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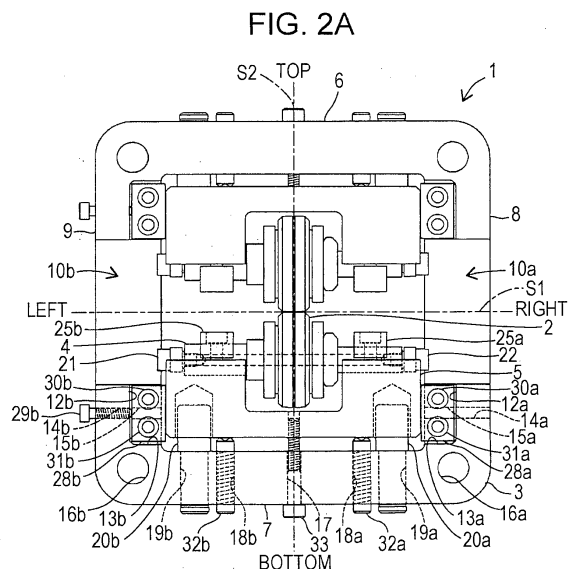
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(54) **WIRE-DRAWING DEVICE**

(57) A wire-drawing device (1) for wire-drawing a wire rod by passing said wire rod through a die hole formed by a pair of roller dies (2), the wire-drawing device being provided with: a frame (3); rotation shafts (4) for supporting said roller dies (2) so as to rotate freely; housings (5), which are separate from the frame (3) and on which the rotation shafts (4) for supporting the roller dies (2) are mounted while also supporting the mounted rotation shafts (4); a first positioning means for positioning a housing (5) with respect to the frame (3) by moving the housing along the axial direction of the rotation shaft (4) supported by the housing (5); and a second positioning means for positioning the housing (5) with respect to the frame (3) by moving the housing along a direction perpendicular to the axial direction of the rotation shaft (4) supported by the housing (5). Provided is a wire-drawing device, which can be assembled and adjusted easily and quickly.



Description

Technical Field

- 5 **[0001]** The present invention relates to a wire-drawing device that is a wire-drawing machine that draws a wire rod. More specifically, the present invention relates to a wire-drawing device that draws an arc-welding wire.

Background Art

- 10 **[0002]** Exemplary arc-welding wires that are used in welding robots and the like include not only a solid wire but also a flux-cored wire obtained by forming a narrow steel strip into a tube-like steel sheath and filling the steel sheath with flux.
- [0003]** Such an arc-welding wire is manufactured as follows: a material such as a steel wire rod or a steel strip is passed through a wire-drawing device such as a holed die or a roller die and is thus drawn. The wire-drawing in which a material such as a steel wire rod or a steel strip is drawn is performed by passing the material such as a steel wire
- 15 rod or a steel strip through a wire-drawing line that includes a plurality of die groups that are aligned in series. Each of the die groups is a combination of a plurality of wire-drawing devices such as holed dies or roller dies.
- [0004]** In many cases of wire-drawing, a plurality of holed dies or roller dies are used. Exemplary applications of such roller dies are disclosed as wire-drawing devices by PTL 1 and PTL 2.
- [0005]** The wire-drawing device disclosed by PTL 1 is a device that draws a wire rod by using a roller die and includes
- 20 bearings that support a pair of rollers that form the roller die, the bearings allowing the rollers to freely rotate; bearing boxes that hold the bearings; and an integrated frame that supports the bearing boxes. The bearing boxes are fixed to the frame with the aid of bearing-box-fixing beams. The bearing-box-fixing beams are fastened to the frame with bolts for adjusting the interval between the rollers. The bearings are each held by a cap in such a manner as to be movable within a corresponding one of the bearing boxes. The cap is supported by a bolt for adjusting the position of a corresponding
- 25 one of the rollers in the direction of axis of rotation of the roller.
- [0006]** The wire-drawing device disclosed by PTL 2 is a wire-drawing device in which a wire rod is drawn by being passed through a die hole provided by a pair of roller dies each having a die groove in the outer periphery thereof. The wire-drawing device includes a frame; first and second eccentric-portion-including supporting shafts each including a one-end-side shaft portion, an other-end-side shaft portion having an axis whose extension coincides with an extension
- 30 of an axis of the one-end-side shaft portion, and an eccentric portion provided between the shaft portions and having an axis that is deflected with respect to the axes of the one-end-side and other-end-side shaft portions, the first and second eccentric-portion-including supporting shafts each further including a cooling-medium passage provided thereinside; a first bearing fixed to the eccentric portion of the first eccentric-portion-including supporting shaft and around which one of the pair of roller dies is fitted, the first bearing supporting the one roller die while allowing the roller die to
- 35 freely rotate; a second bearing fixed to the eccentric portion of the second eccentric-portion-including supporting shaft and around which the other of the pair of roller dies is fitted, the second bearing supporting the other roller die while allowing the roller die to freely rotate; first and second roller-die-axial-direction-position-adjusting mechanisms that allow the first and second eccentric-portion-including supporting shafts, respectively, to be held by the frame such that the eccentric-portion-including supporting shafts are slidable in the axial direction; and first and second roller-die-radial-direction-position-adjusting mechanisms that allow the first and second eccentric-portion-including supporting shafts,
- 40 respectively, to be held by the frame such that the eccentric-portion-including supporting shafts are rotatable about the axes of the one-end-side and other-end-side shaft portions.

Citation List

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Patent Literature

[0007]

- 50 PTL 1: Japanese Unexamined Patent Application Publication No. 2005-34873
PTL 2: Japanese Unexamined Patent Application Publication No. 2007-283314

Summary of Invention

55 Technical Problem

- [0008]** The wire-drawing device disclosed by PTL 1 employs an indirect cooling method in which a cooling-medium passage is provided in the frame that holds the roller die. Therefore, heat generated by the roller die is not absorbed by

the cooling medium unless the heat is transmitted to the frame via the bearings and shafts of the rollers forming the roller die. Hence, the wire-drawing device disclosed by PTL 1 is not considered to be able to fully cool the roller die and the bearings and has a problem in that, since the thermal expansion of the roller die cannot be suppressed, the wire diameter may vary and high loads may be applied to the bearings.

[0009] In the wire-drawing device disclosed by PTL 2, the roller dies are attached to the eccentric shafts having the cooling-medium passages. Since the eccentric supporting shafts to which the bearings of the roller dies are attached are cooled, the effect of cooling the roller dies and the bearings is improved. Consequently, the thermal expansion of the roller dies is suppressed, and the stability in the wire diameter can be improved. Hence, the loads applied to the bearings are reduced, and the lives of the bearings are thus extended.

[0010] On the other hand, however, the wire-drawing device disclosed by PTL 2 requires a high level of skill so as to be assembled and adjusted. For example, to attach the roller dies, while the roller dies are held at predetermined positions in the frame such that the positions of the bearings of the roller dies coincide with the positions of respective shaft-receiving holes provided in the frame, the supporting shafts need to be fitted into the shaft-receiving holes and the bearings. To fit the supporting shafts into both the shaft-receiving holes and the bearings, the supporting shafts need to be driven with a hammer or the like while the driving force is adjusted. If the extent of driving is inappropriate, associated components may be damaged.

[0011] Moreover, the positions of the roller dies need to be adjusted after the roller dies are attached. Particularly, to adjust the radial-direction positions of the roller dies, the positions of the eccentric supporting shafts need to be adjusted. Such work requires the worker of a high level of skill. As is understood from such exemplary situations, the wire-drawing device disclosed by PTL 2 requires a high level of skill so as to be assembled and adjusted, and is therefore only handleable by few skilled workers.

[0012] Accordingly, it is an object of the present invention to provide a wire-drawing device that can be assembled and adjusted easily and quickly.

Solution to Problem

[0013] To achieve the above object, the present invention employs the following technical measures.

[0014] A wire-drawing device according to the present invention draws a wire rod by passing the wire rod through a die hole provided by a pair of roller dies. The wire-drawing device includes a frame; rotation shafts that support the respective roller dies such that the roller dies are rotatable; a supporting body that is separate from the frame and on which the rotation shafts supporting the roller dies are mounted, the supporting body supporting the rotation shafts mounted; a first positioning means that positions the supporting body with respect to the frame by moving the supporting body in an axial direction of the rotation shafts supported by the supporting body; and a second positioning means that positions the supporting body with respect to the frame by moving the supporting body in a direction perpendicular to the axial direction of the rotation shafts supported by the supporting body.

