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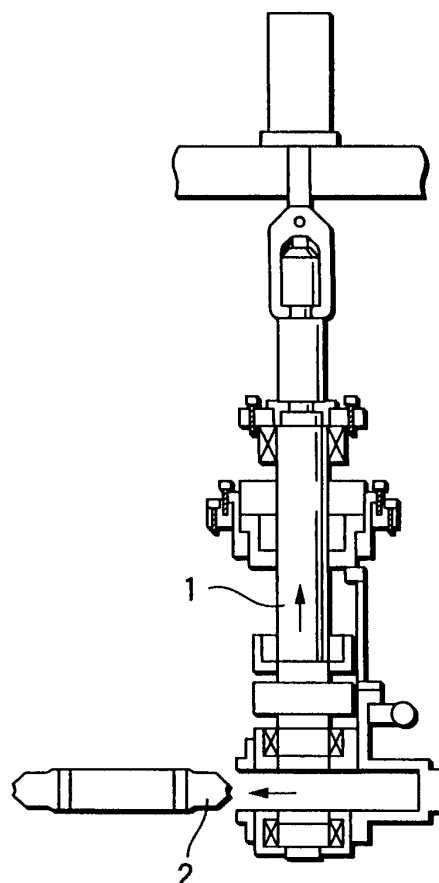
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(54) **Method and apparatus for interchanging ring rolls of a bar and wire rod mill**

(57) The present invention relates to a method and apparatus for changing ring rolls of a bar and wire rod mill which makes roll changing work easy and in particular to a method for changing only the ring rolls without disassembling the housing in accordance with an optimum process. The method for changing ring rolls in a bar and wire rod mill having a plurality of roll assemblies incorporated into a housing (8) and arranged in equiangular positions around a pass (16) comprises the steps of disengaging the interference fit between the spent ring rolls (2)(102) and the roll shaft (1)(101), withdrawing the spent ring rolls by moving the roll shaft in an axial direction, changing the spent ring rolls with new ring rolls in the housing (8), inserting the roll shaft into the new ring rolls, and engaging the new ring rolls in interference fit with the roll shaft (1)(101). Additionally, a main body of a bar and wire rod mill comprising a roll shaft suspending apparatus and a mechanism suitable for the method according to the present invention are provided.

FIG.3J



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Description

[0001] The present invention relates to a method and apparatus for changing ring rolls of a bar and wire rod mill which makes roll changing work easy. Incidentally, the apparatus for changing ring rolls comprises a main body of a bar roll mill having a roll changing mechanism and a roll shaft suspending apparatus.

[0002] A plurality of sizing mills are arranged in the final stage of a continuous rolling mill line for hot-rolling steel materials into bar and/or wire rods. As the sizing mill, a bar and wire rod mill is provided in which a plurality of roll assemblies supported by housings are arranged in equiangular positions around the pass line. With regard to the roll assembly, it comprises a composite structure having ring rolls in contact with rolling materials and a roll shaft fitted into the bore of the ring rolls to support it.

[0003] Japanese Patent Laid-Open No. 104706/1999 discloses a bar and wire rod mill with a construction facilitating the changing operation of the ring rolls. This kind of roll mill has a plurality of roll units and a draft adjusting apparatus of an eccentric cartridge type for a roll unit mounted on the housing. Incidentally, the roll unit is synonymous with the roll assembly. The housing consists of two pieces including first and second housing parts capable of engaging with, and disengaging from, each other. A pair of journal bearing halves are formed in the contact face of the first and second housing parts. The journal part of each roll unit held in an eccentric cartridge is sandwiched between the engaged journal bearing halves of the first and second housing parts. The roll changing operation of this bar and wire rod mill is performed as follows:

- (1) Separate the second housing part from the first housing part;
- (2) Take out the roll unit from the first housing part;
- (3) Change the roll part of the disengaged roll unit;
- (4) Incorporate the roll unit into the first housing part; and
- (5) Engage the second housing part with the first housing part.

[0004] Hence, the roll changing operation is made easy because the roll mill can be disassembled and re-assembled through only a few steps.

[0005] However, the roll changing operation of such a bar and wire rod mill still has the following problems.

- (1) In the case where the same roll shaft is used after the roll changing operation, an operation to change the ring rolls separated from the roll shaft using an apparatus exclusively for this purpose is necessary and the operation requires much time.
- (2) In the case where a different roll shaft is used after the roll changing operation, it is necessary to stock a lot of roll shafts, which causes an increase

in cost. Moreover, a large stock area is needed too. (3) During the roll changing operation, the housing should be disassembled into its two parts so that the journal bearing part or the like is exposed. As a result, machine problems tend to be caused due to the invasion of dust or moisture.

[0006] A method of roll changing which can resolve these problems, and a main body of a bar and wire rod mill and its peripheral apparatus advantageous for performing such a method, are desired.

[0007] Hence, the inventors have developed a method for changing only the ring rolls without disassembling the housing, and found a roll changing method comprising an optimum sequence of steps. In addition, the inventors have developed a main body of a bar and wire rod mill comprising a mechanism for changing only the ring rolls without disassembling the housing, and a roll shaft suspending apparatus capable of dual-use for applying hydraulic oil pressure, required for engaging or disengaging the ring rolls and the roll shaft in interference fit, and for suspending the roll shaft, which is suitable for the roll changing method of the invention.

[0008] In other words, the present invention relates to a method for changing ring rolls used in a bar and wire rod mill having a plurality of roll assemblies incorporated into a pair of housings and arranged in equiangular positions around the pass formed by the ring rolls as shown in Fig. 1, comprising the steps of disengaging the interference fit between the spent ring rolls and roll shaft, withdrawing the roll shaft from the spent ring rolls by lifting-up the roll shaft in an axial direction, changing the spent ring rolls for new ring rolls in said housings, inserting the roll shaft into the new ring rolls, and engaging the new ring rolls with the roll shaft in interference fit.

[0009] According to the present method, only the ring rolls can be changed without disassembling the housing.

[0010] Further, the present invention relates to a bar and wire rod mill suitable for applying the aforesaid method for changing ring rolls, in which a plurality of roll assemblies supported by a housing, comprising ring rolls capable of engaging with and disengaging from the roll shaft in interference fit and the roll shafts movable in an axial direction in a housing, are arranged in equiangular positions around the pass formed by these ring rolls.

[0011] According to one embodiment of the invention, the roll shaft can be withdrawn from the ring rolls by means of a pushing or pulling action of the roll shaft which is grasped at the end thereof. Thus, after having changed the spent ring rolls for new ones, the roll shaft is inserted into the new ring rolls and engaged therewith by interference fit.

