel tube (P) when viewed in the direction in which the steel tube (P) is drawn; and sliding means adapted to enable both of said follower forming rolls (23) to move simultaneously with each other and symmetrically with respect to a center of said main forming roll (19) along the two respective tangents (T) to the curved surface (65) of said main forming roll (19) at opposite end points thereof;

wherein said sliding means comprises a pair of left and right sliding brackets (22) for respectively supporting said follower forming rolls (23), an adjusting screw shaft (27), and a pair of left and right tapered blocks (24L,24R) screwed onto said adjusting screw shaft (27) so that, when said adjusting screw shaft (27) is rotated, said left and right tapered blocks (24L,24R) are simultaneously moved oppositely to each other either toward each other or away from each other along said adjusting screw shaft (27); and

wherein both said sliding brackets (22) are in sliding contact with said respective tapered blocks (24L,24R) so that said sliding brackets (22) together with said follower forming rolls (23) are moved along

said respective tangents (T) by the rotational operation of said adjusting screw shaft (27), thereby adjusting a diametrical reduction of said steel tube (P);

characterized in that

said sliding brackets (22) are respectively formed with sliding faces (38) in parallel to said respective tangents (T), and said stand structure (2) is formed with a pair of left and right sloped faces (44) in parallel to said respective tangents (T), wherein said sloped faces (44) are in sliding contact with said sliding faces (38) of said sliding brackets (22).

Patentansprüche

1. Dreiwalzen-Reduzierwalzwerk (1) zur Herstellung von elektrowiderstandsgeschweißten Stahlrohren (P), mit:

drei Formwalzen (19,23) mit einer positionsmäßig feststehenden Hauptformwalze (19) und zwei positionsmäßig anpassbaren Folgeformwalzen (23), welche antriebsmäßig der Hauptformwalze (19) folgen, wobei die drei Formwalzen (19,23) von einer Gerüststruktur (2) getragen werden und in regelmäßigen Abständen so angeordnet sind, dass ihre Achsen (11,26) in der Form eines gleichseitigen Dreiecks angeordnet sind, wobei die drei Formwalzen (19,23) jeweils gekrümmte Oberflächen (65,66) aufweisen, welche mit einem Außenumfang eines Stahlrohrs (P) in Kontakt gebracht werden können, das in Bezug auf dessen Durchmesser beim Ziehen durch das Walzwerk reduziert wird, wobei die gekrümmten Oberflächen (65,66) der drei Formwalzen (19,23) einen zylindrischen Durchgangsweg festlegen, der einem vorbestimmten Rohrdurchmesser bzw. Kaliber des Stahlrohrs (P), in der Richtung betrachtet, in der das Stahlrohr (P) gezogen wird, entspricht, und

Gleitmitteln, die es beiden Folgeformwalzen (23) ermöglichen, sich gleichzeitig miteinander und symmetrisch in Bezug auf ein Zentrum der Hauptformwalze (19) entlang den beiden jeweiligen Tangenten (T) an die gekrümmte Oberfläche (65) der Hauptformwalze (19) an deren gegenüberliegenden Endpunkten zu bewegen,

wobei das Gleitmittel ein paar linker und rechter Gleitbügel (22) zum jeweiligen Haltern der Folgeformwalzen (23), eine Einstell-Schraubachse (27) und ein Paar linker und rechter, auf die Einstell-Schraubachse (27) aufgeschraubter konischer Blöcke (24L,24R) umfasst, so dass, wenn die Einstell-Schraubachse (27) gedreht wird, die linken und rechten konischen Blöcke (24L,24R) gleichzei-

tig entgegengesetzt zueinander entweder aufeinander zu oder voneinander weg entlang der Einstell-Schraubachse (27) bewegt werden, und

wobei beide Gleitbügel (22) im Gleitkontakt mit den jeweiligen konischen Blöcken (24L,24R) stehen, so dass die Gleitbügel (22) zusammen mit den Folgeformwalzen (23) entlang den jeweiligen Tangenten (T) durch die Drehbetätigung der Einstell-Schraubachse (27) bewegt werden, wodurch eine Reduktion im Durchmesser des Stahlrohrs (P) eingestellt bzw. angepasst wird,

dadurch gekennzeichnet, dass

die Gleitbügel (22) jeweils mit Gleitflächen (38) parallel zu den jeweiligen Tangenten (T) ausgebildet sind und die Gerüststruktur (2) mit einem Paar linker und rechter Neigungsflächen (44) parallel zu den jeweiligen Tangenten (T) ausgebildet ist, wobei die Neigungsflächen (44) in Gleitkontakt mit den Gleitflächen (38) der Gleitbügel (22) stehen.