[0015] It is preferable that the first positioning means include a pressing means that positions the supporting body with respect to the frame by pressing two ends of the supporting body in the axial direction of the rotation shafts that support the roller dies, and a fastening means that fastens the pressing means to the frame.

[0016] It is also preferable that the pressing means include a bolt extending through the frame and applying a pressing force to the supporting body.

[0017] It is also preferable that the second positioning means include a pushing means that exerts a force of pushing a non-supporting surface of the supporting body from a side of the frame, the non-supporting surface being a surface of the supporting body that is opposite a surface on which the rotation shaft is mounted; and a pulling means that exerts a force of pulling the non-supporting surface toward the frame.

[0018] It is also preferable that the pushing means include a pushing bolt extending through the frame and exerting a force of pushing the non-supporting surface from the side of the frame, and that the pulling means include a pulling bolt extending through the frame and exerting a force of pulling the non-supporting surface toward the frame.

[0019] It is also preferable that the rotation shafts of the roller dies each include a cooling means provided inside the rotation shaft and extending along the axis of the rotation shaft; a supply port provided at one end of the rotation shaft of the roller die and through which a cooling medium is supplied to the cooling means; and a discharge port provided at another end of the rotation shaft and through which the cooling medium is discharged from the cooling means.

[0020] It is also preferable that the frame have notches at positions corresponding to the supply port and the discharge port, respectively, and that, when the supporting body is positioned with respect to the frame, the supply port and the discharge port provided to each of the rotation shafts be movable within the notches without interfering with the frame.

Advantageous Effects of Invention

[0021] According to the present invention, the wire-drawing device can be assembled and adjusted easily and quickly.

Brief Description of Drawings

[0022]

[Fig. 1] Fig. 1 is a schematic diagram illustrating a process of drawing an arc-welding wire in which wire-drawing devices according to an embodiment of the present invention are used.

[Fig. 2A] Fig. 2A is a front view of a wire-drawing device according to the embodiment.

[Fig. 2B] Fig. 2B is a right-side view of the wire-drawing device according to the embodiment.

[Fig. 2C] Fig. 2C is an upper-side view of the wire-drawing device according to the embodiment.

[Fig. 3A] Fig. 3A is an upper-side view of a housing of the wire-drawing device according to the embodiment.

[Fig. 3B] Fig. 3B is a front view of the housing of the wire-drawing device according to the embodiment.

[Fig. 3C] Fig. 3C is a right-side view of the housing of the wire-drawing device according to the embodiment.

[Fig. 4] Fig. 4 includes diagrams sequentially illustrating a process of mounting a rotation shaft supporting a roller die on the housing of the wire-drawing device according to the embodiment and a process of positioning the housing on which the rotation shaft has been mounted with respect to a frame.

Description of Embodiments

[0023] An embodiment of the present invention will now be described with reference to the drawings. The following embodiment is only an exemplary embodiment of the present invention and does not limit the configuration of the present invention to that exemplary embodiment. Hence, the technical scope of the present invention is not limited to the content disclosed by the following embodiment.

[0024] Before describing a wire-drawing device 1 according to an embodiment of the present invention, an outline of a wire-drawing process in which a wire rod is drawn will be described with reference to Fig. 1. Fig. 1 is a diagram illustrating a wire-drawing process in which an arc-welding wire W, such as a solid wire or a flux-cored wire, is drawn in such a manner as to have a diameter required of a finished product.

[0025] The process of "roller-die wire-drawing" illustrated in Fig. 1 is a wire-drawing process that is generally called secondary wire-drawing and in which a wire rod, such as a solid wire or a flux-cored wire, formed of a material, such as a steel wire rod or a steel strip, processed in primary wire-drawing performed prior to the secondary wire-drawing is drawn in such a manner as to have a diameter required of a finished product. Subsequent to "roller-die wire-drawing," "finishing wire-drawing" is performed in which the drawn welding wire W is finished into a product having a final diameter, and the welding wire W thus having the finished-product diameter is rinsed, is lubricated with oil, and is coiled as a finished product.

[0026] The wire-drawing device 1 according to the embodiment includes roller dies 2 that draw a welding wire W. A plurality of wire-drawing devices 1 are stacked in series and are integrated into a die group 100. Furthermore, a plurality of die groups 100 are aligned in series, with a take-up capstan 101 that applies a certain tension to the welding wire W is interposed between adjacent ones of the die groups 100. Thus, a wire-drawing line that performs "roller-die wire-drawing" and "finishing wire-drawing" is provided.

[0027] A configuration of the wire-drawing device 1 according to the embodiment will now be described with reference to Figs. 2A to 2C. Fig. 2A is a front view illustrating the front face of the wire-drawing device 1. Fig. 2B is a right-side view of the wire-drawing device 1. Fig. 2C is an upper-side view (top view) of the wire-drawing device 1.

[0028] In the embodiment, the configuration of the wire-drawing device 1 will be described on an assumption of a positional relationship that the vertical direction in the front view illustrated in Fig. 2A corresponds to the vertical direction of the wire-drawing device 1, and the lateral direction in the same front view corresponds to the lateral direction of the wire-drawing device 1. Hence, a side view of the wire-drawing device 1 illustrated in Fig. 2A that is seen from the right side is regarded as the right-side view and is illustrated in Fig. 2B, and a side view of the wire-drawing device 1 that is seen from the upper side is regarded as the upper-side view (top view) and is illustrated in Fig. 2C. Furthermore, in Figs. 2A and 2B, the upper half of the wire-drawing device 1 with respect to a symmetry axis S1 is illustrated as an external view in solid lines, and the lower half of the wire-drawing device 1 is illustrated as an internal view in broken lines.

[0029] Referring to Fig. 2A, the wire-drawing device 1 includes a frame 3 that encloses a substantially rectangular space. Two supporting bodies (housings) 5 on which rotation shafts 4 that support the respective roller dies 2 are mounted are provided in the substantially rectangular space enclosed by the frame 3. The two housings 5 and 5 are positioned with respect to the frame 3 such that the respective roller dies 2 and 2 face each other and thus provide a die hole. For the positioning of the housings 5, the wire-drawing device 1 includes a first positioning means that determine the axial-direction position of each of the rotation shafts 4 supporting the roller dies 2, and a second positioning means that determine the position of each of the rotation shafts 4 in a direction toward the opposing roller die 2 (the radial direction of each of the roller dies 2).

[0030] The wire-drawing device 1 draws a welding wire W, i.e., a wire rod, by passing the welding wire W through the

die hole provided by the pair of roller dies 2 that face each other.

[0031] Now, the configuration of the wire-drawing device 1 will be described in detail.

[0032] As illustrated as the front view in Fig. 2A, the frame 3 is a member including four pieces of steel material that each have a substantially rectangular-parallelepiped shape and are of substantially the same size. The four pieces of steel material are integrated together in such a manner as to form the upper, lower, right, and left sides, respectively, of a substantial square or a substantial rectangle.

[0033] Specifically, the frame 3 is an integrated body formed of the four pieces of steel material, which are an upper beam 6 corresponding to the upper side, a lower beam 7 corresponding to the lower side, a right beam 8 corresponding to the right side, and a left beam 9 corresponding to the left side. Hence, the frame 3 having a substantially square shape or a substantially rectangular shape and including the upper beam 6, the lower beam 7, the right beam 8, and the left beam 9 encloses a space having a shape substantially similar to the shape of the frame 3 in the front view illustrated in Fig. 2A. Here, regarding the frame 3 whose front surface is illustrated in Fig. 2A, a surface opposite the front surface is referred to as rear surface, a surface enclosing the space inside the frame 3 is referred to as inner peripheral surface, and a surface on the outer side of the frame 3 is referred to as outer peripheral surface.