[0012] Incidentally, it is preferable for the roll assembly to equip with a mechanism for engaging or disengaging the ring rolls and the roll shaft in and from interference fit by the use of hydraulic oil pressure, a hydrau-

lic oil passage being provided through the roll shaft from the end thereof and an oil inlet and a suspension jig receiving member both being provided on one end portion of the roll shaft. Furthermore, it is preferable for the internal surface of the ring roll and the journal part of the roll shaft for the ring roll of the roll assemblies to form tapered surfaces.

[0013] The roll shaft can be engaged with, or disengaged from, the ring rolls in interference fit by applying hydraulic oil pressure through the oil passage inside the roll shaft from the end thereof to make both tapered surfaces either engaged in tight contact fit or disengaged from each other. Furthermore, as the journal part of the roll shaft for the ring rolls and the ring rolls are engaged or disengaged through the tapered surface, the interference fit can be made firm to a greater extent and the disengagement can be made smooth to a greater degree due to the wedge effect of the tapered surface.

[0014] In addition, as the end part of the roll shaft for applying hydraulic pressure is arranged outside the housing, both tapered surfaces can be engaged or disengaged freely by applying hydraulic oil pressure from outside the housing successively to all of the roll assembly.

[0015] Incidentally, all of the multiple roll assembly can be of the motor driven type or some of them may be motor driven while others are not.

[0016] The bar and wire rod mill according to the present invention may preferably be a four-roll mill comprising four pieces of roll assembly, supported by a housing arranged in equiangular positions around a pass formed by four rolls as shown in Fig. 1

[0017] Moreover, embodiments of the present invention relate to a roll shaft suspending apparatus suitable for use in the method for changing ring rolls as disclosed, comprising a nozzle for injecting hydraulic oil into the oil inlet provided on one end of the roll shaft, a rod holding the nozzle at the top end thereof and an internal oil feed passage connected to the nozzle through the rod, a cylinder embracing the rod for reciprocal actuation by means of hydraulic oil pressure, and a front end of a rod suspending apparatus engaged with the suspension jig receiving member provided on one end of the roll shaft. It may be further preferable to provide a mechanism by which the rod holds the nozzle through a resilient seat.

[0018] A more steady and quick change of the roll is made possible by applying the roll shaft suspending apparatus in accordance with the method of the invention. It is performed according to the following operation in which the roll shaft of the roll assembly with the roll to be changed is set in an upright position before disengaging the spent ring rolls from the interference fit with the roll shaft, and then the suspending apparatus and one end portion of the roll shaft are coupled together before withdrawing the roll shaft from the spent ring rolls so as to connect the hydraulic piping inside the roll shaft with the hydraulic oil pressure source via the one end

portion of the roll shaft.

[0019] For a better understanding of the invention and to show how the same may be carried out, reference will now be made, by way of example, to the accompanying drawings in which:

Fig. 1 is a cross-sectional view showing the main part of the structure of the bar and wire rod mill according to an embodiment of the present invention; Fig. 2 is a cross-sectional view showing a means for applying hydraulic oil pressure to the tapered surfaces;

Figs. 3a to 3j are drawings illustrating a process involving steps a to j for changing ring rolls employed in a bar and wire rod mill according to the present invention;

Figs. 4a to 4e are drawings illustrating a process involving steps a to e for changing ring rolls using a roll shaft suspending apparatus according to the present invention; and

Fig. 5 is a cross-sectional view showing the top end portion of a rod together with a pawl plate fitted in the groove.

[0020] The present invention shall now be described in more detail with an example of a bar and wire rod mill (referred to as a four-roll mill hereafter) having four roll assemblies arranged in equiangular positions around the pass and supported by the housing.

[0021] Fig. 1 is a cross-sectional view showing the main part of the structure of the four-roll mill according to the present invention. In Fig. 1 a quarter portion centered around the pass 16 is illustrated. The whole view can be obtained from the combination of each rotated view of Fig. 1 by 90°, 180° and 270°.

[0022] The roll assembly is constructed by attaching a ring roll 2 to the journal part 1A located in the lower side of a roll shaft 1. The outer circumferential surface of the ring roll 2 is configured as the working surface of the roll. Both of the outer circumferential surface of the journal part 1A, which is an engagement part of the roll shaft 1 and the ring roll 2, and the internal surface of the ring roll 2 have a tapered surface, and both tapered parts are engaged together in interference fit. Incidentally, in this example, the outer circumferential surface of the journal part 1A is a tapered male surface having upward inclination toward the upper end of the roll shaft 1. A taper sleeve 3, having its internal surface tapered so as to slidably mate with the tapered male surface of the said journal part 1A, is fitted into the internal surface of the ring roll 2. The engagement or the disengagement of the roll shaft 1 and the ring roll 2 in interference fit is performed by engaging or disengaging the male and female tapered surfaces by means of, for example, applied hydraulic oil pressure.

[0023] Bearings 4A and 4B are mounted on respective positions opposite to each other across the ring journal part 1A of the lower portion of the roll shaft 1, and a

bearing 5 is mounted on a position of the upper portion thereof. The lower portion bearings 4A and 4B are supported by a housing 8 through a lower eccentric cartridge 6A. The upper portion bearing 5 is supported by a housing 8 through an upper eccentric cartridge 6B and a thrust adjusting screw 7. Incidentally, the upper end portion of the roll shaft is exposed outside the housing 8.

[0024] The lower eccentric cartridge 6A supports the bearing 4A, 4B and the upper eccentric cartridge 6B supports the bearing 5 slidably along the axial direction of the roll, respectively. The lower eccentric cartridge 6A and the upper eccentric cartridge 6B, that can rotate around their own shaft, are supported by the housing 8. By rotating the lower eccentric cartridge 6A around its own shaft, the center of the roll shaft 1 rotates around the center of the lower eccentric cartridge 6A. The upper eccentric cartridge is also rotated likewise. As described above, the eccentric cartridge 6 moves the roll shaft 1 along the direction perpendicular thereto so that it is used for the adjustment of the distance from the center of the ring roll 2 to the center of the pass, namely the rolling position. Incidentally, the lower eccentric cartridge 6A and the upper eccentric cartridge 6B are interconnected to each other and the distance between them can be varied. In addition, the bearing 5 is held by a fastening screw 9 to the upper eccentric cartridge 6B.

[0025] In such a structure as described above, the external diameter of the bearing 4A and 4B is set to be less than the internal diameter of the tapered sleeve 3 so as to disengage the tapered surface of the roll shaft 1 and the ring roll 2 from each other. Further, the fastening screw 9 is disengaged to move the roll shaft 1 along the axial direction thereof. As a result, the roll shaft 1 can be withdrawn from the ring roll 2.

[0026] The thrust adjusting screw 7 supports the upper eccentric cartridge 6B with its inner peripheral surface so as to rotate around its own shaft. In addition, the thrust adjusting screw 7 is engaged by means of a thread on its periphery with the screw receiving member 10 which is held by a screw to the housing 8. Further, the thrust adjusting screw 7 is connected to the screw receiving member 10 by means of a clamp bolt 11. Therefore, by loosening the clamp bolt 11 and driving the thrust adjusting screw 7, the position of the roll assembly along the axial direction of the roll can be adjusted.