Revendications

1. Laminage réducteur du type à trois cylindres (1) pour fabrication de tubes en acier soudés par électrorésistance (P), comportant :

trois cylindres de formage (19, 23) incluant un premier cylindre de formage principal fixé en position (19) et deux cylindres de formage suivants ajustables en position (23) suivant de manière entraînée ledit cylindre de formage principal (19), lesdits trois cylindres de formage (19, 23) étant supportés par une structure de support (2) et disposés à des intervalles réguliers de telle sorte que leurs axes (11, 26) sont agencés selon une forme de triangle équilatéral, lesdits trois cylindres de formage (19, 23) ayant des surfaces incurvées respectives (65, 66) adaptées pour être amenées en contact avec une périphérie extérieure d'un tube en acier (P) devant être réduit en ce qui concerne son diamètre lorsqu'il est étiré à travers le laminage, lesdites surfaces incurvées (65, 66) desdits trois cylindres de formage (19, 23) définissant un trajet cylindrique correspondant à un calibre prédéterminé pour ledit tube en acier (P) lorsque vu dans la direction dans laquelle le tube en acier (P) est étiré, et

des moyens de coulissement adaptés pour permettre aux deux cylindres de formage suivants (23) de se déplacer simultanément l'un avec l'autre et de manière symétrique par rapport à un centre dudit cylindre de formage principal (19) le long de deux tangentes respectives (T) à la surface incurvée (65) dudit cylindre de formage principal (19) à des points d'extrémité opposés de celle-ci,

dans lequel lesdits moyens de coulissement comportent une paire d'étriers coulissants gauche et droit (22) pour supporter respectivement lesdits cylindres de formage suiveurs (23), un arbre de vis d'ajustement (27), et une paire de blocs coniques gauche et droit (24L, 24R) vissés sur ledit arbre de vis d'ajustement (27) de telle sorte que lorsque ledit arbre de vis d'ajustement (27) est mis en rotation, lesdits blocs coniques gauche et droit (24L, 24R) sont déplacés simultanément de manière opposée l'un par rapport à l'autre soit l'un vers l'autre ou loin l'un de l'autre le long dudit arbre de vis d'ajustement (27), et

dans lequel les deux étriers coulissants (22) sont en contact coulissant avec lesdits blocs coniques respectifs (24L, 24R) de telle sorte que lesdits étriers coulissants (22), ensemble avec lesdits cylindres de formage suiveurs (23), sont déplacés le long desdites tangentes respectives (T) par l'actionnement en rotation dudit arbre de vis d'ajustement (27), en ajustant ainsi une réduction de diamètre dudit tube en acier (P),

caractérisé en ce que

lesdits étriers coulissants (22) sont munis respectivement de faces de coulissement (38) parallèles auxdites tangentes respectives (T), et ladite structure de support (2) est munie d'une paire de faces en pente gauche et droite (44) parallèles auxdites tangentes respectives (T), lesdites faces en pente (44) étant en contact coulissant avec lesdites faces de coulissement (38) desdits étriers coulissants (22).