[0034] As illustrated in Figs. 2A and 2B, the right beam 8 and the left beam 9 forming the right and left sides of the frame 3 each have a recess in and near a longitudinal-direction central portion thereof. The thickness of the frame 3 at each of the recesses is reduced to about 1/2 to 1/3 (one half to one third) of the thickness of a portion of the frame 3 that adjoins the recess. Particularly, as illustrated in Fig. 2B, the portion having the reduced thickness forms a concavity as if a portion of each of the right beam 8 and the left beam 9 of the frame 3 is cut off from the front surface toward the rear surface. The concavity is referred to as notch 10a or 10b. Furthermore, surfaces of the right beam 8 and the left beam 9 where the notches 10a and 10b are provided are referred to as notched surfaces. Hence, the notches 10a and 10b each have a depth from the front surface of the frame 3 of about 1/2 to 2/3 (one half to two thirds) of the thickness of the portion adjoining the notch 10a or 10b.

[0035] The notches 10a and 10b each extend over the entire region of the right beam 8 or the left beam 9 in the lateral direction and over a region of the right beam 8 or the left beam 9 in the longitudinal direction that has a length of about 1/2 to 2/3 (one half to two thirds) of the full length of the right beam 8 or the left beam 9.

[0036] As illustrated in Fig. 2A, the frame 3 having the above notches 10a and 10b (i.e., the notched surfaces) has a horizontally and vertically symmetrical configuration in a state where the upper beam 6 and the lower beam 7 face each other in the vertical direction while the right beam 8 and the left beam 9 face each other in the lateral direction. Although details will be described later, the wire-drawing device 1 illustrated in Fig. 2A that includes the frame 3 and other elements attached thereto also has a horizontally symmetrical shape with respect to the symmetry axis S1, because elements provided in the lower half of the frame 3 are the same as elements provided in the upper half of the frame 3. Hence, the following description starts with details of the configuration of the lower half of the frame 3, followed by details of individual elements provided in the lower half of the frame 3. Thus, the description of the entirety of the wire-drawing device 1 will be complete.

[0037] Referring to the lower half of the frame 3 illustrated in Fig. 2A, the right beam 8 of the frame 3 has a right concavity on the lower side of the notch 10a. The right concavity is concave from the front surface toward the rear surface of the right beam 8. The right concavity is a recess shallower than the notch 10a and has a depth from the front surface of the frame 3 of about 1/3 to 1/2 (one third to one half) of the depth of the notch 10a.

[0038] The right concavity is provided on the left side of the right beam 8, i.e., on a side nearer to the space enclosed by the inner peripheral surface of the frame 3. The upper side of the right concavity is open and is continuous with the notch 10a. The left side of the right concavity is open and is continuous with the space enclosed by the frame 3. Specifically, the right concavity is defined by a substantially rectangular right retracted surface 11a that is retracted from the front surface toward the rear surface of the right beam 8, a right end surface 12a that connects the right end of the right retracted surface 11a to the front surface of the frame 3, and a lower end surface 13a that connects the lower end of the right retracted surface 11a to the front surface of the frame 3. The right retracted surface 11a is continuous with the inner peripheral surface of the frame 3 at the left end thereof and is continuous with the notched surface of the notch 10a at the upper end thereof. Furthermore, the right retracted surface 12a has two screw holes each of whose inner surface is threaded. The screw holes are provided side by side in the vertical direction, i.e., in the longitudinal direction of the right beam 8.

[0039] Furthermore, as illustrated in Figs. 2A and 2B, the right beam 8 has a through hole 14a extending through the frame 3 from the outer peripheral surface of the frame 3 to the right end surface 12a of the right concavity. The through hole 14a has an opening at substantially the center of the right end surface 12a of the right concavity. Apart of or the entirety of the inner surface of the through hole 14a is threaded.

[0040] Furthermore, another through hole 15a is provided at a position nearer to the rear surface of the frame 3 than the through hole 14a. The through hole 15a extends through the frame 3 from the outer peripheral surface to the inner peripheral surface of the frame 3. The through hole 15a has openings in the outer peripheral surface and the inner peripheral surface, respectively, and at substantially the midpoint between the front surface and the rear surface of the

frame 3. Apart of or the entirety of the inner surface of the through hole 15a is threaded.

[0041] As illustrated in Fig. 2A, a through hole 16a is provided on the lower side of the right concavity and at the connection between the right beam 8 and the lower beam 7. The through hole 16a extends through the frame from the front surface to the rear surface of the frame 3. The through hole 16a has a larger diameter than, for example, the through hole 15a extending from the outer peripheral surface to the inner peripheral surface of the frame 3 described above. If a stick member or the like for connection is inserted into the through hole 16a, a plurality of wire-drawing devices 1 can be connected in series.

[0042] The lower half of the frame 3 has been described focusing on the configuration of the right beam 8. The left beam 9 has a configuration that is vertically symmetrical with respect to a symmetry axis S2. Therefore, the left beam 9 has a left concavity corresponding to the right concavity, a left retracted surface 11b corresponding to the right retracted surface 11a, a left end surface 12b corresponding to the right end surface 12a, a lower end surface 13b corresponding to the lower end surface 13a, a through hole 14b corresponding to the through hole 14a, a through hole 15b corresponding to the through hole 15a, and a through hole 16b corresponding to the through hole 16a.

[0043] Referring now to Figs. 2A and 2C, a configuration of the lower beam 7 that connects the right beam 8 and the left beam 9 to each other will be described.

[0044] The lower beam 7 has a lower-central through hole 17, which is a circular through hole provided at substantially the center in the longitudinal direction of the lower beam 7 and extending through the lower beam 7 (the frame 3) from the outer peripheral surface to the inner peripheral surface. The central through hole 17 passes through substantially the midpoint between the front surface and the rear surface of the frame 3 and extends substantially along the symmetry axis S2.

[0045] A lower-right through hole 18a is provided on the right side of the lower-central through hole 17. The lower-right through hole 18a is a circular through hole extending through the lower beam 7 (the frame 3) from the outer peripheral surface to the inner peripheral surface. The lower-right through hole 18a is a through hole having an opening provided in the inner peripheral surface of the lower beam 7 and at substantially the midpoint between the lower-central through hole 17 and the right beam 8. The lower-right through hole 18a passes through substantially the midpoint between the front surface and the rear surface of the frame 3 and extends substantially parallel to the lower-central through hole 17. A part of or the entirety of the inner surface of the lower-right through hole 18a is threaded.

[0046] Furthermore, a circular through hole 19a is provided on the right side of the lower-right through hole 18a. The through hole 19a extends through the lower beam 7 (the frame 3) from the outer peripheral surface to the inner peripheral surface. A guide pin 20a is fitted and fixed in the through hole 19a. The guide pin 20a guides the positioning of the supporting body (housing 5) with respect to the frame 3, which will be described later. The guide pin 20a is a round-columnar member having substantially the same diameter as the through hole 19a and projects from the inner peripheral surface of the lower beam 7 into the space enclosed by the frame 3.

[0047] As illustrated in Fig. 2A, the length of projection of the guide pin 20a from the inner peripheral surface of the lower beam 7 toward the upper side is within such a length that the guide pin 20a does not reach the lower end of the notch 10a. The tip of the guide pin 20a is positioned below the notch 10a in the right-side view illustrated in Fig. 2B.

[0048] The lower beam 7 has a lower-left through hole 18b at a position that is substantially vertically symmetrical to the lower-right through hole 18a with respect to the lower-central through hole 17. The lower beam 7 also has another guide pin 20b at a position that is substantially vertically symmetrical to the guide pin 20a.

[0049] Referring now to Figs. 3A to 3C and Fig. 4, the roller die 2 and the supporting body (housing 5) supporting the roller die 2, both of which are provided in the space enclosed by the inner peripheral surface of the frame 3, will be described. Fig. 3A is an upper-side view (top view) illustrating the upper surface of the housing 5 included in the wire-drawing device 1 according to the embodiment. Fig. 3B is a front view of the housing 5. Fig. 3C is a right-side view of the housing 5. Fig. 4 includes diagrams sequentially illustrating a process of mounting the rotation shaft 4 supporting the roller die 2 on the housing 5 and positioning the housing 5 on which the rotation shaft 4 has been mounted with respect to the frame 3.