[0027] Fig. 2 is a cross-sectional view showing a means for applying hydraulic oil pressure to the tapered surfaces. An oil feed passage 12 extends through the inside of the roll shaft from an oil inlet 12A in the end face of the roll shaft to an oil outlet 12B. The end portion of the roll shaft where the oil inlet 12A opens is extended outside of the housing, and a circumferential groove 22 is provided on the extended end portion of the roll shaft. The circumferential groove 22 serves as a receiving part for the suspension jig when suspending the roll shaft 1. Additionally, the oil outlet 12B opens at a plurality of positions over the tapered surface of the journal part 1A of

the ring.

[0028] In the case where the tapered surfaces are in interference fit with each other in the initial state, the injection of high pressure oil from the oil inlet 12A makes the internal diameter of the tapered sleeve 3 expand within its elastic limit by means of the hydraulic oil pressure from the oil inlet 12A. In addition, due to the expansion of the inside diameter, a counter force is generated between the two tapered surfaces to facilitate their disengagement from each other. Afterwards the hydraulic oil pressure is decreased and when the inside diameter is restored to its original size, both tapered surfaces are left in a disengaged condition. Consequently, the roll shaft 1 can be withdrawn out of the ring roll 2 by pulling it toward the outside of the housing.

[0029] On the other hand, in the case where the tapered surfaces are in a disengaged condition from each other in the initial state, by injecting high pressurized oil while pushing the roll shaft 1 toward the inside of the housing with enough force to overcome the counter force generated between both tapered surfaces, the roll shaft 1 enters into the smaller diameter part of the tapered sleeve 3 which has its internal diameter expanded by means of the hydraulic oil pressure. Afterwards, the hydraulic oil pressure is decreased and when the internal diameter is restored to its original size, a firm, tight contact between both tapered surfaces can be obtained.

[0030] As described above, according to the bar and wire rod mill of the invention, the interference fit and its release between the ring rolls and the roll shaft can be performed within the housing. In other words, only the ring rolls can be changed without disassembling the housing.

[0031] A process of changing a roll of a four-roll mill shall now be explained. This process is performed according to the steps described below and is illustrated in Figs. 3a to 3j.

(I) Preparation of the Housing

[0032]

- (1) Set the housing on a change table using a crane or the like;
- (2) Disengage the roll mill guide (including an installing jig for on line); and
- (3) Align the eccentric position of the eccentric cartridge to a predetermined position.

(II) Change of Roll

(Disengaging Operation)

[0033]

- (1) Operate the change table to rotate the housing and set the roll shaft in an upright position. Incidentally, the exposed end of the roll shaft is set in the

upper position;

- (2) Loosen the clamp bolt 11 (Fig. 3a);
- (3) Drive the thrust adjusting screw 7 to lower down the roll assembly so as to make the lower end of the ring roll 2 come in contact with the lower eccentric cartridge 6A (Fig. 3a);
- (4) Unscrew the fastening screw 9 (Fig. 3b);
- (5) Mount the push ring 13 on the roll shaft 1 (Fig. 3b);
- (6) Set the oil injection apparatus 14 at its operating position (Fig. 3c);
- (7) Couple the injection nozzle 14B with the oil inlet provided on the end portion of the roll shaft (Fig. 3d);
- (8) Push the push ring 13 by means of a shock absorbing cylinder 14A (Fig. 3d);
- (9) Increase the oil pressure in the injection nozzle 14B and decrease the oil pressure in the shock absorbing cylinder 14A (Fig. 3e). The tapered surfaces are now separated;
- (10) Lift up the shock absorbing cylinder 14A and release the pushing force on the push ring (Fig. 3f);
- (11) Remove the injection nozzle 14B from the oil inlet provided on the end portion of the roll shaft (Fig. 3f);
- (12) Return the oil injection apparatus 14 to a waiting position;
- (13) Remove the push ring 13 from the roll shaft 1 (Fig. 3g);
- (14) Set the lifting apparatus 15 at its operating position (Fig. 3g);
- (15) Lower the hook 15B by means of the lifting cylinder 15A (Fig. 3h);
- (16) Fix the hook 15B onto the roll shaft 1 (Fig. 3h);
- (17) Lift up the roll shaft 1 using the hook 15B and the lifting cylinder 15A and withdraw it from the ring roll 2 (Fig. 3i); and
- (18) Take the ring roll 2 out of the housing (Fig. 3j). (Assembling Operation)
- (19) Insert a new ring roll 2 into the housing;
- (20) Lower the roll shaft 1 into the ring rolls using the hook 15B and the lifting cylinder 15A;
- (21) Remove the hook 15B from the roll shaft 1;
- (22) Lift up the hook by means of the lifting cylinder 15A;
- (23) Return the lifting apparatus to the standby position;
- (24) Mount the push ring on the roll shaft;
- (25) Set the oil injection apparatus at its operating position;
- (26) Couple the injection nozzle with the oil inlet provided on the end portion of the roll shaft;
- (27) Increase the oil pressure inside the injection nozzle while pushing the push ring by means of the shock absorbing cylinder. The tapered surfaces are now in close contact;
- (28) Lift up the shock absorbing cylinder and release the pushing force from the push ring;
- (29) Remove the injection nozzle from the end por-

tion of the roll shaft;

- (30) Return the oil injection apparatus to the standby position;
- (31) Remove the push ring from the roll shaft;
- (32) Fix the fastening screw; and
- (33) Coarsely adjust the position of the roll assembly along the axial direction of the roll by driving the thrust adjusting screw and tighten the clamp bolt.

(III) Successively rotate the housing on the change table by 90° and repeat the above operation (II).

(IV) Final Roll Position Adjusting Operation

15 [0034]

- (1) Put the housing in a condition suitable for mounting a projector, which is an apparatus for projecting the external circumferential profile of the ring rolls on to a monitor screen;
- (2) Set the projector;
- (3) Loosen the clamp bolt and align the roll center by means of a thrust adjusting screw;
- (4) Tighten the clamp bolt and fix the thrust adjusting screw;
- (5) Rotate the eccentric cartridge and set the roll gap;
- (6) Remove the projector; and
- (7) Remove the housing from the change table.

[0035] An example of the roll shaft suspending apparatus according to the present invention shall now be described with reference to Fig. 4a. The upper half of Fig. 4a shows a roll shaft suspending apparatus according to the present invention and the lower half shows a part of the bar and wire rod mill. The roll shaft suspending apparatus comprises a nozzle 115 for injecting hydraulic oil into the oil inlet 131 provided on the upper end of the roll shaft 101 of the bar and wire rod mill, a rod 116 holding on the top end thereof the nozzle 115 and having an oil feed passage 117 inside thereof connecting with the nozzle 115, and a cylinder 118 embracing the rod 116 for actuating it reciprocally by means of hydraulic oil pressure.