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Fig.1

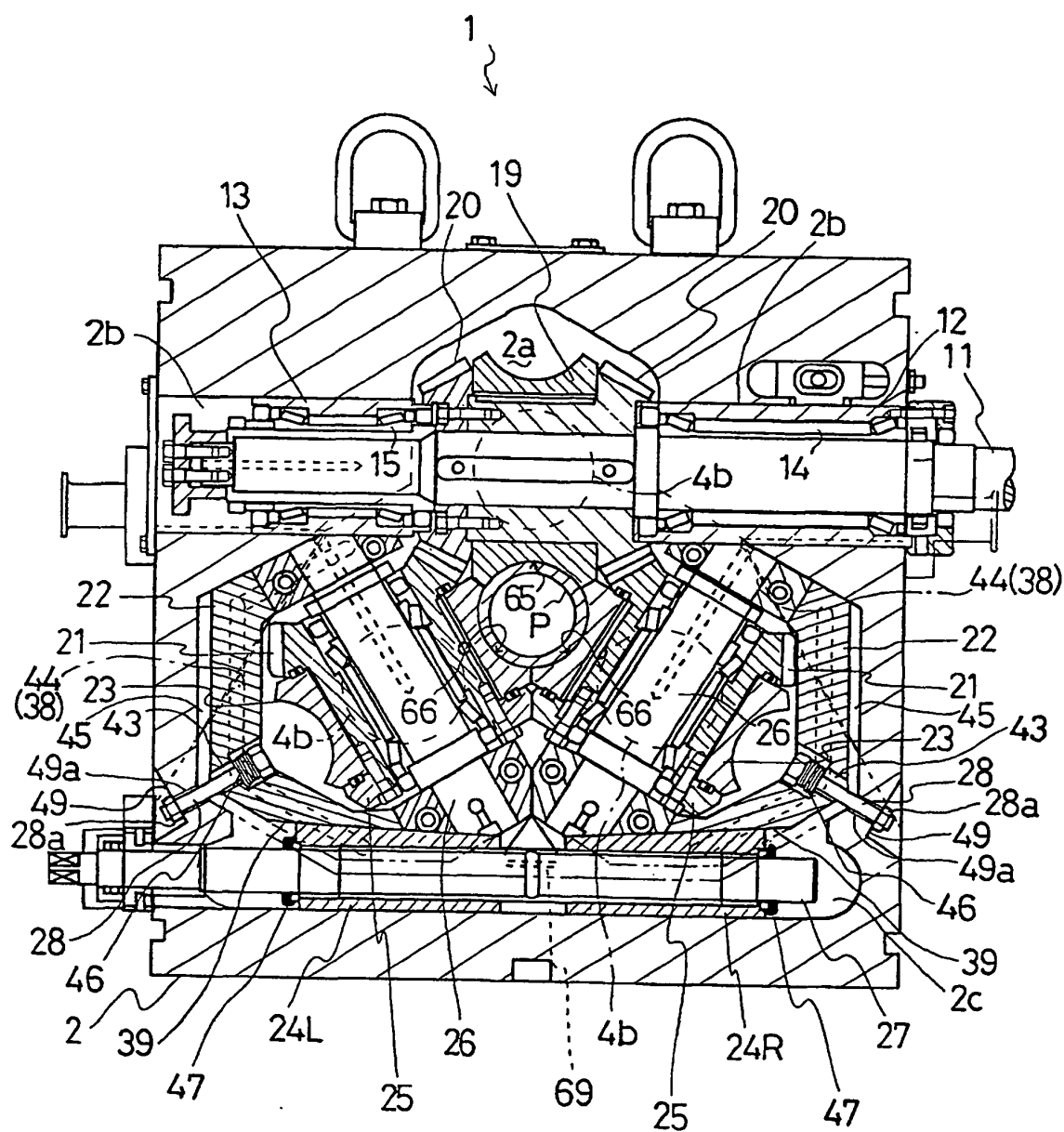


Fig.2