[0050] The roller die 2 is a member having a circular-cylindrical shape or a disc-like shape and includes a bearing provided at a position of the axis of the circular-cylindrical or disc-like shape thereof. The roller die 2 is a wheel-like member that is rotatable on its axis. The roller die 2 has a die groove (caliber) in the outer peripheral surface thereof corresponding to the tread of the wheel. The die groove is provided for drawing a wire rod and extends in the peripheral direction of the roller die 2.

[0051] The rotation shaft 4 is a circular-cylindrical member having substantially the same diameter as the bearing of the roller die 2 and having a hollow therein extending along the axis thereof. The rotation shaft 4 is inserted into and fixed to the bearing of the roller die 2. Thus, the rotation shaft 4 supports the roller die 2 while allowing the roller die 2 to freely rotate about the rotation shaft 4.

[0052] The hollow inside the rotation shaft 4 serves as a cooling means that cools the roller die 2 and the bearing when a cooling medium is supplied thereto. An opening at one end of the rotation shaft 4 is provided with a supply port 21 through which the cooling medium is supplied from the outside into the hollow, which is the cooling means,

provided inside the rotation shaft 4. An opening at the other end of the rotation shaft 4 is provided with a discharge port 22 through which the cooling medium is discharged from the cooling means. The supply port 21 and the discharge port 22 serve as connecting devices (connectors) that each connect a cooling-medium passage pipe to a corresponding one of the openings of the rotation shaft 4. One end of the connector has the same diameter as the opening of the rotation shaft 4. The other end of the connector has the same diameter as the cooling-medium passage pipe.

[0053] Referring now to Figs. 3A to 3C, the housing 5 is separate from the frame 3. The rotation shaft 4 supporting the roller die 2 is mounted on the housing 5, and the housing 5 supports the rotation shaft 4 mounted thereon. The housing 5 is a member having a rectangular-parallelepiped shape with a central portion thereof cut off. The longitudinal size of the housing 5 is slightly smaller than the lateral width of the space enclosed by the frame 3. That is, as illustrated in Fig. 3B, the housing 5 is a U-shaped member whose thickness in the central portion is reduced from the upper-side surface toward the lower-side surface (bottom surface), thereby having a concavity. The roller die 2 is placed in the concavity provided in the center of the housing 5. The concavity has a depth that is well larger than the diameter of the roller die 2 placed therein.

[0054] As illustrated in Figs. 3A and 3B, the housing 5 has a semicircular-cylindrical groove in the upper-side surface thereof. The groove extends in the longitudinal direction of the housing 5 and through the midpoint between the front-surface side and the rear-surface side of the housing 5. The groove is provided for receiving the rotation shaft 4 supporting the roller die 2. The radius of curvature of the semicircular-cylindrical surface is substantially the same as the radius of curvature of the surface of the rotation shaft 4 placed therein. Here, the bottom surface of the housing 5 is positioned opposite the upper-side surface on which the rotation shaft 4 is placed. Therefore, the bottom surface of the housing 5 is occasionally referred to as non-supporting surface.

[0055] Furthermore, the housing 5 has screw holes provided in the upper-side surface thereof and on both the front-surface side and the rear-surface side thereof with respect to the groove for receiving the rotation shaft 4. The inner surface of each of the screw holes is threaded. Specifically, as illustrated in Fig. 3A, two screw holes 23a and 24a are provided on the right side of the concavity and on two respective sides of the groove, and two screw holes 23b and 24b are provided on the left side of the concavity and on two respective sides of the groove. These screw holes are provided for receiving screws with which fastening members 25a and 25b are attached to the housing 5 so as to fasten the rotation shaft 4 to the housing 5.

[0056] As illustrated in Fig. 3B, the housing 5 has, at the center of the non-supporting surface thereof, a pulling through hole 26 as a through hole corresponding to the lower-central through hole 17 provided in the lower beam 7 of the frame 3 described above. The housing 5 further has, near two respective lateral ends thereof, guide holes 27a and 27b into which the guide pins 20a and 20b provided to the lower beam 7 are to be inserted, respectively. The guide holes 27a and 27b each extend from the non-supporting surface toward the upper-side surface of the housing 5. Here, the diameter of the guide holes 27a and 27b is larger than the diameter of the guide pins 20a and 20b. Furthermore, it is preferable that the depth of the guide holes 27a and 27b be longer than the length of the guide pins 20a and 20b. When the housing 5 is positioned such that the guide pins 20a and 20b provided to the frame 3 are inserted into the guide holes 27a and 27b of the housing 5, the through hole 26 provided in the center of the non-supporting surface of the housing 5 substantially faces the lower-central through hole 17 of the lower beam 7. Thus, the housing 5 is movable in the vertical direction along the guide pins 20a and 20b and is also movable in the lateral direction by the size of a gap provided between each of the guide holes 27a and 27b and a corresponding one of the guide pins 20a and 20b.

[0057] Referring now to Fig. 4, a configuration in which the housing 5 supports the rotation shaft 4 supporting the roller die 2 will be described.

[0058] Firstly, as illustrated in Fig. 4 (a), the rotation shaft 4 supporting the roller die 2 is placed in the groove of the upper-side surface of the housing 5 such that the roller die 2 is positioned in the concavity of the housing 5.

[0059] After the rotation shaft 4 is placed in the groove of the upper surface of the housing 5, as illustrated in Fig. 4 (b), the fastening member 25a that extends over the two screw holes 23a and 24a provided in the upper-side surface of the housing 5 with the groove interposed therebetween is placed over the rotation shaft 4, and the fastening member 25b that extends over the screw holes 23b and 24b is placed over the rotation shaft 4. In this state, fastening screws are passed through the fastening members 25a and 25b from above and are screwed into the screw holes 23a and 24a and the screw holes 23b and 24b, respectively, provided in the upper-side surface of the housing 5, whereby the fastening members 25a and 25b are fastened to the housing 5. By fastening the fastening members 25a and 25b to the housing 5 in such a manner, the rotation shaft 4 held between the housing 5 and the fastening members 25a and 25b is supported by the housing 5 and is integrated with the housing 5. Here, since the rotation shaft 4 is placed in the groove extending in the longitudinal direction of the housing 5, the axial direction of the rotation shaft 4 coincides with the longitudinal direction of the housing 5 (i.e., the lateral direction in Fig. 4).

[0060] Subsequently, as illustrated in Fig. 4 (c), the housing 5 integrated with the roller die 2 and the rotation shaft 4 is positioned in the space on the inner side of the inner peripheral surface of the frame 3 such that the guide pins 20a and 20b of the frame 3 are inserted into the guide holes 27a and 27b, respectively. In this state, the housing 5 is positioned and fixed with respect to the frame 3 by the first positioning means and the second positioning means. Now, configurations

of the first positioning means and the second positioning means will be described.

[0061] Referring to Fig. 2 again, the configuration of the first positioning means will be described. The following description is based on an assumption that the housing 5 integrated with the roller die 2 and the rotation shaft 4 has been positioned with respect to the frame 3 such that the guide pins 20a and 20b of the lower beam 7 are inserted into the respective guide holes 27a and 27b thereof.

[0062] The frame 3 described above is provided with the first positioning means that positions the housing 5 with respect to the frame 3 by moving the housing 5 in the axial direction of the rotation shaft 4 supported by the housing 5 (in the longitudinal direction of the housing 5).

[0063] The first positioning means includes a pressing means that presses the housing 5, and a fastening means that fastens the pressing means to the frame 3. The pressing means includes a right pressing member 28a provided in the right concavity, and a right pressing screw 29a (not illustrated) screwed into the through hole 14a having an opening in the right end surface 12a. The right pressing screw 29a applies a pressing force to the right pressing member 28a. The fastening means includes right fastening screws 30a and 31a screwed into respective screw holes provided in the right retracted surface 11a. The right fastening screws 30a and 31a press the right pressing member 28a against the right retracted surface 11a.

[0064] The right pressing member 28a is a rectangular-parallelepiped member having substantially the same shape and size as the right concavity. The right pressing member 28a has two opposing flat surfaces each having substantially the same shape and size as the right retracted surface 11a having a substantially rectangular shape. The right pressing member 28a has two through holes each extending through the right pressing member 28a from one of the two flat surfaces to the other. The two through holes are arranged side by side in the longitudinal direction of the right pressing member 28a such that the interval between the centers thereof becomes the same as the interval between the centers of the two screw holes provided in the right retracted surface 11a. The two through holes have a slightly larger diameter than the screw holes provided in the right retracted surface 11a.