[0036] The high pressurized oil is injected from the oil inlet 126 of the oil feed passage 117. The maximum injection pressure of the high pressurized oil is about 2000 kgf/cm² and it is preferred to set a certain pressure to cause the deformation of the tapered surface within its elastic limit. Upon the injection of the hydraulic oil, the rod 116 pushes down the roll shaft 101. In addition, after the release of the interference fit between the ring roll 102 and the roll shaft 101, the rod 116 lifts up the roll shaft 101. For such pushing down and lifting it is preferable to set the operating pressure of the rod 116 of the hydraulic oil cylinder 118 to a maximum of about 700 kgf/cm² (69 MPa) in order to enable a smooth motion of the roll shaft.

[0037] The nozzle 115 on the top end portion of the rod 116 may be fixed in place by a screw or the like. However, as described in this example, it is preferable to hold the nozzle in place with a resilient seat 125, such as a compression spring or a hydraulic cylinder, because the shock generated upon the injection of the high pressurized oil can be minimised more effectively.

[0038] Incidentally, when it is difficult to push on the end of the roll shaft directly by the top of the rod, it is better to use a pushing jig for transmitting the pushing force. The push ring 119 shown in Fig. 4b is an example of such use. In this case, it is preferable to provide on the top end of the rod 116 a pushing jig receiving member which engages with the pushing jig. Ring fitting hole 121 corresponds to the pushing jig receiving member.

[0039] The roll shaft suspending apparatus according to the present invention further comprises essentially a suspension jig engaging with the suspension jig receiving member provided on the end portion of the roll shaft. A circumferential groove 122 which acts as the suspension jig receiving member and a groove fitting pawl plate 123 which acts as the suspension jig to be engaging with the receiving member are illustrated in Fig. 4a. The use of this suspension jig on the lower end of the rod (116) makes it possible to lift up the roll shaft 101, having been disengaged from the interference fit with the ring roll 102, by means of the upward pulling force of the hydraulic cylinder 118.

[0040] The groove fitting pawl plate 123 is, for example, preferably an arc shaped half as shown in Fig. 5. In addition, in terms of operation efficiency and safety, the roll shaft suspending apparatus according to the present invention is preferably fixed to a mount base 127 as shown in Fig. 4a, having a rigid and firm construction of steel frames or the like.

[0041] The process of changing the ring rolls of the bar and wire rod mill using the roll shaft suspending apparatus according to the present invention is explained hereinafter with reference to Figs. 4a to 4e. The description is omitted about the operation performed before and after the process in which the roll shaft suspending apparatus is out of use.

(I) Rotate the change table (rotatable, but not shown) with the housing 111 thereon and move the roll assembly 120 to the position just below the nozzle 115. After having aligned the center line of the nozzle 115 with the center line of the oil inlet 131, release the fastening bolt 112. Then drive the screw 107 to lower the roll assembly 120 until it contacts with the eccentric cartridge 106 of the ring roll 102 (Fig. 4a);

(II) Loosen the clamp bolt 110 to disengage the screw holder 109 from the housing 111. Afterwards, set the push ring 119 (Fig. 4b);

(III) Select the "push mode" of the cylinder 118 to advance the rod 116 until it contacts with the push ring 119. Hence, the nozzle 115 is connected auto-

matically to the oil inlet 131. Then, fit the groove fitting pawl plate 123 into the circumferential groove 122 (Fig. 4c);

(IV) Inject high pressurized oil from the oil inlet 126. The journal part of the ring 101A and the tapered surface of the taper sleeve 102A deform within their elastic limits and are thereby disengaged from the interference fit. The roll shaft is lifted a little apart from the ring roll 102 (Fig. 4d);

(V) Select the "pull mode" of the cylinder 118 to pull back the rod 116. Hence, the roll shaft 101 is withdrawn upwardly from the ring roll 102 (Fig. 4e); and (VI) Take the ring roll 102 out of the housing 111 and insert a new ring roll. Afterwards, perform the process (I) to (V) inversely. Incidentally, the operation can also be performed inversely by, for example, "pulling" instead of "pushing".

[0042] Finally, perform the above described operations (I) to (VI) for each of the plurality of rolls within the housing.

[0043] According to the present invention various kinds of superior effects are obtained as described below.

[0044] The disassembling process of the housing can be dispensed with so that the time needed for changing the roll is reduced and the labor cost can be cut down.

[0045] Machine problems are reduced because the disassembly of the housing is not involved so that the working ratio and the productivity of the facilities are improved.

[0046] As the changing operation of the roll shaft is not required, the number of equipment stocks are reduced so that the storage space can be cut down.

[0047] The conventional method for changing the roll involves the disassembly of the housing and therefore needs a housing disassembling apparatus and a roll changing apparatus, whereas the present invention only requires the roll changing apparatus and therefore the number of equipment stocks are reduced.

[0048] The handling subject was conventionally a roll assembly, but the present invention involves ring rolls, thereby making the subject light weight so that the safety aspect is improved.

[0049] Furthermore, with the use of the roll suspending apparatus according to the present invention, the changing operation of the ring rolls can be performed within a single apparatus. Therefore, the operability and the work efficiency are improved and the working space can be reduced.

[0050] Additionally, as the tapered surfaces of the inside of the ring rolls and the journal part of the roll shaft for the ring rolls are under the pressure of the injected hydraulic oil, the pressure in sliding at the engagement surface is low and the surface is well lubricated. Therefore, the tapered surface is free from abrasion or deformation and the machine can be maintained in a sound condition for a long time. As a result, the lifetimes of the

components are extended and the problem caused by insufficient torque rarely happens.

Claims

1. A method for changing ring rolls in a bar and wire rod mill having a plurality of roll assemblies incorporated into a housing (8) and arranged in equiangular positions around a pass (16), **characterized by** comprising the steps of:

disengaging a spent ring roll (2) and its roll shaft (1) from interference fit;
 withdrawing the spent ring roll (2) by moving the roll shaft (1) in the axial direction;
 changing the spent ring roll (2) for a new ring roll in the housing (8);
 inserting the roll shaft (1) into the new ring roll; and
 engaging the new ring roll and the roll shaft in interference fit each other.

2. The method according to claim 1, wherein hydraulic oil pressure is used for engaging and disengaging the ring roll and the roll shaft in and from interference fit.

3. The method according to claim 2, further comprising the steps of:

holding the roll shaft (1) of the roll assembly, in which the spent roll is to be changed, in an upright position before disengaging the spent ring roll and the roll shaft from the interference fit; and
 coupling a suspending apparatus with one end of the roll shaft (1) and connecting a hydraulic oil passage within the roll shaft (1) to a hydraulic oil source through said end of the roll shaft before withdrawing the roll shaft (1) from the spent ring roll (2).