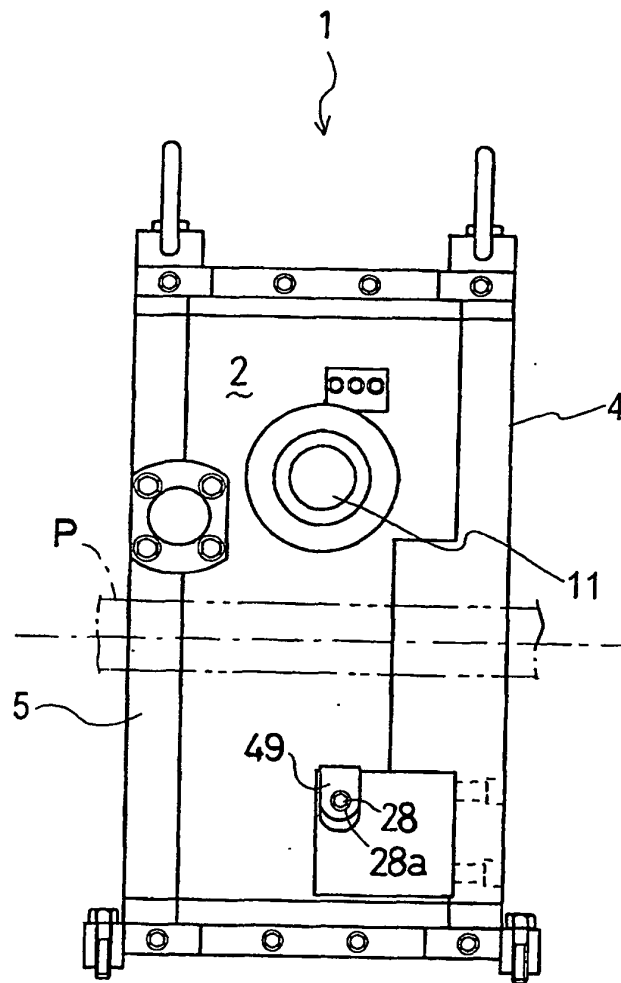


Fig.3

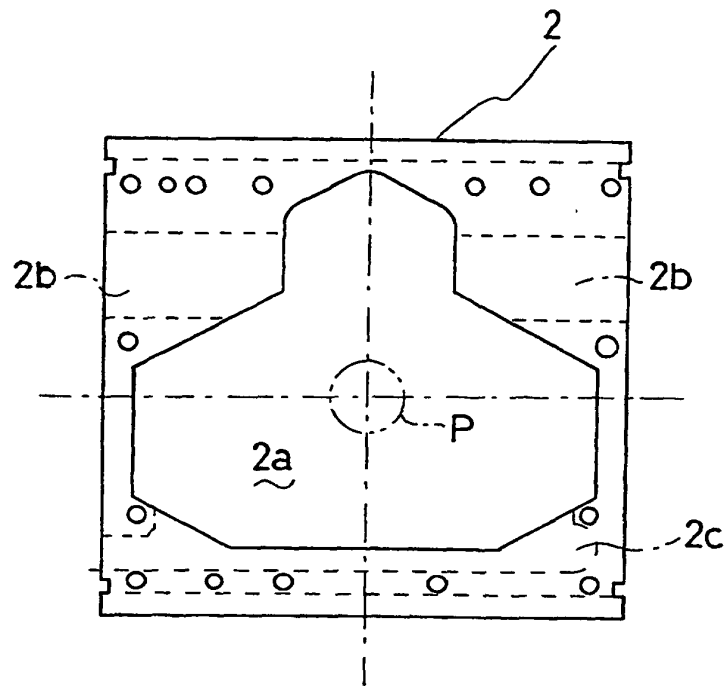


Fig.4

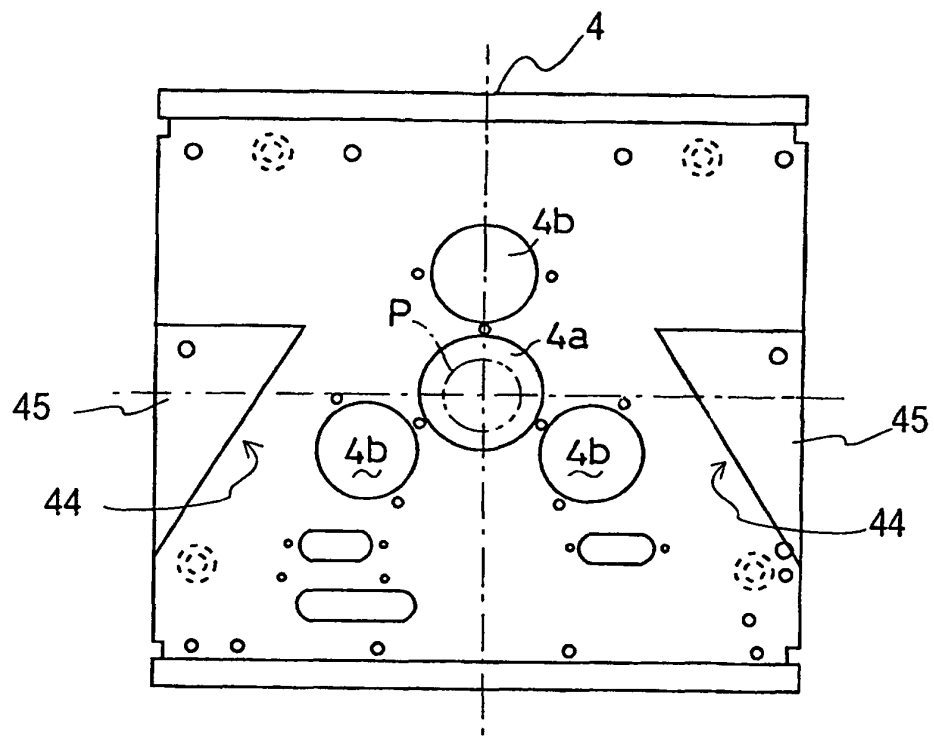