[0065] As illustrated in Figs. 2A and 2B, the right pressing member 28a configured as described above is placed on the right retracted surface 11a such that the positions of the through holes thereof coincide with the positions of the respective screw holes provided in the right retracted surface 11a. The right pressing member 28a does not substantially project with respect to the front surface of the frame 3 and into the notch 10a.

[0066] The right pressing screw 29a is screwed into the through hole 14a from the opening provided in the outer peripheral surface of the frame 3 and projects from the opening provided in the right end surface 12a, thereby pressing the right pressing member 28a placed on the right retracted surface 11a toward the space enclosed by the frame 3.

[0067] The right fastening screws 30a and 31a included in the fastening means are screws having a diameter that is the same as the diameter of the screw holes provided in the right retracted surface 11a and smaller than the diameter of the through holes provided in the right pressing member 28a. The right fastening screws 30a and 31a are inserted into the respective through holes of the right pressing member 28a placed on the right retracted surface 11a, and are screwed and fastened into the respective screw holes provided in the right retracted surface 11a. Thus, the right pressing member 28a is pressed against and fastened to the right retracted surface 11a by the heads of the right fastening screws 30a and 31a.

[0068] Here, the diameter of the through holes of the right pressing member 28a is slightly larger than the diameter of the right fastening screws 30a and 31a. Therefore, the right pressing member 28a is movable within the right concavity by the difference between the diameter of the through holes of the right pressing member 28a and the diameter of the right fastening screws 30a and 31a. Hence, by adjusting the length of projection of the right pressing screw 29a from the opening provided in the right end surface 12a, the lateral-direction position of the right pressing member 28a in the concavity is adjustable by the difference between the diameter of the through holes of the right pressing member 28a and the diameter of the right fastening screws 30a and 31a.

[0069] The pressing means for the left concavity has a configuration that is vertically symmetrical to the configuration of the pressing means for the right concavity with respect to the symmetry axis S2. The pressing means for the left concavity includes a left pressing member 28b corresponding to the right pressing member 28a, and a left pressing screw 29b corresponding to the right pressing screw 29a. The fastening means for the left concavity also has a configuration that is vertically symmetrical to the configuration of the fastening means for the right concavity with respect to the symmetry axis S2. The fastening means for the left concavity includes left fastening screws 30b and 31b corresponding to the right fastening screws 30a and 31a. Needless to say, the left retracted surface 11b has screw holes that are the same as the two screw holes provided in the right retracted surface 11a.

[0070] As described above, the first positioning means has a vertically symmetrical configuration and presses the right pressing member 28a and the left pressing member 28b against the two respective longitudinal-direction-end surfaces (two respective ends) of the housing 5, thereby being capable of determining the position of the housing 5 with respect to the frame 3 in the lateral direction (the axial direction of the rotation shaft 4). After the housing 5 is positioned with respect to the frame 3, the right pressing member 28a is fastened with the right fastening screws 30a and 31a while the left pressing member 28b is fastened with the left fastening screws 30b and 31b. Thus, the housing 5 can be fixed to

the frame 3 in the axial direction of the rotation shaft 4.

[0071] After the housing 5 is positioned by the first positioning means, a fastening screw is screwed into the other through hole 15a extending through the frame 3 from the outer peripheral surface to the inner peripheral surface of the frame 3, whereby the housing 5 can be directly pressed with the fastening screw. With the use of the fastening screw that directly presses the housing 5 in addition to the positioning by the first positioning means, the housing 5 can be more assuredly fixed to the frame 3.

[0072] The frame 3 is further provided with the second positioning means that positions the housing 5 with respect to the frame 3 by moving the housing 5 in a direction perpendicular to the axial direction of the rotation shaft 4 of the roller die 2 supported by the housing 5.

[0073] The second positioning means includes a pushing means that exerts a force of pushing the housing 5 from the side of the frame 3, and a pulling means that exerts a force of pulling the housing 5 toward the frame 3.

[0074] The pushing means includes a right pushing bolt 32a threaded in such a manner as to be screwed into the lower-right through hole 18a provided in the lower beam 7, and a left pushing bolt 32b threaded in such a manner as to be screwed into the lower-left through hole 18b. For example, the right pushing bolt 32a is a bolt that is well longer than the full length of the lower-right through hole 18a. The right pushing bolt 32a is screwed into the lower-right through hole 18a from the opening provided in the outer peripheral surface of the lower beam 7, thereby extending through the frame 3. The right pushing bolt 32a projects from the opening provided in the inner peripheral surface of the lower beam 7 and exerts a force that pushes the bottom surface (non-supporting surface) of the housing 5 from the side of the frame 3 toward the upper side.

[0075] As with the right pushing bolt 32a, the left pushing bolt 32b is screwed into the lower-left through hole 18b, thereby extending through the frame 3. The left pushing bolt 32b exerts a force that pushes the bottom surface (non-supporting surface) of the housing 5 from the side of the frame 3 toward the upper side.

[0076] Thus, the pushing means including the right pushing bolt 32a and the left pushing bolt 32b is capable of moving the housing 5 upward by pushing the non-supporting surface, i.e., the bottom surface, of the substantially rectangular-parallelepiped housing 5 toward the upper-side surface of the housing 5. Accordingly, the pushing means is capable of moving the rotation shaft 4, supported by the upper-side surface of the housing 5, in the direction perpendicular to the axial direction of the rotation shaft 4.

[0077] On the other hand, the pulling means includes a pulling bolt 33 that is a bolt longer than the lower-central through hole 17 provided in the lower beam 7 of the frame 3. The pulling bolt 33 has a diameter that is the same as the diameter of the pulling through hole 26 provided in the non-supporting surface of the housing 5 and slightly smaller than the diameter of the lower-central through hole 17 at the outer peripheral surface of the lower beam 7. The pulling bolt 33 extends through the lower-central through hole 17 by being inserted therein from an opening of the lower-central through hole 17 that is provided in the outer peripheral surface of the lower beam 7, and is screwed into the pulling through hole 26 provided in the non-supporting surface.

[0078] If the pulling bolt screwed into the pulling through hole 26 is fastened, the pulling bolt can exert a force of pulling the non-supporting surface toward the frame 3. By pulling the non-supporting surface, i.e., the bottom surface, of the housing 5 toward the lower side of the housing 5, the housing 5 can be moved downward. Thus, the rotation shaft 4 supported by the upper-side surface of the housing 5 can be moved in the direction perpendicular to the axial direction of the rotation shaft 4.

[0079] By employing the combination of the pushing means and the pulling means described above, the housing 5 can be positioned and fixed with respect to the frame 3 in the vertical direction (the direction perpendicular to the axial direction of the rotation shaft 4).

[0080] The above description concerns the configuration of the lower half of the frame 3 and the elements provided in the lower half of the frame 3, i.e., the lower-half configuration of the wire-drawing device 1 according to the embodiment. As described above, since the wire-drawing device 1 according to the embodiment has a horizontally symmetrical configuration, the frame 3 is provided with two housings 5 each being integrated with and thus supporting the rotation shaft 4 that supports the roller die 2. The two housings 5 are paired such that the die grooves provided in the respective roller dies 2 face each other.

[0081] In the wire-drawing device 1 configured as described above, the frame 3 has the notches 10a and 10b each having a satisfactory size relative to the full length of a corresponding one of the right beam 8 and the left beam 9. That is, the frame 3 has the notches 10a and 10b provided at respective positions corresponding to the supply port 21 and the discharge port 22 provided at the two respective ends of each of the rotation shafts 4. Hence, when the housing 5 is positioned with respect to the frame 3, the supply port 21 and the discharge port 22 move within the notches 10a and 10b without interfering with the frame 3. Accordingly, the cooling-medium passage pipes to be connected to the supply port 21 and the discharge port 22 do not interfere with the frame 3.

[0082] With the housings 5 and 5 that face each other, the positions of and the interval between the roller dies 5 and 5 that face each other can be adjusted easily by using the second positioning means, and the lateral-direction displacement between the die grooves provided in the opposing roller dies 5 and 5 and other like errors can be adjusted easily by

using the first positioning means.