4. A bar and wire rod mill comprising a plurality of roll assemblies each having a ring roll (2) capable of engaging and disengaging a roll shaft (1) in and from interference fit, wherein the roll shaft (1) is movable in the axial direction within a housing (8), said plurality of roll assemblies being arranged in equiangular positions around a pass (16) and supported by said housing (8).

5. The bar and wire rod mill according to claim 4, wherein each roll assembly comprises:

a mechanism for engaging or disengaging the ring roll (2) and the roll shaft (1) in and from interference fit by means of hydraulic oil, with the

inner surface of the ring roll (2) and the journal part (1A) of the roll shaft (1) having a tapered surface;

hydraulic oil passage extending through the roll shaft (1) from one end portion of the roll shaft (1); and

a hydraulic oil inlet (12A) and a suspension jig receiving member (122) provided on one end of the roll shaft (1).

6. The bar and wire rod mill according to claim 5 and further including a roll shaft suspending apparatus comprising a nozzle (14B)(115) for injecting oil into the oil inlet (12A)(131) provided on one end portion of the roll shaft (1)(101) of the roll assembly, a rod (116) holding said nozzle (14B)(115) and having a hydraulic oil passage (117) therethrough connecting with said nozzle (14B)(115), a cylinder (118) embracing said rod (116) for actuating it reciprocally by means of hydraulic oil pressure and a suspension jig member (123) on the lower end of said rod (116), and a suspension jig receiving member (22)(122) provided on said end portion of the roll shaft.

7. The bar and wire rod mill according to claim 4, 5 or 6 wherein there are four roll assemblies.

8. A roll shaft (1) suspending apparatus comprising:

a nozzle (115) for injecting hydraulic oil into an oil inlet (12A)(131) provided on one end portion of a roll shaft (1)(101) of a roll assembly;
 a rod (116) holding said nozzle (14B)(115) on the top end portion thereof and having a hydraulic oil passage (117) therethrough connecting with said nozzle (14B)(115);
 a cylinder (118) embracing said rod (116) for actuating it reciprocally by means of hydraulic oil pressure; and
 a suspension jig (123) for engaging with a suspension jig receiving member (22)(122) provided on one end of said roll shaft (101).

9. The roll shaft suspending apparatus according to claim 8, wherein said rod (116) holds said nozzle (115) through a resilient seat (125).