Fig.5

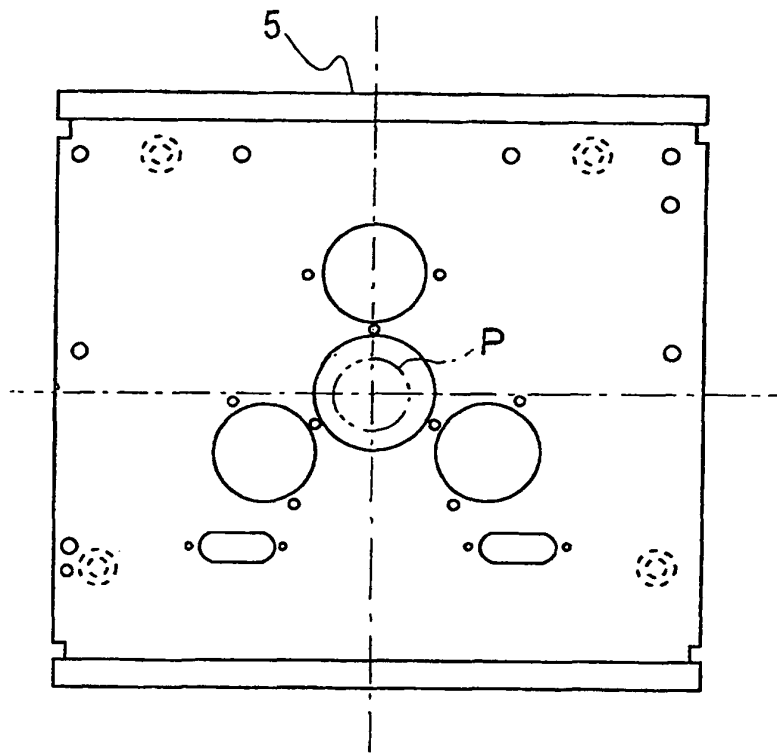


Fig.6

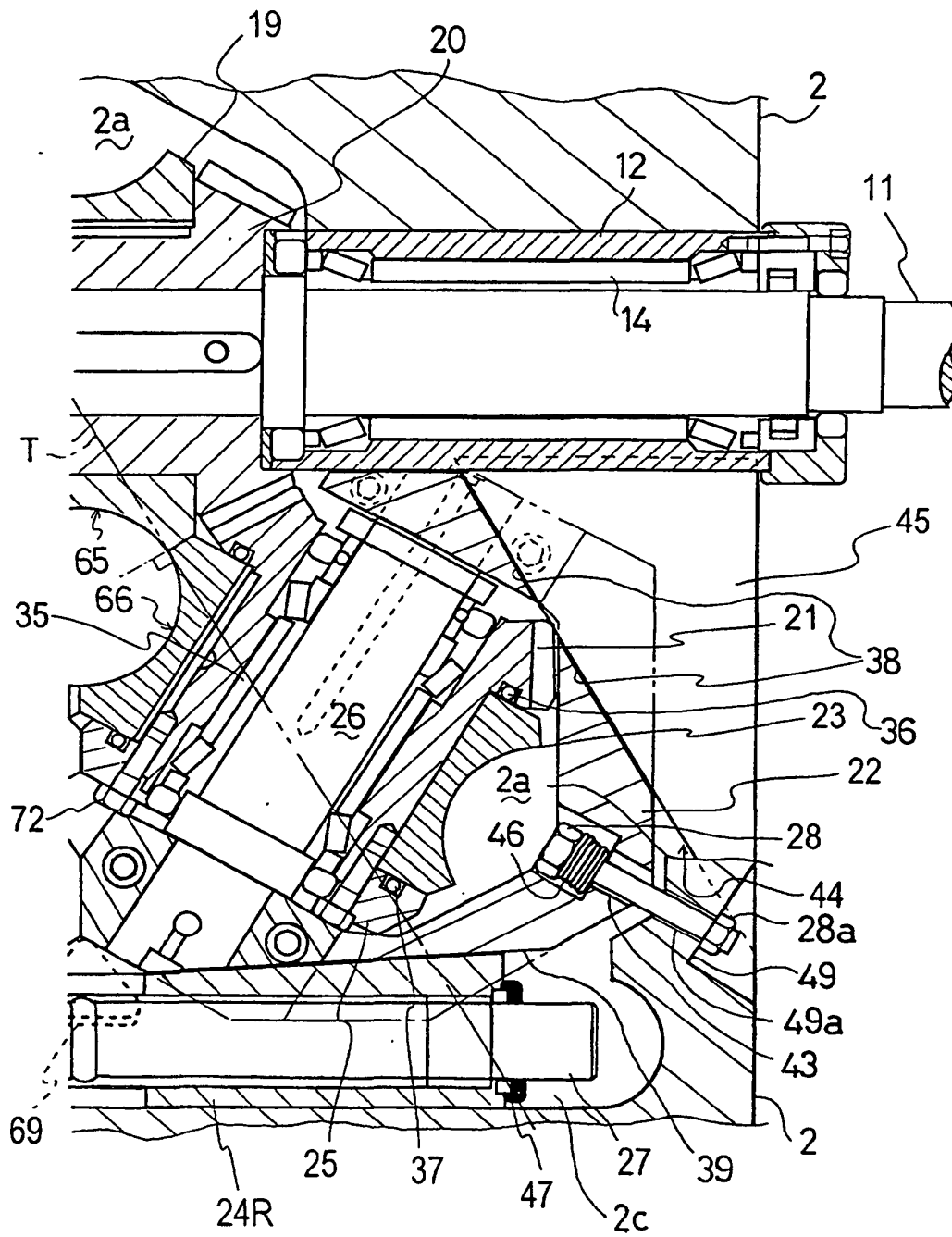


Fig.7

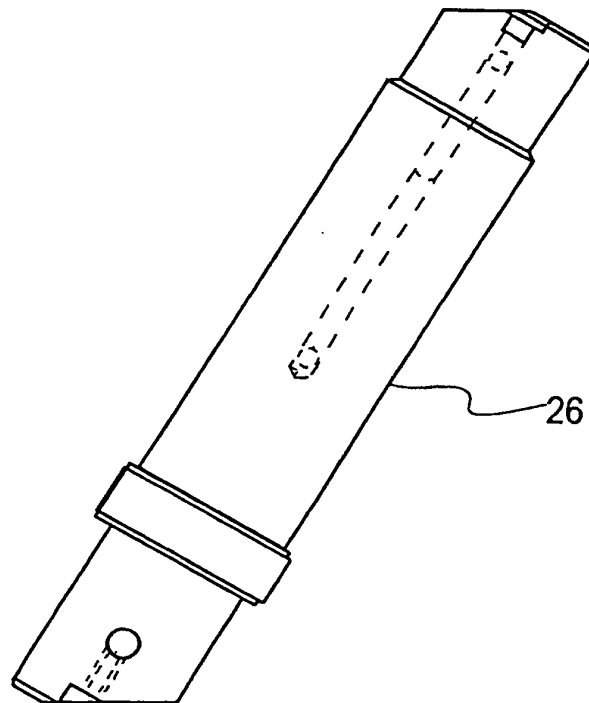