[0083] Furthermore, in the wire-drawing device 1 according to the embodiment, before the housings 5 and the roller dies 2 are positioned, each of the roller dies 2 and each of the rotation shafts 4 are integrated with a corresponding one of the housings 5 that are separate from the frame 3. Subsequently, the integral body including the separate housing 5 is attached to the frame 3. That is, in the process of assembling the wire-drawing device 1, there is no need to directly attach the rotation shaft 4 to the frame 3. Therefore, the wire-drawing device 1 can be assembled very easily. Furthermore, in the process of positioning the roller die 2, there is no need to change the position of the rotation shaft 4 with respect to the roller die 2. Therefore, the position of the roller die 2 can be adjusted very easily and precisely by the first positioning means and the second positioning means.

EXAMPLES

[0084] Table 1 below summarizes the results of comparison of the time taken for assembly, the time taken for adjustment, and the time taken for disassembly between the wire-drawing device 1 described in the above embodiment (hereinafter referred to as the present wire-drawing device) and the known wire-drawing device disclosed by PTL 2.

[Table 1]

	Assembly	Adjustment	Disassembly
Known wire-drawing device	25 to 30 min	1 min	5 to 7 min
Present wire-drawing device	about 15 min	1 min	3 to 5 min

[0085] How long it took for a worker who was not skilled in either the present wire-drawing device or the known wire-drawing device to assemble, adjust, and disassemble each of the wire-drawing devices was measured.

[0086] As a result, the time taken for assembly was about 25 to 30 minutes in the case of the known wire-drawing device but about 15 minutes in the case of the present wire-drawing device. The present wire-drawing device was assembled within about half the time taken in the case of the known wire-drawing device. Moreover, the present wire-drawing device is considered to require the worker of substantially no skill because it can be assembled in as short time as about 15 minutes.

[0087] This is because the present wire-drawing device employs a configuration in which the rotation shaft 4 of the roller die 2 is placed in the groove provided in the surface of the housing 5. Employing such a configuration realizes the omission of the care-requiring, time-consuming work of fitting the rotation shaft directly into the frame that needs to be performed in the case of the known wire-drawing device.

[0088] Secondly, the time taken for adjustment was 1 minute in both cases of the present wire-drawing device and the known wire-drawing device. There was no difference at least in the time taken for adjustment.

[0089] Note that, in the present wire-drawing device, the axial-direction positioning of the rotation shaft 4 that supports the roller die 2 is performed as the positioning of the housing 5 in which the two ends of the housing 5 are pressed in the axial direction of the rotation shaft 4 (in the lateral direction) by using the right pressing member 28a, the right pressing screw 29a, the left pressing member 28b, and the left pressing screw 29b, which are included in the first positioning means provided to the frame 3.

[0090] Thus, instead of directly adjusting the position of the rotation shaft 4, the position of the housing 5 that supports the rotation shaft 4 is adjusted, whereby the roller die 2 is positioned. Therefore, the roller die 2 can be positioned easily while avoiding the occurrence of warpage of the rotation shaft 4 or insufficiency in the holding of the rotation shaft 4.

[0091] Furthermore, in the present wire-drawing device, the positioning of the roller die 2 in the radial direction (the direction perpendicular to the axial direction of the rotation shaft 4) is performed by pushing or pulling the housing 5 by using the pushing bolts 32a and 32b or the pulling bolt 33, which is included in the second positioning means. Thus, in the present wire-drawing device, since the positioning of the roller die 2 in the radial direction can be performed by pushing or pulling the housing 5, the radial-direction positioning can be performed easily, regardless of the torque of fastening the rotation shaft 4.

[0092] Lastly, the time taken for disassembly was about 5 to 7 minutes in the case of the known wire-drawing device but about 3 to 5 minutes in the case of the present wire-drawing device.

[0093] The present wire-drawing device saved about 2 minutes in the disassembly thereof. This is because of the following reason. In the positioning method (position-adjusting method) employed by the present wire-drawing device including the first positioning means and the second positioning means, the range in which the housing 5 is movable in the radial direction of the roller die 2 can be set larger than or equal to the diameter of the rotation shaft 4. By setting the movable range of the housing 5 larger than or equal to the diameter of the rotation shaft 4, the rotation shaft 4 to which the roller die 2 is attached can be removed from the housing 5 without removing the housing 5 from the frame 3,

and the housing 5 can also be removed from the frame 3 without disassembling the frame 3.

[0094] Lastly, there was no difference in the time taken for adjustment between the case of the present wire-drawing device and the case of the known wire-drawing device. However, the present wire-drawing device is adjustable more easily than the known wire-drawing device and is therefore free of problems that may lead to quality deterioration, such as the warpage of the rotation shaft or the insufficiency in the holding of the rotation shaft 4 due to variations in the fastening torque that may occur because of differences in skill between workers, and the displacement of the rotation shaft due to the foregoing factors.

[0095] To summarize, since the present wire-drawing device employs a configuration in which the rotation shaft 4 is held by the housing 5 that is separate from the frame 3, the number of factors that require a high level of skill in the processes of assembly, adjustment, and disassembly is successfully made far smaller than that of the known wire-drawing device. Furthermore, since the present wire-drawing device employs the first positioning means and the second positioning means, a configuration that can be assembled and adjusted easily and quickly without a high level of skill has been realized.

[0096] In addition, the frame 3 has the notches 10a and 10b at the positions corresponding to the supply port 21 and the discharge port 22 that are provided at the two respective ends of the rotation shaft 4. Hence, when the housing 5 is positioned with respect to the frame 3, the supply port 21 and the discharge port 22 can be moved within the notches 10a and 10b without interfering with the frame 3.

[0097] For example, in the wire-drawing device 1 configured as illustrated in Fig. 2A, the supply port (connector) 21 is provided at the right end and the discharge port (connector) 22 is provided at the left end of the rotation shaft 4 mounted on the upper housing 5, and the discharge port (connector) 22 is provided at the right end and the supply port (connector) 21 is provided at the left end of the rotation shaft 4 mounted on the lower housing 5. In this state, the discharge port 22 of the lower rotation shaft 4 and the supply port 21 of the upper rotation shaft 4 are directly connected to each other with a cooling-medium passage pipe running through the notch 10a on the right side of the frame 3. By connecting the upper and lower rotation shafts 4 and 4 with the passage pipe in such a manner, while a cooling medium is supplied via the left notch 10b to the supply port 21 of the lower rotation shaft 4, the cooling medium fed from the lower rotation shaft 4 and flowing through the passage pipe running in the right notch 10a into the upper rotation shaft 4 can be discharged from the discharge port 22 of the upper rotation shaft 4 via the left notch 10b.

[0098] As described above, the frame 3 having the notches 10a and 10b not only facilitates the moving of the supply ports 21 and the discharge ports 22 but also prevents the interference between the frame 3 and the cooling-medium passage pipes connected to the supply ports 21 and the discharge ports 22. Therefore, while realizing a high cooling efficiency by directly cooling the rotation shafts 4 holding the roller dies 2, the present wire-drawing device can have a configuration that is assembled and adjusted easily and quickly.

[0099] It should be noted that the embodiment disclosed above is only exemplary in all respects and is not restrictive. Particularly, factors that are not expressly disclosed in the above embodiment, for example, factors such as operating conditions, measurement conditions, various parameters, and dimensions, weights, and volumes of the individual elements, are set to respective values within the ranges that are typically employed and are easily estimated by those normally skilled in the art.

[0100] For example, the first positioning means and the second positioning means include bolts extending through the frame 3 so as to generate forces of pushing and pulling the housing 5. Alternatively, the first positioning means and the second positioning means may include any members other than bolts, as long as such members or mechanisms can generate the above forces.