FIG.1

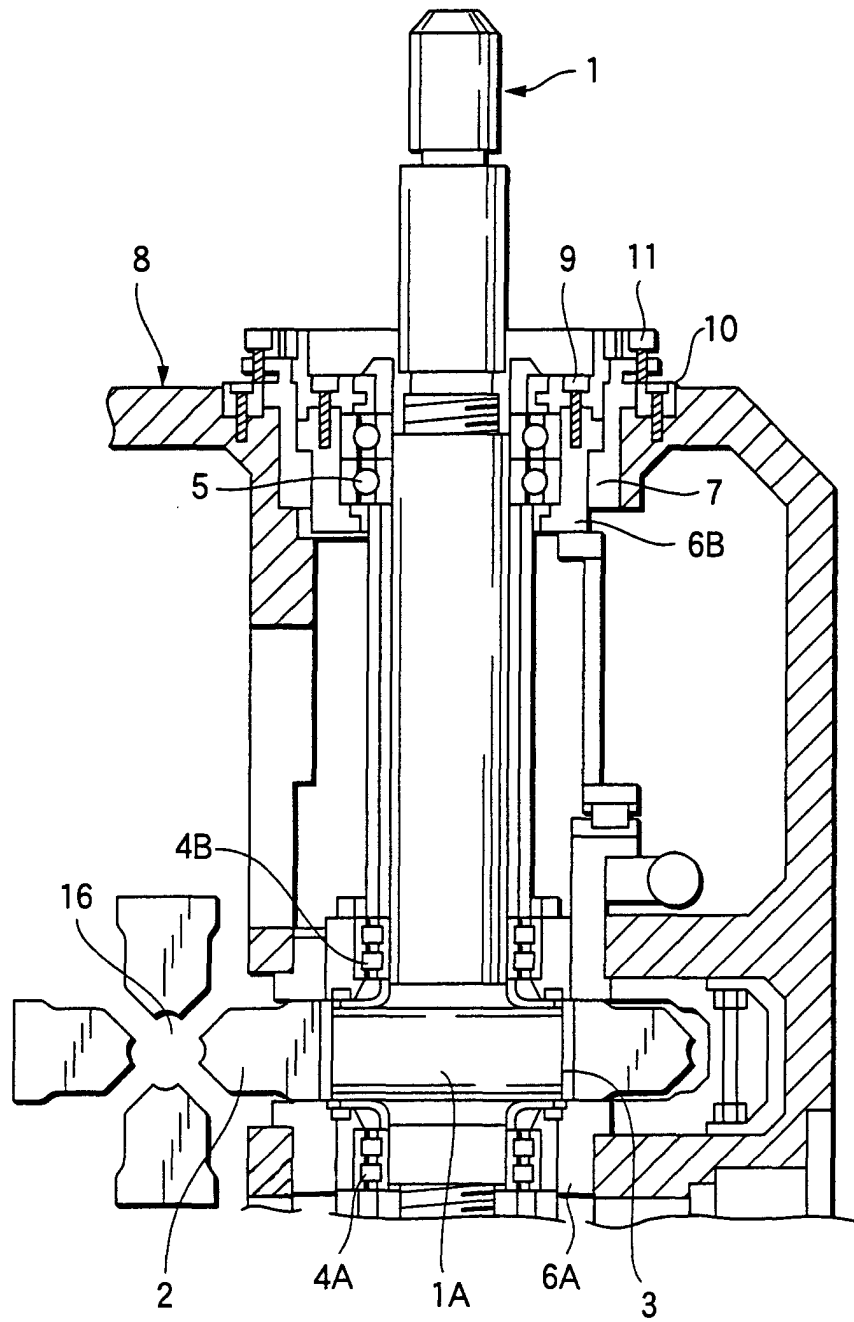


FIG.2

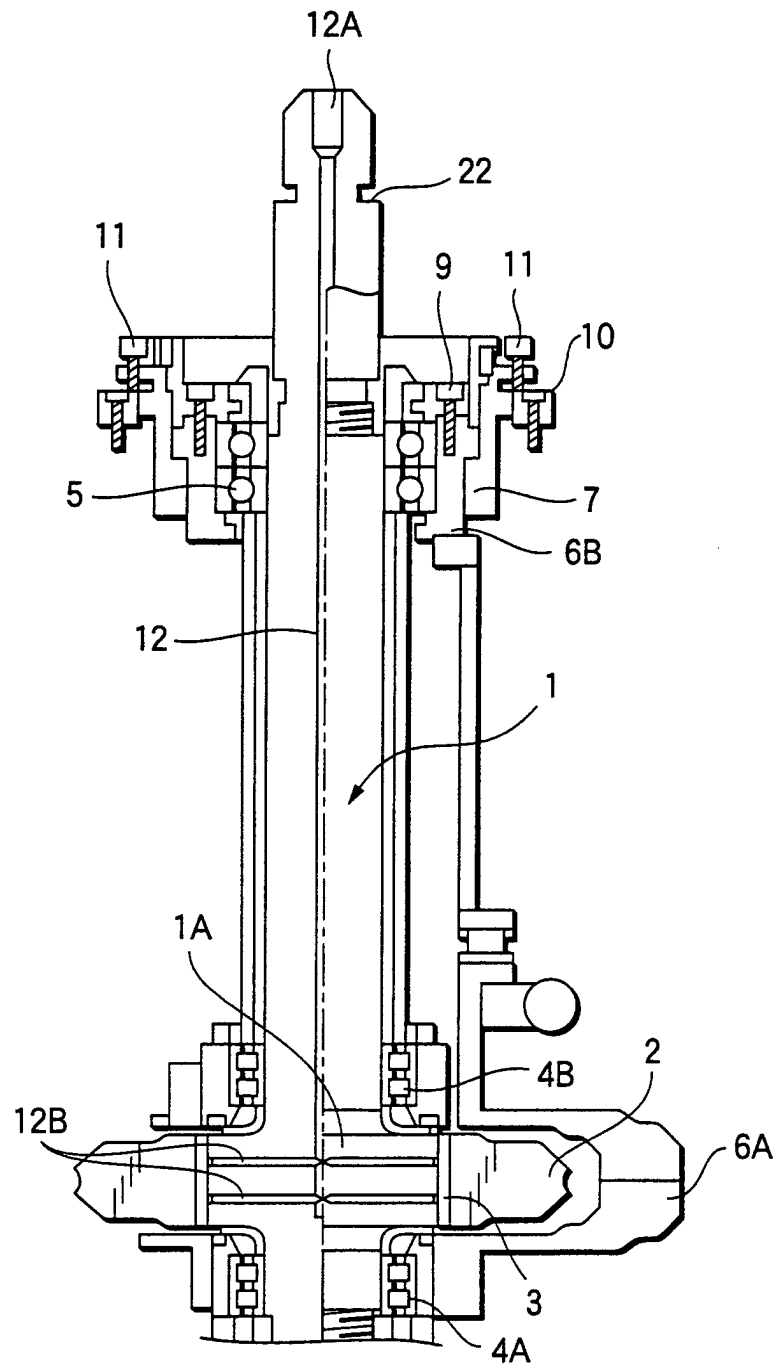


FIG.3A

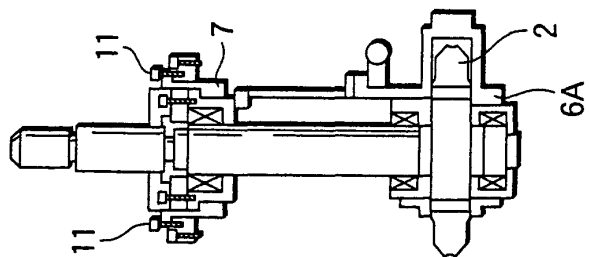


FIG.3B

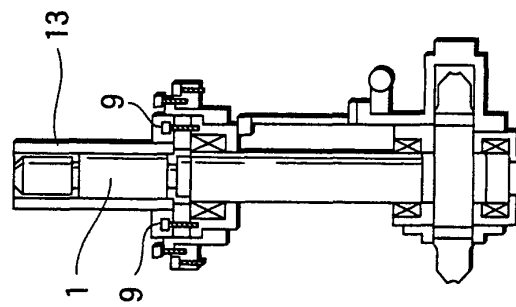


FIG.3C

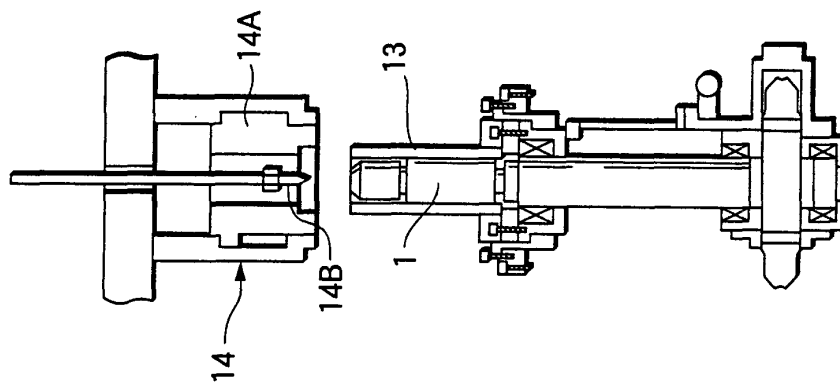


FIG.3D

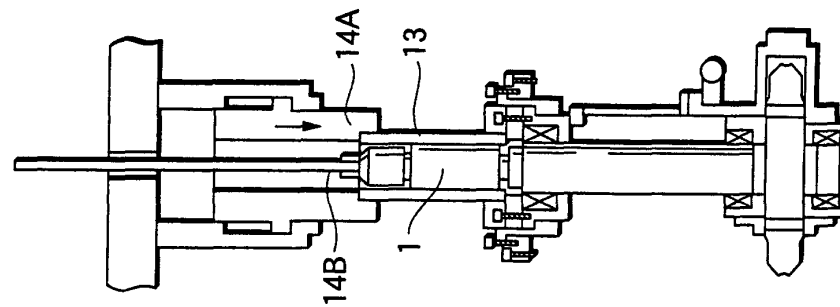