Fig. 8

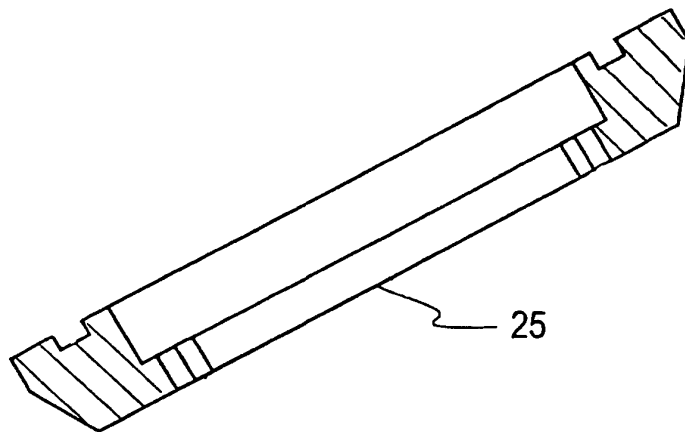


Fig.9

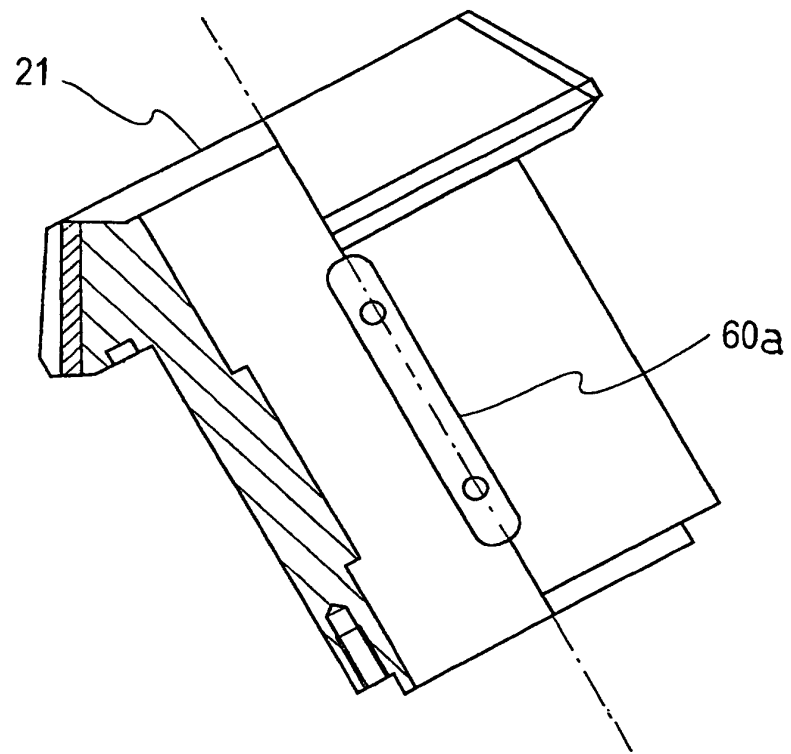


Fig.11