Reference Signs List

[0101]

- 1 wire-drawing device
- 2 roller die
- 3 frame
- 4 rotation shaft
- 5 housing
- 6 upper beam
- 7 lower beam
- 8 right beam
- 9 left beam
- 10a, 10b notch
- 11a, 11b right retracted surface
- 12a, 12b right end surface

13a, 13b lower end surface
 14a, 14b through hole
 15a, 15b through hole
 16a, 16b through hole
 5 17 lower-central through hole
 18a lower-right through hole
 18b lower-left through hole
 19a, 19b through hole
 20a, 10b guide pin
 10 21 supply port
 22 discharge port
 23a, 24a screw hole
 25a, 25b fastening member
 26 through hole
 15 27a, 27b guide hole
 28a, 28b right pressing member
 29a, 29b right pressing screw
 30a, 31a right fastening screw
 32a, 32b right pushing bolt
 20 33 pulling bolt
 100 die group
 101 take-up capstan
 S1, S2 symmetry axis
 W welding wire
 25

Claims

- 30 1. A wire-drawing device that draws a wire rod by passing the wire rod through a die hole provided by a pair of roller dies, the wire-drawing device comprising:
 - a frame;
 - rotation shafts that support the respective roller dies such that the roller dies are rotatable
 - a supporting body that is separate from the frame and on which the rotation shafts supporting the roller dies are mounted, the supporting body supporting the rotation shafts mounted
 - 35 a first positioning means that positions the supporting body with respect to the frame by moving the supporting body in an axial direction of the rotation shafts supported by the supporting body; and
 - a second positioning means that positions the supporting body with respect to the frame by moving the supporting body in a direction perpendicular to the axial direction of the rotation shafts supported by the supporting body.
 - 40
2. The wire-drawing device according to Claim 1, wherein the first positioning means includes
 - a pressing means that positions the supporting body with respect to the frame by pressing two ends of the supporting body in the axial direction of the rotation shafts that support the roller dies; and
 - 45 a fastening means that fastens the pressing means to the frame.
3. The wire-drawing device according to Claim 2, wherein the pressing means includes a bolt extending through the frame and applying a pressing force to the supporting body.
- 50 4. The wire-drawing device according to any of Claims 1 to 3, wherein the second positioning means includes
 - a pushing means that exerts a force of pushing a non-supporting surface of the supporting body from a side of the frame, the non-supporting surface being a surface of the supporting body that is opposite a surface on which the rotation shaft is mounted; and
 - 55 a pulling means that exerts a force of pulling the non-supporting surface toward the frame.

5. The wire-drawing device according to Claim 4,
wherein the pushing means includes a pushing bolt extending through the frame and exerting a force of pushing
the non-supporting surface from the side of the frame, and
wherein the pulling means includes a pulling bolt extending through the frame and exerting a force of pulling the
non-supporting surface toward the frame.
6. The wire-drawing device according to Claim 1,
wherein the rotation shafts of the roller dies each include a cooling means provided inside the rotation shaft and
extending along the axis of the rotation shaft; a supply port provided at one end of the rotation shaft of the roller die
and through which a cooling medium is supplied to the cooling means; and a discharge port provided at another
end of the rotation shaft and through which the cooling medium is discharged from the cooling means.
7. The wire-drawing device according to Claim 6,
wherein the frame has notches at positions corresponding to the supply port and the discharge port, respectively, and
wherein, when the supporting body is positioned with respect to the frame, the supply port and the discharge port
provided to each of the rotation shafts are movable within the notches without interfering with the frame.