FIG.3E

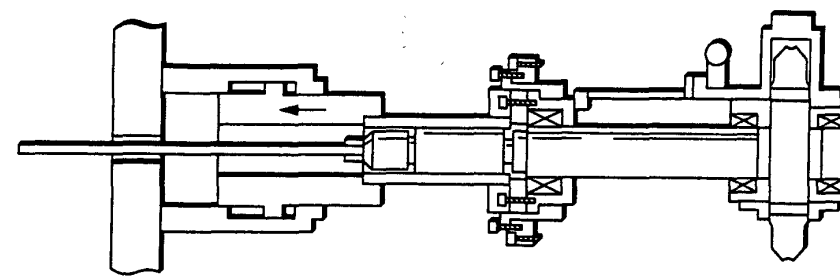


FIG.3F

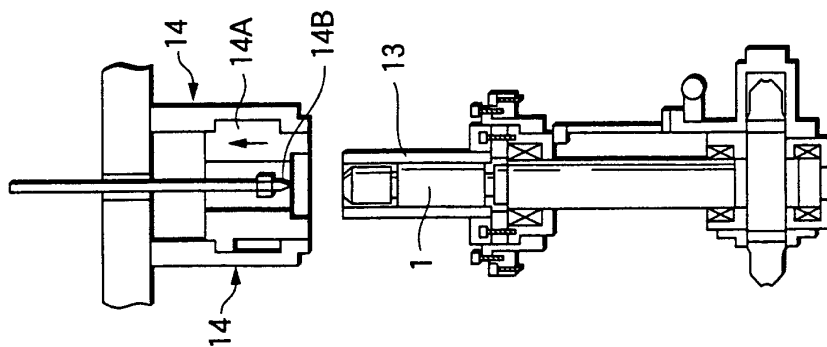


FIG.3G

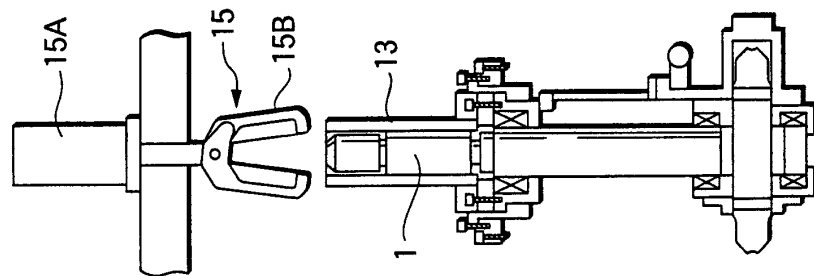


FIG.3H

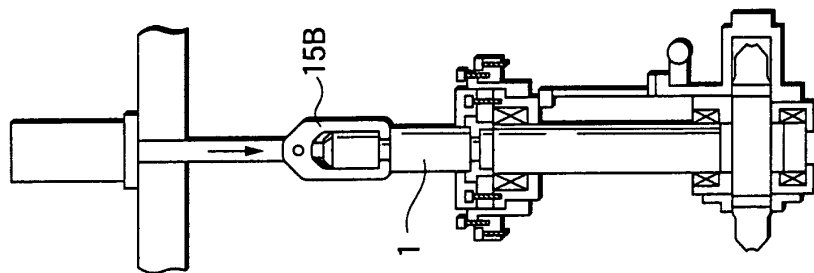


FIG.3I

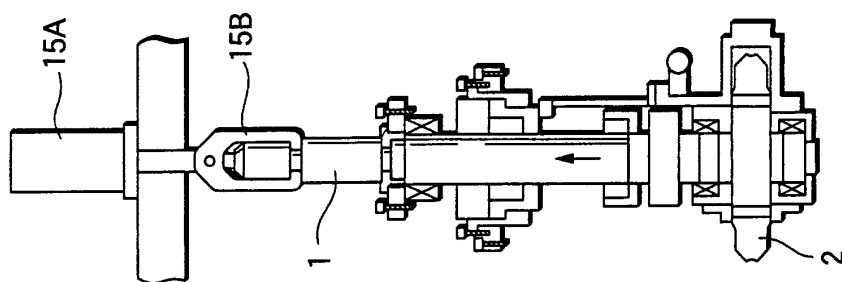


FIG.3J