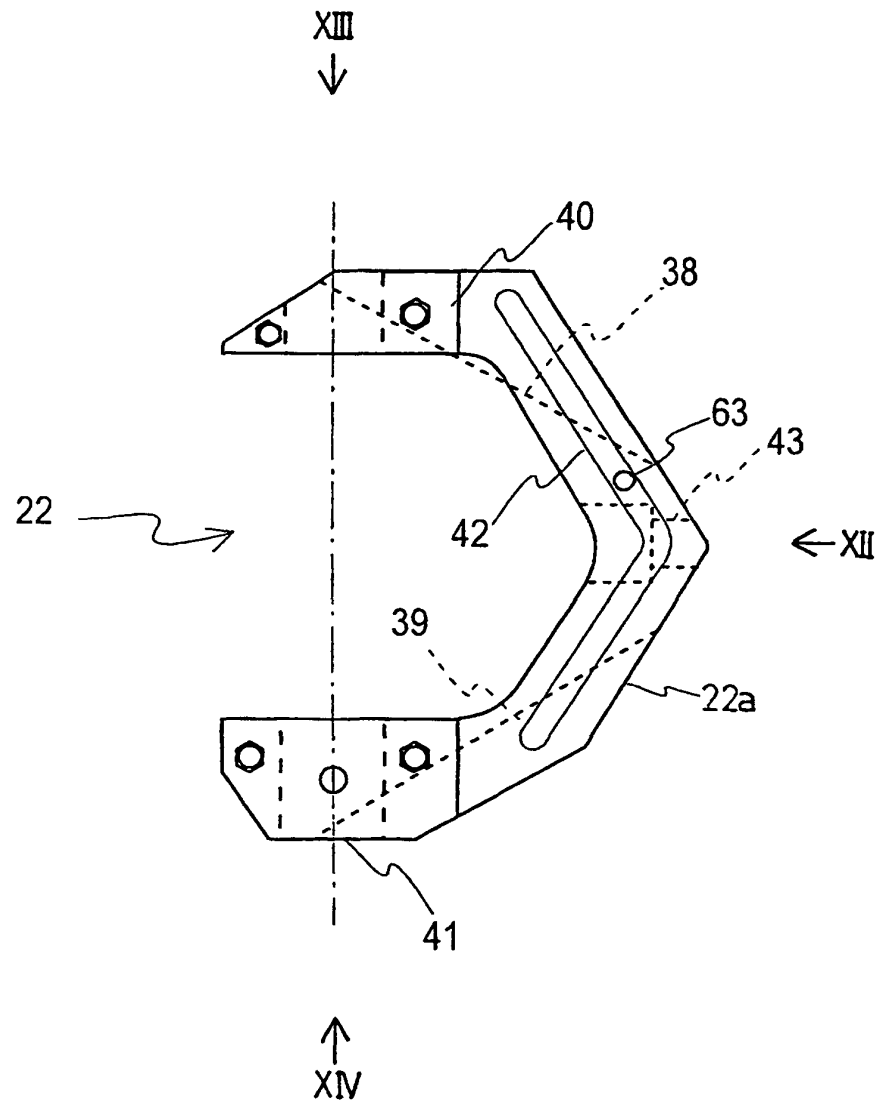


Fig.10

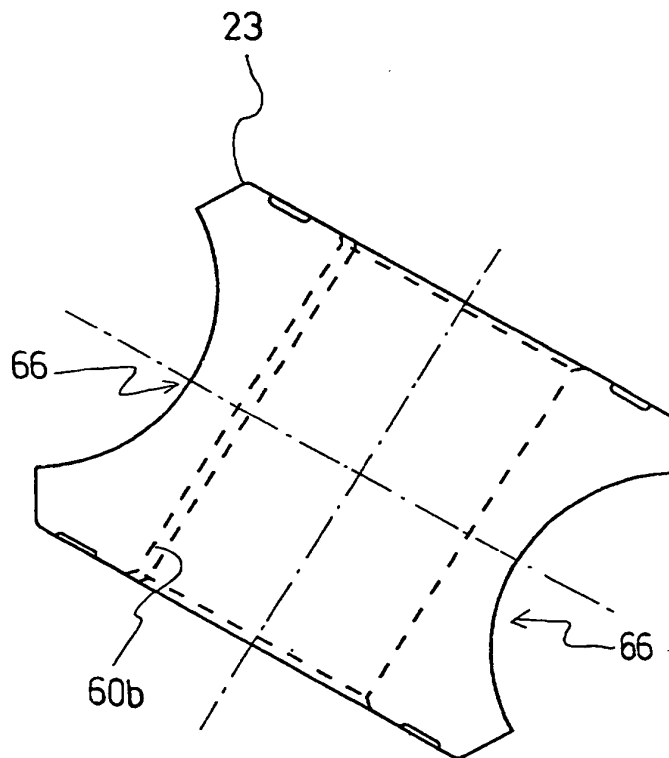


Fig.12

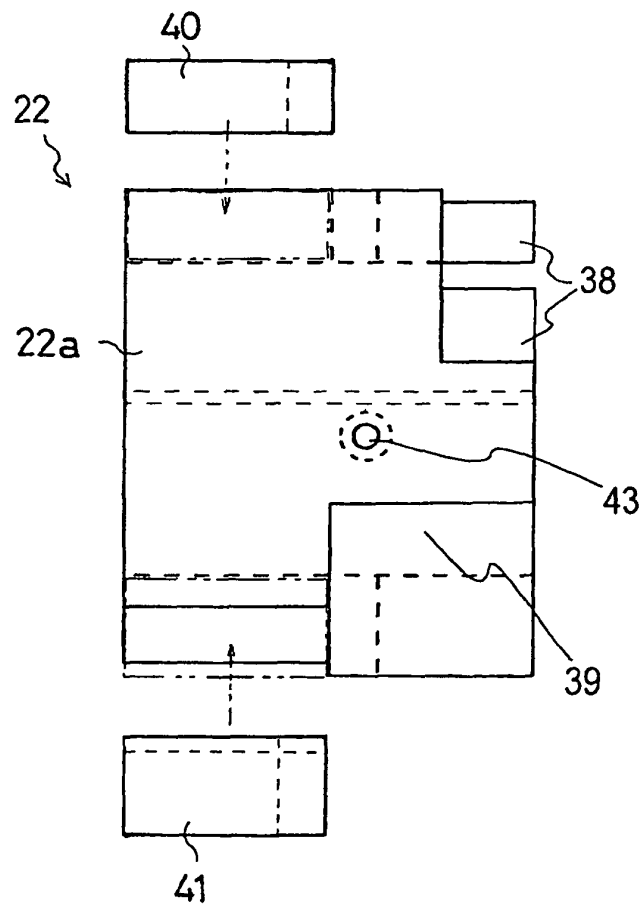