FIG. 1

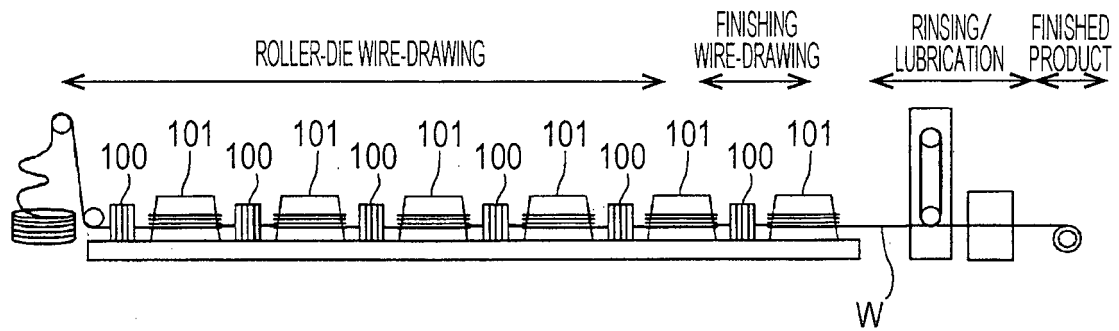


FIG. 2A

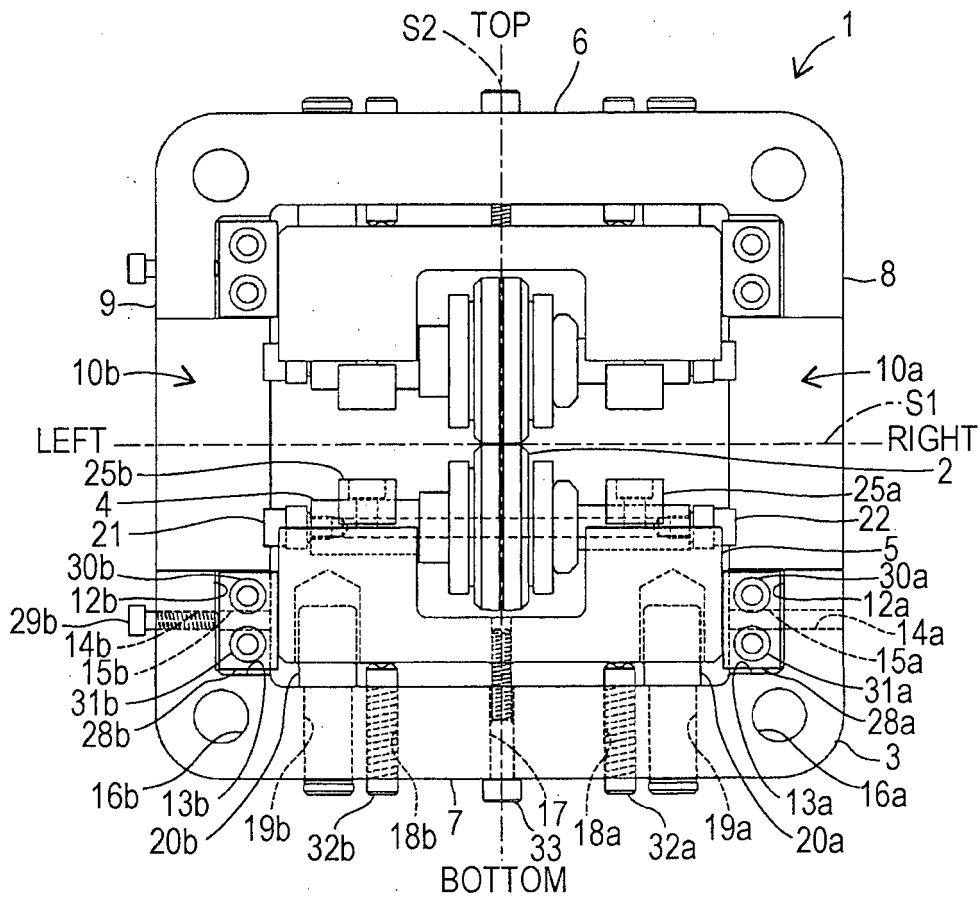


FIG. 2B

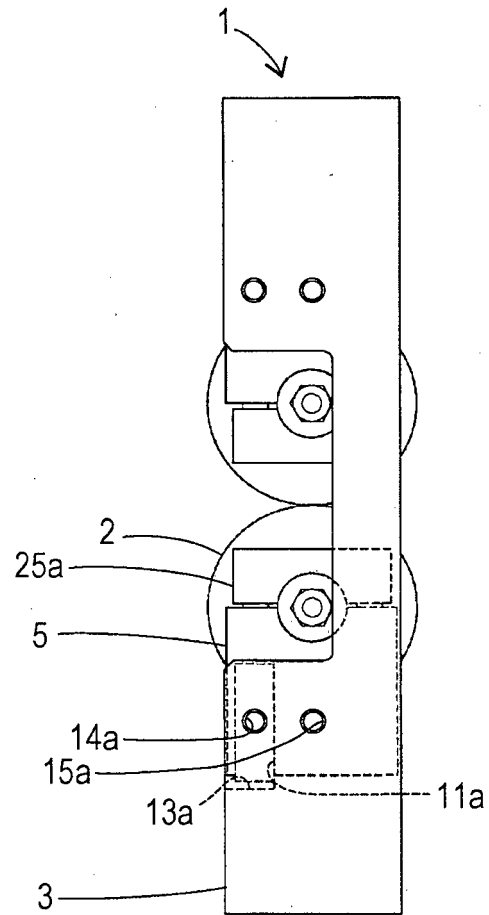


FIG. 2C

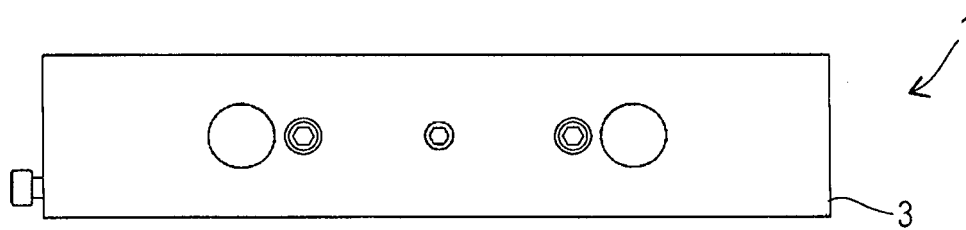


FIG. 3A

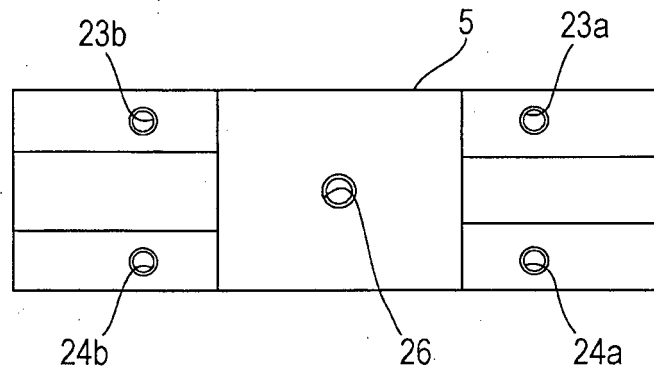


FIG. 3B

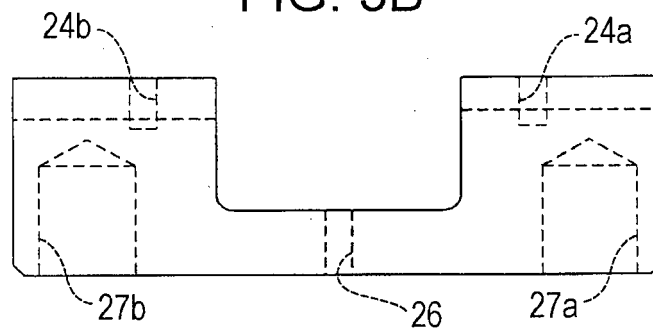


FIG. 3C

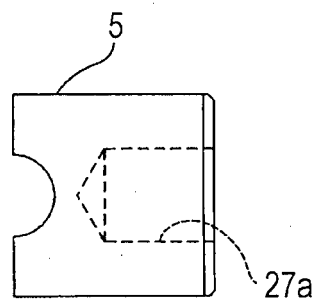
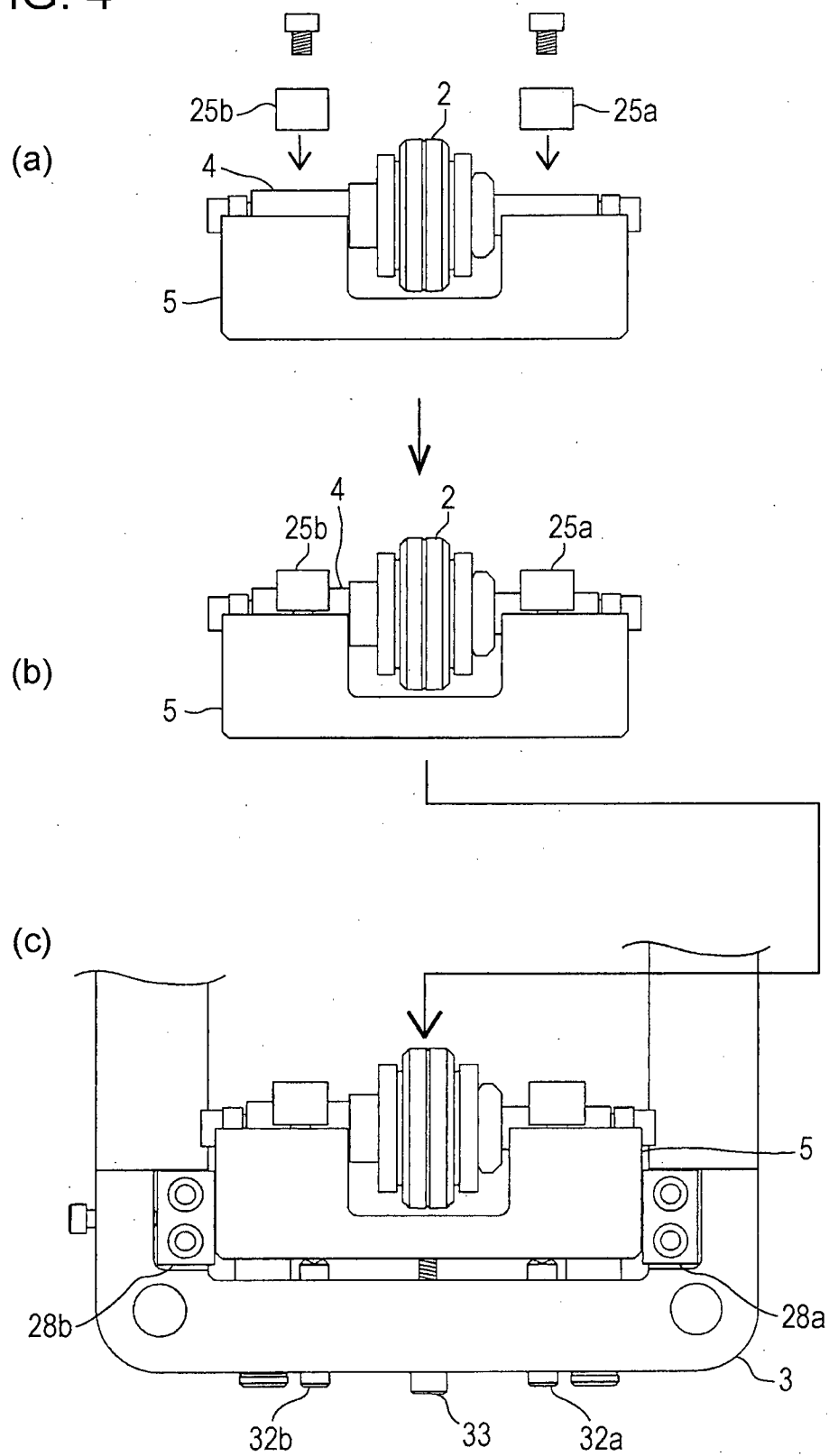


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/062982

A. CLASSIFICATION OF SUBJECT MATTER

B21C3/12(2006.01)i, B21B31/18(2006.01)i, B21B31/20(2006.01)i, B21C3/08(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)

B21C3/12, B21B31/18, B21B31/20, B21C3/08

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 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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.
A	JP 2007-283314 A (Kobe Steel, Ltd.), 01 November 2007 (01.11.2007), entire text; all drawings & KR 10-2007-0101784 A & CN 101053879 A & NL 1033679 C	1-7
A	JP 2005-34873 A (Kobe Steel, Ltd.), 10 February 2005 (10.02.2005), entire text; all drawings (Family: none)	1-7
A	US 4203310 A (Nikolai I. KRYLOV), 20 May 1980 (20.05.1980), entire text; all drawings & DE 2901057 A1 & FR 2447236 A1	1-7

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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Date of the actual completion of the international search
29 July, 2014 (29.07.14)

Date of mailing of the international search report
12 August, 2014 (12.08.14)

Name and mailing address of the ISA/
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- JP 2007283314 A [0007]