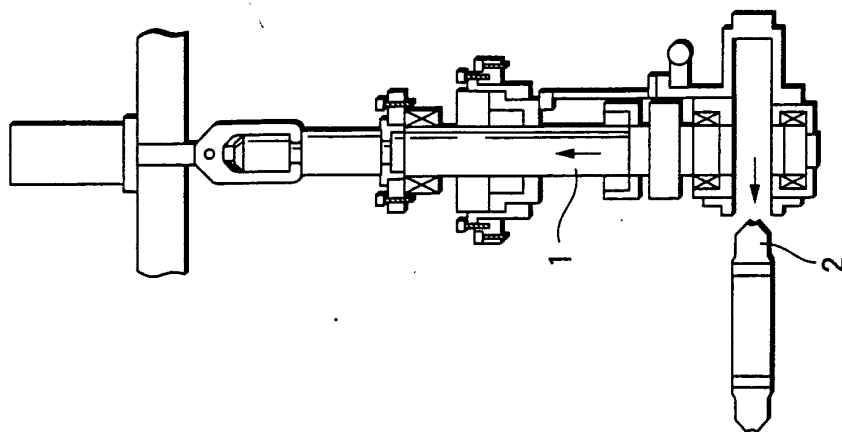


FIG.4A

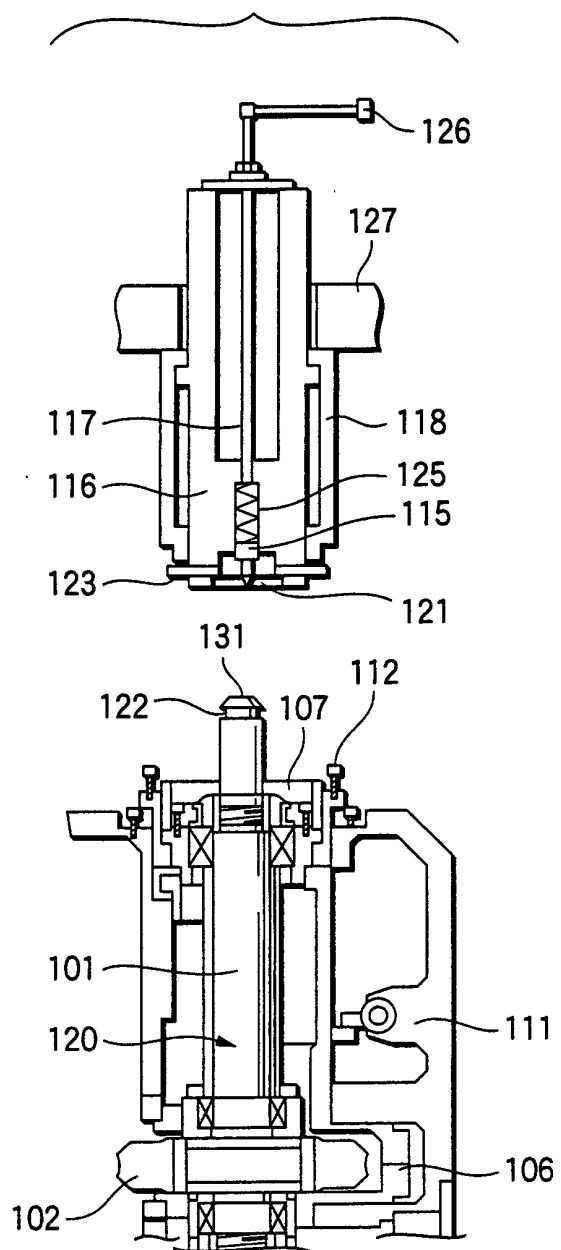


FIG.4B

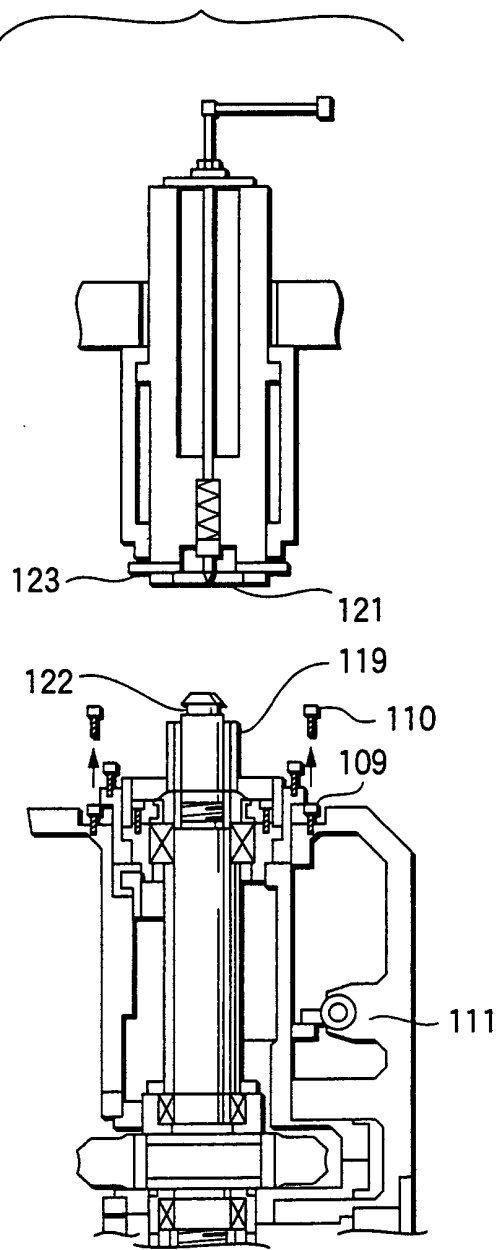


FIG.4E

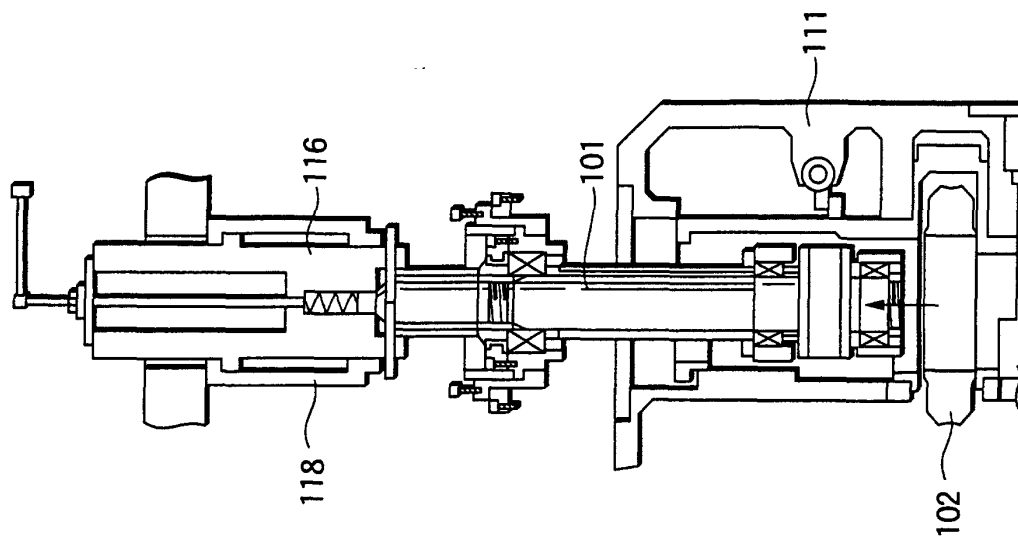


FIG.4D

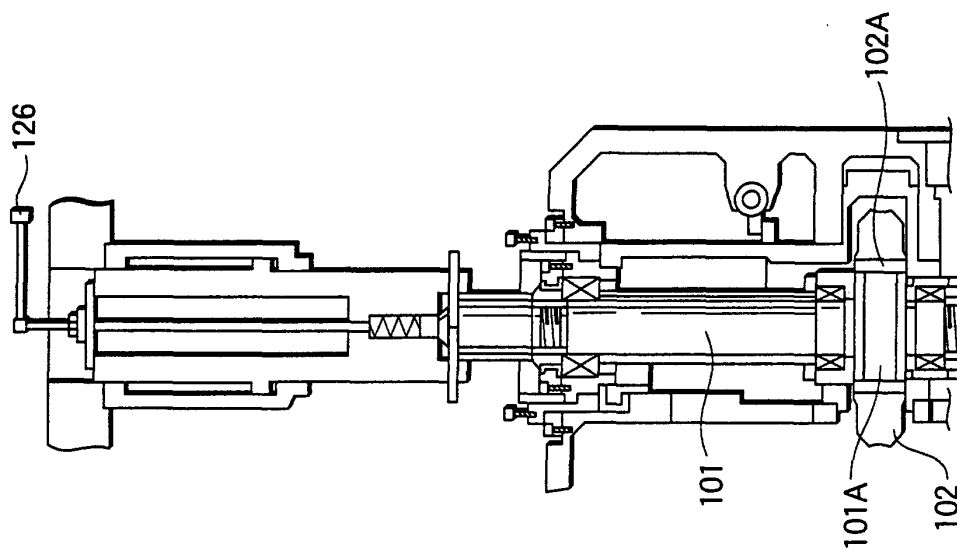


FIG.4C

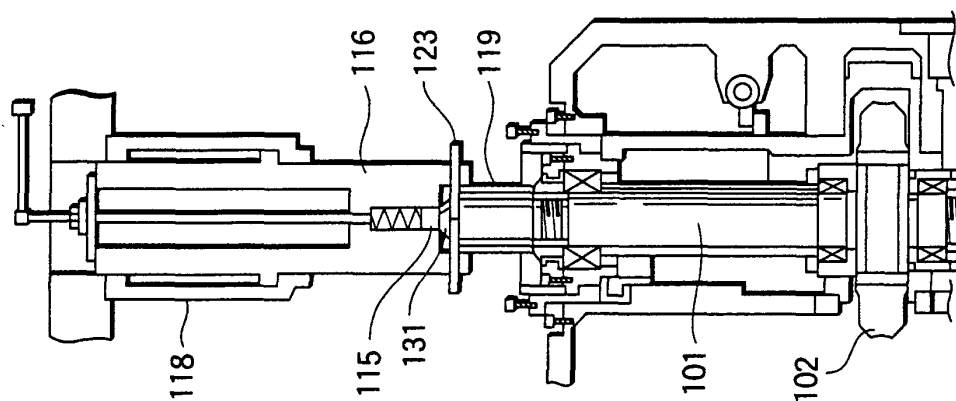


FIG.5