Fig.13

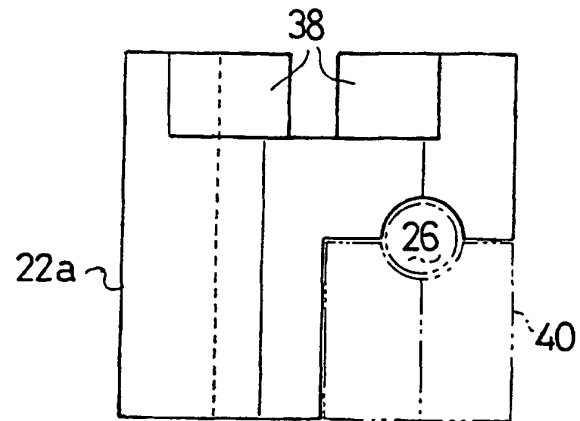


Fig.14

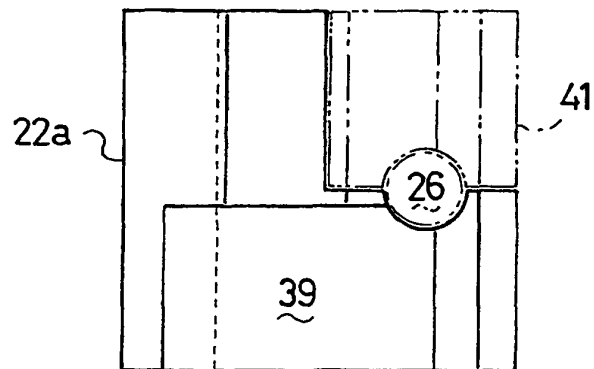


Fig.15

